SG73/D
REV 4

MOTOROLA SEMICONDUCTOR
MASTER SELECTION GUIDE

MOTOROLA

MASTER SELECTION GUIDE

WHERE WE STAND. . .

TOTAL CUSTOMER SATISFACTION

Service, speed and facility of response, product quality and reliability are the goals to which we are dedicated. Programs such as our commitment to Six Sigma performance and Cycle Time Reduction are symbolic of a culture in which Total Customer Satisfaction is, overwhelmingly, our primary objective.

In today's highly competitive market, selecting the most effective semiconductor components for a given application poses a significant challenge. The range of available functions and the sheer number of components within each unique product line is staggering. Add to this the number of vendors capable of satisfying a portion of the overall system demands and the selection of a cost-effective component complement can be as time consuming as the design of the system itself.

This is where Motorola occupies a unique position among semiconductor manufacturers – one that can significantly shorten the product selection cycle. Please consider these facts:

As a manufacturer of semiconductors since the very beginning of the technology, Motorola has emerged as a leading supplier of such components to the world market.

Motorola's product line is the *broadest* in the industry, capable of filling 75-80% of the many applications for semiconductor devices.

In each of its various product categories, Motorola is a recognized leader, with leading edge products as well as commodity products for mass applications.

Motorola's vast network of sales offices and distributors, augmented by manufacturing centers throughout the world, not only insures easy communications, cost-effective pricing and rapid service, but guarantees a continuing stream of state-of-the-art products based on world-wide experience and demand.

HOW TO USE THIS GUIDE. . .

This Selection guide is arranged to provide 3-way assistance to engineers and technicians in making a first-order selection of components best suited for a specific circuit or system design.

1. If you have a device number that needs identification or if you want to know if Motorola manufacturers a particular device type –

Turn to the **Index** for a complete listing of Motorola products, and the page numbers where more detailed information for these products is given.

2. If you have a device name or acronym and wish to know if Motorola makes such a device –

Look for it in the **Subject Cross Reference.**

3. If you want a quick overview of Motorola products for a specific product category –

Use the handy 3-layered **Contents** system, which guides you through the book quickly and efficiently.

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To order technical literature by specific document title, i.e., SGXX/D or DLXXX/D, or by part number only, call

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For design-in assistance, call

1-800-521-6274

NON-NORTH AMERICAN LOCATIONS

Please contact your local Motorola Sales Office or Authorized Distributor. Thank you.

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The information in this book has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies.

Winner 1988 Malcolm Baldrige National Quality Award

SEMICUSTOM

Application Specific Integrated Circuits (ASICs)

ASIC Philosophy

Motorola supports strategic programs and co-development partnerships to accelerate the availability of advanced processes (CMOS, BiCMOS, Bipolar), packaging and CAD technology. Extensive research, manufacturing and financial resources are focused to develop and maintain leading edge capabilities.

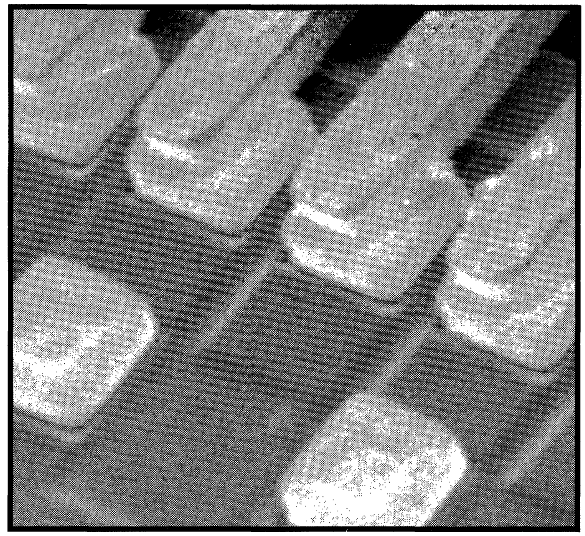
CDA, Ceff-PGA, Customer Defined Array, MicroCool, MOSAIC I, MOSAIC II and MOSAIC III are trademarks of Motorola Inc.

Page

ASIC Preview

Bipolar
High-Speed ECL & ETL Arrays

Motorola's MOSAIC III™ technology features modified transistor structures to reduce series base resistance and collector-base junction capacitance. The result is enhanced switching speed. Mixed ECL/TTL interface compatibility and high frequency (over 1.2 GHz) operation highlights the newly introduced ETL Series.



Motorola's TAB (Tape Automated Bonding) provides maximum I/O density and performance.

CMOS
1.0 Micron HDC Series
Sub-Micron H4C Series

High density CMOS arrays (HDC Series) are built on 1.0 micron drawn (0.8 μ L_{eff}), triple-layer-metal CMOS process. By utilizing three layers of metal for signal routing, designers can typically achieve up to 70% utilization on a channelless architecture of minimum dimensions.

The sub-micron H4C Series enables densities over 300K gates and 180 picosecond typical gate delay. The H4C specifies an effective channel length of 0.7 micron and a power dissipation of only 3 microwatts/Gate/MHz.

Design Automation Software (OACS™)

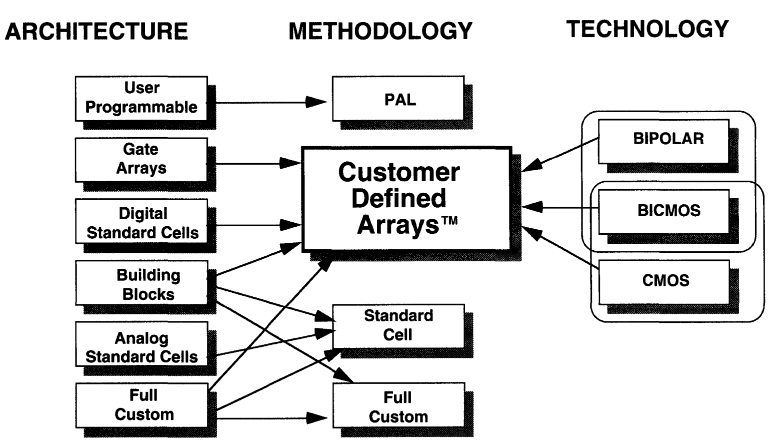
Motorola's Open Architecture CAD System (OACS) provides a complete ASIC development environment using industry-standard workstations and leading third-party design and verification tools. The OACS system integrates sophisticated ASIC design software tools to handle high performance designs and has the required flexibility to support future technology advances.

Architecture for the 90's
CDA™ (Customer Defined Arrays)

Performance, density and power dissipation are critical issues for next generation ASIC designs. The integration of large diffused blocks and embedded memory will enhance intra-chip communication and save board area. The Customer Defined Array (CDA) concept lets designers combine array based, cell based, and full custom logic with diffused memory blocks on a die. The concept equally supports Bipolar and CMOS, each with the capability to incorporate BiCMOS modules.

CDAs customize array architectures to meet specialized system requirements of high density or high performance. This promotes flexibility while minimizing costs (custom test, packaging and elaborate power layout) normally associated with full custom and standard cells.

CDA -THE ARCHITECTURE OF THE 90's



Benefits:

- Time-to-market through integration of functional building blocks and ASIC design methodology.
- Customers can create application specific arrays.
- Diffused RAM optimized for performance and density.
- Fixed die sizes for ease of manufacturing.

Bipolar
High-speed ECL & ETL Arrays

Third Generation ETL Series Arrays Extend Design Flexibility

The newly announced ETL Series is flexible enough to simplify translation between high speed logic families.

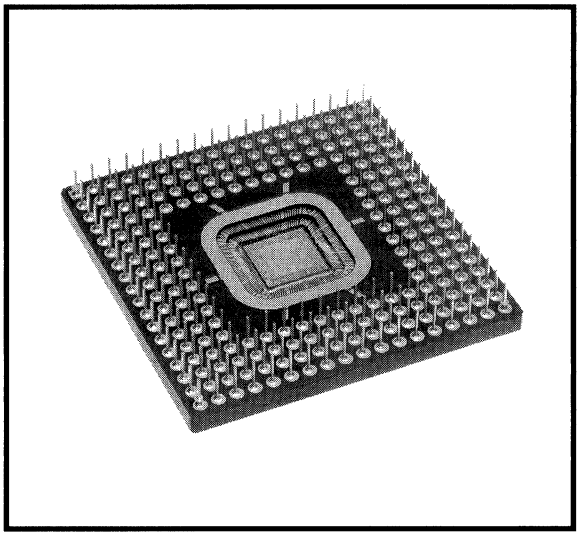
Three base arrays:
MCA750ETL, MCA3200ETL, MCA6200ETL

- 848 to 6915 Equivalent Gates
- Channelled Architecture for up to 100% Utilization
- Input and Internal ECL Gate Delays - 0.15 ns (Typical)
- TTL Input/Translation Cell Delay - 0.55 ns (Typical)
- Up to 168 Universal I/O Signal Ports
- Bidirectional ECL and TTL I/O Macros
- ECL 100K, Pseudo ECL and TTL Logic Interfaces
- Programmable Speed/Power Levels
- Three-Level Series Gated Macros
- MCA2 and MCA3 ECL Series Library Compatible

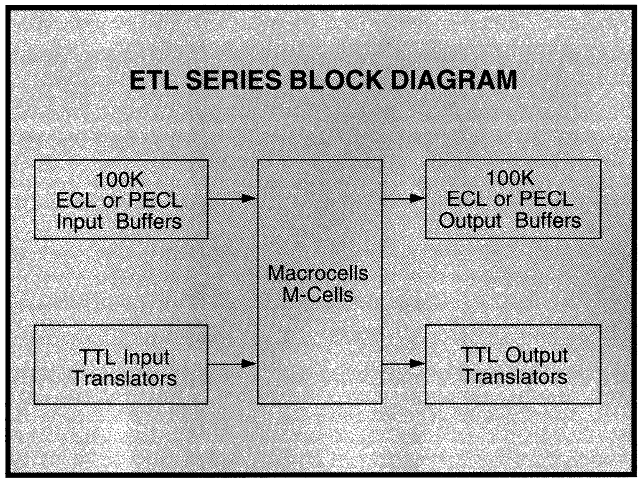
Motorola's MOSAIC III™ bipolar process offers unexcelled mixed TTL/ECL interface capability in a high performance, mature technology.

ETL Series Features Mixed ECL-TTL Interface

The ETL Series offers mixed ECL, PECL (pseudo ECL) and TTL compatible interfaces. The Series combines 150 ps typical gate delays with 1200 MHz operating frequencies. Any signal pin can be programmed for input, output, or bidirectional signals in ECL, TTL or PECL logic. MOSAIC III process technology, combined with innovative design, extensive macrocell library and versatile I/O structure adds up to superior performance and flexibility.



MCA6200ETL in multi-layer ceramic 224 Pin-Grid-Array designed for high frequency, mixed-mode applications.



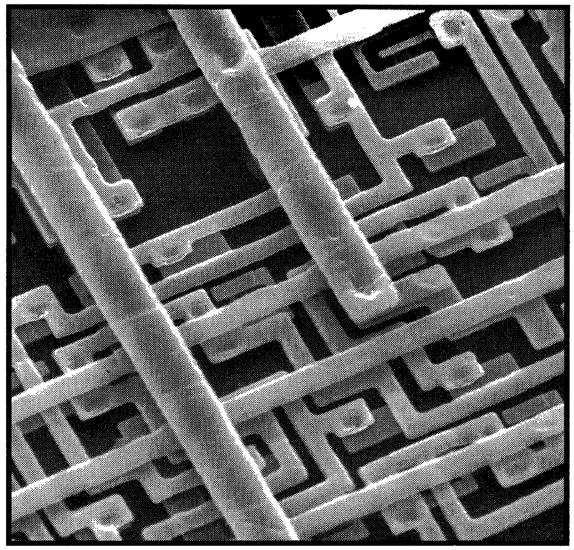
ECL and ETL ARRAY FEATURES

Features / Array	MCA 800ECL	MCA 1500M	MCA 2500ECL	MCA 2200ECL	MCA 10000ECL	MCA 750ETL	MCA 3200ETL	MCA 6200ETL
Technology		MOSAIC II				MOSAIC III		
Equivalent Gates	902	1708+RAM	2760	2412	12402	848	3570	6915
Internal (Major) Cells	36	64	110	68	414	24	110	225
I/O Signals	54	120	120	108	256		Universal I/O Ports	
Input/Interface Cells	NA	NA	NA	96	224	42	120	168
Output (O) Cells	22	60	68	96	200			
Max Gate Delay (ns)	0.5	0.5	0.5	0.175	0.175	0.2	0.2	0.2
Max I/O Frequency (MHz)	770	770	770	1500	1200	1200	1200	1200
Typ. Power Dissipation (W)	2.5	8.0	8.0	3-6	10-30	1-1.5	5-8	6-12

CMOS
1.0 Micron HDC Series

Built on a 1.0 micron, triple-layer metal CMOS process, the HDC Series represents a significant advancement in microchip technology. By utilizing three layers of metal for signal routing and power distribution, designers can achieve over 73,000 usable gates on a channelless architecture having minimum chip dimensions. The result is very high performance (subnanosecond loaded gates) combined with unprecedented I/O flexibility and density.

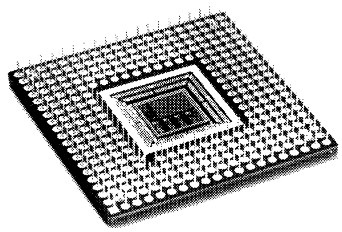
The HDC Series is available in a wide variety of plastic and ceramic, through-board and surface mount packages. The diversity of package style and pin count lets the designer best match system size, cost and performance requirements.



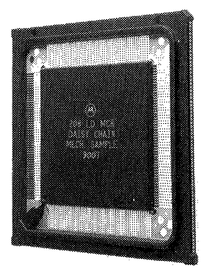
Triple-Layer Metal Signal Routing Enhances Utilization.

Features:

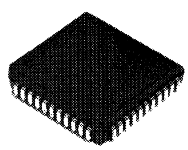
- 3,000 to 105,000 available gates
- Typically up to 70% utilization
- Channelless Sea-Of-Gates architecture
- 1.0 micron drawn gate length (0.8 μ L_{eff})
- Triple layer metal routing and power distribution
- Eight transistor, fully utilizable, oxide isolated primary cell
- 250 picosecond typical gate delay (2-unit NAND)
- Fixed RAM blocks (single, dual and 4 port)
  8x9 to 64 word x 72 bit configurations
  Typical access time (T_{AA}) = 2.29 ns on 8x9 dual port
- 5 V CMOS and TTL compatible I/O options
- Low power consumption of 6 μW/gate /MHz
- I/O Cells can be paralleled on chip for 48 mA drive
- Pin functions are 100% programmable as I/O or power
- 2000 V ESD protection, latchup immunity to 100 mA
- Comprehensive workstation based CAD support



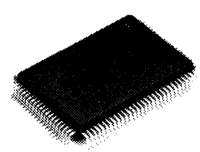
PGA
84–224 Pins



QFP–MCR
64–208 Pins



PLCC
28–84 Pins



QFP
64–208 Pins

TYPICAL HDC SERIES PACKAGES

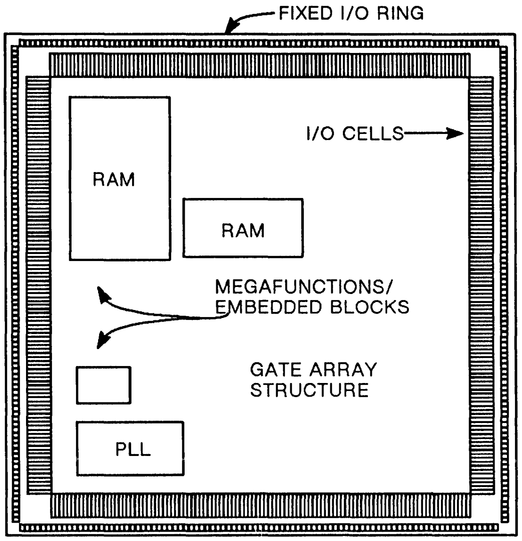
HDC SERIES FEATURES

Array	Available Gates	Usable Gates @ 70% Utilization	Die Pads (Wirebond)	Available I/O Cells	Die Size (mils square)
HDC003	3,036	2,000	76	88	136
HDC006	5,670	4,000	96	120	162
HDC008	8,208	6,000	108	144	182
HDC011	11,208	8,000	120	168	202
HDC016	16,416	11,500	136	204	232
HDC027	27,270	19,500	168	264	282
HDC031	31,290	22,000	180	280	295
HDC049	49,368	34,500	216	348	354
HDC064	63,900	45,000	240	400	402
HDC105	104,832	73,000	300	512	492

CMOS
Sub-Micron H4C Series
CDA™ Architecture

The H4C Series of CMOS Customer Defined Arrays™ (CDA) provides a new generation of ASICs to capture the functionality of the sub-micron process. The new fabrication process of the H4C Series enables densities of up to 318,000 gates and supports speed requirements of 60 MHz processors with a power dissipation of 3 µW/gate/MHz.

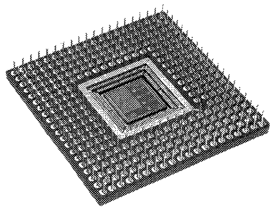
The CDA architecture offers the versatility and efficiency of system design on a single chip by providing large, fully-diffused architectural blocks such as user configurable RAMs. Additionally, to ensure high quality ASIC system designs, several design-for-test implementations and clock skew management macros are available.



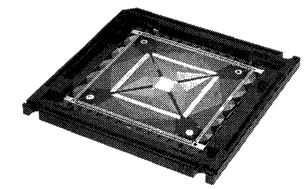
The CDA Concept: Megafunctions and Embedded Blocks Within a Gate Array.

Features:

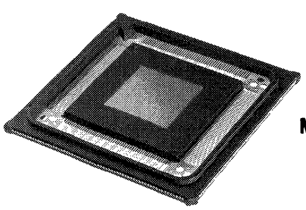
- Up to 318,000 gates
- Compatible channelless, Sea-Of-Gates and CDA architectures
- 0.7 micron effective gate length
- Triple-layer-metal signal routing and power distribution
- Up to 70% gate utilization (typical)
- 180 picosecond typical gate delay (2-input NAND)
- User configurable, fully diffused RAM blocks up to 256K bits
- Low power consumption - 3 µw/gate/MHz
- 3.3 V and 5.0 V CMOS and TTL compatible I/O cells
- JTAG (IEEE 1149.1) and LSSD/ESSD scan supported
- High performance packaging
- Extended workstation-based CAD support for embedded functions
- Special macros available to manage clock distribution and skew control



PGA
299-4XX Pins



TAB
188-376 Leads



MicroCool QFP
160-208 Pins

TYPICAL H4C SERIES PACKAGES

H4C SERIES FEATURES

Array	Available Gates	Usable Gates @70% Utilization	Die Pads Wirebond	Die Pads TAB	Available I/O Cells
H4C027	27,000	19,000	160	188	196
H4C035	35,000	24,500	176	208	224
H4C057*	57,368	40,000	216	256	284
H4C086	86,000	60,000	260	304	344
H4C123*	123,136	86,000	304	360	416
H4C161	161,000	113,000	344	404	476
H4C195*	195,452	136,800	376	444	524
H4C318	318,000	222,500	464	556	648

*Initial product offering.

Design Automation Software

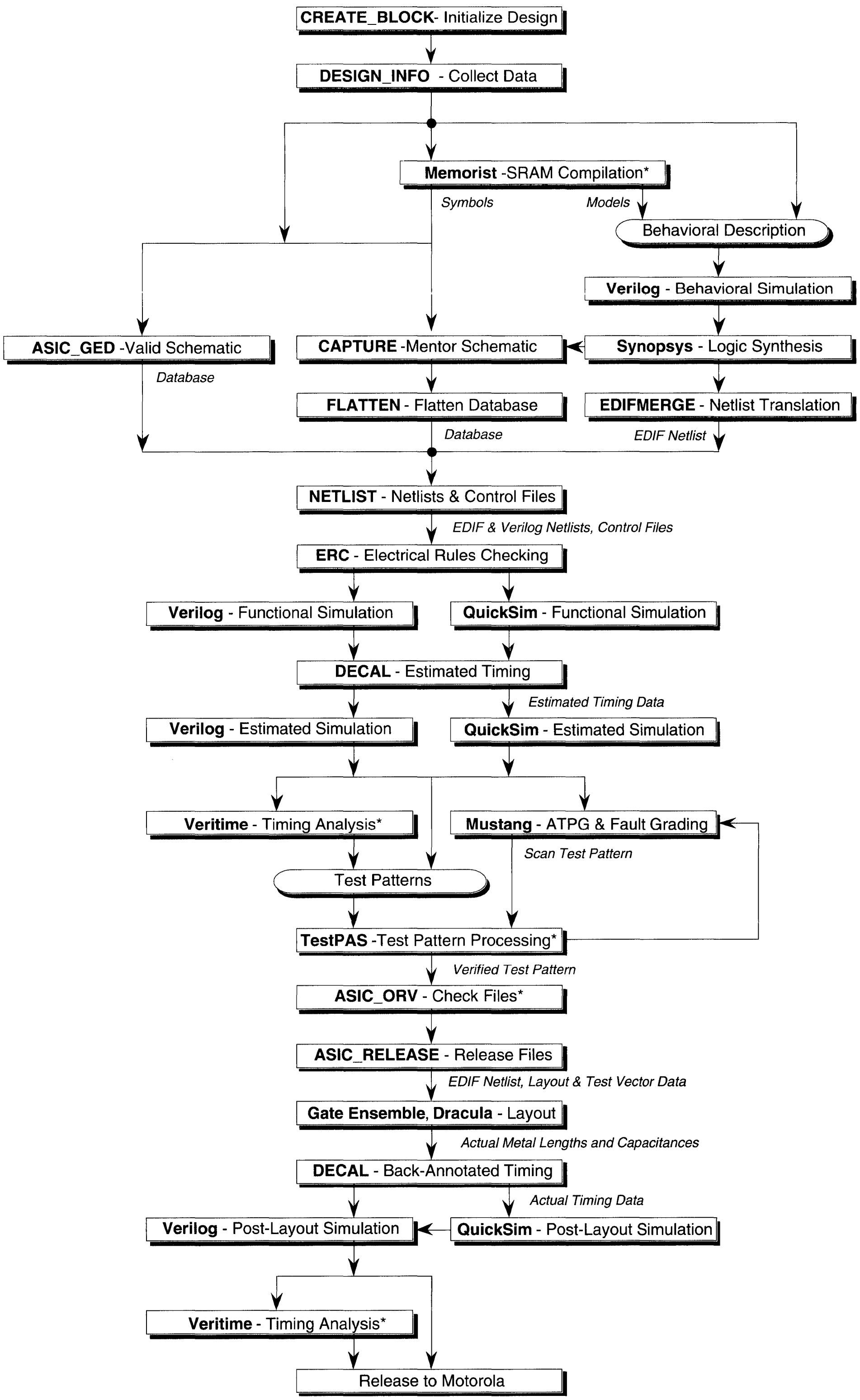
The Open Architecture CAD System (OACS™) provides Motorola customers with a state-of-the-art and complete ASIC design solution. The OACS consists of sophisticated ASIC design software tools to handle today's advanced gate array designs. The system also incorporates the required flexibility to support ASIC technologies of tomorrow.

The OACS system's primary goal is to provide a user-friendly, efficient suite of ASIC design tools to facilitate error-free silicon design. The system allows the user to verify correctness of the ASIC at each stage of the design process with tools that closely mimic the workings of actual silicon. Traditional design tools addressing design capture, logic interconnection verification, and functional/delay simulation are fully supported by the base OACS system. Optional productivity enhancement packages such as diffused memory compilation (Memorist) and Automatic Test Pattern Generation (ATPG) are fully supported.

OACS System Highlights:

- Supports CDA (Customer Defined Array) and Sea-of-Gates Architectures
- EDIF 2.0.0 backplane approach to providing an open CAD architecture
- Tools accessed through interactive menu system
- Extensive Electrical Rules Checking (ERC)
- Supports multiple technologies
- Design-For-Test support: ESSD/LSSD Scan and JTAG Macros
- Clock-tree synthesis, clock skew management, timing driven layout
- Sophisticated delay calculations (DECAL)
    - Continuous temperature, voltage, and process variation
    - Delays computed based upon estimated and post-layout wiring
    - Based upon intrinsic delays, input edge-rates, output loading, and distributed RC delays.
    - User specified output loading
- Supports the following design automation tools:
    - Synopsys' Design Compiler™ and HDL Compiler™ logic synthesis tools
    - Mentor Graphics' NetEd™ schematic capture (Apollo)
    - Valid Logic's GED™ schematic capture (Sun)
    - Functional, pre- and post-layout simulation through:
        - Mentor Graphics' QuickSim™
        - Cadence's Verilog-XL™
    - Multi-Chip and Mixed-Level Simulation (Verilog) (OACS Version 2.0)
    - Cadence Gate Ensemble™ physical layout package
    - Cadence Veritime™ static timing analysis (OACS Version 2.0)
    - Motorola's Mustang™ automatic test pattern generation
    - Motorola's Memorist™ SRAM Compiler (OACS Version 2.0)
    - Motorola's TestPAS™ test vector validation and extraction (OACS Version 2.0)
- Complete documentation covering the entire ASIC design process
- Support available on HP/Apollo™ and Sun™3 and 4 workstations

OACS Design Flow



***OACS Release 2.0**

Packaging and Test

Advanced Packaging

Low cost, high performance systems require excellence in ASIC packaging technology. High density TAB (Tape Automated Bonding), MicroCool, QFP-MCR (Quad Flat Pack in an optional Molded Carrier Ring) and Ceff-PGA™ (Cost-Effective Ceramic Pin Grid Array) packages illustrate cost effective manufacturing solutions for high lead count, high frequency applications.

QFP in the Molded Carrier Ring (MCR)

Motorola currently offers the popular EIAJ standard Plastic Quad Flat Package (QFP) in lead counts from 64 to 208 pins. The Molded Carrier Ring (MCR) is a coplanarity and lead protection device for QFP packages. The ring provides lead protection during manufacturing/testing and shipping.

Standard ring sizes simplify manufacturing across the range of packages and improve component testability.

MicroCool™ Quad Flat Pack

The MicroCool QFP is a new QFP compatible plastic package with improved heat dissipation capacity. It has a heat slug attached to a printed circuit board which supports a copper lead frame. The package incorporates a molded carrier ring to maintain pin coplanarity. MicroCool packaging is cost-effective and capable of meeting high power dissipation (up to 3 W, depending on temperature and ambient conditions).

Ceff-PGA™

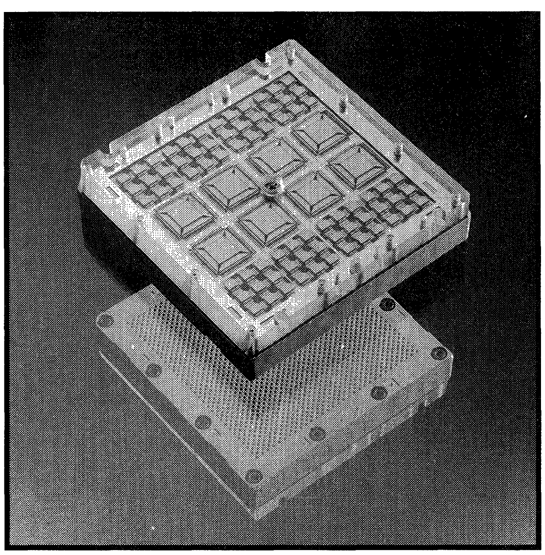
The Ceff-PGA (Cost-Effective-Ceramic Pin Grid Array) package serves applications between surface mount plastic packages and ceramic, high performance, cavity down PGAs. The Ceff-PGA has reduced gold contacts, glass sealed ceramic lid and solder dipped leads. Low thermal resistance allows power dissipation of over 2.5 watts in still-air applications.

Test

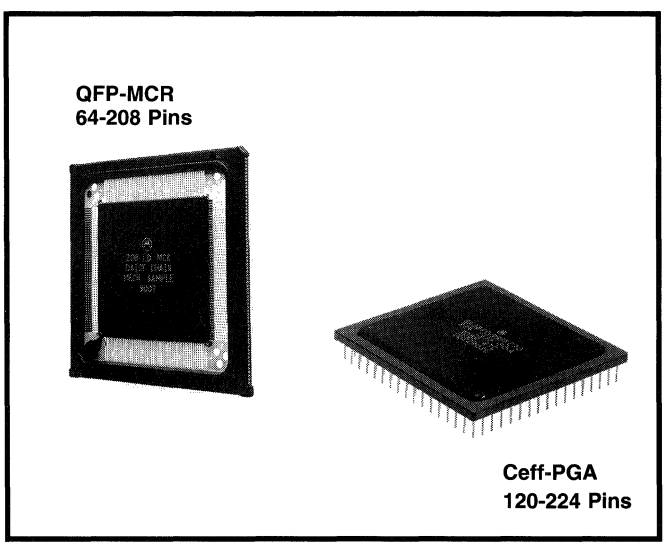
Motorola and Schlumberger's ATE Division have jointly developed advanced test equipment aimed at improving the reliability of high-complexity digital logic chips. The equipment benefits ICs and multichip modules having up to 1,024 signal pins in CMOS, BiCMOS and Bipolar technologies.

Schlumberger's "Typhoon" tester utilizes industry standards for boundary scan I/O channels and full scan internal logic design. The tester supports Built-In-Self-Test (BIST) functionality and ring oscillator measurements to allow "at speed" test of internal logic at clock speeds up to 800 MHz.

Fred Berneche (left), Manager of Motorola ASIC Test Development and David Karpenske, V.P. of Strategic Products for Schlumberger ATE Division announce the "Typhoon" tester scheduled for general market availability.



Flip-TAB minimizes interconnect delays in high performance MOSAIC III-based multichip module.

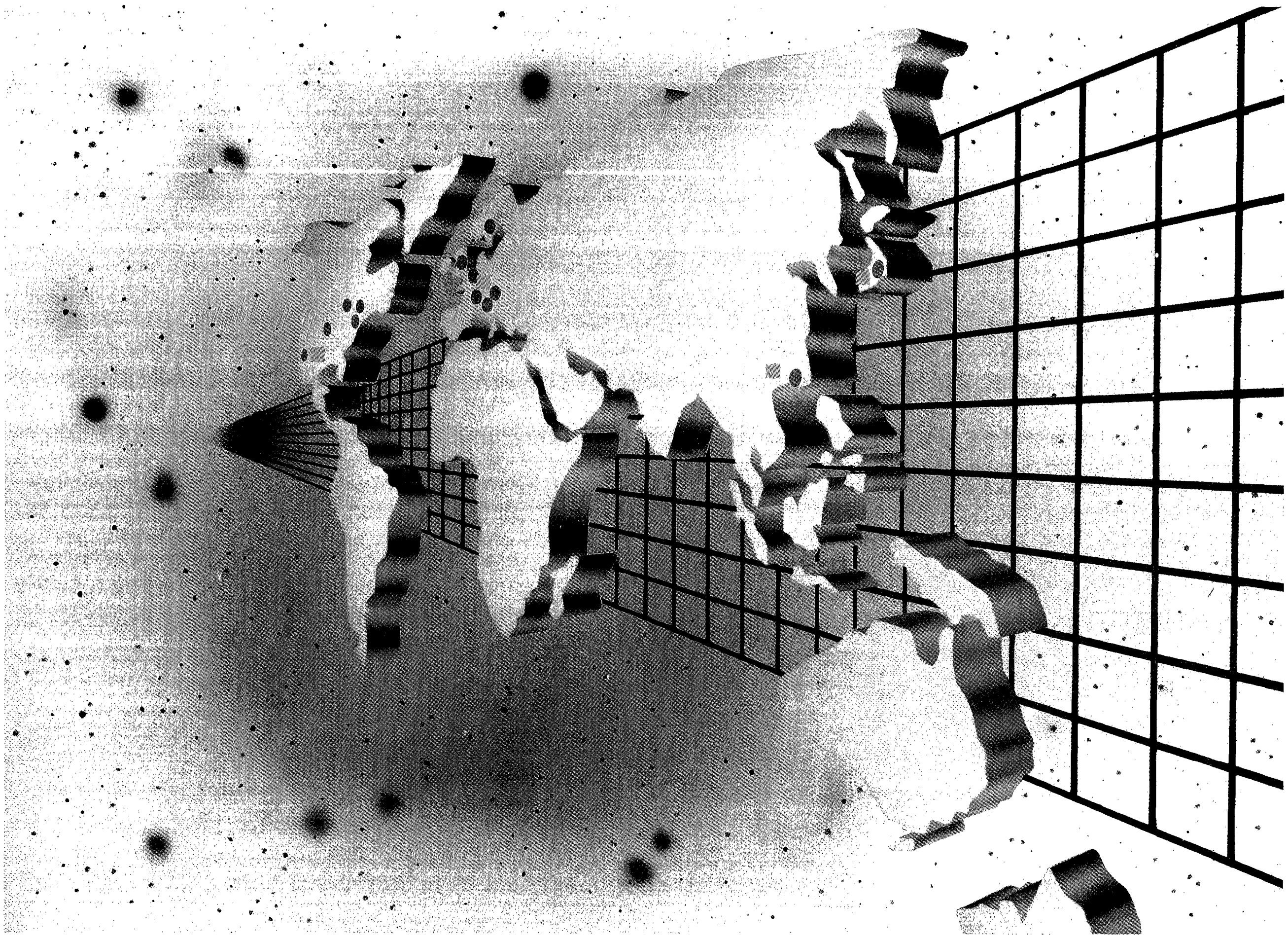


Quad Flat Pack Molded Carrier Ring (QFP-MCR) and Cost Effective Ceramic PGA (Ceff-PGA) packages lower board costs.

ASIC Design Centers

Motorola has established a worldwide network of ASIC design centers to serve the design and applications needs of our customers. The design centers provide support along the entire ASIC design process from performance benchmarking through to place-and-route and design release.

Other design center services include:
- CAD tools and applications support
- Design-For-Test (DFT) recommendations
- Automatic Test Pattern Generation services
- Access to workstations in the design centers
- Periodic design reviews to ensure success



ASIC Design Support Locations

U.S.A.

■ ●	Arizona, Chandler	(602) 821-4000
●	California, Los Angeles	(714) 634-2844
●	California, San Jose	(408) 749-0510
●	DC/Maryland, Washington	(301) 381-1570
●	Illinois, Chicago	(708) 490-9500
●	Massachusetts, Marlborough.	(508) 482-8100

International

●	England, Aylesbury, Bucks	(0296) 395252
●	France, Vanves	(01) 40355877
■ ●	Germany, Munich	(089) 92103-0
●	Holland, Eindhoven	(04998) 61211
■ ●	Hong Kong, Kwai Chung	480 8333
●	Italy, Milan	(02) 82201
■ ●	Japan, Tokyo	(03) 440-3311
●	Sweden, Solna	(08) 734-8800

● Design Center Locations
■ Headquarters

Literature

To order any literature item, call or write:

Motorola Semiconductor Products
Literature Distribution Center
P.O. Box 20912
Phoenix, AZ 85036
(602) 994-6561

Order Number — Description

Design Manuals

H4CDM/D	H4C Series CMOS Arrays
HCA62A00DM/D	HCA62A00 Series CMOS Arrays
HDCDM/D	HDC Series CMOS Arrays
BR165/D	MCA800/2500ECL
BR312/D	MCA2800RAM/2800ALS
MCA3ECL/D	MCA3 ECL Series Arrays
MCA3ETL/D	MCA3 ETL Series Arrays

Data Sheets

ETL/D	MCA750ETL, MCA3200ETL and MCA6200ETL Macrocell Arrays
H4C/D	Sub-micron H4C Series CMOS Arrays
HCA62A00/D	HCA62A00 Series CMOS Arrays
HDC/D	HDC Series CMOS Arrays
MCA800ECL/D	MCA800ECL Macrocell Array
MCA1500M/D	MCA1500M Macrocell Array
MCA2200ECL/D	MCA2200ECL Macrocell Array
MCA2500ECL/D	MCA2500ECL Macrocell Array
MCA2800ALS/D	MCA2800ALS Macrocell Array
MCA2800RAM/D	MCA2800RAM Macrocell Array
MCA10000ECL/D	MCA10000ECL Macrocell Array

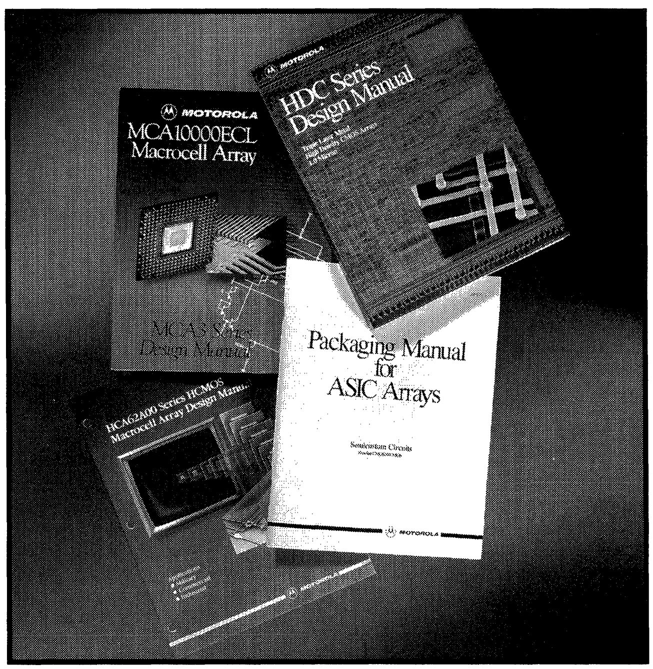
Brochures/Selector Guides

BR334/D	ASIC Overview
BR357/D	EDIF and Semicustom
BR916/D	Packaging Manual for ASIC Arrays
BR931/D	Symbols to Silicon (C_LAN)
BR1400/D	Open Architecture CAD System

Application Notes/Article Reprints

AN1093/D	Delay and Timing Methods for CMOS ASICs
AN1094/D*	Synopsys User's Guide
AN1095/D	Clock Distribution
AN1096/D	Guidelines for Using the Mustang™ ATPG System
AN1098/D*	Design Guidelines
AN1121/D*	HDL-Based Design Methodology
AR330/D	High Density ECL Arrays Ease System Implementation
AR332/D	CDA Array Papers
AR336/D	ASIC TAB Packaging Papers
AR337/D	Surface Mounting Tackles Fine Pitches

*Advance Information



Technical documentation facilitates error-free silicon design.

MUSCLE: Mixed-Mode Unified Scalable Cell Library Elements

Motorola's MUSCLE Families of CMOS standard cells feature a common but diversified set of digital, high-performance analog, and customized memory cells based on unified design rules that allow confident migration from 2.0μ to 0.8μ. This semicustom program provides an unparalleled capability to design mixed-signal integrated circuits with state-of-the-art technologies that support market leadership products.

In 1990 this semicustom program attained an electrical AOQ of 3 ppm, a quality level that exceeded even Motorola's corporate goal of Six Sigma quality.

Basic Digital Cells

A large portfolio of digital cells offers standard SSI/MSI functions such as:

- Input, output, bidirectional, 3-state and open drain buffers with up to 48 mA drive capability
- Active input pull-up and pull-down devices
- Large variety of elementary and complex gates
- Multiplexers and multiplexer blocks
- Single and multiple latches
- Flip-flops with various features including scan/hold flip-flops
- Counters and counter building blocks
- Adder/subtracter blocks

Basic Analog Cells

Standard and high performance analog functions include cells with a wide range of specifications similar to the most popular analog ICs in the industry, such as:

- Analog switches with on-state resistance as low as 100 ohms
- Bandgap references, 1.2 V/2.5 V with power down capability
- Comparators with a variety of common mode ranges and power down capability
- Operational amplifiers featuring low offset, enhanced output drive capabilities and power down mode with 1 to 20 MHz unity gain bandwidth
- A variety of current sources and bias cells
- Crystal oscillator amplifiers with on-chip bias resistor and start-up capacitors
- Self-contained and 3-pin RC oscillators
- Power-on-reset with power supply glitch protection

Customized Memories

Extensive use of modern silicon compilation techniques allows the fast customization of RAM and ROM blocks, supported by CAD generators for schematic capture and simulation. RAMs can be configured to "m" words by "n" bits with "m" being any multiple of 16 up to 4K and "n" being any integer from 1 to 32. Thus, RAM blocks of up to 4K×32 can be generated. Worst case access times for a 256×8 RAM are ranging from 23 ns with MDA20 down to 11 ns with the MDA08.

ROMs can be configured to "m" words by "n" bits with "m" being any multiple of 128 up to 8K and "n" being any integer from 1 to 32. Thus, ROM blocks of up to 8K×32 can be customized with worst-case access times of 66 ns for the MDA20 down to 35 ns with the MDA08 for an 8K×8 ROM.

Programmable Logic Arrays

Motorola is developing a PLA supercell compiler as a component of our semicustom design capability. A PLA compiler provides benefits and advantages which make it an indispensable part of our standard cell library:

- Custom-tailored functions not available in a gate array solution
- Area-saving substitute for ROMs using ESPRESSO reduction
- 10:1 area advantage over combinational logic
- Support for state machine and logic synthesis tool users

Mixed-Signal Solutions

POWER-ON RESET	AND/OR NAND/NOR	OP AMPS	MULTIPLEXERS	ANALOG SWITCH	BUFFERS
SWITCHES	A/Ds D/As	FLIP-FLOPS	BANDGAP REFERENCE	DECODERS	CONFIGURABLE ROM
RC OSCILLATORS	DELAY CELLS	CRYSTAL OSCILLATORS	OR/NOR EXOR/EXNOR	CONFIGURABLE RAM	ADDERS/ SUBTRACTERS

A unique characteristic of PLAs is the "sum-of-products" logic function, which can be minimized using Boolean minimization algorithms such as UC Berkeley's ESPRESSO. By using "don't care" values to consolidate addresses that yield the same output vectors, a PLA can implement the same function as a ROM while using only a fraction of the silicon area.

Special Cells

In addition to the powerful range of cells in the MUSCLE library, Motorola works closely with major customers to develop enhanced solutions according to customer specifications. These enhanced solutions quite often result in design modifications to some existing cells or the development of entirely new cells that are incorporated into our existing library after thorough characterization. Examples of these modified or newly developed cells are:

- 80 mA high drive CMOS output cells
- Low offset comparators (typical 2 mV @ 25°C)
- Low power oscillators (<1 μA)
- LCD cells customized to specific display configurations
- LCD voltage reference cell
- LCD front/backplane drivers
- High performance video cells such as a 30 MHz gain bandwidth operational amplifier, an 8-bit differential DAC with <20 ns settling time, a 7-bit differential ADC with 14 MHz sampling, and a smooth differential 2:1 video multiplexer

JTAG Boundary Scan Cells

As a complement to the MUSCLE standard cell libraries. Motorola is developing scan cells that provide enhanced testability. Designed according to IEEE 1149.1, these scan cells include:

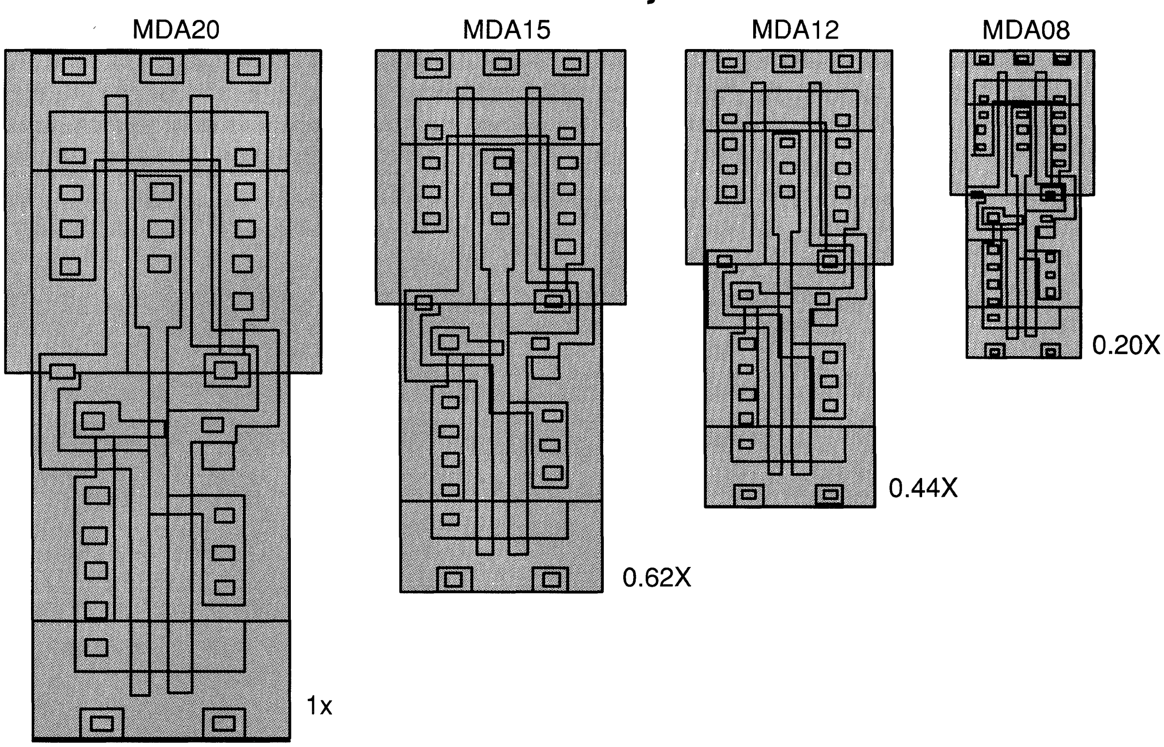
- Input/output
- Bypass register
- TAP controller, etc.

By use of both pad and core cells, and hard and soft macros, scan methodology can be tailored to both pad and core limited designs, making the most efficient use of silicon area. This allows the standard cell itself to be tested by scan techniques in addition to allowing the chip to be integrated into the designer's board/system test requirements.

CAD Support

Motorola has developed the MUSCLE standard cell libraries with software tools that integrate with the most advanced design tools supplied by major CAD software vendors. Design tools supported include Cadence's Amadeus design framework with the Verilog simulator, closely coupled to the Synopsys design compiler and the Cell3 Ensemble sea-of-gates, triple layer metal router. Motorola's Design Verificiation Module (DVM) which is made available to customers for netlisting, schematic capture, and simulation, supports HP-Apollo/Mentor with QuickSim for simulation, TANCELL for placement and routing, and Dracula for layout and verification under Mentor's 7.0 software release. Motorola will support Mentor's 8.0 Falcon software release and QuickSim II simulator.

Scalability



Family Characteristics

	MDA20	MDA15	MDA12	MDA08
Scale Factor	0.56x	0.44x	0.37x	0.25x
Feature Size (Target L_{eff})	1.8μ	1.25μ	0.83μ	0.75μ
Estimated Maximum Die Size (sq mils)	160,000	160,000	160,000	160,000
Process	N-Well	N-Well	N-Well	N-Well
Maximum Number of Gates (DLM/TLM)	20K	60K	80K	175K
Maximum System Frequency (MHz)	≤50	≤65	≤80	>100
D Flip-Flop Toggle Rate (MHz)	59	98	167	TBD-3Q91
Operating Voltage	3.0–6.0 V	3.0–6.0 V	3.0–6.0 V	3.0–6.0 V
Temperature Range	–55 to +125°C	–55 to +125°C	–55 to +125°C	–55 to +125°C
ESD Rating	>6000 V	>6000 V	>6000 V	TBD-3Q91
Latch-Up Rating–Inputs	150 mA	150 mA	150 mA	TBD-3Q91
Latch-Up Rating–Outputs	300 mA	300 mA	300 mA	TBD-3Q91
Number of Base Digital Macros	93	141	141	TBD-3Q91
Number of Base Analog Macros	26	46	6	TBD-3Q91
Number of I/O Buffers	21	21	21	TBD-3Q91
Number of Oscillator Macros	6	6	6	TBD-3Q91
Typical Gate Delay (H/L)	0.75 ns	0.69 ns	0.48 ns	TBD-3Q91
Worst Case Delay	1.98 ns	1.67 ns	1.33 ns	TBD-3Q91
Maximum RAM Size	4K×32	4K×32	4K×32	4K×32
RAM Access Time	<30 ns	<25 ns	<15 ns	TBD-3Q91
Maximum ROM Size	8K×32	8K×32	8K×32	8K×32
ROM Access Time	<85 ns	<60 ns	<35 ns	TBD-3Q91
Schmitt Trigger	Yes	Yes	Yes	Yes
Transmission Gates	Yes	Yes	No	Yes
Scan Macros	Yes	Yes	Yes	Yes
Workstation Platform	HP-Apollo	Sun/HP-Apollo	Sun/HP-Apollo	Sun/HP-Apollo
Design Automation Support	Mentor	Cadence/Mentor	Cadence/Mentor	Cadence/Mentor
Schematic Capture	NETED	Composer/NETED	Composer/NETED	Composer/NETED
Gate Level Simulation	QuickSim	Verilog/QuickSim	Verilog/QuickSim	Verilog/QuickSim
Design Rule Checking (DRC)	Dracula	Dracula	Dracula	Dracula
Transistor Level Simulator	HSPICE	HSPICE	HSPICE	HSPICE
Place and Route	TANCELL	TANCELL/Cell3 Ensemble	TANCELL/Cell3 Ensemble	TANCELL/Cell3 Ensemble
Analog Simulation	HSPICE	HSPICE/Saber	HSPICE/Saber	HSPICE/Saber
Logic Synthesis	N/A	Synopsys	Synopsys	Synopsys
Supported with a DVM Kit**	Yes	Yes	Yes	Yes
Analog Macro Support				
Operational Amplifiers	Yes	Yes	No	Yes
Comparators	Yes	Yes	Yes	Yes
Bandgap Reference	Yes	Yes	No	Yes
A/D Converters	Yes	Yes	No	Yes
D/A Converters	Yes	Yes	No	Yes
Current Bias Generators	Yes	Yes	Yes	Yes
Analog Switch	Yes	Yes	No	Yes
Crystal Oscillators	Yes	Yes	Yes	Yes
RC Oscillators	Yes	Yes	No	Yes
Current Sources	Yes	Yes	No	Yes
Power On Reset	Yes	Yes	Yes	Yes
Data Book Order Number	DL149/D	DL152/D	DL153/D	TBD

**DVM = Design Verification Module for schematic capture and simulation

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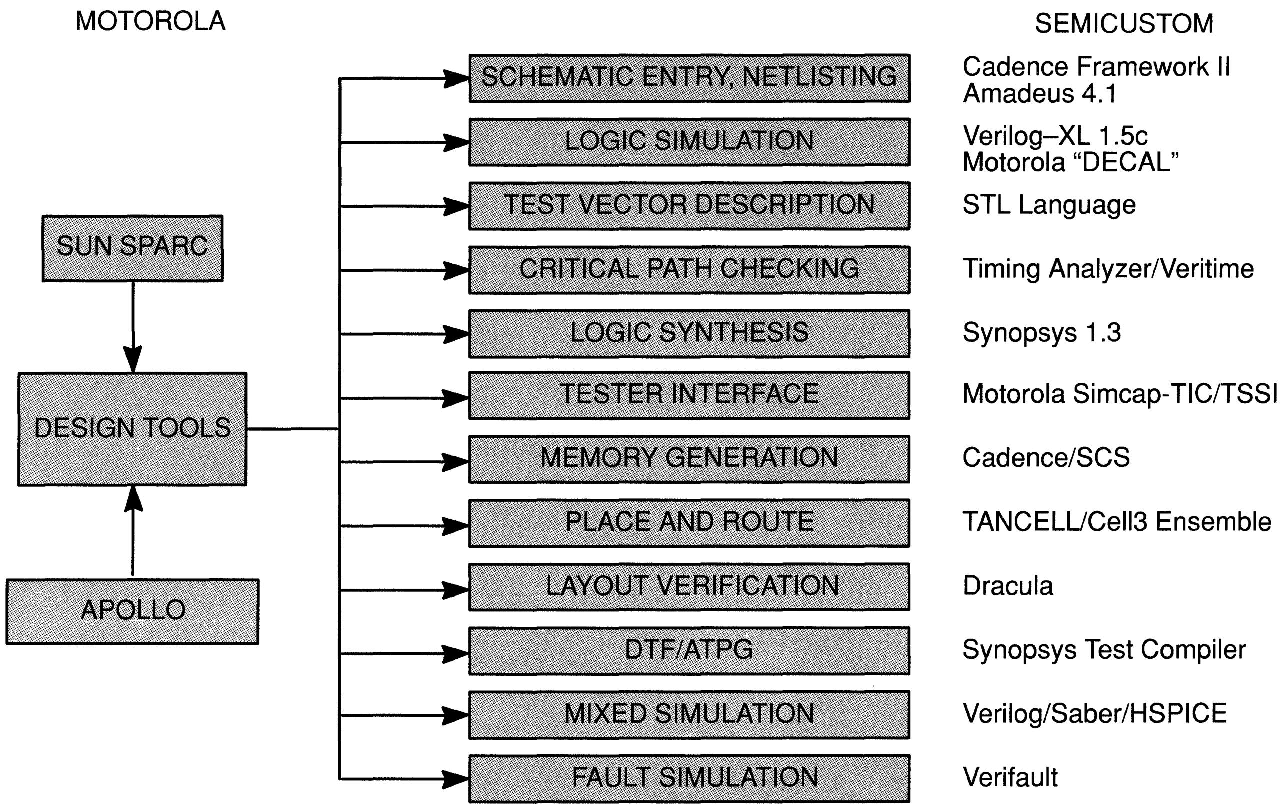
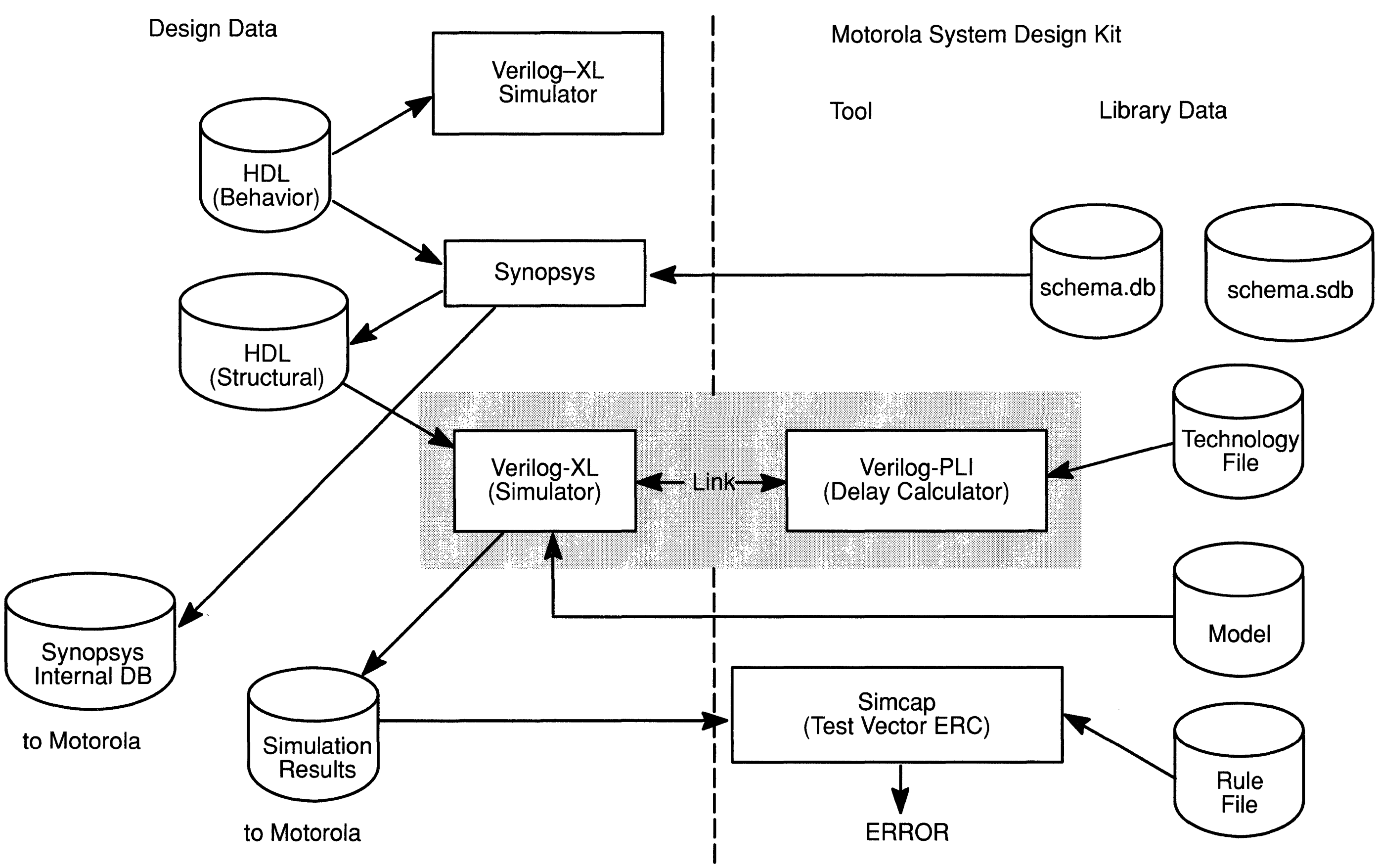
Synopsys is a trademark of Synopsys, Inc.
Saber is a trademark of Analogy, Inc.

CAD Support Features



Front-End System Design



Microcomputer Components

In Brief . . .

Motorola continues to be a leading supplier of components for microcomputer systems. The product portfolio includes digital signal processors; CISC and RISC advanced microprocessors and complementary full-function peripherals; a comprehensive selection of high-performance microcontrollers; VLSI support functions for PC applications; and a broad range of fast static RAM and dynamic RAM chips and modules.

Our commitment is to provide state-of-the-art devices as well as continuing support of established products, with six-sigma quality and total customer satisfaction.

Digital Signal Processors

In Brief . . .

Drawing on both design excellence and expertise in manufacturing, Motorola has created a range of architecturally compatible Digital Signal Processing chips. The philosophy behind the DSP families has been to create compatibility between products as well as conformance to international standards.

Currently, Motorola addresses three main areas of DSP hardware: general purpose, algorithm specific processors and peripherals. Our general purpose processors include 16- and 24-bit fixed point and 32-bit floating point families.

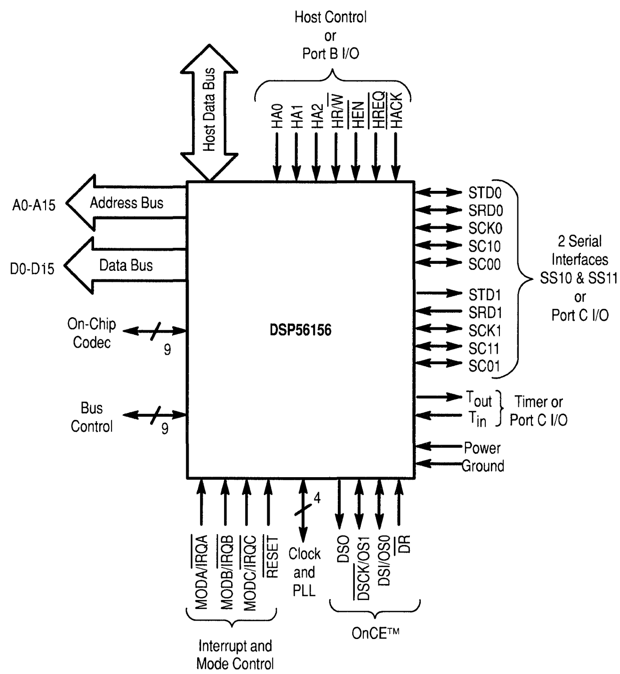
In addition, we offer a comprehensive array of development tools to give the designer access to the full power and versatility of the DSPs with minimum fuss. All the tools were designed for ease of use and functionality. They provide a low-cost means of evaluation and greatly simplify the design and development phase of a DSP project.

Digital Signal Processors
16-/24-/32-bit Families — Your Complete DSP Solution

DSP56100 — 16-bit Digital Signal Processors

The DSP56100 family of HCMOS, low power, 16-bit fixed-point general purpose Digital Signal Processors (DSP) was designed primarily for speech coding, telecommunications and control applications. Each family member combines the high speed 5616 core with 8K bytes of on-chip RAM, two serial ports, one parallel port and a timer, plus the OnCE™ on-chip emulator.

The DSP56156 expands this basic configuration with on-chip codec and phase-locked loop (PLL).



PART NUMBERS

Part	Description
XC56116RC40	40 MHz in PGA
XC56116FE40	40 MHz in CQFP
XC56156FE40	40 MHz in CQFP

DSP56156 BENCHMARKS

Benchmark	Instruction Cycles
Real FIR Filter with Data Shift	1 per Tap
LMS Adaptive Real FIR Filter	2 per Tap
Double Integration Sinewave Generation	2 per Sample
Complex FIR Filter with Data Shift	4 per Tap
General Lattice Filter	4 per Tap
Real Cascaded IIR Biquad Filter Sections (4 coeff.)	5 per Section
PID Loop	5
Double Precision Multiply	6
[1×3][3×3] Matrix Multiplication	21

DSP56156 Features:

- 20 Million Instructions per Second (MIPS) — 50 ns instruction cycle at 40 MHz
- Single-cycle 16×16-bit parallel multiply-accumulator
- Two 40-bit accumulators including extension byte
- Fractional and integer arithmetic with support for multiprecision arithmetic
- Highly parallel instruction set with unique DSP addressing modes
- Nested hardware DO loops including infinite loops
- Zero-overhead fast interrupts (two instruction cycles)
- Three 16-bit internal data buses
- Three 16-bit internal address buses
- On-chip peripheral registers memory mapped in data memory space
- Low power Wait and Stop modes
- Operating frequency down to DC
- On-chip oscillator
- Single 5V power supply
- 2K×16-bit on-chip data RAM
- 2K×16-bit on-chip program RAM
- Bootstrap loading from external PROM, Host Interface or Synchronous Serial Interface 0 (SSI0)
- Synchronous memory expansion port (Port A) with 16-bit address and data buses
- 24 general purpose I/O pins
- Byte-wide Host Interface with DMA support
- Two independent synchronous serial interfaces
- Built in μ-law and A-law compression/expansion
- Up to 32 software selectable time slots in network mode
- 16-bit timer with external input/output
- On-Chip Emulation (OnCE™) for unobtrusive, processor speed independent debugging
- Hardware support for high-level languages
- Two instruction LMS adaptive filter loop
- On-chip codec
- Phase-locked loop frequency synthesizer

DSP56000 — 24-bit Digital Signal Processors

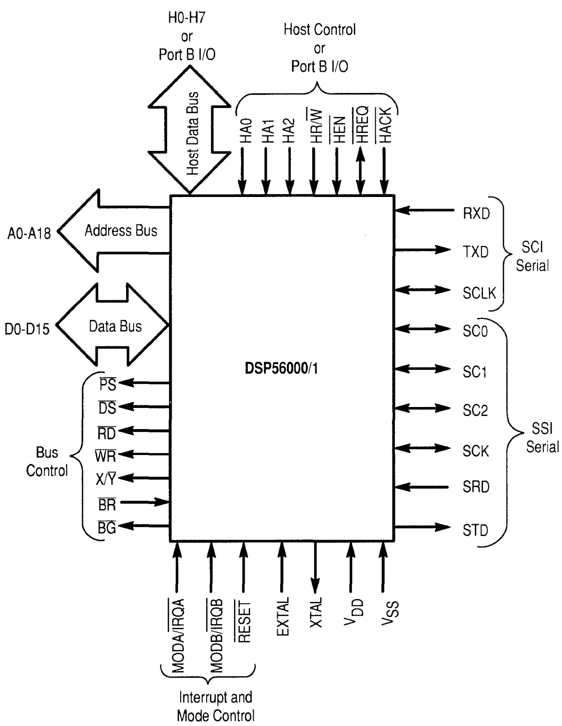
The DSP56000 family of 24-bit fixed-point general purpose DSPs feature three single-cycle execution units — the Data ALU, the Address Arithmetic Unit and the Program Controller — which operate in parallel at instruction speeds up to 16.5 MHz. X data, Y data and Program data memories are provided on–chip and each is expandable off-chip to provide up to 192K words of 24-bit data address space. The on-chip I/O is flexible, with two serial ports and a parallel Host. The high throughput of the DSP56000/1 makes them well-suited for communication, high-speed control, numeric processing and computer and audio applications.

The DSP56000 has on-chip Program and Data ROMs that can be factory customized. It has a run rate of 10.25 million instructions per second and a clock speed of 20.5 MHz.

The DSP56001 is a RAM-based version of the 56000. Due to its on-chip Program RAM, the 56001 is available off the shelf for immediate implementation. It includes two data ROMs containing MU-Law and A-Law tables and sine-wave generation tables and is available in the following speeds.

The DSP56001 (20.5 MHz) has a run rate of 10.25 MIPS. The DSP56001 (27 MHz) has a run rate of 13.5 MIPS. The DSP56001 (33 MHz) has a run rate of 16.5 MIPS.

The DSP56002 is a RAM-based version designed using the Universal Design Rules (UDR) and incorporating on-chip emulation (OnCE™). It is available in 40 MHz.



DSP56001 BENCHMARKS

Benchmark	Instruction Cycles
Real FIR Filter with Data Shift	1 per Tap
Two Dimensional Convolution (3×3 coeff. mask)	1 per Output
LMS Adaptive Real FIR Filter	3 per Tap
Real Cascaded IIR Biquad Filter Sections (4 coeff.)	4 per Section
Complex FIR Filter with Data Shift	4 per Tap
[1×3][3×3] Matrix Multiplication	17
Division	28
Leroux-Gueguen LPC Analysis:	
8th Order	473
10th Order	622
16th Order	1203
256-point Complex FFT	6613
1024-point Complex FFT	33120

DSP56001 Features:

- 16.5 Million Instructions per Second (MIPS) — 60 ns instruction cycle at 33 MHz
- 24×24→56-bit parallel multiply/accumulate
- Two 56-bit accumulators
- Linear, modulo and bit reversed address generation
- Nested hardware DO loops
- No overhead auto-return (fast) interrupts
- 62 MPU-style instruction types
- Suitable for high level language compilers
- On-chip MCU-style peripherals
  - — 24 programmable I/O port pins
  - — 8-bit parallel host MPU/DMA interface
  - — Serial Communication Interface
  - — Synchronous Serial (Codec) Interface
- On-chip memory
  - — Two independent 256×24-bit data RAMs and ROMs
  - — 512×24-bit program RAM (DSP56001)
- Off–chip memory
  - — 128K×24-bit data memory
  - — 64K×24-bit program memory

PART NUMBERS

Part	Description
XSP56000RC20	20 MHz ROM-based in PGA
XSP56000FE20	20 MHz ROM-based in CQFP
XSP56001RC27	27 MHz RAM-based in PGA
XSP56001FE27	27 MHz RAM-based in CQFP
XC56001FD27	27 MHz RAM-based in PQFP
XC56001RC33	33 MHz RAM-based in PGA
XC56001FE33	33 MHz RAM-based in CQFP
XC56001FD33	33 MHz RAM-based in PQFP
XC56001RC40	40 MHz RAM-based in PGA
XC56001FE40	40 MHz RAM-based in CQFP
XC56001FD40	40 MHz RAM-based in PQFP
XC56002RC40	40 MHz RAM-based in PGA
XC56002FD40	40 MHz RAM-based in PQFP

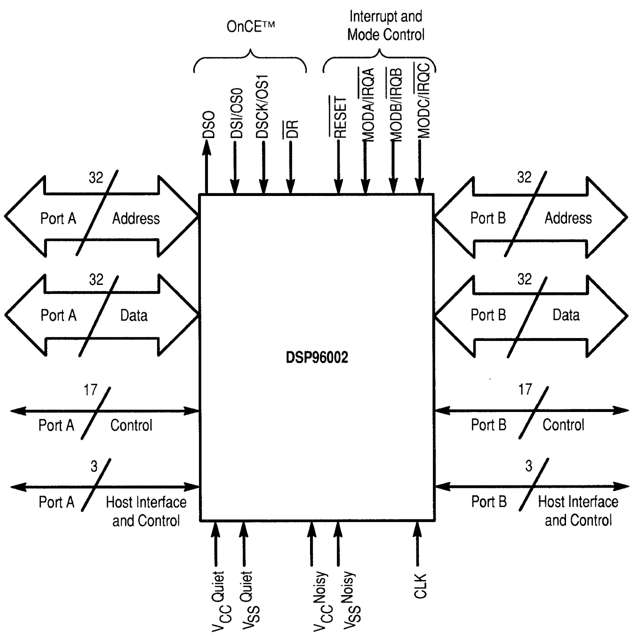
DSP96000 — 32-bit IEEE Floating Point Dual-Port Processors

The DSP96000 is a family of single-chip, dual port, low-power, general purpose 32-bit IEEE floating-point DSPs. The central processing unit consists of three execution units operating in parallel: the Data ALU, the Address Generation Unit and the Program Control Unit. The DSP96002 has full architecture compatibility with the DSP56100 and DSP56000 families which allows for ease of design and programming when working on any Motorola DSP.

The DSP96002 has two identical memory expansion ports simplifying network configurations for multiprocessor and DSP96002 communications. These ports interface with SRAMs, DRAMs (operating in their fast access modes) and video RAMs. Each port can be transformed into a Host Interface which supports easy interfacing to other processors for multiprocessor applications.

The superior performance of the DSP96002 has allowed Motorola to designate it as the Media Engine™ processor. Although designed primarily for graphics processing, other applications include communication, spectrum analysis, instrumentation, speech processing and pattern recognition.

The DSP96002 is available in 27 MHz, 33 MHz and 40 MHz.



PART NUMBERS

Part	Description
XC96002RC27	27 MHz in PGA
XC96002RC33	33 MHz in PGA
XC96002RC40	40 MHz in PGA

DSP96002 BENCHMARKS

Benchmark	Instruction Cycles
Real	
FIR Filter with Data Shift	1 per Tap
C = V + S	2
V = V*S + V	2
Lattice Filter with Data Shift	3 per Tap
Cascaded IIR Biquad Filter Sections (4 coeff.)	4 per Section
1024-point FFT and bit reversal	12880
Complex	
V = V*V + V	4
FIR Filter with Data Shift	4 per Tap
1024-point FFT and bit reversal	20931
Graphics/Image Processing	
Divide (32-bit accuracy)	7
Square Root (32-bit accuracy)	12
Bezier Cubic Evaluation for Font Compilation	13
[4×4][4×4] = [4×4]	67

DSP96002 Features:

- IEEE 754 Standard SP (32-bit) and SEP (44-bit) arithmetic
- 20 Million Instructions per Second (MIPS) — 50 ns instrcution cycle at 40 MHz
- 60 Million Floating Point Instructions per Second (MFLOPS) peak with a 40 MHz clock
- Single-cycle 32×32-bit parallel multiplier
- Highly parallel instruction set with unique DSP addressing modes
- Nested hardware DO loops
- Fast auto-return interrupts
- Two independent on-chip 512×32-bit data RAMs
- Two independent on-chip 1024×32-bit data ROMs
- Off-chip expansion to $2{\times}2^{32}$ 32-bit words of data memory
- On-chip 1024×32-bit program RAM
- On-chip 64×32-bit bootstrap ROM
- Off-chip expansion to 2^{32} 32-bit words of program memory
- Two identical external memory expansion ports
- On-chip 2-channel DMA controller
- On-chip emulation (OnCE) for unobtrusive, processor speed independent debugging

DSP Peripherals —

DSP56200 — The Cascadable Adaptive Finite Impulse Response Digital Filter

The DSP56200 is an algorithm-specific DSP peripheral designed to perform computationally-intensive tasks. Two principal algorithms are implemented on the DSP56200 making the primary functions finite impulse response (FIR) and adaptive FIR filtering. Its performance, features and simple interface with host microprocessors make the DSP56200 a natural solution for echo cancelling, noise cancelling, convolution, correlation and orthogonal transform applications.

Key Features:

- Low Power HCMOS
- 100 ns per tap throughput
- 256×16-bit data RAM
- 256×24-bit coefficient RAM
- 16×24-bit multiplier, 40-bit accumulation
- Three modes of Operation
  - — Single FIR filter
  - — Dual FIR filter
  - — Single adaptive FIR filter with dc tap and leakage control
- Programmable tap lengths
  - — 256 taps in single channel mode
  - — 128 taps per channel in dual mode
- Cascadable in single channel mode
- Programmable leakage and gain
- 8-bit I/O port with 7 control lines
- Scratch pad memory
- Power down mode

PART NUMBERS

Part	Description
XC56200LC10	10.5 MHz in CERDIP

DSP56ADC16 — The Analog to Digital Converter

The DSP56ADC16 is a single-chip, linear analog-to-digital (A/D) converter. It is an ideal choice for high-performance digital audio systems, voice-bandwidth communication and control applications. It does not require antialiasing filters and sample-and-hold circuitry because they are an inherent part of the sigma-delta technology. The DSP56ADC16 can be easily interfaced to the DSP56001 and other host processors using its flexible serial interface.

Key Features:

- 16-bit output resolution at 100 kHz from FIR filter
- 12-bit output resolution at 400 kHz from Comb filter
- 96-dB dynamic range
- 90-dB signal-to-THD ratio
- 90-dB signal-to-noise ratio
- In-band ripple: <0.001 dB
- Maximum output sample rates:
  - — FIR filter — 100 kHz
  - — Comb filter — 400 kHz
- Maximum input sample rate is 6.4 MHz
- Maximum internal clock rate is 12.8 MHz
- DC stability is 10-bits
- Supply voltage is single +5V (±10%)
- Supply current is <100 mA
- Linear-phase analog front end and internal digital filters
- Simple serial interface to host microprocessors
- Fully differential inputs

PART NUMBERS

Part	Description
XC56ADC16S	16-bit in CERDIP
XC56ADC16P	16-bit in PDIP

DSP Development Tools —

Application Development Systems

Every member of the Motorola Family of 16, 24 and 32-bit DSPs is supported by a multi-component Application Development System (ADS) which acts as a tool for designing, debugging and evaluating real-time DSP target system equipment. The ADS simplifies evaluation of the user's prototype hardware/software product by making all of the essential timing and I/O circuitry easily accessible. Using an IBM PC™, Macintosh™ II or a SUN-3™ as a medium between the user and the DSP hardware significantly reduces the overall complexity and cost of development while increasing the capabilities of the system. With the ADS, DSP programs can be executed in real-time, single instruction traced or multiple instruction stepped with registers and/or memory block contents displayed. The ADS is fully compatible with the CLAS design-in software package for each product and may act as an accelerator for testing DSP algorithms.

Emulation capability is available for the DSP56000ADS with the addition of an emulator cable which plugs into the euro–card connector on the ADS board. The DSP56156ADS and DSP96002ADS offer an On-Chip Emulation (OnCE™) circuit for unobtrusive, processor speed independent debugging. The ADS takes full advantage of this circuit to allow the user non-intrusive control of the target.

General ADS Features:

Software —
- Single/multiple stepping through DSP object programs
- Conditional/unconditional software and hardware breakpoints
- Program patching using a single-line assembler/disassembler
- Session and/or command logging for later reference
- Loading and saving of files to/from ADM memory
- Macro command definition and execution
- Display enable/disable of registers and memory
- Debug commands which support multiple DSP development
- Hexadecimal/decimal/binary calculator
- Multiple input/output file access from DSP object programs
- On-line help screens for each command and register

Hardware —
- Full speed operation
- Multiple ADM support with programmable ADM addressing
- Stand-alone operation of ADM after initial development

DSP56156ADS Features:

- System commands from within ADS user interface program
- 16K words of configurable static RAM expandable to 64K words
- 2K words of EPROM with sockets expandable to 16K words
- Full support of multiple data memory maps
- 96-pin connector provides access to all DSP56156 pins

DSP56000ADS Features:

- Host operating system commands from within ADS user interface program
- 8K/32K words of configurable RAM for DSP56000/1 code development
- 96-pin euro-card connector for accessing all DSP56000/1 pins
- 1K words of monitor ROM expandable to 4K words
- Separate connectors for accessing serial or host/DMA ports

DSP96000ADS Features:

- System commands from within ADS user interface program
- 128K words of configurable static RAM expandable to 512K words
- 2K words of EPROM with sockets expandable to 64K words
- Full support of multiple data memory maps
- Two sets of 96-pin connectors provide access to all DSP96002 pins

PART NUMBERS

Development Systems	Host Machine
DSP56156ADSA	IBM PC™
DSP56156ADSB	Macintosh™II
DSP56156ADSC	SUN-3™
DSP56000ADSA	IBM PC™
DSP56000ADSA27	IBM PC™ (27 MHz)
DSP56000ADSB	Macintosh™II
DSP56000ADSB27	Macintosh™II (27 MHz)
DSP56000ADSC	SUN-3™
DSP56000ADSC27	SUN-3™ (27 MHz)
DSP96000ADSA	IBM PC™
DSP96000ADSB	Macintosh™II
DSP96000ADSC	SUN-3™

Design-In Software Packages

The Simulator/Macro-Assembler/Linker/Librarian software package is a development system support tool. The Simulator program imitates the operation of the DSP on a clock-cycle by clock-cycle basis and gives an accurate measurement of code execution time. All on-chip peripheral operations, memory and register updates and exception processing activities may be functionally simulated.

The full-featured Macro Cross Assembler translates one or more source files containing instruction mnemonics, operands and assembler directives into a Common Object File Format (COFF) file which is directly loadable by the Simulator. It supports the full instruction set, memory spaces and parallel transfer fields of the DSP.

The Linker relocates and links relocatable COFF object modules from the Assembler to create an absolute load file which can be loaded directly into the Simulator. The Librarian utility will merge separate, relocatable object modules into a single file allowing frequently used modules to be grouped for convenient linking and storing.

Each package is available in three versions depending upon the Host machine that will be used. The available options are for an IBM PC, Macintosh II, SUN-3, SUN-4, or NeXT workstation.

PART NUMBERS

Simulator/Assembler/ Linker/Library	Host Machine
DSP56156CLASA	IBM PC™
DSP56156CLASB	Macintosh™II
DSP56156CLASC	SUN-3™
DSP56156CLASF	SUN-4™
DSP56156CLASG	NeXT™
DSP56000CLASA	IBM PC™
DSP56000CLASB	Macintosh™II
DSP56000CLASC	SUN-3™
DSP56000CLASF	SUN-4™
DSP56000CLASG	NeXT™
DSP96000CLASA	IBM PC™
DSP96000CLASB	Macintosh™II
DSP96000CLASC	SUN-3™
DSP96000CLASF	SUN-4™
DSP96000CLASG	NeXT™

NEW C-Compiler Packages

A full ANSI C compliant compiler, based on GNU technology, provides higher efficiency and implements more than 20 major optimization techniques. It has improved in-line assembly capability and an ANSI C preprocessor. The package includes the C Compiler, a new COFF Assembler, Linker, complete ANSI C Libraries and a new C source level debugger as well as expanded user's reference manual. The software package is available for various host computers listed below.

PART NUMBERS

GNU C Compiler	Host Machine
DSP56000/1	
DSP56KCCA	IBM PC™ 386
DSP56KCCB	Macintosh™II
DSP56KCCC	SUN-3™
DSP56KCCF	SUN-4™
DSP96002	
DSP96KCCA	IBM PC™ 386
DSP96KCCB	Macintosh™II
DSP96KCCC	SUN-3™
DSP96KCCF	SUN-4™

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Macintosh is a trademark of Apple Computer, Inc.
NeXT is a trademark of NeXT Computer, Inc.
SUN-3 and SUN-4 are trademarks of Sun Microsystems, Inc.

Winner 1988 Malcolm Baldrige National Quality Award

The M68000 MPU Family

. . . the upward compatible 8-/16-/32-Bit Microprocessor Family

In Brief . . .

An MPU For All Functions

To designers of the most advanced microcomputer systems, the Motorola M68000 Family of microprocessors need no introduction. Products based on its members have become the standard for systems utilizing the UNIX operating system and for CAD/CAM engineering workstations. They are invading the next generation designs of personal computers and color graphics systems, and they find widespread implementation in multi-user/multi-tasking applications and in small business systems. M68000 MPUs are found in the leading products in fault-tolerant systems requiring high performance and parallel processing, and they are the preferred components for artificial intelligence engines requiring large linear addressing capabilities. Control applications include graphics, numerical controllers, robotics, telecommunications switching and PBX voice/data transmission.

Upward Compatibility

The M68000 MPU Family consists of a line of processors based on a 32-bit flexible register set, a large linear address space, a simple yet powerful instruction set and flexible addressing modes. The internal architecture of the 8-, 16-, and 32-bit MPU versions, and the common instruction set, provide software compatibility and offer an easy upward migration path for products requiring increasing levels of processing power.

A Host of Peripherals

A large selection of full-function peripheral chips complements the processor family. Compatible LSI and VLSI chips for memory management, data communications, DMA control, network control, system interfacing, general I/O and graphics, all simplify system design and reduce design and manufacturing cost while improving system performance.

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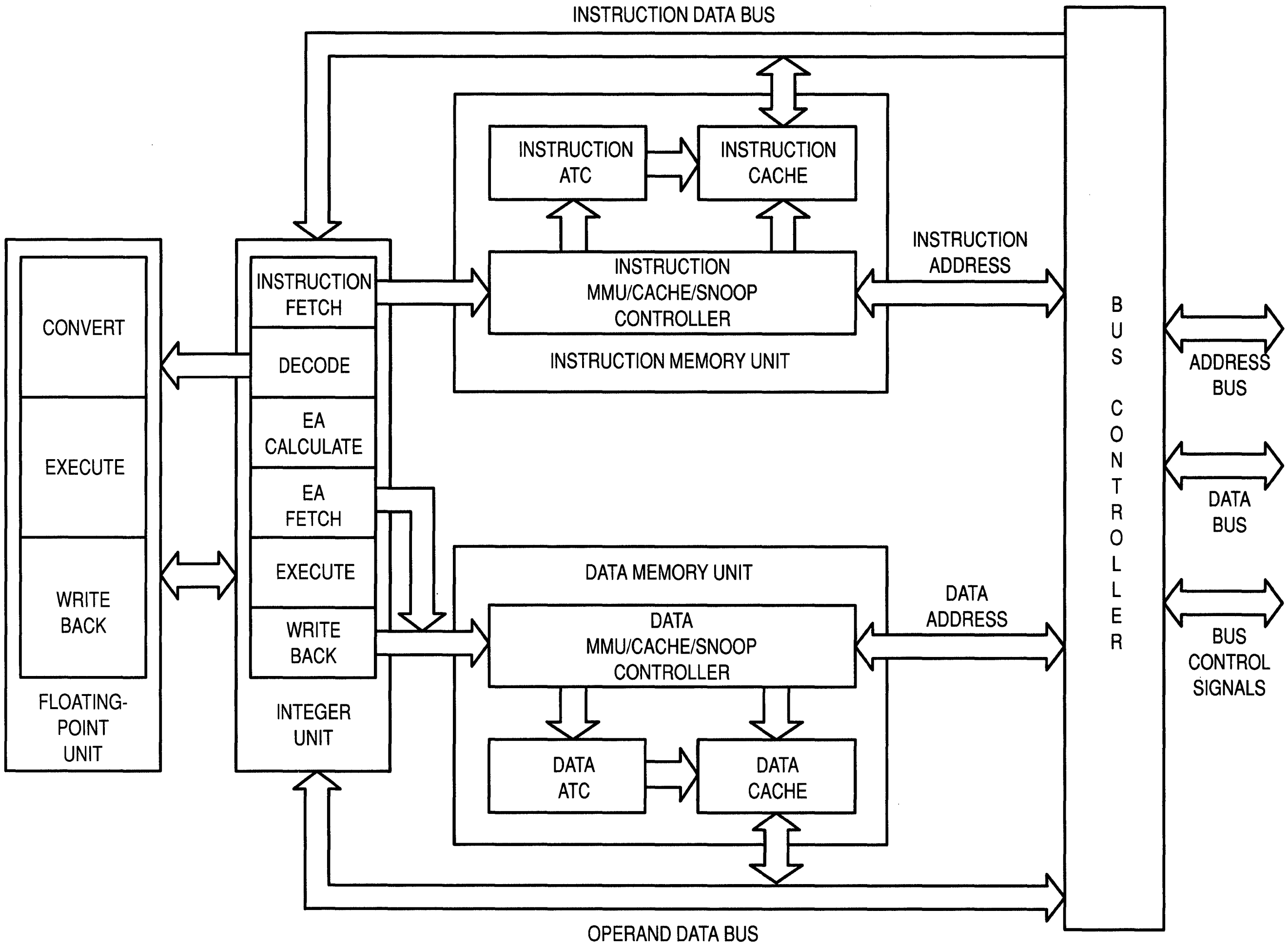


MC68040 — Block Diagram

MC68040
Third-Generation 32-Bit Microprocessor

The MC68040 is Motorola's third generation of M68000-compatible, high-performance, 32-bit microprocessors. The MC68040 is a virtual memory microprocessor employing multiple, concurrent execution units and a highly integrated architecture to provide very high performance in a monolithic HCMOS device. On a single chip, the MC68040 integrates an MC68030-compatible integer unit, an IEEE 754-compatible floating-point unit (FPU), and fully independent instruction and data demand-paged memory management units (MMUs), including independent 4K-byte instruction and data caches. A high degree of instruction execution parallelism is achieved through the use of multiple independent execution pipelines, multiple internal buses, and a full internal Harvard architecture, including separate physical caches for both instruction and data accesses. The MC68040 also directly supports cache coherency in multimaster applications with dedicated on-chip bus snooping logic.

The MC68040 is an enhanced, 32-bit, HCMOS microprocessor that combines the integer unit processing capabilities of the MC68030 microprocessor with independent 4K-byte data and instruction caches and an on-chip FPU. The MC68040 maintains the 32-bit registers available with the entire M68000 Family as well as the 32-bit address and data paths, rich instruction set, and versatile addressing modes. Instruction execution proceeds in parallel with accesses to the internal caches, MMU operations, and bus controller activity. Additionally, the integer unit is optimized for high-level language environments.The MC68040 is user-object-code compatible with previous members of the M68000 Family and is specifically optimized to reduce the execution time of compiler-generated code. The MC68040 is implemented in Motorola's latest HCMOS technology, providing an ideal balance between speed, power, and physical device size.

Instruction execution is pipelined in both the integer unit and FPU. Independent data and instruction MMUs control the main caches and the address translation caches (ATCs). The ATCs speed up logical-to-physical address translations by storing recently used translations. The bus snooper circuit ensures cache coherency in multimaster and multiprocessing applications. The MC68040 FPU is user-object-code compatible with the MC68882 floating-point coprocessor. The FPU has been optimized to execute the most commonly used subset of the MC68882 instruction set, and includes additional instruction formats for single- and double-precision rounding of results.

The MMUs support multiprocessing, virtual memory systems by translating logical addresses to physical addresses using translation tables stored in memory. Each MMU has two transparent translation registers available that define a one-to-one mapping for address space segments ranging in size from 16 Mbytes to 4 Gbytes each. The instruction and data caches operate independently from the rest of the machine, storing information for fast access by the execution units. Each cache resides on its own internal address bus and internal data bus, allowing simultaneous access to both. The data cache provides writethrough or copyback write modes that can be configured on a page-by-page basis.

The MC68040 bus controller supports a high-speed, nonmultiplexed, synchronous external bus interface, which allows the following transfer sizes: byte, word (2 bytes), long word (4 bytes), and line (16 bytes). Line accesses are performed using burst transfers for both reads and writes to provide high data transfer rates.

MC68030RC,RL,RP,FE
The Second Generation 32-Bit MPU

The 030 started with a high performance 020 core and added many performance improvement features including increased internal parallelism, dual on-chip caches with a burst fillable mode, dual internal data and address buses, improved bus interface, and on-chip paged memory management unit.

Two independent 32-bit address buses and two 32-bit data buses allow the CPU, caches, MMU, and the bus controller to operate in parallel, so the 030 can, for example, simultaneously access an instruction from the instruction cache, data from the data cache and instruction/data from external memory.

Performance is further enhanced by on-chip instruction and data caches. Separate 256-byte data and instruction caches reduce the access time and increase CPU throughput by providing data and instructions on-chip.

Overall bus requirements are reduced and multiple processors can run more efficiently thanks to increased bandwidth of the 030 bus, achieved by the enhanced bus controller allowing high speed fills of both data and instruction caches.

The on-chip paged memory management unit translates logical address to the corresponding physical addresses in 1/2 the time required by the 020 and MC68851 Paged Memory Management Unit. Pipelining permits this translation to be performed in parallel with other functions so that no translation time is added to any bus cycle.

MC68EC030RP
32-Bit Enhanced Embedded Controller

The MC68EC030 is a 32-bit embedded controller that streamlines the functionality of an MC68030 for the requirements of embedded control applications. The MC68EC030 is optimized to maintain performance while using cost-effective memory subsystems. The rich instruction set and addressing mode capabilities of the MC68020, MC68030, and MC68040 have been maintained, allowing a clear migration path for M68000 systems. The MC68EC030 is object-code compatible with the MC68020, MC68030, and earlier M68000 microprocessors. Burst-mode bus interface is provided for efficient DRAM access.

The MC68EC030 has an on-chip data cache and on-chip instruction cache with 256 bytes each. Dynamic bus sizing is available for direct interfacing to 8-, 16-, and 32-Bit Devices. The EC030 is available in 25- and 40-MHz operating frequency providing up to 9.2 MIPS. The MC68EC030 includes 32-bit nonmultiplexed address and data buses, sixteen 32-bit general-purpose data and address registers, and two 32-bit supervisor stack pointers and eight special-purpose control registers. The EC030 provides complete support for coprocessors with the M68000 coprocessor interface. There is two access control registers that allow blocks to be defined for cacheability protection. The pipelined architecture, along with increased parallelism, allows internal caches accesses in parallel with bus transfers and overlapped instruction execution. The enhanced bus controller supports asynchronous bus cycles (three clocks minimum), synchronous bus cycles (two clocks minimum), and burst data transfers (one clock).

MC68020RC,RL,RP,FC,FE
The Original 32-Bit Performance Standard

The MC68020, oh twenty, is the industry's leading 32-bit microprocessor because of high performance, architecture, ease of design-in, and long-range compatible growth path.

The 020 has a full 32-bit internal and 32-bit external, regular, symmetrical architecture designed with the customer in mind. It offers all the functionality of the other M68000 Family MPUs, and maintains software user-code compatibility which controls the expense of your product migration.

Programmers appreciate the large general purpose register set, simple yet powerful instruction set and the many flexible M68000 addressing modes. The unique on-chip instruction cache heps provide burst-mode operation to 12.5 MIPS.

The 020 is the proven leader in high performance systems in office automation, engineering workstations, fault tolerant computers, parallel processors, telephone switching systems, and intelligent controllers.

See package suffix definitions on page 2-18.

MC68010LC,P,R,RC,FN
A Virtual Memory Enhancement

The MC68010 offers the advantage of Virtual Memory. A high-speed loop mode operation executes tight software loops faster to enhance performance. Its instruction continuation feature has made it the choice for fault-tolerant and parallel processing systems. The MC68010 can support a governing operating system which handles the supervisory chores of any number of subordinate operating systems.

MC68HC000LC,P,R,RC,FN,FC
A Micropower Alternative

HCMOS design gives the MC68HC000 all the functions and performance of its MC68000 predecessors . . . at one-tenth of the operating power requirements. With a maximum power dissipation of only 0.175 watts, the MC68HC000 is ideal for high-performance computer peripherals, industrial controllers, instrumentation and communications equipment.

MC68HC001RC,FN,FC
Low Power HCMOS 8-/16-/32-Bit Microprocessor

The MC68HC001 provides a functional extension of the MC68HC000 HCMOS 16-/32-bit microprocessor with the addition of statically selectable 8- or 16-bit data bus operation. The MC68HC001 is object-code compatible with the MC68HC000, and code written for the MC68HC001 can be migrated without modification to any member of the M68000 Family. This is possible because the user programming model is identical for all members of the M68000 Family and the instruction sets are proper subsets for the complete architecture.

MC68000L,LC,P,R,RC,FN
The 16-Bit Foundations

As the first member of the M68000 family, the state-of-the-art technology and advance circuit design concepts of the MC68000 16-bit MPU started a new trend in microprocessor architecture. Its seventeen 32-bit data and address registers permit rapid internal execution of its powerful yet simple instruction set. It is designed for large multiprocessing systems and real-time applications with vectored interrupts, seven priority levels and a 16 megabyte linear addressing space. It offers mainframe-like performance, supporting high-level languages and sophisticated operating systems.

The MC68000 MPU has been joined by more advanced products with even greater capabilities, yet it satisfies a large segment of the existing applications. It is extremely cost competitive and it remains one of the major growth products in the entire MPU line.

MC68008LC,P,FN
An 8-Bit Compatible Competitor

With an 8-bit data bus and 32-bit internal architecture, the MC68008 offers performance that competes with a number of 16-bit MPUs. It has the same register set, same instructions, and the same functionality as the MC68000 with extensive exception processing. Large modular programs can be developed and executed efficiently because of the large, 1-megabit non-segmented, linear address space. It is the choice for high performance, cost effective, 8-bit designs, particularly those requiring a migration path to 16-bit or full 32-bit operation.

Integrated Processors

MC68302RC,FE
Integrated Multiprotocol Processor

The MC68302 integrated multiprotocol processor (IMP) is a very large-scale integration (VLSI) device incorporating the main building blocks needed for the design of a wide variety of controllers used in the communications industry. The IMP is the first device to offer the benefits of a closely coupled, industry-standard M68000/MC68008 microprocessor core and a flexible communications architecture. The three-channel communications device may be configured to support a number of popular industry interfaces, including those for the Integrated Services Digital Network (ISDN) basic rate and terminal adaptor applications. Through a combination of architectural and programmable features concurrent operation of different protocols (HDLC/SDLC™, UART, BISYNC, DDCMP™, or transparent modes) can easily be achieved. Data concentrators, modems, line cards, bridges, and gateways are examples of suitable applications for this device

The IMP is a complementary metal-oxide semiconductor (CMOS) device consisting of an M68000/MC68008 microprocessor core, a system integration block (SIB), and a communications processor (CP). By integrating the microprocessor core with the serial ports (in the CP) and the system peripherals (in the SIB), the IMP is capable of handling complex tasks such as all ISDN basic rate (2B+D) access tasks.

MC68340RP,FE
Integrated Processor with DMA

The MC68340 is a high-performance 32-bit integrated processor with direct memory access (IPD), combining an enhanced M68000-compatible processor, 32-bit direct memory access (DMA), and other peripheral subsystems in a single package. The combination of peripherals offered in the MC68340 is found in most

See package suffix definitions on page 2-18.

MC68340RP,FE (continued)

microprocessor-based systems and in a diverse range of applications, including embedded control and general computing. Applications requiring very high-speed DMA transfers will especially benefit from the MC68340. For all applications, the high level of functional integration results in significant reductions in component count, power consumption, board space, and cost while yielding much higher system reliability and shorter design time.

The MC68340 includes the Central Processor Unit (CPU), where most of the data manipulation and decisions are made, and a DMA controller for independently moving large blocks of data around memory or between memory and peripherals. Both of these in a single chip, the MC68340 IPD comprises many of these common elements of a digital system. Each element is designed to operate with the other elements of the chip at peak efficiency: all talking together over the same bus; all synchronized with the same signals; all running at the same high speed. The resulting chip allows system designers to more quickly develop their specific product since a major portion of their hardware design has been completed. Since much of the system is supplied in the MC68340, many smaller applications need only to add the memory system. All that remains is to program the hardware to perform the desired tasks.

Coprocessors

MC68851RC
Paged Memory Management Unit, PMMU

The PMMU is a 32-bit memory manager which provides full support for a demand paged virtual environment with the 68010 or MC68020. It supports a 4-gigabyte addressing space when used as a coprocessor with the MC68020. It supports a 4-gigabyte addressing space when used as a coprocessor with the MC68020. An on-chip address translation cache minimizes translation delays and maximizes system performance.

MC68881RC,FN
A Floating Point Coprocessor

Designed specifically for arithmetic expansion of the MC68020 MPUI, this powerful coprocessor can also be used as a peripheral to all other M68000 family members, and with non-M68000 processors as well. It performs floating point math calculations in strict conformance to a full implementation of the IEEE Standard for Binary Floating Point Arithmetic (754) and, in addition to the basic add, subtract, multiply, and divide functions, it handles full selection of transcendental and non-transcendental operations. These operations include root values, trigonometric functions, exponentials, hyperbolics, and logs. All functions are calculated to 80 bits of extended precision in hardware.

MC68882RC,FN
Enhanced Floating Point Coprocessor

The MC68882 is pin-to-pin hardware and software compatible with the MC68881 Floating Point Coprocessor and implements a variety of performance enhancements including dual-ported registers and an advanced pipeline. Additional circuitry allows execution of multiple instructions in parallel for more than twice the Floating Point performance of the trail-blazing MC68881. Where higher performance requirements indicate, the MC68882 is a drop-in replacement for the MC68881.

DMA Controllers

MC68450L,R,RC
DMA Controller DMAC

The DMAC maintains high-performance data movement for complex M68000 MPU-based systems. While pin compatible with the MC68440 DDMA, the DMAC offers four completely independent DMA channels. In addition to all the features of the DDMA, the DMAC also provides very sophisticated manipulation of data through sequential and linked array-chained addressing capabilities.

MC68440L,P,R,FN
Dual Direct Memory Access Controller, DDMA

The DDMA complements the performance capabilities of M68000 microprocessors by moving blocks of data in a quick, efficient manner with a minimum of intervention from the MPU. The DDMA performs memory-to-memory, peripheral-to-memory, and memory-to-peripheral transfers through each of two completely independent DMA channels. The DDMA also offers two interrupt vectors per channel and supports both 8-bit and 16-bit data transfers.

Network Devices

MC68824RC,R,FN
Token Bus Controller, TBC

The TBC is the industry's first single-chip VLSI device to implement the IEEE 802.4 Media Access Control Sublayer of the ISO Data Link Layer, as specified by General Motors Manufacturing Automation Protocol, MAP. The TBC supports serial data rates of 1, 5, and 10 Mbps and relieves the host processor of the frame formatting and token management functions. For efficient transfer of data frames, to and from memory, the TBC features an on-chip four-channel DMA with bus master capability, a 32-bit address range, an 8- or 16-bit data bus, and a 40-byte FIFO. The MC68824 also offers support options for network bridges, real-time support and network monitoring services.

See package suffix definitions on page 2-18.

MC68184P
Broadband Interface Controller

The MC68184 broadband interface controller (BIC) is a high-performance interface device for use with the MC68824 token bus controller (TBC) to implement the digital portion of the physical layer of a broadband IEEE 802.4 token bus node. The BIC manipulates both data and control for RF transmitter circuitry and RF receiver circuitry. The CMOS BIC supports data rates up to 10 Mbps using a duo-binary modulation technique and provides 20 lines for receiver/transmitter control with 13 user-defined outputs.

The BIC performs the digital functions of the physical layer when implementing a broadband token bus node. The modem side of the BIC provides data and control for the RF transmitter/receiver circuitry. A standard serial interface is used to connect the BIC to the MC68824 TBC. The TBC performs the media access control (MAC) function. The MC68184 has the ability to scramble and descramble data.

MC68185RC,FN
Twisted-Pair Modem

The MC68185 twisted-pair modem (TPM) is used in conjunction with a MC68824 token pus controller (TBC), an RS485 transceiver, and a twisted-pair media to implement a low-cost area network (LAN). The MC68824 TBC implements the layer 2 media access control (MAC) portion of the IEEE 802.4 LAN station and receiver portion for the IEEE 802.2 logical link control (LLC) type 3 as well as providing support for LLC type 1 and type 2. The TPM interfaces directly to the TBC, providing physical layer management, including MAC symbol encoding/decoding at data rates up to 2 Mbps.

The TPM contains an 32 kHz to 20 MHz on-chip crystal oscillator that generates a transmit clock without external circuitry. The physical layer management includes local loopback mode, transmitter enable, and reset. An on-chip digital filter provides for noise reduction of received data.

MC68194RC,FN
Carrierband Modem

The bipolar LSI MC68194 carrierband modem (CBM), when combined with the MC68824 token bus controller (TBC), provides an IEEE 802.4 single-channel, phase-coherent carrierband, local area network (LAN) connection. The CBM performs the physical layer function, including symbol encoding/decoding, signal transmission and reception, and physical management.

The CBM provides the three basic functions of the physical layer: data transmission to the coaxial cable, data reception from the cable, and management of the physical layer. For standard data mode (also called MAC mode), the CBM receives a serial transmit data stream from the TBC (called symbols or atomic symbols), encodes, modulates the carrier, and transmits the signal to the coaxial cable. Also in the data mode, the CBM receives a signal from the cable, demodulates the signal, recovers the data, and sends the received data symbols to the TBC. End-of-transmission receiver blanking as required by IEEE 802.4 is supported. Communication between the TBC and CBM is through a standardized serial interface consistent with the IEEE 802.4 DTE-DCE interface.

MC68195FN
LocalTalk Adaptor

The MC68195 LocalTalk adaptor (LA) is used in conjunction with the MC68302 integrated multiprotocol processor (IMP) to build a network interface to LocalTalk™, also known as AppleTalk™. LocalTalk refers to the 230.4-kbps local area network (LAN) that connects multiple MacIntosh™ computers and printers.

The LA provides LocalTalk support for any two of the three IMP serial channels. Combinations of multiple LA and/or IMP devices may be used to support additional LocalTalk channels. Non-LocalTalk applications can use the LA device with the IMP to build proprietary HDLC-based LANs at up to 2.5 Mbps using bi-phase space (FM0) encoding.

MC68605RC,R,FN
X.25 Protocol Controller, XPC

The XPC implements the 1984 CCITT X.25 Recommendation Data Link Procedure (level 2) LAPB. In addition to handling the lower level communications functions (HDLC framing, CRC generation/checking, and zero insertion/deletion), the XPC also independently handles higher level communications functions (frame sequencing, retransmission, flow control, retries limit and timeout conditions). This allows the host to operate almost totally isolated from the task of ensuring error-free transmission and reception of data.

MC68606RC,FN
Multi-Link LAPD Controller CCITT Q.920/Q.921, LAPD

The MC68606 Multi-link LAPD (MLAPD) Protocol Controller fully implements CCITT Recommendation Q.920/Q.921 Link Layer Access Procedure (LAPD) protocol for ISDN networks. The MLAPD is designed to handle both signalling and data links in high-performance ISDN primary rate applications.

This VLSI device provides a cost-effective solution to ISDN link-level processing with simultaneous support for up to 8K logical links. The MC68606 is an intelligent communications protocol controller compatible with AT&T specifications for ISDN devices and features low power consumption and high performance, with an aggregate data rate in excess of 2.048 Mbps.

See package suffix definitions on page 2-18.

Data Communication Devices

MC68681P,L,FN
MC2681L,P,FN
Dual Universal Asynchronous Receiver/Transmitter, DUART

The MC68681 features two completely independent full-duplex asynchronous receiver/transmitter channels that interface directly to the M68000 microprocessor bus. Receiver data registers are quadruple buffered and transmitter data registers are double buffered for minimum MPU intervention. Each has its own independently selectable baud rate. Multifunction 6-bit input port and 8-bit output port, a 16-bit programmable counter/timer, interrupt handling capabilities, and a maximum one-megabyte per second transfer rate make the DUART an extremely powerful device for complex data communication applications. Full device functionality with an M6800 bus interface is provided by the MC2681.

MC68661P
MC2661P
Enhanced Peripheral Communication Interface, EPCI

The EPCI is a universal synchronous/asynchronous data communications controller that interfaces to the M68000 Family and most other 8- or 16-bit microprocessors. Its receiver and transmitter are double buffered for efficient full- and half-duplex operation. An internal baud rate clock (with various baud rate sets available) eliminates the need for a system clock. The EPCI converts parallel data characters accepted from the microprocessor data bus into transmit-serial data. Simultaneously, the EPCI can convert receive-serial data to parallel data characters for input to the MPU.

General Purpose I/O

MC68230LC,P,FN
Parallel Interface/Timer, PI/T

The PI/T provides versatile double-buffered parallel interfaces and a system-oriented timer for M68000 systems. The parallel interfaces operate either in a unidirectional or bidirectional mode, either 8- or 16-bit wide. The timer is 24 bits with full programmability and a 5-bit prescaler. The PI/T has a complete M68000 bus interface and is fully compatible with the MC68450 DMAC.

MC68901LC,P,FN
Multifunction Peripheral, MFP

The MFP provides basic microcomputer function requirements as a single companion chip to the M68000 Family of Micorprocessors. Features provided via a direct M68000 system bus interface include a full-function, single-channel universal serial asynchronous receiver/transmitter (USART) for data communication, an 8-source interrupt controller, eight parallel I/O lines, and four 8-bit timers.

Fiber Distributed Data Interface

Fiber Distributed Data Interface (FDDI) is defined as a dual fiber-optic token ring LAN (Local Area Network) that can support rates up to 100 Mbps. It can accommodate rings with 1,000 stations. Two Kilometers between stations, and up to 200 kilometers in total length. This technology is driven by the need to support high performance distributed computer systems which are becoming faster and more powerful, thus imposing a greater need for network speed and bandwidth. Other uses for FDDI include backbone networks connecting Ethernet, Token Bus, and Token Ring segments and back end networks connecting high-speed peripherals. FDDI is an American National Standards Institute (ANSI) standard. Motorola's FDDI chip set includes the MC68836, MC68837, MC68838, and MC68839.

MC68836FN
FDDI Clock Generator

The MC68836 FDDI Clock Generator (FCG) implements part of the Physical Layer (PHY) functions of the FDDI standard including clock recovery, data recovery, and NRZI conversions. The FCG also does a five-bit parallel to serial conversion during transmission, and a serial to five-bit parallel conversion during reception. The FCG uses the five-bit parallel interface to communicate with the MC68837 device. The FCG directly connects to fiber optic modules through differential driver/receiver pins. Features include full duplex operations, 125 MHz clock recovery from incoming serial NRZI data stream, and 125 MHz transmit clock generation.

MC68837RC,FC
Elasticity Buffer and Link Manager

The Elasticity Buffer and Link Manager (ELM) implements the remaining of the PHY functions of the FDDI standard including data framing, elasticity buffer, encoding, decoding, smoothing, line sate detection, and repeat filter. The ELM also implements some Station Management (SMT) functions which are : Connection Management (CMT), Physical Connection Management (PCM), Physical Connection Insertion (PCI), and Link Error Monitor (LEM).

See package suffix definitions on page 2-18.

MC68838RC,FC
Media Access Controller

The Media Access Controller (MAC) implements the MAC portion of the FDDI standard. The MAC protocol is the lower sublayer of the ISO OSI data link layer and provides for fair and deterministic sharing of the physical medium, address recognition, frame check sequence generation and verification, frame insertion, frame repetition, frame removal, token generation, and certain error recovery procedures. Features on the MC68838 include independent receive and transmit data paths and state machines, bridging support including a bit order reversal option, a count and void frame bridge stripping algorithm, and CRC appendage on a per frame basis. The MAC also contains an interface to Content Addressable Memory (CAM) for individual and multicast address recognition.

MC68839RC,FC
FDDI System Interface

The FDDI System Interface (FSI) is a high performance interface device which can easily connect to any bus including high speed processors, little- and big-endian busses, and multiplexed/non-multiplexed address data busses. Its primary purpose is to interface the FDDI protocol devices to the user system bus. FSI features include support for a ring buffer structure, addressing flexibility, programmable partitioned internal RAM for temporary data storage, two 32-bit ports, the ability to sustain (60 μs) bus latencies, support for synchronous and asynchronous frames, and the ability to chain multiple buffers per frame.

Development Tools

M68302ADS
Application Development System

The M68302ADS is a stand-alone board developed by Motorola that includes software modules (driver code, LAPB, LAPD, and X.25), a real-time kernel, and a monitor/debugger. The board consists of the MC68302, memory (512K bytes of RAM expandable to 1M bytes, 256 bytes of EPROM and EEPROM), and an MC68681 DUART (to allow all MC68302 serial ports to be available to the user). It is an inexpensive, ideal platform for software development and testing.

M68FADS
FDDI Chip Set

This development tool includes the FDDI ADS board and SMT source code on an Apple or MS-DOS 3.5″ diskette or DC600A cartridge tape.

M68340EVS
Evaluation System

The M68340EVS consists of a platform board (PFB), a business card computer (BCC), and a BCC development interface (BCCDI).

Support Software

M68KESW-PC1

This Intermetrics software package is for the 68K Family (68000, 68008, 68HC001, 68010, 68020, 68030, 68EC030, 68040, 683xx). The M68KESW InterTools package includes C compiler, assembler/linker, run-time libraries, and one year of support from Intermetrics.

M68040FPSP

This software provides 68040 floating point emulation of unimplemented 68881/68882 functions.

Package Definitions:

L	— Ceramic DIP	RP	— Plastic Pin Grid Array
LC	— Ceramic DIP, Gold Lead Finish	FN	— Plastic Quad Pack (PLCC)
P	— Plastic DIP	FG	— Plastic Quad Flat Pack (PQFP)
RC	— Pin Grid Array, Gold Lead Finish	FE	— Ceramic Quad (Gull Wing)
RL	— Pin Grid Array, Solder Lead Finish	FC	— Plastic Quad (Gull Wing)
R	— Pin Grid Array, Solder Lead Finish		

InterTools is a trademark of Intermetrics, Inc.

The M88000 RISC Family

In Brief . . .

The life of a successful microprocessor architecture can be expected to span decades. The 88000 RISC architecture was designed as an extensible architecture allowing generations of future product family members well into the next century. The flexible design of the 88000 allows for the addition of special function units in the future. These special function units will accelerate floating point operations, graphics, and other sophisticated applications.

Motorola's 88000 RISC Microprocessors

. . . an architecture you can build on

The 88000 RISC was designed from the start for superscaler implementations. In fact, the design of the coming second generation 88110 microprocessor is a unique superscaler implementation called Symmetric Superscaler.™ The Symmetric Superscaler design allows you to execute multiple instructions in a single clock cycle without any restrictions on instruction ordering. So there are no wait states or performance penalties because of out of order instructions.

Also, while other RISC microprocessors may be limited in the number of instructions they can execute in a single clock cycle, future members of the 88000 will be able to deliver 6, 8, 10 or even more instructions per clock cycle, thus providing the performance edge required for next generation system designs.

Performance Plus Software Compatibility

Although high performance is recognized as a key feature for systems design, it is even more important to maintain software compatibility. Motorola's 88000 Family comes from the only company committed to long term upward software compatibility through such features as register scoreboarding and protected pipelines. Our goal is to make sure each successive generation of the 88000 RISC family delivers a performance level 4 times greater than the preceding generation while maintaining software compatibility. This gives, the opportunity for designing one of the industry's highest performance systems, while leveraging your largest dollar investment in new systems, your software.

Software compatibility is also promoted through standards to provide an open systems environment benefitting system companies, software developers, and end users because 88000 based systems from different vendors will run all of the same software.

Microprocessor

MC88100RC
32-Bit RISC Microprocessor

The MC88100 is the first processor in the M88000 Family of RISC (reduced instruction set computer) microprocessors. Implemented with Motorola's HCMOS technology, the MC88100 incorporates 32-bit registers, data paths, and addresses. In designing the MC88100, Motorola has incorporated a high degree of fine-grain parallelism; four, independent execution units maintain separate, fully concurrent execution pipelines. Most instructions operate in one machine cycle or effective concurrent execution can be accomplished through internal pipelines in one machine cycle. A common register file provides data sharing and synchronization control among the execution units through register scoreboarding.

The MC88100 addresses a variety of applications requiring high operational speeds and efficient, fast-execution architectures. All data manipulation instructions are nondestructive register to register or register with immediate operations, allowing both fast operand access and operand reuse. IEEE 754 floating-point arithmetic is supported in the processor. Instruction and data memory space are accessed through separate memory ports, allowing simultaneous access to dedicated memory areas. The 88000 Family includes the MC88200 CMMU (cache/memory management unit), which adds high-speed memory caching, two-level, demand-paged memory management, and support for shared-memory multiprocessing. The 88000 Family also includes a full line of highly optimizing compilers, operating systems, development boards, and development tools.

Cache/Memory Management Units

MC88200RC
16-Kilobyte Cache/Memory Management Unit (CMMU)

The MC88200 CMMU is a high-performance, HCMOS VLSI device providing zero-wait-state memory management and data caching. The MMU (memory management unit) efficiently supports a demand-paged virtual memory environment with two logical address ranges (user/supervisor) of 4 gigabytes each. Translated addresses are provided by one of two ATCs (address translation caches), providing address translation in one clock cycle for most memory accesses. The PATC (page address translation cache) is a 56-entry, fully associative cache containing recently used translations for 4-kilobyte memory pages and is maintained by MC88200 hardware. The BATC (block address translation cache) is a 10-entry cache, loaded by software, containing translations for 512-kilobyte memory blocks. The BATC translations are used for operating system software or for other memory-resident instructions and data. In addition, the MMU provides access control for the two logical address spaces. The CMMU data cache is a 16-kilobyte, four-way, set-associative cache for instruction or data storage. The cache incorporates memory-update policies and cache-coherency mechanisms that support multiprocessor applications. The MC88200 CMMU also includes an MC88100-compatible P bus (processor bus) interface and an M bus (memory bus) interface. A processor may use two or more CMMUs for increased data cache and ATC sizes.

MC88204RC
64K-Byte Cache/Memory Management Unit (CMMU)

The MC88204 CMMU is a high-performance, HCMOS VLSI device providing zero-wait-state memory management and data caching. The memory management unit (MMU) efficiently supports a demand-paged virtual memory environment with two logical address ranges (user/supervisor) of 4 Gbytes each. Translated addresses are provided by one of two address translation caches (ATCs), providing address translation in one clock cycle for most memory accesses. The page address translation cache (PATC) is a 56-entry, fully associative cache containing recently used translations for 4K-byte memory pages and is maintained by MC88204 hardware. The block address translation cache (BATC) is a 10-entry cache, loaded by software, containing translations for 512K-byte memory blocks. The BATC translations are used for operating system software or for other memory-resident instructions and data. In addition, the MMU provides access control for the two logical address spaces. The CMMU data cache is a 64K-byte, four-way set-associative cache for instruction or data storage. The cache incorporates memory-update policies and cache-coherency mechanisms that support multiprocessor applications. The MC88204 CMMU also includes an MC88100-compatible processor bus (P-bus) interface and memory bus (M-bus) interface.

The MC88204 CMMU is completely software and pin-level compatible with the MC88200 16K-byte CMMU. The functionality of the MC88204 is identical to that of the MC88200. With board layout constraints in mind, a central processing unit (CPU) may use up to two MC88204 CMMUs on the data P-bus and up to two MC88204 CMMUs on the instruction P-bus to increase data cache and ATC sizes.

TCS

Single-Chip Microcontrollers (MCUs)

Motorola offers the most comprehensive selection of high-performance microcontrollers anywhere—from our industry-standard 8-bit devices to the cutting-edge technology of our new 16- and 32-bit products. Just pick the family of products that meets your needs for price and performance, then select from the incredible variety of on-chip peripherals to fill the precise requirements of your design.

The sophisticated on-chip capabilities of the M68HC11, M68HC16, and M68332 Families in particular have proved ideal for the fast-response, interrupt-intensive demands of embedded control environments.

All our 8-bit families are "related," so you can change families to upgrade a system without having to start over with new architecture or software. The same upward source code compatibility exists within our 16- and 32-bit families. Not only that, but the 16-bit line is fully compatible with the 8-bit families, so you can even jump from 8- to 16-bit technology without starting from scratch.

Page

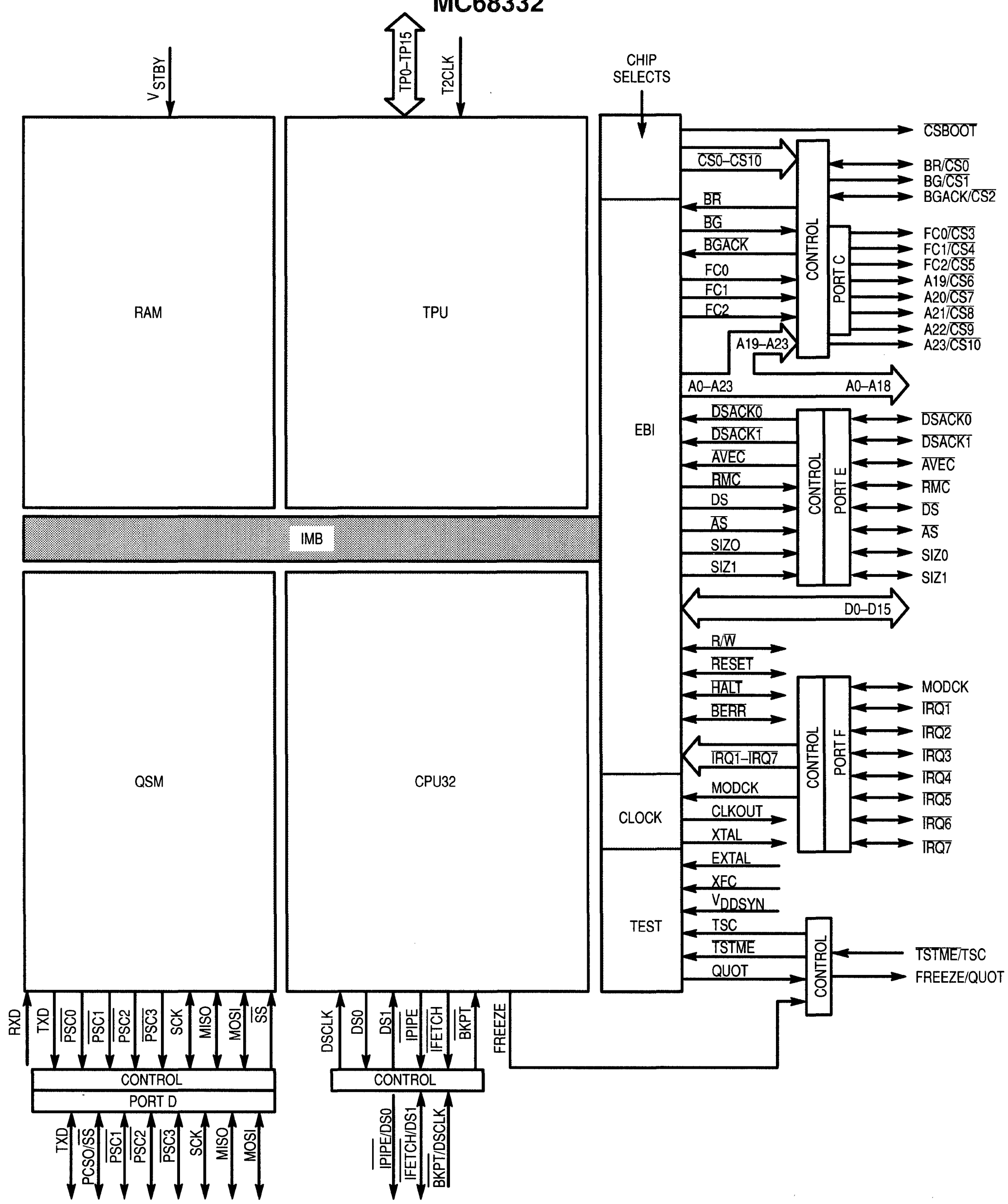
The M68300 Family — 32-Bit, HCMOS

The high-performance M68300 Family is designed for embedded control applications. It integrates the proven performance of the 6800-based microcontrollers with the incredible power of 68000-based microprocessors. The result is more design flexibility, with microcontroller-family upward migration capabilities and compatibility with our large 68000 installed software base.

Motorola Part Number	ROM	RAM	EEPROM	Timer/DMA	Serial	A/D	I/O	Bus Speed, MHz	Package†	EPROM or EEPROM Version	Comments
MC68330	0	0	0	RTI, WDOG	No	No	16	0-16.8	132 FC 132 FE	N/A	Available from MPU Div 32 Address Lines 2 Chip Selects
MC68331	0	0	0	General Purpose Timer: 3 or 4 IC, 4 or 5 OC, Pulse Accumulator, 2 PWM, RTI, WDOG	Queued SPI, SCI	No	43	0-16.8	132 FC 132 FE	N/A	External Bus 12 Chip Selects Synthesized Clock
MC68332	0	2K	0	TPU: 16 Intelligent μ coded channels, RTI, WDOG	Queued SPI, SCI	No	47	0-16.8	132 FC 132 FE	N/A	External Bus 12 Chip Selects Synthesized Clock
MC68340	0	0	0	2 16 bit Timers w/ 8 bit prescaler, RTI, WDOG 2 ch 32 bit DMA	2 ch UART	No	28	0-16.8	144 FE 144 RP	N/A	Available from MPU Div 32 Address Lines 2 Chip Selects

See Definitions on page 2-26.

MC68332



The M68HC16 Family — 16-Bit, HCMOS

The M68HC16 Family uses a modular approach incorporating peripherals from our rapidly-growing M68300 Family, powerful control-oriented DSP instructions, and speed that is eight times that of the M68HC11 line. Coupled with the ease of moving up from 8-bit predecessors, it gives unparalleled power, speed, and room to grow.

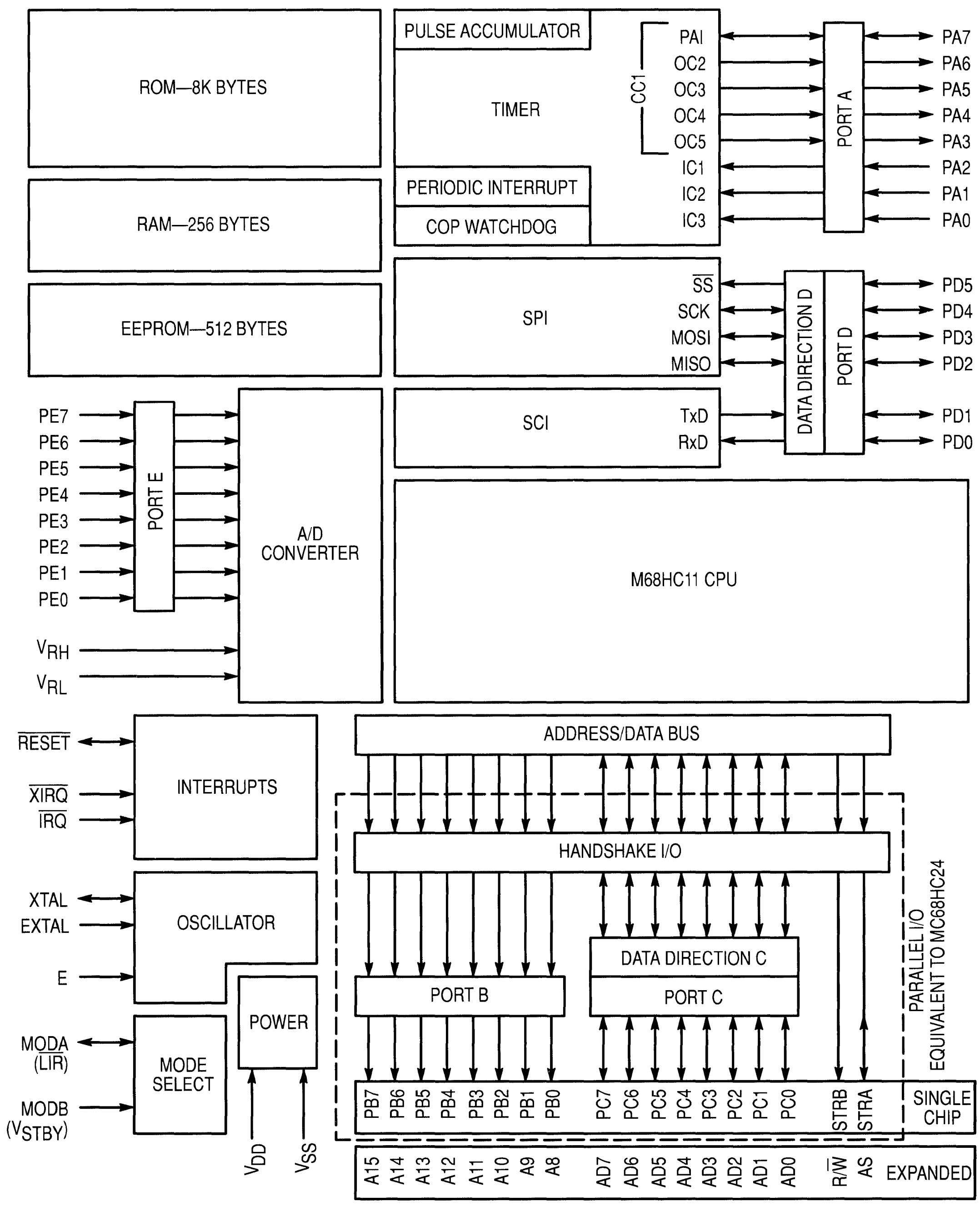
Motorola Part Number	ROM	RAM	EEPROM	Timer/DMA	Serial	A/D	I/O	Bus Speed, MHz	Package	EPROM or EEPROM Version	Comments
MC68HC16Z1	0	1K	0	General Purpose Timer: 3 or 4 IC, 4 or 5 OC, Pulse Accumulator, 2 PWM, RTI, WDOG	Queued SPI, SCI	Yes	50	0-16.8	132 FC † 132 FE	N/A	External Bus 12 Chip Selects Synthesized CLock

See Definitions on page 2-26.

The M68HC11 Family — 8-Bit, HCMOS

The MCUs in the high-speed, low-power M68HC11 Family contain a variety of sophisticated on-chip peripheral capabilities, including flexible serial interfaces, powerful timers, and highly accurate A/D converters.

MC68HC11A8



Microcontrollers

Motorola Part Number	ROM	RAM	EEPROM	Timer/DMA	Serial	A/D	I/O	Bus Speed, MHz	Package†	EPROM or EEPROM Version	Comments
MC68HC11A0	0	256	0	16 bit–3 IC, 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	22	0-3.0	52 FN 48 P	N/A	External Bus Port Replacement HC24
MC68HC11A1	0	256	512	16 bit–3 IC, 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-3.0	52 FN 48 P	N/A	External Bus Port Replacement HC24
MC68HC11A7	8K	256	0	16 bit–3 IC, 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-3.0	52 FN 48 P	711E9	
MC68HC11A8	8K	256	512	16 bit–3 IC, 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-3.0	52 FN 48 P	711E9	
MC68HC11D0	0	192	0	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	No	14	0-3.0	40 P 44 FN 44 FU	N/A	External Bus Port Replacement HC27
MC68HC11D3	4K	192	0	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	No	32	0-3.0	40 P 44 FN 44 FU	711D3	
MC68HC11E0	0	512	0	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	22	0-3.0	52 FN	N/A	External Bus Port Replacement HC24
MC68HC11E1	0	512	512	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-3.0	52 FN	N/A	External Bus EEPROM Block Protect Port Replacement HC24
MC68HC11E8	12K	512	0	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-3.0	52 FN	711E9	
MC68HC11E9	12K	512	512	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-3.0	52 FN	711E9	EEPROM Block Protect
MC68HC811E2	0	256	2K	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	38	0-2.0	52 FN	N/A	External Bus EEPROM Block Protect Port Replacement HC24
MC68HC11F1	0	1K	512	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	54	0-4.0	68 FN	N/A	External Bus Programmable Chip Selects EEPROM Block Protect Port Replacement HC27
MC68HC11G5	16K	512	0		SPI, SCI	Yes			84 FN	N/A	4 PWM, Event Counter
MC68HC11G7	24K	512	0		SPI, SCI	Yes			84 FN	N/A	4 PWM, Event Counter
MC68HC11K4	24K	768	640	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG	SPI, SCI	Yes	64	0-2.1	84 FN	711K4	Non-Mux Address/Data Bus
MC68HC11L0	0	512	0	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	30	0-3.0	64 FU 68 FN	N/A	External Bus Port Replacement HC24
MC68HC11L1	0	512	512	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	46	0-3.0	64 FU 68 FN	N/A	External Bus EEPROM Block Protect Port Replacement HC24
MC68HC11L5	16K	512	0	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	46	0-3.0	64 FU 68 FN	711L6	
MC68HC11L6	16K	512	512	16 bit–3 or 4 IC, 4 or 5 OC, RTI, WDOG, Pulse Accumulator	SPI, SCI	Yes	46	0-3.0	64 FU 68 FN	711L6	EEPROM Block Protect

Definitions:

DTMF —Dual-Tone Multi-Frequency
IC —Input Capture
I^2C —Inter-Integrated Circuit
OC —Output Compare
PWM —Pulse Width Modulation
RTC —Real-Time Clock
RTI —Real-Time Interrupt
SCI —Serial Communications Interface
SIOP —Simple Serial I/O Port
SPI —Serial Peripheral Interface
WDOG—Watch Dog Timer

†Package Definitions:

B —Shrink Dual-in-Line Plastic
DW —Small Outline (Wide-Body SOIC)
FB —10x10 mm Quad Flat Pack (QFP)
FC —Fine-Pitch Plastic Quad (PQFP)
FN —Plastic Quad (PLCC)
FS —Windowed Cerquad
FT —28x28 mm Quad Flat Pack (QFP)
FU —14x14 mm Quad Flat Pack (QFP)
L —Ceramic
P —Dual-in-Line Plastic
S —Cerdip (windowed or non-windowed)

One-Time Programmable and Reprogrammable MCUs

Motorola Part Number	EPROM	RAM	EEPROM	Timer	Serial	A/D	I/O	Bus Speed, MHz	Package†	Comments
MC68HC711D3	4K	192	0	16 Bit–3 or 4 IC, 4 or 5 OC, Pulse Accumulator, RIT, WDOG	SPI, SCI	No	32	0-3.0	40 P 44 FN 40 S 44 FS	Multiplexed Bus
MC68HC711E9	12K	512	512	16 Bit–3 or 4 IC, 4 or 5 OC, Pulse Accumulator, RTI, WDOG	SPI, SCI	Yes	38	0-3.0	52 FS 52 FN	Multiplexed Bus EEPROM Block Protect
MC68HC711K4	24K	768	640	16 Bit–3 or 4 IC, 4 or 5 OC, 4 PWM Pulse Accumulator, RTI, WDOG	SPI, SCI	Yes	62	0-4.0	84 FN 84 FS	Non-Multiplexed Bus EEPROM Block Protect
MC68HC711J6	16K	512	0	16 Bit–3 or 4 IC, 4 or 5 OC, Pulse Accumulator, RTI, WDOG	SPI, SCI	No	54	0-2.0	68 FN 68 FS	Non-Multiplexed Bus
MC68HC711L6	16K	512	512	16 Bit–3 or 4 IC, 4 or 5 OC, Pulse Accumulator, RTI, WDOG	SPI, SCI	Yes	46	0-3.0	64 FU 68 FN 68 FS	Multiplexed Bus EEPROM Block Protect

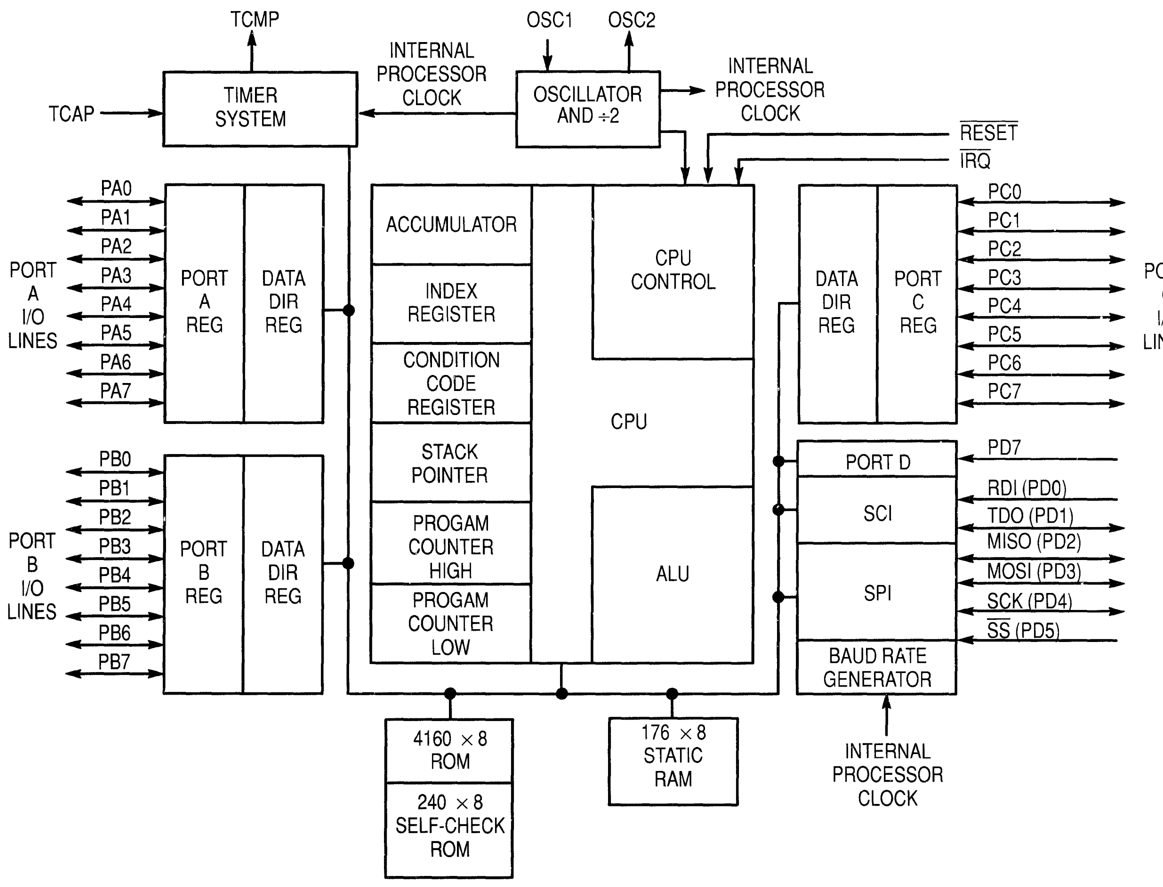
See Definitions on page 2-26.

The M68HC05 Family — 8-Bit, HCMOS

The rapidly growing M68HC05 Family is the basis for Motorola's popular CSIC program of affordable customer-specified microcontrollers. It offers more on-chip memory and peripheral options than virtually any other microcontroller line, making it possible for designers to match "ideal" system requirements without having to invest time and money on developing a whole new device.

The following table lists the most popular devices currently available. Over 100 CSICs are available or in development, with more being designed all the time.

MC68HC05C4



Microcontrollers

Motorola Part Number	ROM	RAM	EEPROM	Timer	Serial	A/D	I/O	Bus Speed, MHz	Package†	EPROM or EEPROM Version	Comments
MC68HC05B4	4K	176	0	16-Bit–2 IC, 2 OC, WDOG	SCI	Yes	32	0-2.1	56-B 52-FN	705B5 805B6	2 PWMs
MC68HC05B6	6K	176	256	16-Bit–2 IC, 2 OC, WDOG	SCI	Yes	32	0-2.1	56-B 52-FN	705B5 805B6	2 PWMs
MC68HC05B8	8K	176	256	16-Bit–2 IC, 2 OC, WDOG	SCI	Yes	32	0-2.1	56-B 52-FN	N/A	On-Chip Charge Pump
MC68HC05C4	4K	176	0	16-Bit–1 IC, 1 OC	SPI, SCI	No	31	0-2.1	40-P 44-FN 44-FB	705C8 805C4	Low Voltage & High Speed Versions Available
MC68HC05C5	5K	176	128	16-Bit–1 IC, 1 OC, WDOG	SIOP	No	32	0-2.1	40-P 44-FN	705C5	10 mA Sink Port
MC68HC05C8	8K	176	0	16-Bit–1 IC, 1 OC	SPI, SCI	No	31	0-4.0	40-P 44-FN 44-FB	705C8	Low Voltage & High Speed Versions Available
MC68HC05C9	16K	352	0	16-Bit–1 IC, 1 OC, WDOG	SPI, SCI	No	31	0-2.1	40-P 44-FB 44-FN	705C9	Expanded Port D
MC68HC05D9	16K	352	0	16-Bit–1 IC, 1 OC	SCI	No	31	0-2.1	40-P 44-FN	705D9	5 PWMs, 25 mA Sink Port
MC68HC05D24	24K	352	0	16-Bit–1 IC, 1 OC, WDOG	SCI	No		0-2.1	40-P 44-FN	N/A	5-Channel PWM, 24 mA Port
MC68HC05E0	0	480	0	2 Periodic Timers, WDOG	SPI or I^2C	No	36	0-4.0	68-FN	N/A	External Address
MC68HC05E1	4K	368	0	15 stage multi-function, RTC, RTI, WDOG	—	No	20	0-4.0	28-P 28-DW	705E1	Internal PLL Clock Synthesizer
MC68HC05F6	4K	320	0	16-Bit–2 IC, 2 OC	SPI	No	26	0-2.1	42-B	705F6	DTMF, Tone Generator
MC68HC05J1	1K	64	0	15 stage multi-function, RTI, WDOG	—	No	14	0-2.1	20-P 20-DW	705J2	Low Cost
MC68HC05L6	6K	176	0	16-Bit–1 IC, 1 OC	SPI	No	24	0-2.1	68-FN	N/A	96-Segment LCD
MC68HC05L7	6K	176	0	16-Bit–1 IC, 1 OC, RTC	SCI	No	27	0-2.1	128-FT Die	N/A	960 Segment LCD, External Address
MC68HC05L9	6K	176	0	16-Bit–1 IC, 1 OC, RTC	SCI	No	27	0-2.1	128-FT Die	N/A	640 Segment LCD, External Address
MC68HC05L10	13K	352	0	16-Bit–1 IC, 1 OC	SPI, SCI	No	28	0-2.1	128-FT Die	N/A	MMU, 2 On-Chip Oscillators
MC68HC05M4	4K	128	0	8-Bit; 16-Bit–1 IC, 1 OC, WDOG	—	Yes	32	0-2.1	52-FN	N/A	24 Lines (3 Ports) VFD on Chip
MC68HC05M9	16K	352	0	2 Timers (8-/16-Bit), 1 IC, 1 OC	SCI	No	24	0-2.1	64-FU 68-FN	N/A	16 Lines High-Voltage Interrupt
MC68HC05P1	2K	128	0	16-Bit–1 IC, 1 OC	—	No	21	0-2.1	28-P 28-DW	705P9	
MC68HC05P4	4K	176	—	16-Bit–1 IC, 1 OC, WDOG	SIOP	—	21	0-2.1	28-P 28-DW	705P9	
MC68HC05P7	2K	128	0	16-Bit–1 IC, 1 OC, WDOG	SIOP	No	21	0-2.1	28-P 28-DW	705P9	
MC68HC05P8	2K	112	32	15 stage multi-function, RTI, WDOG	—	Yes	20	0-2.1	28-P 28-DW	505P8	LVI Option on EEPROM (LVPI)
MC68HC05P9	2K	128	—	16-Bit–1 IC, 1 OC, WDOG	SIOP	Yes	21	0-2.1	28-P 28-DW	705P9	Low cost
MC68HC05SC11	6K	128	0	—	—	No	5	0-2.1	Die	N/A	8K EPROM, Security
MC68HC05SC21	6K	128	3K	—	—	No	5	0-2.1	Die	N/A	Smart Card MCU, Security
MC68HC05SC24	3K	128	1K	—	—	No	5	0-2.1	Die	N/A	Smart Card MCU, Security
MC68HC05T1	8K	320	—	16-Bit–1 IC, 1 OC, WDOG	SIOP	Yes	30	0-2.1	40-P	N/A	On-Screen Display, 9 PWMs
MC68HC05T2	15K	320	0	16-Bit–1 IC, 1 OC, WDOG	SIOP	Yes	30	0-2.1	40-P	N/A	On-Screen Display, 9 PWMs
MC68HC05T4	5K	96	—	16-Bit–1 IC, 1 OC, RTC	SIOP	Yes	16	0-2.1	42-B	705T8	On-Screen Display, 5-Channel PWM
MC68HC05T7	8K	320	0	16-Bit–1 IC, 1 OC, RTC	I^2C	Yes	28	0-2.1	56-B	705T7	On-Screen Display, 9 PWMs

THE M68HC05 FAMILY (continued)

One-Time Programmable and Reprogrammable MCUs

Motorola Part Number	EPROM	RAM	EEPROM	Timer	Serial	A/D	I/O	Bus Speed, MHz	Package†	Comments
MC68HC705B5	6K	176	0	16-Bit–2 IC, 2 OC, WDOG	SCI	Yes	32	0-2.1	56-B 52-FN	PWM
MC68HC705C5	5K	176	128	16-Bit–2 IC, 2 OC, WDOG	SIOP	No	32	0-2.1	40-P 40-FN	LVI Option, 10 mA Sink Port
MC68HC705C8	8K	304	0	16-Bit–1 IC, 1 OC, WDOG	SPI, SCI	No	31	0-4.0	40-P 44-FN 40-S 40-FS	Low Voltage & High Speed Versions Available
MC68HC705C9	16K	352	0	16-Bit–1 IC, 1 OC, WDOG	SPI, SCI	No	31	0-2.1	40-P 44-FS 40-S	Expanded Port D
MC68HC705D9	16K	352	0	16-Bit–1 IC, 1 OC	SCI	No	31	0-2.1	40-P 44-FN 40-S	5-Channel PWM, 24 mA Sink Port
MC68HC705E1	4K	368	0	15-Stage–RTI, WDOG, RTC	—	No	20	0-2.1	28-P 28-DW 28-S	Internal PLL Clock Synthesizer.
MC68HC705F6	4K	320	0	16-Bit–2 IC, 2 OC	SPI	No	26	0-2.1	42-B	DTMF, Tone Generator
MC68HC705J2	2K	112	0	15 stage multi-function, RTI, WDOG	—	No	14	0-2.1	20-P 20-DW 20-S	
MC68HC705L5	2K	256	0	16-Bit–1 IC, 1 OC	SPI	No	28	0-2.1	80-FB	8-Bit Event Counter
MC68HC705P9	2K	128	0	16-Bit–1 IC, 1 OC, WDOG	SIOP	Yes	21	0-2.1	28-P, 28-DW, 28-S	
MC68HC705T7	8K	320	—	16-Bit–1 IC, 2 OC, RTC	IIC	Yes	24	0-2.1	56-B	On-Screen Display, 8-Channel PWM
MC68HC805B6	0	176	6K+256	16-Bit–2 IC, 2 OC, WDOG	SCI	Yes	32	0-2.1	56-B 52-FN	PWMs
MC68HC805C4	0	176	4K	16-Bit–1 IC, 1 OC	SPI, SCI	No	31	0-2.1	40-P 44-FN	Low Voltage & High Speed Versions Available

Definitions:
- DTMF —Dual-Tone Multi-Frequency
- IC —Input Capture
- I^2C —Inter-Integrated Circuit
- LVI —Low-Voltage Interrupt
- OC —Output Compare
- OSD —On-Screen Display
- PWM —Pulse Width Modulation
- RTC —Real-Time Clock
- RTI —Real-Time Interrupt
- SCI —Serial Communications Interface
- SIOP —Simple Serial I/O Port
- SPI —Serial Peripheral Interface
- VFD —Vacuum Fluorescent Display
- WDOG—Watch Dog Timer

† **Package Definitions:**
- B —Shrink Dual-in-Line Plastic
- DW —Small Outline (Wide-Body SOIC)
- FB —10x10 mm Quad Flat Pack (QFP)
- FN —Plastic Quad (PLCC)
- FS —Cerquad
- FT —28x28 mm Quad Flat Pack (QFP)
- FU —14x14 mm Quad Flat Pack (QFP)
- L —Ceramic
- P —Dual-in-Line Plastic
- S —Cerdip (windowed or non-windowed)

The M6801 Family — 8-Bit, HMOS

The powerful, versatile M6801 Family devices can be hardware-programmed into eight different operating modes to function in a variety of applications, and each device can function monolithically or be expanded to address up to 64K bytes of external memory.

Microcontrollers

Motorola Part Number	ROM	RAM	EEPROM	Timer/DMA	Serial	A/D	I/O	Bus Speed, MHz	Package†	EPROM or EEPROM Version	Comments
MC6801	2048	192	0	16 bit: 1 IC, 1 OC	SCI	No	29	0.5-2.0	40 P	68701	
MC6803	0	192	0	16 bit: 1 IC, 1 OC	SCI	No	13	0.5-2.0	40 P	N/A	
MC6801U4	4096	256	0	16 bit: 2 IC, 3 OC	SCI	No	29	0.5-1.25	40 P	68701U4	
MC6803U4	0	256	0	16 bit: 2 IC, 3 OC	SCI	No	13	0.5-1.25	40 P	N/A	

The M6804 Family — 8-Bit, HMOS

The M6804 Family combines the cost-efficiency of 4-bit devices with the processing power of 8-bit technology. Their low cost makes them ideal replacements for TTL logic.

Microcontrollers

Motorola Part Number	ROM	RAM	EEPROM	Timer	Serial	A/D	I/O	Bus Speed, MHz	Package†	EPROM or EEPROM Version	Comments
MC6804J1	504	32	0	8-Bit	—	No	12	83-229 kHz	20-P	N/A	
MC6804J2	1000	32	0	8-Bit	—	No	12	83-229 kHz	20-P	N/A	
MC6804P2	1024	32	0	8-Bit	—	No	20	83-229 kHz	28-P	704P2	

The M6805 Family — 8-Bit, HMOS

The M6804 Family design includes bit-modify and test instructions, as well as powerful indexing mode. A range of ROM/RAM capacity and various on-chip peripherals are available.

Microcontrollers

Motorola Part Number	ROM	RAM	EEPROM	Timer	Serial	A/D	I/O	Bus Speed, MHz	Package†	EPROM or EEPROM Version	Comments
MC6805P2	1K	64	0	8-Bit	—	No	20	0.1-1.0	28-P 28-FN	705P3	LVI Option
MC6805P6	2K	64	0	8-Bit	—	No	20	0.1-1.0	28-P	705P3	LVI Option
MC6805R2	2K	64	0	8-Bit	—	Yes	32	0.1-1.0	40-P 44-FN	705R3	LVI Option, Prog. Prescaler Option
MC6805R3	4K	112	0	8-Bit	—	Yes	32	0.1-1.0	40-P 44-FN	705R3	7-Bit Prescaler, LVI Option
MC6805R6	4K	112	0	8-Bit	—	Yes	32	0.1-1.0	40-P 44-FN	705R3	
MC6805S2	1K	64	0	16-Bit; 8-Bit	SPI	Yes	16	0.1-1.0	28-P	705S3	15-Bit Prescaler, LVI
MC6805S3	4K	104	0	2 8-Bit; 16-Bit	SPI	Yes	21	0.1-1.0	28-P	705S3	1 Extra 8-Bit Timer
MC6805U2	2K	64	0	8-Bit	—	No	32	0.1-1.0	40-P 44-FN	705U3	LVI Option
MC6805U3	4K	112	0	8-Bit	—	No	32	0.1-1.0	40-P 44-FN	705U3	7-Bit Prescaler LVI Option

One-Time Programmable and Reprogrammable MCUs

Motorola Part Number	EPROM	RAM	EEPROM	Timer	Serial	A/D	I/O	Bus Speed, MHz	Package†	Comments
MC68705R3	4K	112	0	8-Bit	—	Yes	32	0-2.1	40-P 44-FN 40-S	7-Bit Prescaler, LVI Option

See Definitions on page 2-29.

8-Bit MPU/Peripherals

Device	Pins	Package	Part Description
MC6800	40	P, S	8-Bit MPU Addresses 64K Memory, 1 or 2 MHz Versions
MC6802	40	P, S	MC6800+Int. Clock Oscillator; 128 Bytes RAM
MC6809	40	P, S	High Performance MPU, 10 Powerful Addressing Modes
MC6809E	40	P, S	MC6809 With External Clock Input For External Sync.
MC6821	40	P, S	Peripheral Interface Adaptor
MC6840	28	P, S	Programmable Timer Module Contains 3 16-Bit Timers
MC6845	40	P, S	CRT Ctrl, Refresh Memory Addressing; 2nd Source HD6845R
MC6847	40	P, S	Video Display Generator, Multi Display
MC6850	24	P, S	Asynchronous Communication Interface Adaptor
MC68HC24	40, 44	P, FN	MC68HC11 Port Replacement (Expanded Mode)
MC68HC27	64, 68	FU, FN	Port Replacement for D3, K4, F1
MC68HC34	40	P, S, FN	256 Bytes Dual Port RAM, 6 Semaphore Registers
MC68HC68L9	80	QFP	LCD Expansion to the HC05L9
MC146818	24	P	Real Time Clock, 50 Bytes RAM, Programmable Square Wave
MC146818A	24,28	P, FN	Enhanced Version of the MC146818
MC146823	40,44	P, FN	Three 8-Bit Ports, Handshake Control Logic
MC146805E2	40,44	P, FN	CMOS 8-Bit Microprocessor

Serial Peripheral Interface

MPUs and some MCUs can be used in expandable multi-chip systems using Serial Peripheral Interface. SPI is a simple 2-3 wire interconnect method to allow MPUs, MCUs, and peripherals to communicate with each other, even in multi-master CPU configurations. To satisfy these system requirements, Motorola supplies a broad line of CMOS SPI peripherals.

PLL Frequency Synthesizers — Typical applications include the areas of televisions, CATV, radios, scanners, cordless telephones, and personal computers.

MC145149 — Dual PLL; dual modulus; ÷ R = 14 stages, ÷ A = 7 stages, ÷ N = 10 stages

MC145155 — Single modulus; ÷ R = 14 stages; ÷ N = 14 stages

MC145156 — Dual modulus; ÷ R = 12 stages, ÷ A = 7 stages, ÷ N = 10 stages

MC145157 — Single modulus; ÷ R = 14 stages, ÷ N = 14 stages

MC145158 — Dual modulus; ÷ R = 14 stages, ÷ A = 7 stages, ÷ N = 10 stages

MC145159 — Sample and hold detector, dual modulus; ÷ R = 14 stages, ÷ A = 7 stages, ÷ N = 10 stages

MC145167 — 60 MHz dual PLL for Cordless Phones, 10 channel pairs

MC145169 — 60 MHz dual PLL for Cordless Phones, 15 channel pairs

MC145170 — VHF single-chip device; ÷ R = 15 stages, ÷ N = 16 stages

Data Converters — These parts may be applied to instrumentation, automotive uses, industrial controls and home electronics.

MC145040 — ADC; 8 bits, 11 inputs, SAR, external clock

MC145041 — ADC; 8 bits, 11 inputs, SAR, internal clock

MC145050 — ADC; 10 bits, 11 inputs, SAR, external clock

MC145051 — ADC; 10 bits, 11 inputs, SAR, internal clock

MC145053 — ADC, 10 bits, 5 inputs, SAR, internal clock

MC144110 — DAC; six 6-bit converters

MC144111 — DAC, four 6-bit converters

Display Decoders/Drivers — These products find applications over a wide range of equipments such as automotive dash boards, home computers, appliances, radios and clocks.

MC14489 — 5-digit plus decimals 7-segment LED driver; can drive 25 lamps

MC14499 — 4-digit 7-segment LED driver

MC145000 — 48-segment LCD driver (master); multiplexed-by-four

MC145001 — 44-segment LCD driver (slave); multiplexed-by-four

MC145453 — LCD driver; 33 nonmultiplexed segments (for 4 1/2-digit, 7-segment-plus-decimal display); may be paralleled for more digits.

Development Support

. . . for the M68300, M68HC11, and M6801 Families

EVALUATION MODULES/BOARDS

	Evaluation Modules/Boards						
Device Supported	M68HC11EVB	M68HC711D3EVB	M68HC11EVBU	M68701EVM	M68HC11EVM	M68HC11F1EVM	M68332EVS
MC6801				x			
MC6801U4				x			
MC68701				x			
MC68701U4				x			
MC6803				x			
MC6803U4				x			
MC68HC11A0/A1/A8	x		x		x		
MC68HC11D0/D3					x		
MC68HC711D3		x			x		
MC68HC11E0/E1/E9	x		x		x		
MC68HC711E9			x		x		
MC68HC811A8/E2	x		x		x		
MC68HC11F1						x	
MC68331							x
MC68332							x
Document	BR278	BR737	BR736	BR285	BR266	BR706	BR734

COMPACT DEVELOPMENT SYSTEMS

System	Description	Documentation	Available
M68CDS8HC11	CDS8 Development System for the 68HC11 Family	CDS11*	2Q91
M68CDS32	CDS32 Development System for the 68331 and 68332	CDS32*	2Q91

*Contact Product Marketing, (512) 891-2715.

. . . for the M68HC05 and M6805 Families

DEVELOPMENT TOOLS

	Evaulation Systems/Modules/Boards				Jewelbox Compact Development System
Devices Supported	M68705EVM	M68HC05EVM	M68HC05P8EVS	MC68HC05P9EVS	M68CDS8HC05
MC68HC05A6		x			x
MC68HC05B4/B6		x			x
MC68HC705B5		x			x
MC68HC805B6		x			x
MC68HC05C2/C3/C4/C5/C8/C9		x			x
MC68HC705C8		x			x
MC68HC805C4		x			x
MC68HC05J1			x		x
MC68HC705J2			x		x
MC68HC05L6		x			
MC68HC05P1/P4/P7		x		x	x
MC68HC05P8			x		x
MC68HC705P9				x	x
MC6805P2/P6	x				
MC6805R2/R3	x				
MC6805U2/U3	x				
MC68705P3/P5	x				
MC68705R3/R5	x				
MC68705U3/U5	x				

Winner 1988

Malcolm Baldrige National Quality Award

PC Chip Products

In Brief . . .

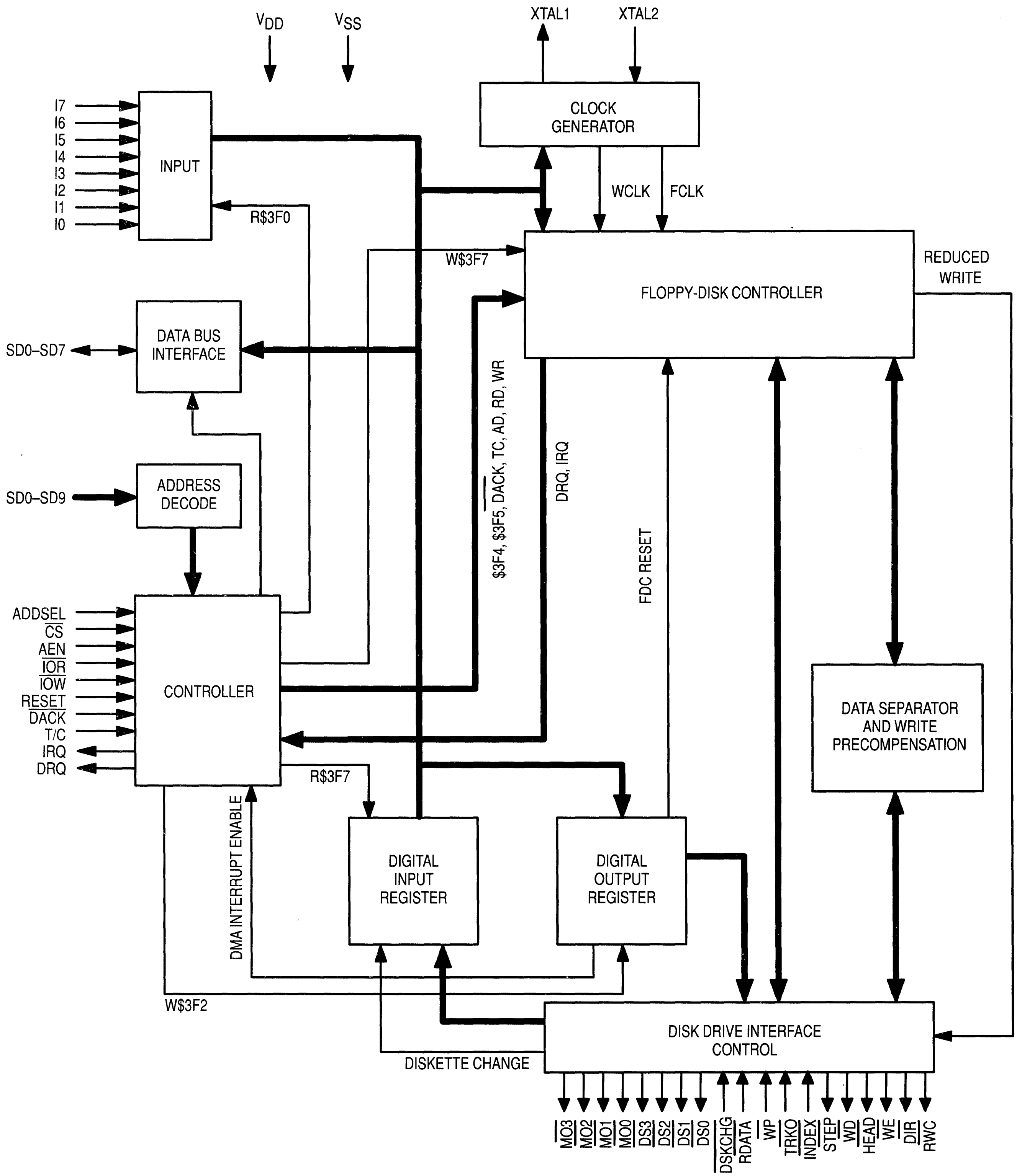
Motorola broadens its product portfolio with an offering of VLSI support functions designed for use in Personal Computer applications. These controller, timer, interface, and receiver/driver devices enable circuit board designers to increase flexibility in integrating functionality while saving valuable board space and development costs.

These products are the initial offerings from the MOS Digital-Analog IC Division and will lead to other peripheral products in the future.

Floppy Disk Controller

Device	Description	Suffix/Case
MCS3201	PC-XT/AT compatible. Drives 360K, 720K, 1.2M, and 1.44M drives, or any combination of these four formats or tape backup drives. Transfer rates of 250, 300, and 500 kb/s. On-chip address decoder and clock generation.	FN/779 FU/64-pin

PC-XT/AT are trademarks of International Business Machines Corp.

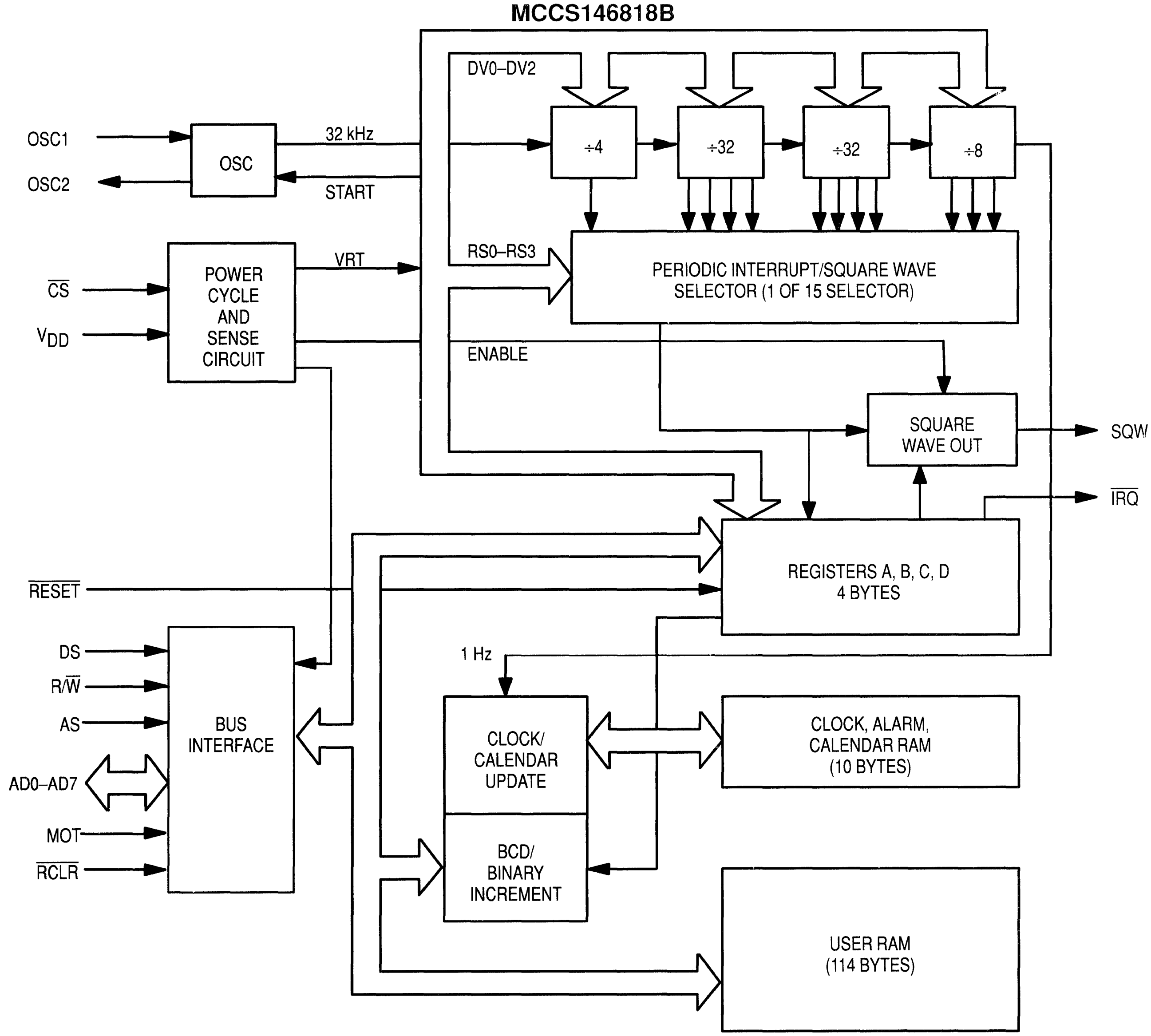


Real-Time Clocks

Device	Description	Suffix/Case
Parallel		
MCCS146818B	114 bytes of user SRAM. Low-power oscillator. Drop into the Dallas 1285.	P/709 FN/706
MCCS146818BM	114 bytes of user SRAM with crystal and battery included in the module. Low-power oscillator. Drop into the Dallas 1287.	Module
MCCS146818B1M	114 bytes of user SRAM with crystal and battery included in the module. Low-power oscillator. Drop into the Dallas 1287A.	Module
MC146818A	50 bytes of DRAM	P/709
Serial		
MCCS1850	64 bytes of SRAM. Power switch enable circuit. Suited for workstation environments.	P/620 DW/16-pin
MC68HC68T1	32 × 8 SRAM. Watch dog circuitry.	P/648 DW/751G

MCCS is a trademark of Motorola Inc.

MCCS146818B



Multifunction I/O Controllers

Device	Description	Suffix/Case
MCCS16C451	Single serial/single parallel UART. Industry-standard pinout. TTL clock.	FN/779
MCCS16C452	Dual serial/single parallel UART. Industry-standard pinout. TTL clock.	FN/779
MCCS16C462	Dual serial/single parallel UART. Crystal clock.	FN/779

SCSI Devices

Device	Description	Suffix/Case
MCCS53C90	8-bit SCSI I- and II-compatible controller. Has both initiator and target modes. 16-byte FIFO buffers data. Transfer rates up to 6.25M bytes/s.	FN/779 FU/80-pin
MCS143322	SCSI terminator.	TBD

EIA-232 Driver/Receivers

Device	Organization	Supply Voltage	Description	Suffix/Case
MC145406	3 drivers, 3 receivers	Drivers: $\pm$ 5 to $\pm$ 12 V Receivers: $\pm$ 25 V at V_{DD} = 12 V, V_{SS} = – 12 V	EIA-232-D/V.28	L/620 P/648 DW/752G
MC145407	3 drivers, 3 receivers and charge pumps	5 V	Ideal for low-power operations. Drivers and receivers functionally equivalent to MC145406.	L/732 P/738 DW/751G
MC145705*	2 drivers, 3 receivers	5 V	Integrated standby mode ideal for power management in notebook, laptop, and palmtop environments.	20-pin
MC145706*	3 drivers, 2 receivers	5 V		20-pin
MC145707*	3 drivers, 3 receivers	5 V		24-pin

*To be introduced.

MOS Memories

In Brief . . .

Motorola's MOS memory portfolio has been expanded to support a broad range of engineering applications.

Technological leadership is the main goal for fast static RAMs. These high-density, high-speed products are targeted for specific solutions in microprocessor applications, providing access times as fast as 12 and 15 ns. Included in this portfolio are application-specific SRAMs, along with standard and custom static RAM modules. The CMOS devices, plus the BiCMOS RAMs, are the technology process drivers for the future.

The dynamic RAM operation uses alliances as a vehicle for global customer support in this highly competitive commodity memory market. The portfolio includes high-density DRAMs in a variety of operating modes and packages, and standard and custom modules up to 8M bytes to reach a broad range of responsive engineering solutions. Application-specific DRAM modules are available for many microprocessor applications that require high-density memory and implementation of byte parity logic and error detection and correction.

Page

Static RAMs

Fast Static RAMs (10 to 55 ns)

Motorola is designing the fastest, most technologically advanced fast SRAMs. From 1.2 micron technology to sub-micron dimensions, devices are progressively smaller, faster, and lower cost. SRAMs developed with double-layer metal and BiCMOS technology will keep pace with machines of the future. Selected Fast Static RAMs are also available on 2M and 8M memory modules.

Density	Organization	Motorola Part Number	Pin Count	Packaging Package width in mils	Address/ Cycle Time (ns Max)	Technology	Comments
16K	2Kx8	MCM2018AN	24	300 (P)DIP	35/45/55	NMOS	Replaces TMM2019D, MCM2016HN, MCM2018N.
	4Kx4	MCM6268	20	300 (P)DIP	20/25/35/45/55	HCMOS	
		MCM6269	20	300 (P)DIP	20/25/35	HCMOS	Fast Chip Select access time = 10/12/15 ns.
		MCM6270	24/22	300 (J)SOJ/(P)DIP	20/25/35	HCMOS	Fast Output Enable access time = 10/12/15 ns.
64K	8Kx8**	MCM6264B	28	300 (NJ)SOJ/(P)DIP	25/35/45	HCMOS	Use 'B' device for new designs and quals.
		MCM6264C	28	300 (J)SOJ/(P)DIP	12/15/20/25/35	HCMOS	
		MCM6264	28	300 (NJ)SOJ/(P)DIP	15/20	HCMOS	
	8Kx9**	MCM6265	28	300 (NJ)SOJ/(P)DIP	15/20/25	HCMOS	Ideal for applications requiring parity.
		MCM6265C	28	300 (J)SOJ/(P)DIP	12/15/20/25/35	HCMOS	
	16Kx4	MCM6288	22	300 (P)DIP	12/15	HCMOS	Use 'C' device for new designs and quals.
		MCM6288B	22	300 (P)DIP	20/25/35	HCMOS	Use 'C' device for new designs and quals.
		MCM6288C	22	300 (P)DIP	10/12/15/20/25/35	HCMOS	Use 'C' device for new designs and quals.
		MCM6290	24	300 (J)SOJ/(P)DIP	12/15	HCMOS	Use 'C' device for new designs and quals.
		MCM6290B	24	300 (J)SOJ/(P)DIP	20/25/35	HCMOS	Use 'C' device for new designs and quals.
		MCM6290C	24	300 (J)SOJ/(P)DIP	10/12/15/20/25/35	HCMOS	Use 'C' device for new designs and quals.
	64Kx1	MCM6287	24/22	300 (J)SOJ/(P)DIP	12/15/20	HCMOS	Mainframe applications, also use for parity.
		MCM6287B	24/22	300 (J)SOJ/(P)DIP	25/35	HCMOS	Use 'B' device for new designs and quals.
256K	32Kx8**	MCM6206	28	300 (NJ)SOJ/(NP)DIP	15/17/20/25	HCMOS	
		MCM6206B	28	300 (NJ)SOJ/(NP)DIP	35	HCMOS	Use 'B' device for new designs and quals.
		MCM6206C	28	300 (J)SOJ/(NP)DIP	12/15/17/20/25/30/35	HCMOS	
		MCM6706	28	300 (J)SOJ/(P)DIP	10/12	BiCMOS	
	32Kx9**	MCM6205	32	300 (NJ)SOJ/(NP)DIP	15/17/20/25	HCMOS	Ideal for applications requiring parity.
		MCM6205B	32	300 (NJ)SOJ/(NP)DIP	35	HCMOS	Ideal for applications requiring parity.
		MCM6205C	32	300 (J)SOJ/(NP)DIP	15/17/20/25/30/35	HCMOS	
	64Kx4	MCM6208	24	300 (J)SOJ/(P)DIP	15/20/25	HCMOS	
		MCM62L08	24	300 (J)SOJ/(P)DIP	25	HCMOS	Battery backup appl. I_{DR} = 50 µA. Main memory appl. I_{SB2} = 100 µA.
		MCM6208C	24	300 (J)SOJ/(P)DIP	15/20/25/35	HCMOS	
		MCM6708	24	300 (J)SOJ/(P)DIP	10/12	BiCMOS	
		MCM6209	28	300 (J)SOJ/(P)DIP	15/20/25	HCMOS	8, 10, and 12 ns Output Enable function.
		MCM62L09	28	300 (J)SOJ/(P)DIP	25	HCMOS	Battery backup appl. I_{DR} = 50 µA. Main memory appl. I_{SB2} = 100 µA.
		MCM6209C	28	300 (J)SOJ/(P)DIP	15/20/25/35	HCMOS	Output Enable Access Time = 6 ns.
		MCM6709	28	300 (J)SOJ/(P)DIP	10/12	BiCMOS	
	256Kx1	MCM6207	24	300 (J)SOJ/(P)DIP	15/20/25	HCMOS	15 ns 256K with separate I/O.
		MCM62L07	24	300 (J)SOJ/(P)DIP	25	HCMOS	Battery backup appl. I_{DR} = 50 µA. Main memory appl. I_{SB2} = 100 µA.
		MCM6207C	24	300 (J)SOJ/(P)DIP	12/15/20/25	HCMOS	
1M	128Kx8	MCM6226	32	400 (WJ)SOJ	25/30	HCMOS	
	256Kx4	MCM6229	28	400 (WJ)SOJ	25/30	HCMOS	6228 Part Number changed to 6229.

**Some 8Kx8/9 and 32Kx8/9 devices are also available in industrial temperature range, –40°C to 85°C.

NOTE: Package suffixes are enclosed by ( ) in packaging column.

Fast Static RAM Modules

Density	Organi-zation	Motorola Part Number	Pin Count	Packaging	Address/ Cycle Time (ns Max)	Tech-nology	Comments
2M	64Kx32	MCM3264Z	64	ZIP	15/20/25	HCMOS	Perfect for 32-bit system, JEDEC standard.
	256Kx8	MCM8256Z	60	ZIP	15/20/25	HCMOS	JEDEC standard module.
	2x32Kx36	MCM36232Z*	76	ZIP	15/20	HCMOS	Designed for parity applications.
8M	256Kx32	MCM32257Z	64	ZIP	20/25	HCMOS	High density module using 1M fast SRAMs.

General Static RAMs

(HCMOS unless otherwise noted)

Density	Organi-zation	Motorola Part Number	Pin Count	Packaging Package width in mils	Address Access Time (ns Max)	Operating Current (mA Max)	Comments
16K	2Kx8	MCM2018AN	24	300 (P)DIP	35/45/55	135	NMOS. Replaces TMM2019D, MCM2016HN, MCM2018N.
256K	32Kx8	MCM60L256A-C	28	600 (P)DIP, 330 (F)SOG	100	70	Industrial temp range (–40° to +85°C), low power.
		MCM60L256A-V	28	600 (P)DIP, 330 (F)SOG	100	70	Extended temp range (–40° to +105°C), low power.

Application Specific Static RAMs

Application specific memories are designed for high-performance microprocessors that require more specialization from memory cache than is available from standard devices. Products include those for use with digital signal processors as well as a variety of popular microprocessors.

Description	Organi-zation	Motorola Part Number	Pin Count	Packaging	Address/ Cycle Time (ns Max)	Tech-nology	Comments
Cache Tag RAM	4Kx4	MCM4180	24/22	300 (J)SOJ/(P)DIP	18/20	HCMOS	Pin and function compatible with Mostek MK41H80.
Cache Tag RAM with Status Bit Registers	4Kx4	MCM62351	24	300 (P)DIP	20/25	HCMOS	Housekeeping bits function, open drain match output. Flash clearable.
Synchronous Static RAM	16Kx4	MCM6294	28	300 (NJ)SOJ/(P)DIP	20/25	HCMOS	Registered outputs plus output enable, separate I/O's.
		MCM6295	28	300 (NJ)SOJ/(P)DIP	25/30	HCMOS	Transparent outputs plus output enable, separate I/O's.
	64Kx4	MCM62980	28	300 (J)SOJ	15/20	HCMOS	Large cache memory for RISC and CISC systems.
		MCM62982	28	300 (J)SOJ	12/15	HCMOS	Registered outputs for two stage pipeline.
	16Kx16	MCM62990	52	(FN) PLCC	17/20	HCMOS	Designed for advanced RISC-CISC cache applications.
		MCM62990A	52	(FN) PLCC	12/15/20	HCMOS	Designed for advanced RISC-CISC cache applications.
	4x64Kx1	MCM62981	32	300 (J)SOJ	15/20	HCMOS	Cache memory parity RAM.
		MCM62983	32	300 (J)SOJ	12/15	HCMOS	Registered outputs, cache memory parity RAM.
	4Kx10	MCM62963	44	(FN) PLCC	18/25	HCMOS	Registered addresses and outputs, separate I/O with Chip Enable.
	4Kx12	MCM62973	44	(FN) PLCC	18/25	HCMOS	Same as MCM62963 but with 12 I/O's.
		MCM62974	44	(FN) PLCC	18/25	HCMOS	Registered addresses and outputs, separate I/O with Output Enable.
		MCM62975	44	(FN) PLCC	25/30	HCMOS	Registered addresses with Output Enable.
	32Kx9	MCM62940	44	(FN) PLCC	14/19/24	HCMOS	Burst mode for 040 applications.
		MCM62950	44	(FN) PLCC	20/25/35	HCMOS	Designed for advanced RISC-CISC cache applications.
		MCM62960	44	(FN) PLCC	17/20/25	HCMOS	Designed for high performance SPARC™ applications.
		MCM62486	44	(FN) PLCC	14/19/24	HCMOS	Burst mode for 486 applications.
		MCM62486A	44	(FN) PLCC	12/19/24	HCMOS	Burst mode for 486 applications >50 MHz.
		MCM62110	52	(FN) PLCC	12/15/20	HCMOS	Dual I/O's for 88110 and other multiprocessor applications.
DSPRAM	8Kx24	MCM56824	52	(FN) PLCC	25/30/35	HCMOS	Designed for DSP56001 applications, replaces 3 8Kx8's.
		MCM56824A	52	(FN) PLCC	20/25/35	HCMOS	Designed for DSP56001 applications, replaces 3 8Kx8's.
Latched Address SRAM	8Kx20	MCM62820	52	(FN) PLCC	23	HCMOS	Designed for MIPS R3000 cache.
		MCM62820A	52	(FN) PLCC	17	HCMOS	Designed for MIPS R3000 cache.
	16Kx16	MCM62995	52	(FN) PLCC	17/20	HCMOS	

NOTE: Package suffixes are enclosed by ( ) in packaging column.

Dynamic RAMs

DRAMs offer the lowest cost per bit of any memory. Because of this, they are very popular for a wide range of applications, particularly for high-density memories involving very high memory capacity such as mainframe computers, personal computers, and workstations. Motorola's dynamic RAM portfolio includes 1M and 4M devices with ×1 and ×4 organizations in fast page, nibble, and static column mode options that significantly reduce access time. These devices are also available on memory modules in densities to 64M, with and without parity and error correction.

All devices are fabricated using HCMOS technology and designed for single 5-volt power supply operation. All have $\overline{CAS}$ before $\overline{RAS}$ and $\overline{RAS}$ only refresh modes.

DRAMs

Density	Organization	Motorola Part Number	Pin Count	Packaging Package width in mils	Address Access Time (ns Max)	Operating Current (mA Max)	Comments
1M	1Mx1	MCM511000A	18, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Fast page mode cycle time = 40/45/55 ns
		MCM511000A-C	18, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	85/75/65	Industrial temp range (–40° to +85°C)
		MCM51L1000A	18, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Fast page mode with low power battery backup
		MCM51L1000A-C	18, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	85/75/65	Industrial temp range (–40° to +85°C), low power
		MCM511001A	18, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Nibble mode access time = 35/35/40 ns
		MCM511002A	18, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Static column mode cycle time = 40/45/55 ns
	256Kx4	MCM514256A	20, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Fast page mode cycle time = 40/45/55 ns
		MCM514256A-C	20, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	85/75/65	Industrial temp range (–40° to +85°C)
		MCM51L4256A	20, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Fast page mode with low power battery backup
		MCM51L4256A-C	20, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	85/75/65	Industrial temp range (–40° to +85°C), low power
		MCM514258A	20, 20, 20/26	300 (P)DIP, 100 (Z)IP, 300 SO(J)	70/80/100	80/70/60	Static column mode cycle time = 40/45/55 ns
4M	4Mx1	MCM514100	20, 20/26	350 SO(J), 400 (Z)IP	80/100	100/85	Fast page mode cycle time = 50/60 ns
		MCM514100A	20, 20/26	100 (Z)IP, 350 SO(J), 300 SO(NJ)	60/70/80	120/100/85	Fast page mode cycle time = 50/60 ns
		MCM51L4100A	20, 20/26	100 (Z)IP, 350 SO(J), 300 SO(NJ)	60/70/80	120/100/85	Fast page mode with low power battery backup
	1Mx4	MCM514400	20, 20/26	350 SO(J), 400 (Z)IP	80/100	105/90	Fast page mode cycle time = 50/60 ns
		MCM514400A	20, 20/26	100 (Z)IP, 350 SO(J), 300 SO(NJ)	60/70/80	120/100/85	Fast page mode cycle time = 50/60 ns
		MCM51L4400A	20, 20/26	100 (Z)IP, 350 SO(J), 300 SO(NJ)	60/70/80	120/100/85	Fast page mode with low power battery backup

NOTE: Package suffixes are enclosed by ( ) in packaging column.

DRAM Modules

Density	Organization	Motorola Part Number	Pin Count	Packaging	Address Access Time (ns Max)	Operating Current (mA Max)	Comments
8M	1Mx8	MCM81000	30	(S)IMM, (L)SIP, (LH)SIP	70/80/100	640/560/480	Fast page mode cycle time = 40/45/55 ns
		MCM81000A	30	(S)IMM	70/80/100	640/560/480	Low cost derivative of MCM81000
		MCM8L1000	30	(S)IMM, (L)SIP	70/80/100	640/560/480	Fast page mode with low power battery backup
		MCM8L1000A	30	(S)IMM	70/80/100	640/560/480	Low cost derivative of MCM8L1000, low power
		MCM81001	30	(S)IMM, (L)SIP	70/80/100	640/560/480	Nibble mode access time = 35/35/40 ns
		MCM81002	30	(S)IMM, (L)SIP	70/80/100	640/560/480	Static column mode cycle time = 40/45/55 ns
8M with Parity	1Mx9	MCM91000	30	(S)IMM, (L)SIP, (LH)SIP	70/80/100	720/630/540	Fast page mode cycle time = 40/45/55 ns
		MCM9L1000	30	(S)IMM, (L)SIP, (SG)-gold	70/80/100	720/630/540	Fast page mode with low power battery backup
		MCM91000A	30	(S)IMM	70/80/100	720/630/540	Low cost derivative of MCM91000
		MCM9L1000A	30	(S)IMM	70/80/100	720/630/540	Low cost derivative of MCM9L1000
		MCM91001	30	(S)IMM, (L)SIP	70/80/100	720/630/540	Nibble mode access time = 35/35/40 ns
		MCM91002	30	(S)IMM, (L)SIP	70/80/100	720/630/540	Static column mode cycle time = 40/45/55 ns
2M	256Kx8	MCM84256	30	(S)IMM	70/80/100	160/140/120	Fast page mode cycle time = 40/45/55 ns
		MCM8L4256	30	(S)IMM	70/80/100	160/140/120	Fast page mode with low power battery backup
2M with Parity	256Kx9	MCM94256	30	(S)IMM	70/80/100	240/210/190	Fast page mode cycle time = 40/45/55 ns
		MCM94256A	30	(S)IMM	70/80/100	240/210/190	Fast page mode cycle time = 40/45/55 ns
		MCM9L4256	30	(S)IMM	70/80/100	240/210/190	Fast page mode with low power battery backup
		MCM9L4256A	30	(S)IMM	70/80/100	240/210/190	Fast page mode with low power battery backup
4M	1Mx4	MCM41000	26	(Z)IMM	80/100	280/240	Fast page mode cycle time = 40/45/55 ns
	4Mx1	MCM11400	23	(Z)IMM	80/100	90/80	Fast page mode cycle time = 40/45/55 ns
32M	4Mx8	MCM84000	30	(S)IMM, (L)SIP, (LH)SIP	80/100	800/680	Fast page mode cycle time = 50/60 ns
		MCM84000A	30	(S)IMM	60/80	800/680	Low cost derivative of MCM84000
		MCM8L4000	30	(S)IMM	80/100	800/680	Fast page mode cycle time = 50/60 ns
32M with Parity	4Mx9	MCM94000	30	(S)IMM, (L)SIP, (LH)SIP	90/100	900/765	Fast page mode cycle time = 50/60 ns
		MCM94000A	30	(S)IMM	60/90	900/765	Low cost derivative of MCM94000
		MCM9L4000	30	(S)IMM	80/100	900/765	Fast page mode cycle time = 50/60 ns
8M	256Kx32	MCM32256	72	(S)IMM, (SG)-gold	70/80/100	640/560/480	Fast page mode cycle time = 40/45/55 ns
16M	512Kx32	MCM32512	72	(S)IMM, (SG)-gold	70/80/100	656/576/496	Fast page mode cycle time = 40/45/55 ns
32M	1Mx32	MCM32100	72	(S)IMM, (SG)-gold	80/100	840/720	Fast page mode cycle time = 40/45/55 ns
64M	2Mx32	MCM32200	72	(S)IMM, (SG)-gold	80/100	856/736	Fast page mode cycle time = 40/45/55 ns
8M with Parity	256Kx36	MCM36256	72	(S)IMM, (SG)-gold	70/80/100	960/840/760	Fast page mode cycle time = 40/45/55 ns
16M with Parity	512Kx36	MCM36512	72	(S)IMM, (SG)-gold	70/80/100	1920/1680/1520	Fast page mode cycle time = 40/45/55 ns
32M with Parity	1Mx36	MCM36100	72	(S)IMM, (SG)-gold	80/100	1144/984	Fast page mode cycle time = 40/45/55 ns
64M with Parity	2Mx36	MCM36200	72	(S)IMM, (SG)-gold	80/100	1120/960	Fast page mode cycle time = 40/45/55 ns
8M used for EDC	256Kx40	MCM40256	72	(S)IMM, (SG)-gold	70/80/100	800/700/600	Same as MCM36xxx, for error correction applications
16M used for EDC	512Kx40	MCM40512	72	(S)IMM, (SG)-gold	70/80/100	820/720/620	Same as MCM36xxx, for error correction applications
32M used for EDC	1Mx40	MCM40100	72	(S)IMM, (SG)-gold	80/100	1050/900	Same as MCM36xxx, for error correction applications
64M used for EDC	2Mx40	MCM40200	72	(S)IMM, (SG)-gold	80/100	1070/920	Same as MCM36xxx, for error correction applications

EEPROM
Electrically Erasable Programmable Read-Only Memory

Density	Organization	Motorola Part Number	Pin Count	Packaging Package width in mils	Address Access Time (Max)	Operating Current (mA Max)	Comments
2K	256x8	MCM2814P	8	300 (P)DIP	3.5 μs	10	2 or 4 wire serial access, data protection after reset.

NOTE: Package suffixes are enclosed by ( ) in packaging column.

Standard Logic Families

Page

In Brief . . .

Since the inception of IC technology, Motorola has earned a reputation as the supermarket for digital logic circuits. Although early circuit designs such as RTL, DTL, HTL, etc., have been largely supplanted by newer techniques, Motorola's reputation as a leading-edge supplier of standard logic families remains unchallenged.

Motorola currently concentrates on supplying those logic families and functions that advance the state of the art as well as serving the needs of designers requiring interface circuits for more complex ICs and semicustom designs. It does so with three technologies:

ECL	(four unique families), for high speed
TTL	(two families), for high performance at lowest cost
CMOS	(four families), for lowest power dissipation

This selector guide contains only devices in production at Motorola's Logic I.C. Division, accurate to the date of publication.

There are numerous new devices introduced between printings of the Master Selector Guide. Therefore, the Logic Division publishes individual selector guides on a quarterly basis. These selector guides can be ordered from your nearest Motorola Sales office or from the Motorola Literature Distribution Center.

Product Line	**Order Number**
TTL FAST & LS	SG60/D
ECL	SG77/D
FACT	SG122/D
HIGH SPEED & METAL GATE CMOS	SG125/D

The Logic I.C. Division publishes a New Product Calendar quarterly that reflects any recent device releases and the approximate dates new devices are expected to be released.

There are many new devices in various stages of development on Motorola's Logic I.C. Division design schedule. Call your nearest Motorola Sales Office for the current status of any device not listed within this guide.

MECL in Perspective

Motorola's Emitter Coupled Logic (MECL) is a nonsaturated form of digital logic which eliminates transistor storage time as a speed limiting characteristic, permitting very high speed operation.

Motorola offers four versions of MECL: MECL 10K, MECL 10KH, MECL III and the recently introduced ECLinPS (ECL in picoseconds) family.

The *MECL 10K* series has become the industry standard for high-speed applications. In order to make the circuits comparatively easy to use, edge speed was slowed to 2.0 ns while the important propagation delay was held to 2.0 ns. The slow edge speed permits use of wire-wrap and standard printed circuit lines; however, the circuits are specified to drive transmission lines for optimum performance.

The newer *MECL 10KH* family features 100% improvement in propagation delay and clock speeds while maintaining power supply current equal to MECL 10K. This new MECL family is voltage compensated which allows guaranteed dc and switching parameters over a ±5% power supply range. Noise margins of MECL 10KH are 75% better than the MECL 10K series. MECL 10KH is compatible with MECL 10K and MECL III, a key element in allowing users to enhance existing systems by increasing the speed in critical timing areas.

ECLinPS is the latest ECL family to enter the competition and represents a major advance in high-speed logic capabilities. With a gate propagation delay of only 0.33 ns and a flip-flop toggle frequency at least 600 MHz it literally eclipses the performance of the earlier ECL lines while maintaining signal and power-supply compatibility with MECL 10H and with ECL 100K (not manufactured by Motorola).

MECL III, with its 1.0 ns gate propagation delays and greater than 1.0 GHz flip-flop toggle rates, remains the industry speed leader. The 1.0 ns rise and fall times require a transmission line environment for all but the smallest systems. For this reason, all circuit outputs are designed to drive transmission lines and all output logic levels are specified when driving 50-ohm loads. Because of MECL III's fast edge speeds, multi-layer boards are recommended above 200 MHz. MECL III's popularity is with high-speed test and communications equipment.

Speed/power comparisons for Motorola ECL families are as follows:

SPEED/POWER CHARACTERISTICS FOR MECL

(ALL TYPICAL RATINGS)		MECL 10K		MECL/10KH	ECLinPS	MECL III	
Characteristic	**Symbol**	**MC101xx**	**MC102xx**	**MC10H1xx**	**MC10E/100E**	**MC16xx**	**Units**
Quiescent Supply Current/Gate	I_G	5.0	5.0	5.0	5.0	10	mA
Power/Gate (Quiescent)	P_G	26	26	26	26	54	mW
Propagation Delay	t_p	2.0	1.5	1.0	0.33	1.1	ns
Speed Power Product	—	52	39	26	8.6	59	pJ
Clock Frequency (D-F/F)	f_{max}	125	200	250	600	550	MHz
Clock Frequency (Counter)	f_{max}	125	—	250	500	1000	MHz

Selector Guide Contents

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Contents

System Considerations

Figure 2 summarizes system considerations when designing with MECL 10KH, MECL 10K and MECL III. For more detailed information refer to Motorola's MECL System Design Handbook (HB205) and the most current edition of the MECL Data Book (DL122).

System Considerations — A Summary of Recommendations

	MECL 10KH	MECL 10K	MECL III	ECLinPS
Power Supply Regulation	±5%[1]	10%[2]	10%[2]	
Maximum Non-Transmission Line Length (No Damping Resistor)	1″	8″	1″	
Unused Inputs	Leave Open[3]	Leave Open[3]	Leave Open[3]	
PC Board	Multilayer	Standard 2-Sided or Multilayer	Multilayer	
Bus Connection Capability	Yes (Wire-OR)	Yes (Wire-OR)	Yes (Wire-OR)	
Maximum Twisted Pair Length (Differential Drive)	Limited By Cable Response Only, Usually >1000′	Limited By Cable Response Only, Usually >1000′	Limited By Cable Response Only, Usually >1000′	
The Ground Plane to Occupy Percent Area of Card	>75%	>50%	>75%	
Wirewrap may be used	Not Recommended	Yes	Not Recommended	
Compatible with MECL 10,000	Yes	—	Yes	

1 All dc and ac parameters guaranteed for V_{EE} = –5.2 V ±5%.
2 Functional only. AC and DC parametrics are guaranteed at V_{EE} = –5.2 V ±5%.
3 Except special functions without input pull-down resistors.

MECL 10KH Compatible LSI Devices

MECL 10KH provides the ideal solution for peripheral (glue) circuitry for Motorola's Macrocell Arrays MCA600ECL, MCA1200ECL and the MCA2500ECL as well as the MC10900 family.

MECL 10KH versus 100K

Choosing a logic family to meet system performance/cost targets can be a time consuming task. To facilitate this process, Motorola has compiled a comparison of family features and a system cost analysis for MECL 10KH and 100K ECL. The study indicates that the use of 10KH can result in smaller, less costly, and more efficient logic systems.

MC12000 Series

The MECL Phase-Locked Loop (PLL) family (MC12000 Series) offers a selection of devices for high performance PLL applications as well as prescalers up to 1.1 GHz. New high performance prescaler devices and prescaler/PLL single chip devices are planned for this family which are described in this selector guide.

MECL 10KH

MECL 10KH

Integrated Circuits

MECL 10KH is a voltage compensated, one nanosecond logic family developed for high performance computers, computer peripherals, automatic test equipment, digital communications and other equipment where the ultimate in performance is demanded. MECL 10KH is the logical extension of the industry standard MECL 10K family offering many pin compatible functions with twice the speed at the same power dissipation as MECL 10K. MSI type functions not currently available in MECL 10K are planned for the MECL 10KH family. Denser functions are made possible by a new high-density, oxide-isolated process called MOSAIC. MECL 10KH is the most cost effective, high performance emitter-coupled logic family available today.

MECL 10KH/100KH Translators

A new 9-bit translator series is included here and will be available 3Q89. This series is composed of the MC10H600-603, and is compatible with MECL 10KH logic levels. A compliment set, MC100H600-603 is compatible with 100K logic levels.

Additional 100H devices, the MC100H351-352, TTL-NMOS and CMOS-to-ECL Translators will be available in 2Q89.

MC10H100 Series — (0 to +75°C)

Suffix: P . . . Plastic DIP
L . . . Ceramic DIP

Device	Function	Pins
MC10H016	Binary Counter	16
MC10H100	Quad 2-Input NOR Gate with Strobe	16
MC10H101	Quad 2-Input OR/NOR Gate	16
MC10H102	Quad NOR Gate	16
MC10H103	Quad 2-Input OR Gate	16
MC10H104	Quad AND Gate	16
MC10H105	Triple 2-3-2 Input OR/NOR Gate	16
MC10H106	Triple 4-3-3 Input NOR Gate	16
MC10H107	Triple Exclusive OR/NOR Gate	16
MC10H109	Dual 4-5 Input OR/NOR Gate	16
MC10H113	Quad Exclusive OR Gate	16
MC10H115	Quad Line Receiver	16
MC10H116	Triple Line Receiver	16
MC10H117	Dual 2-Wide OR-AND/OR-AND-INVERT Gate	16
MC10H118	Dual 2-Wide 3-Input OR-AND Gate	16
MC10H119	4-Wide 4-3-3-3 Input OR-AND Gate	16
MC10H121	4-Wide OR-AND/OR-AND-INVERT Gate	16
MC10H123	Triple 4-3-3 Input Bus Driver (25Ω)	16
MC10H124	Quad TTL-to-MECL Translator	16
MC10H125	Quad MECL-to-TTL Translator	16
MC10H130	Dual D Latch	16
MC10H131	Dual D Master-Slave Flip-Flop	16
MC10H135	Dual J-K Master-Slave Flip-Flop	16
MC10H136	Universal Hexadecimal Counter	16
MC10H141	4-Bit Universal Shift Register	16
MC10H145	16 x 4-Bit Register File	16
MC10H155	Content Addressable Memory	18
MC10H158	Quad 2-Input Multiplexer, Non-Inverting Output	16

Device	Function	Pins
MC10H159	Quad 2-Input Multiplexer, Inverting Output	16
MC10H160	12-Bit Parity Generator/Checker	16
MC10H161	Binary to 1-8 Line Decoder, (Low)	16
MC10H162	Binary to 1-8 Line Decoder,(High)	16
MC10H164	8-Line Multiplexer	16
MC10H165	8-Input Priority Encoder	16
MC10H166	5-Bit Magnitude Comparator	16
MC10H171	Dual Binary to 1-4 Decoder (Low)	16
MC10H172	Dual Binary to 1-5 Decoder (High)	16
MC10H173	Quad 2 Input Mux with Latch	16
MC10H174	Dual 4-to-1 Multiplexer	16
MC10H175	Quint Latch	16
MC10H176	Hex D Flip-Flop	16
MC10H179	Look Ahead Carry Block	16
MC10H180	Dual High-Speed Adder/Subtracter	16
MC10H181	4-Bit ALU	24
MC10H186	Hex D Flip-Flop with Common Reset	16
MC10H188	Hex Buffer with Enable	16
MC10H189	Hex Inverter with Enable	16
MC10H209	Dual 4-5-Input OR/NOR Gate	16
MC10H210	Dual 3-Input, 3-Output OR Gate	16
MC10H211	Dual 3-Input, 3-Output NOR Gate	16
MC10H301	Dual 4-Bit Parity Checker plus 2-Bit Exclusive OR Gate	16
MC10H302	Dual 6-4 Input Parity Checker	16
MC10H303	Dual 5-Bit Parity Checker	16
MC10H304	8-Bit/Dual 4-Bit Parity Checker	16
MC10H330	Quad Bus Transceiver with 2-1 Output Mux (25 Ω)	24
MC10H332	Dual Bus Transceiver with 4-1 Output Mux (25 Ω)20	
MC10H334	Quad Bus Transceiver with Transmit and Receiver Latches (25 Ω)	20
MC10H350	Quad MECL-to-TTL Translator (Single Power Supply @ +5.0 V)	16
MC10H351	Quad TTL NMOS to ECL Translator (Single Power Supply @ 5.0 V)	20
MC10H352	Quad CMOS to ECL Translator (Single Power Supply @ +5.0 V)	20
MC10H423	Triple 3-Input Bus Driver with Enable (25 Ω)	16
MC10H424	Quad TTL-to-MECL Translator (ECL Strobe)	16
MC10H600	9-Bit TTL-ECL Translator	28
MC100H600	9-Bit TTL-ECL Translator	28
MC10H601	9-Bit ECL-TTL Translator	28
MC100H601	9-Bit ECL-TTL Translator	28
MC10H602	9-Bit Latch/TTL-ECL Translator	28
MC100H602	9-Bit Latch/TTL-ECL Translator	28
MC10H603	9-Bit Latch/ECL-TTL Translator	28
MC100H603	9-Bit Latch/ECL-TTL Translator	28
MC10H640	1-8 TTL-TTL Clock Distribution Chip (Single @ 5.0 V)	28
MC100H640	1-8 TTL-TTL Clock Distribution Chip (Single @ 5.0 V)	28
MC10H641	1-9 Latch/ECL-TTL Clock Distribution Chip (Single Power Supply @ 5.0 V)	28
MC100H641	1-9 Latch/ECL-TTL Clock Distribution Chip (Single Power Supply @ 5.0 V)	28
MC10H642	68040 ECL-TTL Clock Driver (Sim. to H640)	28
MC100H642	68040 ECL-TTL Clock Driver (Sim. to H640)	28
MC10H643	1:9 ECL-TTL Clock Driver (Dual Supply, H641)	28
MC100H643	1:9 ECL-TTL Clock Driver (Dual Supply, H641)	28
MC10H660	Quad Dual Output ECL-TTL DRAM Driver with Latch	28
MC100H660	Quad Dual Output ECL-TTL DRAM Driver with Latch	28
MC10H680	Quad TTL — ECL 25 Ω Bus Transceiver	28
MC100H680	Quad TTL — ECL 25 Ω Bus Transceiver	28
MC10H681	6-Bit 50 Ω ECL-TTL Transceiver	28
MC100H681	6-Bit 50 Ω ECL-TTL Transceiver	28

MECL 10KH (continued)

Function Selection — (0 to +75°C)

Function	Device
AND Gates	
Quad AND Gate	MC10H104
Arithmetic Functions	
Look Ahead Carry Block	MC10H179
Dual High-Speed Adder/Subtractor	MC10H180
4-Bit ALU	MC10H181
Bus Drivers	
Triple 4-3-3 Input Bus Driver (25 Ohms)	MC10H123
Quad Bus Transceiver w/2-1 Output Multiplexers (25 Ohms)	MC10H330
Dual Bus Transceiver w/4-1 Output Multiplexers (25 Ohms)	MC10H332
Quad Bus Receiver with Transmit and Receiver Latches (25 Ohms)	MC10H334
Triple 3-Input Bus Driver w/Enable (25 Ohms)	MC10H423
Quad Dual Output ECL-TTL DRAM Driver w/Latch	MC10H660
Quad Dual Output ECL-TTL DRAM Driver w/Latch	MC100H660
Quad TTL — ECL 25 Ohms Bus Transceiver	MC10H680
Quad TTL — ECL 25 Ohms Bus Transceiver	MC100H680
6-Bit 50 Ohms ECL-TTL Transceiver	MC10H681
6-Bit 50 Ohms ECL-TTL Transceiver	MC100H681
Clock Drivers	
1-8 TTL-TTL Clk Distribution Chip (Sing. @ 5.0 V)	MC10H640
1-8 TTL-TTL Clk Distribution Chip (Sing. @ 5.0 V)	MC100H640
1-9 Latch/ECL-TTL Clock Distribution Chip (Sing. P.S. @ 5.0 V)	MC10H641
1-9 Latch/ECL-TTL Clock Distribution Chip (Sing. P.S. @ 5.0 V)	MC100H641
68040 ECL-TTL Clock Driver (Similar to H640)	MC10H642
68040 ECL-TTL Clock Driver (Similar to H640)	MC100H642
1:9 ECL-TTL Clock Driver (Dual Supply, H641)	MC10H643
1:9 ECL-TTL Clock Driver (Dual Supply, H641)	MC100H643
Complex Gates	
Quad 2-Input OR/NOR Gate	MC10H101
Triple 2-3-2 Input OR/NOR Gate	MC10H105
Triple Exclusive OR/NOR Gate	MC10H107
Dual 4-5 Input OR/NOR Gate	MC10H109
Quad Exclusive OR Gate	MC10H113
Dual 2-Wide OR-AND/OR-AND-INVERT Gate	MC10H117
Dual 2-Wide 3-Input OR-AND Gate	MC10H118
4-Wide 4-3-3-3 Input OR-AND Gate	MC10H119
4-Wide OR-AND/OR-AND-INVERT Gate	MC10H121
Hex Buffer w/Enable	MC10H188
Hex Inverter w/Enable	MC10H189
Dual 4-5-Input OR/NOR Gate	MC10H209
Counters	
Binary Counter	MC10H016
Universal Hexadecimal Counter	MC10H136
Encoders/Decoders	
Binary to 1-8 Line Decoder, (Low)	MC10H161
Binary to 1-8 Line Decoder, (High)	MC10H162
8-Input Priority Encoder	MC10H165
Dual Binary to 1-4 Decoder (Low)	MC10H171
Dual Binary to 1-5 Decoder (High)	MC10H172

Function	Device
Flip-Flop Latches	
Dual D Latch	MC10H130
Dual D Master-Slave Flip-Flop	MC10H131
Dual J-K Master-Slave Flip-Flop	MC10H135
Quint Latch	MC10H175
Hex D Flip-Flop	MC10H176
Hex D Flip-Flop w/Common Reset	MC10H186
Memories	
16 x 4-Bit Register File	MC10H145
Content Addressable Memory	MC10H155
Data Selector Multiplexers	
Quad 2-Input Multiplexer, Noninverting Output	MC10H158
Quad 2-Input Multiplexer, Inverting Output	MC10H159
8-Line Multiplexer	MC10H164
Quad 2-Input Multiplexer w/Latch	MC10H173
Dual 4-to-1 Multiplexer	MC10H174
NOR Gates	
Quad 2-Input NOR Gate w/Strobe	MC10H100
Quad NOR Gate	MC10H102
Triple 4-3-3 Input NOR Gate	MC10H106
Dual 3-Input, 3-Output NOR Gate	MC10H211
OR Gates	
Quad 2-Input OR Gate	MC10H103
Dual 3-Input, 3-Output OR Gate	MC10H210
Parity Checker	
12-Bit Parity Generator/Checker	MC10H160
Receivers	
Quad Line Receiver	MC10H115
Triple Line Receiver	MC10H116
Special Functions	
4-Bit Universal Shift Register	MC10H141
5-Bit Magnitude Comparator	MC10H166
Translators	
Quad TTL-to-MECL Translator	MC10H124
Quad MECL-to-TTL Translator	MC10H125
Quad MECL-to-TTL Translator (Sing. P.S. @ +5.0 V)	MC10H350
Quad TTL NMOS to ECL Translator (Sing. P.S. @ 5.0 V)	MC10H351
Quad CMOS to ECL Translator (Sing. P.S. @ +5.0 V)	MC10H352
Quad TTL-to-MECL Translator (ECL Strobe)	MC10H424
9-Bit TTL-ECL Translator	MC10H600
9-Bit TTL-ECL Translator	MC100H600
9-Bit ECL-TTL Translator	MC10H601
9-Bit ECL-TTL Translator	MC100H601
9-Bit Latch/TTL-ECL Translator	MC10H602
9-Bit Latch/TTL-ECL Translator	MC100H602
9-Bit Latch/ECL-TTL Translator	MC10H603
9-Bit Latch/ECL-TTL Translator	MC100H603
Exclusive OR Gates	
Dual 4-Bit Parity Checker plus 2-Bit Exclusive OR Gate	MC10H301
Dual 6-4 Input Parity Chekcer	MC10H302
Dual 5-Bit Parity Checker	MC10H303
8-Bit/Dual 4-Bit Parity Checker	MC10H304

MECL 10K

Integrated Circuits

MECL 10K is the industry standard emitter-coupled logic family. Nearly all high performance mainframe computers in production today utilize emitter-coupled logic and most are designed with MECL 10K. It is a 2 nanosecond logic family with a speed-power product of 50 picojoules. Controlled rise and fall times in the order of 2 nanoseconds, small voltage swings (typically 850 mV p-p) and transmission line termination techniques result in the lowest noise high-performance designs achievable.

MC10100/10200 — (–30°C to +85°C)

Suffix: P . . . Plastic DIP
L . . . Ceramic DIP

Numeric Listing

Device	Function	Pins
MC10100	Quad NOR Gate w/Strobe	16
MC10101	Quad OR/NOR Gate	16
MC10102	Quad NOR Gate	16
MC10103	Quad 2-Input OR Gate	16
MC10104	Quad AND Gate	16
MC10105	Triple 2-3-2 OR/NOR Gate	16
MC10106	Triple 4-3-3 NOR Gate	16
MC10107	Triple Exclusive OR/NOR Gate	16
MC10109	Dual 4-5 Input OR/NOR Gate	16
MC10110	Dual 3-Input/3-Output OR Gate	16
MC10111	Dual 3-Input/3-Output NOR Gate	16
MC10113	Quad Exclusive OR Gate	16
MC10114	Triple Line Receiver	16
MC10115	Quad Line Receiver	16
MC10116	Triple Line Receiver	16
MC10117	Dual 2-Wide OR-AND/OR-AND-INVERT Gate	16
MC10118	Dual 2-Wide 3-Input OR-AND Gate	16
MC10119	4-Wide 4-3-3-3-Input OR-AND Gate	16
MC10121	4-Wide OR-AND/OR-AND-INVERT Gate	16
MC10123	Triple 4-3-3-Input Bus Driver	16
MC10124	Quad TTL-to-MECL Translator	16
MC10125	Quad MECL-to-TTL Translator	16
MC10128	Dual Bus Driver	16
MC10129	Quad Bus Receiver	16
MC10130	Dual D Latch	16
MC10131	Dual D Flip-Flop	16
MC10132	Dual MUX w/Latch (Common Reset)	16
MC10133	Quad Latch	16
MC10134	Dual MUX w/Latch (Separate Select)	16
MC10135	Dual J-K Master-Slave Flip-Flop	16
MC10136	Universal Hexadecimal Counter	16
MC10137	Universal Decade Counter	16
MC10138	Bi-Quinary Counter	16
MC10141	4-Bit Universal Shift Register	16
MC10153	Quad Latch (Negative Clock)	16
MC10154	Binary Counter	16
MC10158	Quad 2-Input Multiplexer (Noninverting Output)	16
MC10159	Quad 2-Input Multiplexer (Inverting Output)	16
MC10160	12-Bit Parity Generator/Checker	16
MC10161	Binary to 1-8 Line Decoder (Low)	16
MC10162	Binary to 1-8 Line Decoder (High)	16
MC10163	Error Detection/Correction Ckt. (IBM Pattern)	16
MC10164	8-Line Multiplexer	16
MC10165	Priority Encoder	16
MC10166	5-Bit Comparator	16
MC10168	Quad Latch (Common Clock)	16
MC10170	9 + 2-Bit Parity Checker	16
MC10171	Dual 4-Line Decoder (Low)	16
MC10172	Dual 4-Line Decoder (High)	16
MC10173	Quad 2-Input Multiplexer with Latch	16
MC10174	Dual 4-to-1 Multiplexer	16
MC10175	Quint Latch	16
MC10176	Hex D Flip-Flop	16
MC10177	Triple MECL-to-MOS Translator (N-Channel)	16
MC10178	Binary Counter	16
MC10179	Look Ahead Carry Block	16
MC10180	Dual High-Speed Adder/Subtractor	16
MC10181	4-Bit Arithmetic Logic Unit	24
MC10182	16-Pin 2-Bit ALU	16
MC10186	Hex D Flip-Flop w/Common Reset	16
MC10188	Hex Buffer w/Enable	16
MC10189	Hex Inverter w/Enable	16
MC10190	Quad IBM-to-MECL Translator	16
MC10191	Quad MECL-to-IBM Translator	16
MC10192	Quad Bus Driver	16
MC10193	Error Detection/Correction Ckt. (Motorola Pattern)	16
MC10195	Hex Inverter/Buffer	16
MC10197	Hex AND Gate	16
MC10198	Retriggerable 1-Shot Multivibrator	16
MC10210	High-Speed Dual 3-Input/3-Output OR Gate	16
MC10211	High-Speed Dual 3-Input/3-Output NOR Gate	16
MC10212	High-Speed Dual 2-NOR/1-OR Gate	16
MC10216	High-Speed Triple Line Receiver	16
MC10231	High-Speed Dual D Flip-Flop	16

MECL 10K (continued)

MECL 10K

Function	Device
NOR Gates	
Quad 2-Input Gate/Strobe	MC10100
Quad 2-Input Gate	MC10102
Triple 4-3-3 Input Gate	MC10106
Dual 3-Input 3-Output Gate	MC10111
Dual 3-Input 3-Output Gate	MC10211
OR Gates	
Quad 2-Input Gate	MC10103
Dual 3-Input 3-Output Gate	MC10110
Dual 3-Input 3-Output Gate	MC10210
AND Gates	
Quad 2-Input Gate	MC10104
Hex Gate	MC10197
Complex Gates	
Quad OR/NOR Gate	MC10101
Triple 2-3-2 Input OR/NOR Gate	MC10105
Dual 4-5 Input OR/NOR Gate	MC10109
Dual 3-Input 3-Output OR/NOR Gate	MC10212
Triple 2-Input Exclusive OR/NOR Gate	MC10107
Quad 2-Input Exclusive OR/NOR Gate	MC10113
Dual 2-Wide 2-3 Input OR-AND/OR-AND INVERT	MC10117
Dual 2-Wide 3-Input OR/AND	MC10118
4-Wide 4-3-3-3 Input OR-AND	MC10119
4-Wide 3-Inut OR-AND/OR-AND INVERT	MC10121
Buffers/Inverters	
Hex Buffer/Enable	MC10188
Hex Inverter/Enable	MC10189
Hex Inverter/Buffer	MC10195
Line Drivers/Line Receivers	
Triple Line Receiver	MC10114
Quad Line Receiver	MC10115
Triple Line Receiver	MC10116
Quad Bus Receiver	MC10129
Quad Bus Driver	MC10192
Triple Line Receiver	MC10216
Triple 4-3-3 Input Bus Driver	MC10123
Dual Bus Driver	MC10128
Dual Transceiver	MC10194
Translators	
Quad TTL-MECL	MC10124
Quad MECL-TTL	MC10125
Triple MECL-MOS	MC10177
Quad MST to MECL	MC10190
Hex MECL-MST	MC10191
Flip-Flop/Latches	
Dual D Master Slave Flip-Flop	MC10131
Dual J-K Master Slave Flip-Flop	MC10135
Hex D Master Slave Flip-Flop	MC10176
Hex D Common Reset Flip-Flop	MC10186
Dual D Master Slave Flip-Flop	MC10231
Quad Latch	MC10133
Quint Latch	MC10175
Quad/Common Clock Latch	MC10168
Quad/Negative Clock Latch	MC10153
Dual Latch	MC10130

Function	Device
Multiplexer	
Quad 2-Input/Noninverting	MC10158
Dual Multiplexer/Latch	MC10132
Dual Multiplexer/Latch	MC10134
Quad 2-Input/Latch	MC10159
8-Line	MC10164
Quad 2-Input/Latch	MC10173
Dual 4-1	MC10174
Encoders	
8-Input Encoder	MC10165
Decoders	
Binary to 1-8 (Low)	MC10161
Binary to 1-8 (High)	MC10162
Dual Binary to 1-4 (Low)	MC10171
Dual Binary to 1-4 (High)	MC10172
Parity Generator/Checkers	
12-Bit Parity Generator-Checker	MC10160
9 + 2 Bit Parity	MC10170
Error Detector/Correction	
IBM Code	MC10163
Motorola Code	MC10193
Counters	
Hexadecimal	MC10136
Decade	MC10137
Binary	MC10138
Binary Down Counter	MC10154
Binary	MC10178
Arithmetic Functions	
5-Bit Magnitude Comparator	MC10166
Look Ahead Carry Block	MC10179
Dual 2-Bit Adder/Subtractor	MC10180
4-Bit Arithmetic Function Gen.	MC10181
2-Bit Arithmetic Function Gen.	MC10182
Shift Register	
4-Bit Universal	MC10141
Multivibrators	
Monostable Multivibrators	MC10198

Phase-Locked Loop

PHASE-LOCKED LOOP

Motorola offers the designer an array of devices to perform phase-locked loop functions, such as phase detectors, dividers, and oscillators. These devices include MECL, Linear, TTL, and CMOS technologies.

Detailed specification of these devices may be obtained from Motorola sales offices or authorized distributors.

Device	Function	Family	Temp. Range	Pins
MC1494	Analog Modulator/Demodulator	Linear	0 to +75°C	14
MC1495	Analog Modulator/Demodulator	Linear	0 to +75°C	14
MC1496	Analog Modulator/Demodulator	Linear	0 to +75°C	14
MC1594	Analog Modulator/Demodulator	Linear	–55 to +125°C	14
MC1595	Analog Modulator/Demodulator	Linear	–55 to +125°C	14
MC1596	Analog Modulator/Demodulator	Linear	–55 to +125°C	14
MC1648	Voltage Controller Oscillator	MECL	–30 to +85°C	14
MC1658	Voltage Controlled Multivibrator	MECL	–30 to +85°C	14
MC1699	÷4 Counter, 1.0 GHz	MECL	–30 to +85°C	16
MC4016	Programmable ÷N Decade	TTL	0 to +75°C	16
MC4024	Dual Voltage Controlled Multivibrator	TTL	0 to +75°C	14
MC4044	Digital Phase Frequency Detector	TTL	0 to +75°C	14
MC4316	Programmable ÷N Decade	TTL	–55 to +125°C	16
MC4324	Dual Voltage Controlled Multivibrator	TTL	–55 to +125°C	14
MC4344	Digital Phase Frequency Detector	TTL	–55 to +125°C	14
MC12002	Analog Mixer: Double Balanced	MECL	–30 to +85°C	14
MC12009	Two Modulus ÷5, ÷6, 600 MHz Typ	MECL	–30 to +85°C	16
MC12011	Two Modulus ÷5, ÷6, 600 MHz Typ	MECL	–30 to +85°C	16
MC12013	Two Modulus ÷5, ÷6, 600 MHz Typ	MECL	–30 to +85°C	16
MC12014	Counter Control Logic	MECL	0 to +75°C	14
MC12015	÷32, ÷33, Dual Modulus Prescaler, 225 MHz	MECL	–40 to +85°C	8
MC12016	÷40, ÷41, Dual Modulus Prescaler, 225 MHz	MECL	–40 to +85°C	8
MC12017	÷64, ÷65, Dual Modulus Prescaler, 225 MHz	MECL	–40 to +85°C	8
MC12018	÷128, ÷129, Dual Modulus Prescaler, 520 MHz	MECL	–40 to +85°C	8
MC12019	÷20, ÷21, Dual Modulus Prescaler, 225 MHz	MECL	–40 to +85°C	8
MC12022A	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.1 GHz, Pos Trig	MECL	–40 to +85°C	8
MC12022B	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.2 GHz, Neg Trig	MECL	–40 to +85°C	8
MC12022LVA	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.1 GHz, Pos Trig	MECL	–40 to +85°C	8
MC12022LVB	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.2 GHz, Neg Trig	MECL	–40 to +85°C	8
MC12022SLA	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.1 GHz, Pos Trig	MECL	–40 to +85°C	8
MC12022SLB	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.2 GHz, Neg Trig	MECL	–40 to +85°C	8
MC12022TSB	÷64, ÷65, ÷128, ÷129, 1.1 GHz, SLB w/X LD Die Lo-I	MECL	–40 to +85°C	8
MC12022TVB	÷64, ÷65, ÷128, ÷129, 1.1 GHz, LVB w/X LD Die Lo-V	MECL	–40 to +85°C	8
MC12023	÷64 Low-Power Prescaler, 225 MHz, V_{CC} = 3.2–5.5 V	MECL	0 to +70°C	8
MC12025	÷64, ÷65, Dual Modulus Prescaler, 520 MHz	MECL	–40 to +85°C	8
MC12028A	÷32, ÷33, ÷64, ÷65, 1.1 GHz	MECL	–40 to +85°C	8
MC12028B	÷32, ÷33, ÷64, ÷65, 1.1 GHz	MECL	–40 to +85°C	8
MC12032A	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 2.0 GHz, Pos Trig	MECL	–40 to +85°C	8
MC12032B	÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 2.0 GHz, Neg Trig	MECL	–40 to +85°C	8
MC12034A	÷32, ÷33, ÷64, ÷65, 2.0 GHz	MECL	–40 to +85°C	8
MC12034B	÷32, ÷33, ÷64, ÷65, 2.0 GHz	MECL	–40 to +85°C	8
MC12040	Digital Phase Frequency Detector	MECL	0 to +75°C	14
MC12061	Crystal Oscillator	MECL	0 to +75°C	16

PHASE-LOCKED LOOP (continued)

PHASE-LOCKED LOOP

Device	Function	Family	Temp. Range	Pins
MC12073	÷64 Low Power Prescaler, 1.1 GHz	MECL	0 to +70°C	8
MC12074	÷256 Low Power Prescaler, 1.1 GHz	MECL	0 to +70°C	8
MC12076	÷256 Low Power Prescaler, Enhanced 12074, 1.3 GHz	MECL	0 to +85°C	8
MC12078	÷256 Low Power Prescaler, Enhanced 12074, 1.3 GHz	MECL	0 to +85°C	8
MC12090	÷2 UHF Prescaler, 750 MHz	MECL	0 to +75°C	16
MC14046BA	Phase Comp/VCO	CMOS	–55 to +125°C	20
MC14046BC	Phase Comp/VCO	CMOS	–40 to +85°C	20
MC14159	Frequency Synthesizer	CMOS	–40 to +85°C	20
MC14568BA	Phase Comp/Prog Counter	CMOS	–55 to +125°C	20
MC14568BC	Phase Comp/Prog Counter	CMOS	–40 to +85°C	20
MC145106	Frequency Synthesizer	CMOS	–40 to +85°C	18
MC145145	Frequency Synthesizer	CMOS	–40 to +85°C	18
MC145146	Frequency Synthesizer	CMOS	–40 to +85°C	20
MC14151-2	Frequency Synthesizer	CMOS	–40 to +85°C	28
MC14152-2	Frequency Synthesizer	CMOS	–40 to +85°C	28
MC14155-2	Frequency Synthesizer	CMOS	–40 to +85°C	18
MC14156-2	Frequency Synthesizer	CMOS	–40 to +85°C	20
MC14157-2	Frequency Synthesizer	CMOS	–40 to +85°C	16
MC14158-2	Frequency Synthesizer	CMOS	–40 to +85°C	16

Phase Locked Loop SG Functional

Combination Functions

Function	Device	Family	Temp Range
Frequency Synthesizer	MC14159	CMOS	–40 to +85°C
Frequency Synthesizer	MC145106	CMOS	–40 to +85°C
Frequency Synthesizer	MC145145	CMOS	–40 to +85°C
Frequency Synthesizer	MC145146	CMOS	–40 to +85°C
Frequency Synthesizer	MC14151–2	CMOS	–40 to +85°C
Frequency Synthesizer	MC14152–2	CMOS	–40 to +85°C
Frequency Synthesizer	MC14155–2	CMOS	–40 to +85°C
Frequency Synthesizer	MC14156–2	CMOS	–40 to +85°C
Frequency Synthesizer	MC14157–2	CMOS	–40 to +85°C
Frequency Synthesizer	MC14158–2	CMOS	–40 to +85°C
Phase Comp/Prog Counter	MC14568BA	CMOS	–55 to +125°C
Phase Comp/Prog Counter	MC14568BC	CMOS	–40 to +85°C
Phase Comp/VCO	MC14046BA	CMOS	–55 to +125°C
Phase Comp/VCO	MC14046BC	CMOS	–40 to +85°C

Control Functions

Function	Device	Family	Temp Range
Counter Control Logic	MC12014	MECL	0 to +75°C

Oscillators

Function	Device	Family	Temp Range
Crystal Oscillator	MC12061	MECL	0 to +75°C
Dual Voltage Controlled Multivibrator	MC4024	TTL	0 to +75°C
Dual Voltage Controlled Multivibrator	MC4324	TTL	–55 to +125°C
Voltage Controlled Multivibrator	MC1658	MECL	–30 to +85°C
Voltage Controlled Oscillator	MC1648	MECL	–30 to +85°C

Phase Locked Loop SG Functional (continued)

Phase Detectors

Function	Device	Family	Temp Range
Analog Mixer: Double Balanced	MC12002	MECL	–30 to +85°C
Analog Modulator/Demodulator	MC1494	LINEAR	0 to +75°C
Analog Modulator/Demodulator	MC1495	LINEAR	0 to +75°C
Analog Modulator/Demodulator	MC1496	LINEAR	0 to +75°C
Analog Modulator/Demodulator	MC1594	LINEAR	–55 to +125°C
Analog Modulator/Demodulator	MC1595	LINEAR	–55 to +125°C
Analog Modulator/Demodulator	MC1596	LINEAR	–55 to +125°C
Digital Phase Frequency Detector	MC4044	TTL	0 to +75°C
Digital Phase Frequency Detector	MC4344	TTL	–55 to +125°C
Digital Phase Frequency Detector	MC12040	MECL	0 to +75°C

Prescalers/Counters

Function	Device	Family	Temp Range
Programmable ÷N Decade	MC4016	TTL	0 to +75°C
Programmable ÷N Decade	MC4316	TTL	–55 to +125°C
Two Modulus ÷5, ÷6, 600 MHz Typ	MC12009	MECL	–30 to +85°C
Two Modulus ÷5, ÷6, 600 MHz Typ	MC12011	MECL	–30 to +85°C
Two Modulus ÷5, ÷6, 600 MHz Typ	MC12013	MECL	–30 to +85°C
÷128, ÷129 Dual Modulus Prescaler, 520 MHz	MC12018	MECL	–40 to +85°C
÷2 UHF Prescaler, 750 MHz	MC12090	MECL	0 to +75°C
÷20, ÷21 Dual Modulus Prescaler, 225 MHz	MC12019	MECL	–40 to +85°C
÷256 Low Power Prescaler, 1.1 GHz	MC12074	MECL	0 to +70°C
÷256 Low Power Prescaler, Enhanced 12074, 1.3 GHz	MC12076	MECL	0 to +85°C
÷256 Low Power Prescaler, Enhanced 12074, 1.3 GHz	MC12078	MECL	0 to +85°C
÷32, ÷33 Dual Modulus Prescaler, 225 MHz	MC12015	MECL	–40 to +85°C
÷32, ÷33, ÷64, ÷65, 1.1 GHz	MC12028A	MECL	–40 to +85°C
÷32, ÷33, ÷64, ÷65, 1.1 GHz	MC12028B	MECL	–40 to +85°C
÷32, ÷33, ÷64, ÷65, 2.0 GHz	MC12034A	MECL	–40 to +85°C
÷32, ÷33, ÷64, ÷65, 2.0 GHz	MC12034B	MECL	–40 to +85°C
÷4 Counter, 1.0 GHz	MC1699	MECL	–30 to +85°C
÷40, ÷41, Dual Modulus Prescaler, 225 MHz	MC12016	MECL	–40 to +85°C
÷64 Low Power Prescaler, 225 MHz, V_{CC} = 3.2–5.5 V	MC12023	MECL	0 to +70°C
÷64 Low Power Prescaler, 1.1 GHz	MC12073	MECL	0 to +70°C
÷64, ÷65, Dual Modulus Prescaler, 520 MHz	MC12025	MECL	–40 to +85°C
÷64, ÷65, Dual Modulus Prescaler, 225 MHz	MC12017	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.1 GHz, Pos Trig	MC12022A	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.1 GHz, Pos Trig	MC12022LVA	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.1 GHz, Pos Trig	MC12022SLA	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.2 GHz, Neg Trig	MC12022B	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.2 GHz, Neg Trig	MC12022LVB	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 1.2 GHz, Neg Trig	MC12022SLB	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 2.0 GHz, Neg Trig	MC12032B	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, Dual Modulus Prescaler, 2.0 GHz, Pos Trig	MC12032A	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, 1.1 GHz, LVB w/X LD Die Lo-V	MC12022TVB	MECL	–40 to +85°C
÷64, ÷65, ÷128, ÷129, 1.1 GHz, SLB w/X LD Die Lo-I	MC12022TSB	MECL	–40 to +85°C

MECL III

Integrated Circuits

MECL III

MECL III is a one nanosecond propagation delay emitter-coupled family. Typical edge speeds are also one nanosecond. The fast edge speeds and low propagation delays result in devices with large bandwidths making them especially useful in high-speed communications and test equipment.

All device types are available with "BETTER" Program screening.

MC1600 Series — (–30 to +85°C)

Suffix: P . . . Plastic DIP (not all devices available)
L . . . Ceramic DIP

Numeric Listing

Device	Function	Pins
MC1648	Voltage-Controlled Oscillator	14
MC1650	Dual A/D Converter	16
MC1658	Voltage-Controlled Multivibrator	16
MC1660	Dual 4-Input Gate	16
MC1662	Quad 2-Input NOR Gate	16
MC1670	Master-Slave Flip-Flop	16
MC1672	Triple 2-Input Exclusive-OR Gate	16
MC1690	UHF Prescaler Type D Flip-Flop	16
MC1692	Quad Line Receiver	16

Function Selection — (–30 to +85°C)

Function	Device
Gates	
Dual 4-Input OR/NOR	MC1660
Quad 2-Input NOR	MC1662
Triple 2-Input Exclusive OR	MC1672
Flip-Flops	
Master-Slave Type D	MC1670
UHF Prescaler Type D	MC1690
Multivibrator	
Voltage-Controlled	MC1658
Oscillator	
Emitter Coupled	MC1648
Comparator	
Dual A/D	MC1650
Receiver	
Quad Line	MC1692

ECLinPS
Family DC Specification

Each member of the ECLinPS family is available in both of the existing ECL standards: 10E series devices are compatible with the MECL 10KH family; 100E series devices are compatible with ECL 100K.

DC characteristics specified in this section are parametric limits guaranteed for the appropriate version (10E or 100E) unless specified otherwise on the individual device data sheet.

The section below presents a comparison between the two standards in the new context of the ECLinPS family. The user is also referred to the appropriate family databooks and other literature for descriptive information on the earlier ECL families.

10E versus 100E Comparison

Because no supplier previous to Motorola has offered both ECL standards on an identical process, comparison of existing 10KH and 100K style devices has some limitations. Comparison of the two standards fabricated with two different processes has sometimes led to the erroneous conclusion that there are inherent AC performance differences between them. In reality this is not the case. The only inherent difference between the two standards is the difference in the behavior of the DC characteristics with temperature.

DC Parameters

The 10KH (10E) style ECL gate is voltage compensated but is not temperature compensated. Therefore, although constant over supply voltage, the output voltage levels and internal bias levels vary over temperature.

The 100K (100E) style gate on the other hand is both temperature and voltage compensated so that the output levels and internal bias levels remain fairly constant over both temperature and supply voltage.

The only other difference between the two standards is in the area of I_{EE}. Because the 10KH (10E) style bias driver tracks with temperature the I_{EE} of a 10KH (10E) device remains fairly constant over temperature. However the 100K (100E) bias driver levels remain constant over temperature. As a result, as the V_{BE}'s of the current-source device reduce with temperature, the I_{EE} of a 100E device tends to increase. This increase is reflected in the 100E specs in the ECLinPS data sheets.

Mixing 10KH and 100K

The difference in the DC behavior of the outputs of the two different standards necessitates caution when mixing the two technologies into a single design. As illustrated in Table 1, there is no problem when a 10KH device is used to drive a 100K device, but problems arise if the scenario is reversed.

Table 1. Worst-Case Noise Margins When Mixing 10KH and 100K

Drvr > Rcvr	NM-High	NM-Low
10KH > 10KH	150 mV	150 mV
10KH > 100K	145 mV	125 mV
100K > 100K	130 mV	135 mV
100K > 10KH	35 mV	130 mV

For the case of a 100K device driving a 10KH device the worst-case noise margin is reduced to 35 mV, a noise margin which is unacceptable for most designs. Fortunately the ECLinPS family, by offering devices in both standards, allows the user to integrate higher performance technology into his design without having to face interfacing problems.

AC Performance

From an IC design standpoint the only difference between a 10E device and a 100E device in the ECLinPS family is a small temperature compensation network in the 100E device, and very minimal differences in the two bias driver networks. Therefore one would expect that from an AC standpoint the performance of the two standards in the ECLinPS family should be nearly identical; measurements prove this to be the case. There is no significant measurable difference in the rise/fall times, propagation delays or toggle frequencies when comparing a 10E and 100E device. The minor differences between previous 10KH and 100K designs is due to the fact that the two are fabricated on different processes, and in some cases are designed for operation at different power levels.

Summary

Summarizing the above information; in general the two ECL design standards, although differing somewhat in DC parameters, are nearly identical when one compares the AC performance for a given device. There may be very small differences in the AC measurements due to the slightly smaller output swing of a 100E device. However these differences are negligible when compared to the absolute values of the measurements. Therefore from an AC standpoint there is no real advantage in using one standard over the other, thus removing AC performance as a decision variable in high speed system design.

Package Data

ECLinPS is offered in the 28-lead plastic leaded chip carrier (PLCC) package, a leaded surface mount IC package. The lead form is of the "J-lead" type.

The PLCC was selected as the optimum combination of performance, physical size and thermal handling in a low cost, standard package. While more exotic packages exist to improve these qualities still further, the cost of these is prohibitive for many applications.

The PLCC features considerably faster propagation delay and reduced parasitics compared to a DIP package of similar pin-count; two properties that make it eminently suitable for very high performance logic.

Thermal Management

An important parameter of system design is the junction-ambient thermal resistance, θ_{JA}, of the package. θ_{JA} is expressed in °C per watt (°C/W) and determines the temperature elevation of the die (junction) over the external package ambient temperature. Standard lab measurements of this parameter for the 28-lead PLCC yield the following result:

θ_{JA} = 45°C/W, under 500 lfpm air flow.

As in any system, proper thermal management is essential to etablish the appropriate trade-off between performance, density, reliability and cost. In particular, the designer should be aware of the reliability implication of continuously operating semiconductor devices at high junction temperature.

ECLinPS devices are designed with chip powers that permit acceptable reliability levels, in most systems, under the conventional ECL cooling requirement of 500 lfpm airflow.

A discussion on thermal management can be found in the *MECL Device Databook*.

Numeric Listing

Device	Function	Pins
MC10E016	8-Bit Binary Counter	28
MC100E016	8-Bit Binary Counter	28
MC10E101	4-Bit 4-Input OR/NOR Gate	28
MC100E101	4-Bit 4-Input OR/NOR Gate	28
MC10E104	5-Bit 2-Input AND/NAND Gate	28
MC100E104	5-Bit 2-Input AND/NAND Gate	28
MC10E107	5-Bit 2-Input XOR/XNOR Gate	28
MC100E107	5-Bit 2-Input XOR/XNOR Gate	28
MC10E111	1:9 Differential Clock Driver w/Low Skew, Enable, V_{BB}	28
MC100E111	1:9 Differential Clock Driver w/Low Skew, Enable, V_{BB}	28
MC10E112	4-Bit Differential Line Receiver	28
MC100E112	4-Bit Differential Line Receiver	28
MC10E116	Quint Differential Line Receiver	28
MC100E116	Quint Differential Line Receiver	28
MC10E122	9-Bit Buffer	28
MC100E122	9-Bit Buffer	28
MC10E131	4-Bit D F/F Individual Clk, Reset Diff. Output	28
MC100E131	4-Bit D F/F Individual Clk, Reset Diff. Output	28
MC10E141	8-Bit Shift Register	28
MC100E141	8-Bit Shift Register	28
MC10E142	9-Bit Shift Register, 500 MHz, w/Asyn. Reset Single Ended	28
MC100E142	9-Bit Shift Register, 500 MHz, w/Asyn. Reset Single Ended	28
MC10E143	9-Bit Hold Register, 500 MHz, w/Asyn. Reset Single Ended	28
MC100E143	9-Bit Hold Register, 500 MHz, w/Asyn. Reset Single Ended	28
MC10E150	6-Bit D Latch	28
MC100E150	6-Bit D Latch	28
MC10E151	6-Bit D Register w/Common Clk, Reset, Differential Outputs	28
MC100E151	6-Bit D Register w/Common Clk, Reset, Differential Outputs	28
MC10E154	5-Bit 2:1 Mux-Latch, w/Common Enable, Reset Differential Output	28
MC100E154	5-Bit 2:1 Mux-Latch, w/Common Enable, REset Differential Output	28
MC10E155	6-Bit 2:1 Mux-Latch, w/common Enable, Reset Single Ended	28
MC100E155	6-Bit 2:1 Mux-Latch, w/Common Enable, Reset Single Ended	28
MC10E156	3-Bit 4:1 Mux-Latch, w/Common Enable, Reset Differential Output	28
MC100E156	3-Bit 4:1 Mux-Latch, w/Common Enable, Reset Differential Output	28
MC10E157	4-Bit Individual-Select 2:1 Mux	28
MC100E157	4-Bit Individual-Select 2:1 Mux	28
MC10E158	5-Bit 2:1 Multiplexer, w/Differential Output	28
MC100E158	5-Bit 2:1 Multiplexer, w/Differential Output	28
MC10E160	12-Bit Parity Generator/Checker, Reg.-Shiftable, Differential Output	28

Device	Function	Pins
MC100E160	12-Bit Parity Generator/Checker, Reg.-Shiftable, Differential Output	28
MC10E163	2-Bit 8:1 Multiplexer	28
MC100E163	2-Bit 8:1 Multiplexer	28
MC10E164	16:1 Multiplexer	28
MC100E164	16:1 Multiplexer	28
MC10E166	9-Bit Magnitude Comparator	28
MC100E166	9-Bit Magnitude Comparator	28
MC10E167	6-Bit 2:1 Mux-Register w/Common Clk, Reset Single Ended	28
MC100E167	6-Bit 2:1 Mux-Register w/Common Clk, Reset Single Ended	28
MC10E171	3-Bit 4:1 Multiplexer, w/Split Select Dif. Output	28
MC100E171	3-Bit 4:1 Multiplexer, w/Split Select Dif. Output	28
MC10E175	9-Bit Latch	28
MC100E175	9-Bit Latch	28
MC10E193	EDAC	28
MC100E193	EDAC	28
MC10E195	Programmable Delay Chip (Dig. 20PS Res.)	28
MC100E195	Programmable Delay Chip (Dig. 20PS Res.)	28
MC10E196	Programmable Delay Chip (Dig. 80PS Anal. 1.6 PS/MV)	28
MC100E196	Programmable Delay Chip (Dig. 80PS Anal. 1.6 PS/MV)	28
MC10E212	3-Bit Scannable ECL Address Driver	28
MC100E212	3-Bit Scannable ECL Address Driver	28
MC10E241	8-Bit Scannable Register	28
MC100E241	8-Bit Scannable Register	28
MC10E256	3-Bit 4:1 Mux-Latch (Integrated E156 & E171)	28
MC100E256	3-Bit 4:1 Mux-Latch (Integrated E156 & E171)	28
MC10E336	3-Bit Registered Cutoff Bus Transceiver 25 Ω Cutoff Outputs	28
MC100E336	3-Bit Registered Cutoff Bus Transceiver 25 Ω Cutoff Outputs	28
MC10E404	Differential AND/NAND Gate	28
MC100E404	Differential AND/NAND Gate	28
MC10E416	Quint Differential Line Receiver	28
MC100E416	Quint Differential Line Receiver	28
MC10E431	3-Bit Differential Flip-Flop	28
MC100E431	3-Bit Differential Flip-Flop	28
MC10E451	6-Bit D Reg. w/Differential Data & Clk Inputs, V_{BB}, Common Reset, Single Ended	28
MC100E451	6-Bit D Reg. w/Differential Data & Clk Inputs, V_{BB}, Common Reset, Single Ended	28
MC10E452	5-Bit Differential Register	28
MC100E452	5-Bit Differential Register	28
MC10E457	Differential 2:1 Multiplexer	28
MC100E457	Differential 2:1 Multiplexer	28

ECLinPS Function Selection

Function	Device
Buffers	
1:9 Diff. Clk Driver w/Low Skew, Enable, V_{BB}	MC10E111
1:9 Diff. Clk Driver w/Low Skew, Enable, V_{BB}	MC100E111
4-Bit Differential Line Receiver	MC10E112
4-Bit Differential Line Receiver	MC100E112
9-Bit Buffer	MC10E122
9-Bit Buffer	MC100E122
Bus Transceivers	
3-Bit Reg. Cutoff Bus X–cvr 25 Ω Cutoff Outputs	MC10E336
3-Bit Reg. Cutoff Bus X–cvr 25 Ω Cutoff Outputs	MC100E336
Counters	
8-Bit Binary Counter	MC10E016
8-Bit Binary Counter	MC100E016
Flip-Flops/Registers	
4-Bit D F/F Individual Clk, Reset Dif. Output	MC10E131
4-Bit D F/F Individual Clk, Reset Dif. Output	MC100E131
6-Bit D Reg. w/Common Clk, Reset, Dif. Outputs	MC10E151
6-Bit D Reg. w/Common Clk, Reset, Dif. Outputs	MC100E151
3-Bit Differential Flip-Flop	MC10E431
3-Bit Differential Flip-Flop	MC100E431
6-Bit D Reg., w/Diff. Data & Clk Inputs, V_{BB}, Common Reset, Single Ended	MC10E451
6-Bit D Reg., w/Diff. Data & Clk Inputs, V_{BB}, Common Reset, Single Ended	MC100E451
5-Bit Differential Register	MC10E452
5-Bit Differential Register	MC100E452
Gates	
4-Bit 4-Input OR/NOR Gate	MC10E101
4-Bit 4-Input OR/NOR Gate	MC100E101
5-Bit 2-Input AND/NAND Gate	MC10E104
5-Bit 2-Input AND/NAND Gate	MC100E104
5-Bit 2-Input XOR/XNOR Gate	MC10E107
5-Bit 2-Input XOR/XNOR Gate	MC100E107
Differential AND/NAND Gate	MC10E404
Differential AND/NAND Gate	MC100E404
Latches	
6-Bit D Latch	MC10E150
6-Bit D Latch	MC100E150
9-Bit Latch	MC10E175
9-Bit Latch	MC100E175
Miscellaneous	
Dual Analog Comparator w/Latch	MC10E1651
Dual Analog Comparator w/Latch: (Hi-Perf 1651)	MC10E1652
Multiplexers	
4-Bit Individual-Select 2:1 Mux	MC10E157
4-Bit Individual-Select 2:1 Mux	MC100E157
5-Bit 2:1 Multiplexer, w/Differential Output	MC10E158
5-Bit 2:1 Multiplexer, w/Differential Output	MC100E158
2-Bit 8:1 Multiplexer	MC10E163
2-Bit 8:1 Multiplexer	MC100E163
16:1 Multiplexer	MC10E164
16:1 Multiplexer	MC100E164
3-Bit 4:1 Multiplexer, w/Split Select Dif. Output	MC10E171
3-Bit 4:1 Multiplexer, w/Split Select Dif. Output	MC100E171
Differential 2:1 Multiplexer	MC10E457
Differential 2:1 Multiplexer	MC100E457

Function	Device
Mux-Latches	
5-Bit 2:1 Mux-Latch, w/Common Enable, Reset Differential Output	MC10E154
5-Bit 2:1 Mux-Latch, w/Common Enable, Reset Differential Output	MC100E154
6-Bit 2:1 Mux-Latch, w/Common Enable, Reset Single Ended	MC10E155
6-Bit 2:1 Mux-Latch, w/Common Enable, Reset Single Ended	MC100E155
3-Bit 4:1 Mux-Latch, w/Common Enable, Reset Differential Output	MC10E156
3-Bit 4:1 Mux-Latch, w/Common Enable, Reset Differential Output	MC100E156
3-Bit 4:1 Mux-Latch (Integrated E156 & E171)	MC10E256
3-Bit 4:1 Mux-Latch (Integrated E156 & E171)	MC100E256
Mux-Registers	
6-Bit 2:1 Mux-Register w/Common Clock, Reset Single-Ended	MC10E167
6-Bit 2:1 Mux-Register w/Common Clock, Reset Single-Ended	MC100E167
Parity Generators/Comparators	
12-Bit Parity Generator/Checker, Reg.-Shiftable, Differential Output	MC10E160
12-Bit Parity Generator/Checker, Reg.-Shiftable, Differential Output	MC100E160
9-Bit Magnitude Comparator	MC10E166
9-Bit Magnitude Comparator	MC100E166
EDAC	MC10E193
EDAC	MC100E193
Programmable	
Programmable Delay Chip (Dig. 20PS Res.)	MC10E195
Programmable Delay Chip (Dig. 20PS Res.)	MC100E195
Programmable Delay Chip (Dig. 80PS Anal. 1.6 PS/MV)	MC10E196
Programmable Delay Chip (Dig. 80PS Anal. 1.6 PS/MV)	MC100E196
Line Receivers	
Quint Differential Line Receiver	MC10E116
Quint Differential Line Receiver	MC100E116
Quint Differential Line Receiver	MC10E416
Quint Differential Line Receiver	MC100E416
Shift Registers	
8-Bit Shift Register	MC10E141
8-Bit Shift Register	MC100E141
9-Bit Shift Register, 500 MHz, w/Asyn. Reset Single Ended	MC10E142
9-Bit Shift Register, 500 MHz, w/Asyn. Reset Single Ended	MC100E142
9-Bit Hold Register, 500 MHz w/Asyn. Reset Single Ended	MC10E143
9-Bit Hold Register, 500 MHz w/Asyn. Reset Single Ended	MC100E143
3-Bit Scannable ECL Address Driver	MC10E212
3-Bit Scannable ECL Address Driver	MC100E212
8-Bit Scannable Register	MC10E241
8-Bit Scannable Register	MC100E241

Bipolar Logic Surface Mount

Why Surface Mount?

Surface Mount Technology is now being utilized to offer answers to many problems that have been created in the use of insertion technology.

Limitations have been reached with insertion packages and PC board technology. Surface Mount Technology offers the opportunity to continue to advance the State-of-the-Art designs that cannot be accomplished with Insertion Technology.

Surface Mount Packages allow more optimum device performance with the smaller Surface Mount configuration. Internal lead lengths, parasitic capacitance and inductance that placed limitations on chip performance have been reduced.

The lower profile of Surface Mount Packages allows more boards to be utilized in a given amount of space. They are stacked closer together and utilize less total volume than insertion populated PC boards.

Printed circuit costs are lowered with the reduction of the number of board layers required. The elimination or reduction of the number of plated through holes in the board, contribute significantly to lower PC board prices.

Surface Mount assembly does not require the preparation of components that are common on insertion technology lines. Surface Mount components are sent directly to the assembly line, eliminating an intermediate step.

Automatic placement equipment is available that can place Surface Mount components at the rate of a few thousand per hour to hundreds of thousands of components per hour.

Surface Mount Technology is cost effective, allowing the manufacturer the opportunity to produce smaller units and offers increased functions with the same size product.

Dual-in-Line Package to PLCC Pin Conversion Data

The following table gives the equivalent I/O pinouts of Dual-In-Line (DIL) package configuration and Plastic Leaded Chip Carrier (PLCC) packages.

Conversion Tables

16 PIN DIL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
28 PIN PLCC	2	3	4	5	7	8	9	10	12	13	14	15	17	18	19	20

20 PIN DIL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20 PIN PLCC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

24 PIN DIL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
28 PIN PLCC	2	3	4	5	6	7	9	10	11	12	13	14	16	17	18	19	20	21	23	24	25	26	27	28

Devices Available in PLCC

MECL 10KH

MC10H100 Series — (0°C to +75°C)

Device	Function	Pins
H016	Binary Counter	20
H100	Quad 2-Input NOR Gate with Strobe	20
H101	Quad 2-Input OR/NOR Gate	20
H102	Quad NOR Gate	20
H103	Quad 2-Input OR Gate	20
H104	Quad AND Gate	20
H105	Triple 2-3-2 Input OR/NOR Gate	20
H106	Triple 4-3-3 Input NOR Gate	20
H107	Triple Exclusive OR/NOR Gate	20
H109	Dual 4-5 Input OR/NOR Gate	20
H113	Quad Exclusive OR Gate	20
H115	Quad Line Receiver	20
H116	Triple Line Receiver	20
H117	Dual 2-Wide OR-AND/OR-AND INVERT Gate	20
H118	Dual 2-Wide 3-Input OR/AND Gate	20
H119	4-Wide 4-3-3-3 Input OR-AND Gate	20
H121	4-Wide OR-AND/OR-AND INVERT Gate	20
H123	Triple 4-3-3 Input Bus Driver (250 Ohm)	20
H124	Quad TTL-to-MECL Translator	20
H125	Quad MECL-to-TTL Translator	20
H130	Dual D Latch	20
H131	Dual D Master Slave Flip-Flop	20
H135	Dual J-K Master Slave Flip-Flop	20
H136	Universal Hexadecimal Counter	20
H141	4-Bit Universal Shift Register	20
H145	16 x 4 Bit Register File	20
H158	Quad 2-Input Multiplexer (Noninverting)	20
H159	Quad 2-Input Multiplexer (Inverting)	20
H160	12-Bit Parity Generator-Checker	20
H161	Binary to 1-8 Line Decoder (Low)	20
H162	Binary to 1-8 Line Decoder (High)	20
H164	8-Line Multiplexer	20
H165	8-Input Priority Encoder	20
H166	5-Bit Magnitude Comparator	20
H171	Dual Binary to 1-4 Decoder (Low)	20
H172	Dual Binary to 1-4 Decoder (High)	20
H173	Quad 2-Input Multiplexer/Latch	20
H174	Dual 4-1 Multiplexer	20
H175	Quint Latch	20
H176	Hex D Flip-Flop	20
H179	Look Ahead Carry Block	20
H180	Dual High Speed Adder/Subtractor	20
H181	4-Bit ALU	20
H186	Hex D Flip-Flop w/Common Reset	20
H188	Hex Buffer w/Enable	20
H189	Hex Inverter w/Enable	20
H209	Dual 4-5-Input OR/NOR Gate	20
H210	Dual 3-Input 3-Output OR Gate	20
H211	Dual 3-Input 3-Output NOR Gate	20
H330	Quad Bus Driver/Receiver with 2-to-1 Output Multiplexers (25 Ohm)	20
H332	Dual Bus Driver/Receiver with 4-to-1 Output Multiplexers (25 Ohm)	20
H334	Quad Bus Driver/Receiver with Transmit and Receiver Latches (25 Ohm)	20
H350	Quad MECL-to-TTL Translator Single Power Supply (–5.2 V or +5.0 V)	20
H423	Triple 3-Input Bus Driver w/Enable (25 Ohm)	20
H424	Quad TTL-to-MECL Translator (ECL Strobe)	20
H600	9-Bit TTL-ECL Translator	20
H601	9-Bit ECL-TTL Translator	20
H602	9-Bit TTL-ECL Translator, Latch	20
H603	9-Bit ECL-TTL Translator, Latch	20
H640	ECL-TTL 68030/040 Clock Driver	20
H641	ECL-TTL Clock Driver	20
H642	ECL-TTL 68030/040 Clock Driver	20
H643	ECL-TTL Clock Driver	20
H660	4-Bit ECL-TTL DRAM Driver	20
H680	4-Bit ECL-TTL Bus Transceiver	20

MECL 10K

MC10100/10200 — (–30°C to +85°C)

Suffix: FN = Plastic Leaded Chip Carrier

Device	Function	Pins
MC10100	Quad NOR Gate w/Strobe	20
MC10101	Quad OR/NOR Gate	20
MC10102	Quad NOR Gate	20
MC10103	Quad 2-Input OR Gate	20
MC10104	Quad AND Gate	20
MC10105	Triple 2-3-2 OR/NOR Gate	20
MC10106	Triple 4-3-3 NOR Gate	20
MC10107	Triple Exclusive OR/NOR Gate	20
MC10109	Dual 4-5 Input OR/NOR Gate	20
MC10110	Dual 3-Input/3-Output OR Gate	20
MC10111	Dual 3-Input/3-Output NOR Gate	20
MC10113	Quad Exclusive OR Gate	20
MC10114	Triple Line Receiver	20
MC10115	Quad Line Receiver	20
MC10116	Triple Line Receiver	20
MC10117	Dual 2-Wide OR-AND/OR-AND-INVERT Gate	20
MC10118	Dual 2-Wide 3-Input OR-AND Gate	20
MC10119	4-Wide 4-3-3-3-Input OR-AND Gate	20
MC10121	4-Wide OR-AND/OR-AND-INVERT Gate	20
MC10123	Triple 4-3-3-Input Bus Driver	20
MC10124	Quad TTL-to-MECL Translator	20
MC10125	Quad MECL-to-TTL Translator	20
MC10130	Dual D Latch	20
MC10131	Dual D Flip-Flop	20
MC10133	Quad Latch	20
MC10134	Dual Mux w/Latch (Separate Select)	20
MC10135	Dual J-K Master-Slave Flip-Flop	20
MC10136	Universal Hexadecimal Counter	20
MC10138	Bi-Quinary Counter	20
MC10141	4-Bit Universal Shift Register	20
MC10153	Quad Latch (Negative Clock)	20
MC10158	Quad 2-Input Multiplexer (Noninverting Output)	20
MC10159	Quad 2-Input Multiplexer (Inverting Output)	20
MC10160	12-Bit Parity Generator/Checker	20
MC10161	Binary to 1-8 Line Decoder (Low)	20
MC10162	Binary to 1-8 Line Decoder (High)	20
MC10164	8-Line Multiplexer	20
MC10165	Priority Encoder	20
MC10166	5-Bit Comparator	20
MC10168	Quad Latch (Common Clock)	20
MC10170	9 + 2-Bit Parity Checker	20
MC10171	Dual 4-Line Decoder (Low)	20
MC10172	Dual 4-Line Decoder (High)	20
MC10173	Quad 2-Input Multiplexer with Latch	20
MC10174	Dual 4-to-1 Multiplexer	20
MC10175	Quint Latch	20
MC10176	Hex D Flip-Flop	20
MC10178	Binary Counter	20
MC10186	Hex D Flip-Flop w/Common Reset	20
MC10188	Hex Buffer w/Enable	20
MC10189	Hex Inverter w/Enable	20
MC10190	Quad IBM-to-MECL Translator	20
MC10192	Quad Bus Driver	20
MC10195	Hex Inverter/Buffer	20
MC10197	Hex AND Gate	20
MC10198	Retriggerable 1-Shot Multivibrator	20
MC10210	High-Speed Dual 3-Input/3-Output OR Gate	20
MC10211	High-Speed Dual 3-Input/3-Output NOR Gate	20
MC10212	High-Speed Dual 2-NOR/1-OR Gate	20
MC10216	High-Speed Triple Line Receiver	20
MC10231	High-Speed Dual D Flip-Flop	20

Prescalers Available in SOIC

Suffix: D = Narrow Body SOIC

Prescaler Series — (–40°C to +85°C)

Device*	Function	I_{CC} Max mA	Maximum Frequency, MHz	Pins
MC12015	Two-Modulus, ÷32/÷33	7.8	225	8
MC12016	Two-Modulus, ÷40/÷41	7.8	225	8
MC12017	Two-Modulus, ÷64/÷65	7.8	225	8
MC12018	Two-Modulus, ÷128/÷129	10.2	520	8
MC12019	Two-Modulus, ÷20/÷21	7.5	225	8
MC12022A	Two-Modulus, Selectable ÷64/÷65 or ÷128/÷129	10	1100	8
MC12022B	Two-Modulus, Selectable ÷64/÷65 or ÷128/÷129	10	1100	8
MC12023	Single-Modulus, ÷64	4.8	225	8
MC12073	Single-Modulus, ÷64	30	1100	8
MC12074	Single-Modulus, ÷256	30	1100	8
MC12076	Low-Power ÷256 Prescaler, Enhanced 12074, 1.3 GHz	50	1300	8
MC12078	Low-Power ÷256 Prescaler, Enhanced 12074, 1.3 GHz	35	1300	8
MC12022LVA MC12022LVB	Two-Modulus ÷64, ÷65, ÷128, ÷129 Two-Modulus ÷64, ÷65, ÷128, ÷129	8.0 8.0	1100 1100	8 8
MC12022SLA MC12022SLB	Two-Modulus ÷64, ÷65, ÷128, ÷129 Two-Modulus ÷64, ÷65, ÷128, ÷129	6.5 6.5	1100 1100	8 8
MC12022TSB	Two-Modulus ÷64, ÷65, ÷128, ÷129	6.5	1100	8
MC12022TVB	Two-Modulus ÷64, ÷65, ÷128, ÷129	8.0	1100	8
MC12028A MC12028B	Two-Modulus ÷32, ÷33, ÷64, ÷65 Two-Modulus ÷32, ÷33, ÷64, ÷65	6.5 6.5	1100 1100	8 8
MC12032A MC12033B	Two-Modulus ÷64, ÷65, ÷128, ÷129 Two-Modulus ÷64, ÷65, ÷128, ÷129	12 12	2000 2000	8 8
MC12034A MC12034B	Two-Modulus ÷32, ÷33, ÷64, ÷65 Two-Modulus ÷32, ÷33, ÷64, ÷65	12 12	2000 2000	8 8

* All 'A' devices are positive edge triggered: All 'B' devices are negative edge triggered. All MC12022 devices with 'B' nomenclatures are pin and functionally compatible with Fujitsu's MB501 devices.

Contents

Selector Guide Contents

This selector guide contains only devices in production at Motorola's Logic I.C. Division, accurate to the date of publication.

The Logic I.C. Division publishes a New Product Calendar quarterly that reflects any recent device releases and the approximate dates new devices are expected to be released.

There are many new devices in various stages of development on Motorola's Logic I.C. Division design schedule. Call your nearest Motorola sales office for the current status of any device not listed within this guide.

TTL in Perspective

Since its introduction, TTL has become the most popular form of digital logic. It has evolved from the original gold-doped saturated 7400 logic, to Schottky-Clamped logic, and finally to the modern advanced families of TTL logic. The popularity of these TTL families stems from their ease of use, low cost, medium-to-high speed operation, and good output drive capability.

Motorola offers two modern TTL logic families — LS and FAST™. They are pin and functionally compatible and can easily be combined in a system to achieve maximum performance at minimum cost.

LS (Low Power Schottky) is currently the more popular and commands by far the largest share of the total TTL logic market. It is low-cost and provides moderate performance at low power.

FAST, the state-of-the-art, high-performance TTL family, is growing rapidly and gaining a significant share of the total TTL logic market. FAST offers a 20–30 percent improvement in performance over the older Standard Schottky family (74S) with a 75–80 percent reduction in power. When compared with the Advanced Schottky family (74AS), FAST offers nearly equal performance at a 25–50 percent savings in power.

FAST is manufactured on Motorola's MOSAIC (oxide-isolated) process. This process provides FAST with inherent speed/power advantages over the older junction-isolated 74S and 74LS families. This allows the FAST family to be designed and specified with improved noise margins, reduced input currents, and superior line driving capabilities in comparison to these earlier families. Additionally, FAST designs incorporate power-down circuitry on all three-state outputs, and buffered outputs on all storage devices.

Two further advantages of FAST are the load specifications and power supply specifications. FAST ac characteristics are specified at a heavier capacitive load than the earlier families (50 pF versus 15 pF) to more accurately reflect actual in-circuit performance. Motorola's dc and ac characteristics for FAST are specified over a full 10% supply voltage range — a significant improvement over the industry standard specifications for the earlier families (5% for dc, 0% for ac).

These design and specification improvements offered by the Motorola FAST family provide the user with better system performance, enhanced design flexibility, and more reliable system operation.

TTL Family Comparisons

General Characteristics for Schottky TTL Logic (ALL MAXIMUM RATINGS)

Characteristic	Symbol		LS		FAST		Units
			54LSxxx	74LSxxx	54Fxxx	74Fxxx	
Operating Voltage Range	V_{CC}		5 ± 10%	5 ± 5%	5 ± 10%	5 ± 10%	Vdc
Operating Temperature Range	T_A		–55 to 125	0 to 70	–55 to 125	0 to 70	°C
Input Current	I_{IN}	I_{IH}	20	20	20	20	µA
		I_{IL}	–400	–400	–600	–600	µA
Output Drive	I_{OH}		–0.4	–0.4	–1.0	–1.0	mA
Standard Output	I_{OL}		4.0	8.0	20	20	mA
	I_{SC}		–20 to –100	–20 to –100	–60 to –150	–60 to –150	mA
Buffer Output	I_{OH}		–12	–15	–12	–15	mA
	I_{OL}		12	24	48	64	mA
	I_{SC}		–40 to –225	–40 to –225	–100 to –225	–100 to –225	mA

Speed/Power Characteristics for Schottky TTL Logic[1] (ALL TYPICAL RATINGS)

Characteristic	Symbol	LS	FAST	Units
Quiescent Supply Current/Gate	I_G	0.4	1.1	mA
Power/Gate (Quiescent)	P_G	2.0	5.5	mW
Propagation Delay	t_p	9.0	3.7	ns

Characteristic	Symbol	LS	FAST	Units
Speed Power Product	—	18	19.2	pJ
Clock Frequency (D-F/F)	f_{max}	33	125	MHz
Clock Frequency (Counter)	f_{max}	40	125	MHz

NOTES: 1. Specifications are shown for the following conditions: a) V_{CC} = 5.0 Vdc; b) T_A = 25°C and c) C_L = 50 pF for FAST; 15 pF for LS.

FAST TTL Numeric Listing

MC54F00 Series (–55 to +125°C)
MC74F00 Series (0 to +70°C)

Suffix: N . . . Plastic (only 74-series)
J . . . Ceramic (54/74 series)

Device	Function	Pins
F00	Quad 2-Input NAND Gate	14
F02	Quad 2-Input NOR Gate	14
F04	Hex Inverter	14
F08	Quad 2-Input AND Gate	14
F10	Triple 3-Input NAND Gate	14
F11	Triple 3-Input AND Gate	14
F13	Dual 4-Input NAND Schmitt Trigger	14
F14	Hex Inverter Schmitt Trigger	14
F20	Dual 4-Input NAND Gate	14
F21	Dual 4-Input AND Gate	14
F32	Quad 2-Input OR Gate	14
F37*	Quad 2-Input NAND Buffer	14
F38*	Quad 2-Input NAND Buffer OC	14
F40*	Dual 4-Input NAND Buffer	14
F51	Dual 2 Wide 2-Input/3-Input AND-OR-INVERT Gate	14
F64	4-2-3-2 Input AND-OR-INVERT Gate	14
F74	Dual D Flip-Flop	14
F85	4-Bit Magnitude Comparator	16
F86	Quad Ex/OR Gate	14
F109	Dual J-K Flip-Flop w/Preset	16
F112*	Dual J-K Flip-Flop	16
F125	Quad Buffer, 3-State, Enable-LO	14
F126	Quad Buffer, 3-State, Enable-HI	14
F132	Quad 2-Input NAND Schmitt Trigger	14
F138	1-of-8 Decoder/Demultiplexer	16
F139	Dual 1-of-4 Decoder/Demultiplexer	16
F148	8-Line to 3-Line Priority Encoder	16
F151	8-Input Multiplexer	16
F153	Dual 4-Input Multiplexer	16
F157,	Quad 2-Input Multiplexer	16
F157A*	Quad 2-Input Multiplexer	16
F158,	Quad 2-Input Multiplexer, Inverting	16
F158A*	Quad 2-Input Multiplexer, Inverting	16
F160A*	BCD Decade Counter, Asynchronous Reset	16
F161A*	4-Bit Binary Counter, Asynchronous Reset	16
F162A*	BCD Decade Counter, Synchronous Reset	16
F163A*	4-Bit Binary Counter, Synchronous Reset	16
F164	8-Bit Serial-In Parallel-Out Shift Register	14
F168	Up/Down Decade Counter	16
F169	Up/Down Binary Counter	16
F174	Hex D Flip-Flop	16
F175	Quad D Flip-Flop	16
F181	4-Bit ALU	24
F182	Look-Ahead Carry Generator	16
F194*	Universal Shift Register	16
F195	4-Bit Shift Register	16
F240	Octal Buffer/Line Driver/Inverting/3-State	20
F241	Octal Buffer/Line Driver/3-State	20
F242	Quad Bus Transceiver/Inverting/3-State	14
F243	Quad Bus Transceiver/Non-Inverting/3-State	14
F244	Octal Buffer Driver/Non-Inverting/3-State	20
F245*	Octal Bus Transceiver	20
F251	8-Input Multiplexer/3-State	16
F253	Dual 4-Input Multiplexer/3-State	16
F256	Dual 4-Bit Addressable Latch	16
F257,	Quad 2-Input Multiplexer/3-State	16
F257A*	Quad 2-Input Multiplexer/3-State	16
F258,	Quad 2-Input Multiplexer, Inverting/3-State	16
F258A*	Quad 2-Input Multiplexer/Inverting/3-State	16

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Device	Function	Pins
F259	8-Bit Addressable Latch	14
F269	8-Bit Bidirectional Binary Counter	24
F273	Octal D Flip-Flop, common CLK/CLR	20
F280	9-Bit Odd/Even Parity Gen/Checker	14
F283	4-Bit Full Adder	
F299	8-Bit Shift/Store Register	20
F323	8-Bit Universal Shift/Storage Register	20
F350	4-Bit Shifter/3-State	
F352	Dual 4-Input Multiplexer	
F353	Dual 4-Input Multiplexer/3-State	
F365	Hex Bus Driver/Gated Enable/Non-Inverting/ 3-State	
F366	Hex Bus Driver/Gated Enable/Inverting/3-State	
F367	Hex Bus Driver 4/2-Bit/Non-Inverting/3-State	
F368	Hex Bus Driver 4/2-Bit Inverting/3-State	
F373	Octal Transparent Latch/3-State	20
F374	Octal D Flip-Flop/3-State	20
F377	Octal D F/F, common CLK/Enable/ Non-Inverting	20
F378	Hex Parallel D Register w/Enable	20
F379	Quad Parallel Register w/Enable	
F381	4-Bit ALU	20
F382	4-Bit ALU	20
F398	Quad 2-Port Register	20
F399	Quad 2-Port Register	
F521	Octal Comparator	20
F533	Octal Transparent Latch/3-State	20
F534	Octal D Flip-Flop 3-State	20
F537	1-of-10 Decoder/3-State	20
F538	1-of-8 Decoder/3-State	20
F539	1-of-4 Decoder/3-State	20
F543	Octal Reg XCVR/Non-Inverting/Bus Pinout/ 3-State	24
F544	Octal Reg XCVR/Inverting/Bus Pinout/3-State	24
F568	Decade Up/Down Counter/3-State	20
F569	Binary Up/Down Counter/3-State	20
F574	Octal D-FF/Non-Inverting/Bus Pinout/3-State	20
F579	8-Bit Bidirectional Binary Counter/3-State	20
F620	Octal Bus Transceiver/Inverting/3-State	20
F623	Octal Bus Transceiver/3-State	20
F640	Octal Bus Transceiver/Inverting/3-State	20
F657A	Octal Bus Transceiver w/Parity Gen Chk 3-State	24
F657B	Octal Bus Transceiver w/Parity Gen Chk 3-State	24
F779	8-Bit Bidirectional Binary Counter/3-State	16
F803*	Quad D-FF w/Mtchd. Prop. Delays	14
F827	10-Bit Buffer/Line Driver (Non-Inverting)	24
F828	10-Bit Buffer/Line Driver (Inverting)	24
F1245	Octal Bus Transceiver 3-State Lite Load 'F245	20
F2960,A*	Error Detection and Correction Unit (EDAC)	48
F2961A*	EDAC Bus Buffer, Inverting	24
F2962A*	EDAC Bus Buffer, Non-Inverting	24
F2968A*	Dynamic Memory Controller (256K DRAM)	48
F2969*	Memory Timing Controller w/EDAC	48
F2970*	Memory Timing Controller w/o EDAC	24
F29368	Dynamic Memory Controller (1 Meg DRAM)	48

* = 74F Only

LS TTL Numeric Listing

SN54LS00 Series (–55 to +125°C)
SN74LS00 Series (0 to +70°C)

Suffix: N . . . Plastic (only 74-series)
J . . . Ceramic (54/74 series)

Device	Function	Pins
LS00	Quad 2-Input NAND Gate	14
LS01	Quad 2-Input NAND Gate, Open-Collector	14
LS02	Quad 2-Input NOR Gate	14
LS03	Quad 2-Input NAND Gate, Open-Collector	14
LS04	Hex Inverter	14
LS05	Hex Inverter, Open-Collector	14
LS08	Quad 2-Input AND Gate	14
LS09	Quad 2-Input AND Gate, Open-Collector	14
LS10	Triple 3-Input NAND Gate	14
LS11	Triple 3-Input AND Gate	14
LS12	Triple 3-Input NAND Gate, Open-Collector	14
LS13	Dual 4-Input Schmitt Trigger	14
LS14	Hex Schmitt Trigger	14
LS15	Triple 3-Input AND Gate, Open-Collector	14
LS20	Dual 4-Input NAND Gate	14
LS21	Dual 4-Input AND Gate	14
LS22	Dual 4-Input NAND Gate, Open-Collector	14
LS26	Quad 2-Input NAND, High Voltage	14
LS27	Triple 3-Input NOR Gate	14
LS28	Quad 2-Input NOR Buffer	14
LS30	8-Input NAND Gate	14
LS32	Quad 2-Input OR Gate	14
LS33	Quad 2-Input NOR Buffer, Open-Collector	14
LS37	Quad 2-Input NAND Buffer	14
LS38	Quad 2-Input NAND Buffer, Open-Collector	14
LS40	Dual 4-Input NAND Buffer	14
LS42	1-of-10 Decoder	16
LS47	BCD to 7-Segment Decoder/Driver, Open-Collector	16
LS48	BCD to 7-Segment Decoder/Driver, with Pull-Ups	16
LS51	Dual AND-OR-INVERT Gate	14
LS54	3-2-2-3 Input AND-OR-INVERT Gate	14
LS55	2-Wide 4-Input AND-OR-INVERT Gate	14
LS73A	Dual JK Flip-Flop	14
LS74A	Dual D Flip-Flop	14
LS75	4-Bit Bi-Stable Latch with Q and $\overline{Q}$	16
LS76A	Dual JK Flip-Flop	16
LS77	4-Bit Bi-Stable Latch	14
LS83A	4-Bit Full Adder	16
LS85	4-Bit Magnitude Comparator	16
LS86	Quad Exclusive OR Gate	14

Device	Function	Pins
LS90	Decade Counter	14
LS92	Divide-By-12 Counter	14
LS93	4-Bit Binary Counter	14
LS95B	4-Bit Shift Register	14
LS107A	Dual JK Flip-Flop with Clear	14
LS109A	Dual JK Flip-Flop with Preset	16
LS112A	Dual JK Edge-Triggered Flip-Flop	16
LS113A	Dual JK Edge-Triggered Flip-Flop	14
LS114A	Dual JK Edge-Triggered Flip-Flop	14
LS122	Retriggerable Monostable Multivibrator	14
LS123	Dual Retriggerable Monostable Multivibrator	16
LS125A	Quad Buffer, Low Enable, 3-State	14
LS126A	Quad Buffer, High Enable, 3-State	14
LS132	Quad 2-Input Schmitt Trigger	14
LS133	13-Input NAND Gate	16
LS136*	Quad Exclusive OR Gate, Open-Collector	14
LS137	3-Line to 8-Line Decoder/Demultiplexer	16
LS138	1-of-8 Decoder/Demultiplexer	16
LS139	Dual 1-of-4 Decoder/Demultiplexer	16
LS145	1-of-10 Decoder/Driver, Open-Collector	16
LS147	10-Line Decimal to 4-Line Priority Encoder	16
LS148	8-Input to 3-Line Priority Encoder	16
LS151	8-Input Multiplexer	16
LS153	Dual 4-Input Multiplexer	16
LS155	Dual 1-of-4 Decoder	16
LS156	Dual 1-of-4 Decoder, Open-Collector	16
LS157	Quad 2-Input Multiplexer, Non-Inverting	16
LS158	Quad 2-Input Multiplexer, Inverting	16
LS160A	BCD Decade Counter, Asynchronous Reset (9310 Type)	16
LS161A	4-Bit Binary Counter, Asynchronous Reset (9316 Type)	16
LS162A	BCD Decade Counter, Synchronous Reset	16
LS163A	4-Bit Binary Counter, Synchronous Reset	16
LS164	8-Bit Serial-In/Parallel-Out Shift Register	14
LS165	8-Bit Parallel-In/Serial-Out Shift Regsiter	16
LS166	8-Bit Parallel-In/Serial-Out Shift Register	16
LS168	Up/Down Decade Counter	16
LS169	Up/Down Binary Counter	16
LS170	4 x 4 Register File, Open-Collector	16
LS173A	4-Bit D Register, 3-State	16
LS174	Hex D Flip-Flop with Clear	16
LS175	Quad D Flip-Flop with Clear	16
LS181	4-Bit ALU	24
LS190	UP/Down Decade Counter	16
LS191	Up/Down Binary Counter	16
LS192	Up/Down Decade Counter with Clear	16
LS193	Up/Down Binary Counter with Clear	16
LS194A	4-Bit Right/Left Shift Register	16
LS195A	4-Bit Shift Register (9300 Type)	16
LS196	Decade Counter, Asynchronously Presettable	14
LS197	4-Bit Binary Counter, Asynchronously Presettable	14

*74LS only

LS TTL NUMERIC LISTING (continued)

Device	Function	Pins
LS221	Dual One-Shot (Very Stable)	16
LS240	Octal Bus/Line Driver, Inverting 3-State	20
LS241	Octal Bus/Line Driver, 3-State	20
LS242	Quad Bus Transceiver, Inverting, 3-State	14
LS243	Quad Bus Transceiver, Non-Inverting, 3-State	14
LS244	Octal Driver, Non-Inverting, 3-State	20
LS245	Octal Bus Transceiver, Non-Inverting, 3-State	20
LS247	BCD to 7-Segment Decoder/Driver, Open-Collector	16
LS248	BCD to 7-Segment Decoder/Driver with Pull-Ups	16
LS251*	8-Input Multiplexer, 3-State	16
LS253	Dual 4-Input Multiplexer, 3-State	16
LS256	Dual 4-Bit Addressable Latch	16
LS257A	Quad 2-Input Multiplexer, Non-Inverting, 3-State	16
LS258A	Quad 2-Input Multiplexer, Inverting 3-State	16
LS259	8-Bit Addressable Latch (9334)	16
LS260	Dual 5-Input NOR Gate	14
LS266	Quad Exclusive NOR Gate, Open-Collector	14
LS273	Octal D Flip-Flop with Clear	20
LS279	Quad Set/Reset Latch	16
LS280	8-Bit Odd/Even Parity Generator/Checker	14
LS283	4-Bit Full Adder (Rotated LS83A)	16
LS290	Decade Counter (Divide By 2 and 5)	14
LS293	4-Bit Binary Counter	14
LS298	Quad 2-Multiplexer, with Output Register	16
LS299	8-Bit Shift/Storage Register, 3-State	20
LS322A	8-Bit Shift Register with Sign Extend, 3-State	20
LS323	8-Bit Shift/Storage Register, 3-State	20
LS348	8-Input to 3-Line Priority Encoder, 3-State	16
LS352	Dual 4-Multiplexer (Inverting LS153)	16
LS353	Dual 4-Multiplexer (3-State LS352)	16
LS365A	Hex Buffer, Common Enable, 3-State	16
LS366A	Hex Inverter, Common Enable, 3-State	16
LS367A	Hex Buffer, 4-Bit and 2-Bit, 3-State	16
LS368A	Hex Inverter, 4-Bit and 2-Bit, 3-State	16
LS373	Octal Transparent Latch, 3-State	20
LS374	Octal D Flip-Flop, 3-State	20
LS375	Quad Latch	16
LS377	Octal D Flip-Flop with Enable	20
LS378	Hex D Flip-Flop with Enable	16
LS379	4-Bit D Flip-Flop with Enable	16
LS386	2-Input Quad/Exclusive OR Gate	14
LS390	Dual Decade Counter	16
LS393	Dual 4-Bit Binary Counter	14
LS395*	4-Bit Shift Register, 3-State	16
LS398	Quad 2-Input Multiplexer with Output Register	20
LS399	Quad 2-Input Multiplexer with Output Register	16

*74LS only

Device	Function	Pins
LS490	Dual Decade Counter	16
LS540	Octal Buffer/Line Driver, 3-State	20
LS541	Octal Buffer/Line Driver, 3-State	20
LS569	Binary Up/Down Counter, 3-State	20
LS623	Octal Transceiver with Storage, 3-State	20
LS640	Octal Bus Transceiver, Inverting, 3-State	20
LS641	Octal Bus Transceiver, Non-Inverting, Open-Collector	20
LS642	Octal Bus Transceiver, Inverting, Open-Collector	20
LS645	Octal Bus Transceiver, Non-Inverting, 3-State	20
LS669	Synchronous 4-Bit Up/Down Counter	16
LS670	4 x 4 Register File, 3-State	16
LS682	8-Bit Magnitude Comparator	20
LS684	8-Bit Magnitude Comparator	20
LS688	8-Bit Magnitude Comparator	20
LS748	8-Input to 3-Line Priority Encoder	16
LS783*	Synchronous Address Multiplexer (MC6883)	40
LS785*	Synchronous Address Multiplexer	40
LS795	Octal Buffer (81LS95), 3-State	20
LS796	Octal Buffer (81LS96), 3-State	20
LS797	Octal Buffer (81LS97), 3-State	20
LS798	Octal Buffer (81LS98), 3-State	20
LS848	8-Input to 3-Line Priority Encoder, 3-State	16

*74LS only

Functional Selection

Abbreviations:

S = Synchronous
A = Asynchronous
2S = 2-State Output
3S = 3-State Output
OC = Open-Collector Output
P = Planned
X = Available

Inverters

Description	Type of Output	No.	LS	FAST
Hex	2S	04	X	X
	OC	05	X	

AND Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	08	X	X
	OC	09	X	
Triple 3-Input	2S	11	X	X
	OC	15	X	
Dual 4-Input	2S	21	X	X

NAND Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	00	X	X
	OC	01	X	
	OC	03	X	
Quad 2-Input, High Voltage	OC	26	X	
Triple 3-Input	2S	10	X	X
	OC	12	X	
Dual 4-Input	2S	20	X	X
	OC	22	X	
8-Input	2S	30	X	
13-Input	2S	133	X	

OR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	32	X	X

NOR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	2	X	X
Triple 3-Input	2S	27	X	
Dual 5-Input	2S	260	X	

Exclusive OR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	2S	86	X	X
	OC	136	X	
	2S	386	X	

Exclusive NOR Gates

Description	Type of Output	No.	LS	FAST
Quad 2-Input	OC	266	X	

AND-OR-INVERT Gates

Description	Type of Output	No.	LS	FAST
Dual 2-Wide, 2-Input 3-Input	2S	51	X	X
4-Wide, 2-3-2-3-Input	2S	54	X	
2-Wide, 4-Input	2S	55	X	
4-Wide, 4-2-2-3-Input	2S	64		X

Schmitt Triggers

Description	Type of Output	No.	LS	FAST
Dual 4-Input NAND Gate	2S	13	X	X
Hex, Inverting	2S	14	X	X
Quad 2-Input NAND Gate	2S	132	X	X

SSI Flip-Flops

Description	Type of Output	No.	LS	FAST
Dual D w/Set & Clear	Pos	74	X	X
Dual JK w/Clear	Neg	73	X	
	Neg	107	X	
Dual JK w/Set & Clear Individual J, K, C_P, S_D, C_D Inputs	Neg	76	X	
Same as 76 with Different Pinout	Neg	112	X	X
Dual J$\overline{K}$ w/Set & Clear	Pos	109	X	X
Quad D w/Mtchd. Prop. Delays	Pos	803		X

Multiplexers

Description	Type of Output	No.	LS	FAST
Quad 2-to-1, Non-Inverting	2S	157,A	X	X
	3S	257,A	X	X
Quad 2-to-1, Inverting	2S	158,A	X	X
	3S	258,A	X	X
Dual 4-to-1, Non-Inverting	2S	153	X	X
	3S	253	X	X
Dual 4-to-1, Inverting	2S	352	X	X
	3S	353	X	X
8-to-1	2S	151	X	X
	3S	251	X	X
Quad 2-to-1 with Output Register				
298 — Negative edge triggered	2S	298	X	
398 — Positive edge triggered, Q/$\overline{O}$ Outputs	2S	398	X	X
399 — Positive edge triggered, Q Output Only	2S	399	X	X

Encoders

Description	Type of Output	No.	LS	FAST
10-to-4 Line BCD	2S	147	X	
8-to-3-Line Priority Encoder	2S	148	X	X
	3S	348	X	
	2S	748	X	
	3S	848	X	

Decoders/Demultiplexers

Description	Type of Output	No.	LS	FAST
Dual 1-of-4	2S	139	X	X
	2S	155	X	
	OC	156	X	
	3S	539		X
1-of-8	2S	138	X	X
	3S	538		X
1-of-8 with Latch	2S	137	X	
1-of-10	2S	42	X	
	3S	537		X

Latches

Description	No. of Bits	Type of Output	No.	LS	FAST
Transparent, Non-Inverting	4	2S	77	X	
	8	3S	373	X	X
Octal, Non-Inverting	8	3S	573		
Transparent, Inverting	8	3S	533		X
Transparent, Q and $\overline{Q}$	4	2S	75	X	
Outputs	4	2S	375	X	
Quad Set-Reset Latch	4	2S	279	X	
Addressable	8	2S	259	X	X
Dual 4-Bit Addressable	4	2S	256	X	X

Shift Registers

Description			Mode*				No.	LS	FAST
			SR	SL	Hold	Reset			
Serial In-Parallel Out	8	2S	X			A	165	X	X
Parallel In-Serial Out	8	2S	X		X		165	X	
	8	2S	X		X	A	166	X	
Parallel In-Parallel Out	4	2S	X				95	X	
	4	2S	X	X	X	A	194	X	X
	4	2S	X			A	195	X	X
	4	3S	X			A	395	X	
Parallel In-Parallel Out, Bidirectional	8	3S	X	X	X	A	299	X	X
	8	3S	X	X	X	S	323	X	X
Sign Extended Bidirectional	8	3S	X		X	A	322	X	

* SR = Shift Right
SL = Shift Left

FUNCTIONAL SELECTION (continued)

Register Files

Description	Type of Output	No.	LS	FAST
4 x 4	OC	170	X	
	3S	670	X	

Asynchronous Counters — Negative Edge-Triggered

Description	Load	Set	Reset	No.	LS	FAST
Decade (2/5)		X	X	90	X	
	X		X	196	X	
		X	X	290	X	
Dual Decade (2/5)			X	390	X	
Dual Decade		X	X	490	X	
Modulo 12 (2/6)			X	92	X	
4-Bit Binary (2/8)			X	93	X	
	X		X	197	X	
			X	293	X	
Dual 4-Bit Binary			X	393	X	

Display Decoders/Drivers with Open-Collector Outputs

Description	No.	LS	FAST
1-of-10	145	X	
BCD-to-7 Segment	47	X	
	48*	X	
	247	X	
	248*	X	

*The 48 and 248 have internal pullup resistors to V_{CC} on their outputs.

Cascadable Synchronous Counters — Positive Edge-Triggered

Description	Type of Output	Load	Reset	No.	LS	FAST
Decade	2S	S	A	160A	X	X
	2S	S	S	162A	X	X
Decade, Up/Down	2S	S		168	X	X
	2S	A		190	X	
	2S	A	A	192*	X	
	3S	S	B	568		X
4-Bit Binary	2S	S	A	161A	X	X
	2S	S	S	163A	X	X
4-Bit Binary,	2S	S		169	X	X
UP/Down	2S	A		191	X	
	2S	A	A	193*	X	
	3S	S	B	569	X	X
	2S	S		669	X	
8-Bit Bidirectional	3S	S		579		X
	3S	S		779		X
	2S	S		269		X

*The 192 and 193 do not provide a clock enable for synchronous cascading.

MSI Flip-Flops/Registers

Description	No. of Bits	Type of Output	Set or Reset	Clock Enable	No.	LS	FAST
D-Type, Non-Inverting	4	3S	A	X	173	X	
	4	2S		X	377	X	X
	6	2S	A		174	X	X
	6	2S		X	378	X	X
	8	2S	A		273	X	X
	8	3S			374	X	X
Octal D Bus Pinout	8	3S			574		X
D-Type, Inverting	8	3S			534		X
D-Type, Q and $\overline{Q}$ Outputs	4	2S	A		175	X	X
	4	2S		X	379	X	X

FUNCTIONAL SELECTION (continued)

Arithmetic Operators

Description	No.	LS	FAST
4-Bit Adder	83	X	
	283	X	X
4-Bit ALU	181	X	X
	381		X
	382		X
Look Ahead Carry Generator	182		X
4-Bit Barrel Shifter	350		X

Magnitude Comparators

Description	Type of Output	P=Q	P>Q	P<Q	No.	LS	FAST
4-Bit	2S	X	X	X	85	X	X
8-Bit	2S	X	X		682	X	
	2S	X	X		684	X	
	2S	X			521		X
Registered 8-Bit with Output Enable	2S	X			688	X	

Dynamic Memory Support

Description	No.	LS	FAST
Synchronous Address Multiplexer (MC6883)	783	X	
Synchronous Address Multiplexer	785	X	
Error Detection and Correction Circuit	2960		X
(EDAC)	2960A		X
EDAC Bus Buffer (Inverting)	2961A		X
EDAC Bus Buffer (Non-Inverting)	2962A		X
Dynamic Memory Controller (256K DRAM)	2968A		X
Dynamic Memory Controller (1M DRAM)	29368		X
Dynamic Memory Timing Controller with EDAC	2969		X
Dynamic Memory Timing Controller without EDAC	2970		X

VCOs and Multivibrators

Description	No.	LS	FAST
Retriggerable Monostable Multivibrator	122	X	
Dual 122	123	X	
Precision Non-Retriggerable Monostable Multivibrator	221	X	

Parity Generators/Checkers

Description	No.	LS	FAST
9-Bit Odd/Even Parity Generator/Checker	280	X	X

Buffers/Line Drivers

Description	Type of Output	No.	LS	FAST
Quad 2-Input NOR	2S	28	X	
	OC	33	X	
Quad 2-Input NAND	2S	37	X	X
	OC	38	X	X
Dual 4-Input NAND	2S	40	X	X
Quad, Non-Inverting	3S	125	X	X
	3S	126	X	X
Hex, Non-Inverting	3S	365	X	X
	3S	367	X	X
Hex, Inverting	3S	366	X	X
	3S	368	X	X
Octal, Non-Inverting	3S	241	X	X
	3S	244	X	X
Bus Pinout	3S	541	X	
	3S	795	X	
	3S	797	X	
Octal, Inverting	3S	240	X	X
Bus Pinout	3S	540	X	
	3S	796	X	
	3S	798	X	
10-Bit Buffer/Line Driver (Non-Inverting)	2S	827		X
10-Bit Buffer/Line Driver (Inverting)	2S	828		X

Transceivers

Description	Type of Output	No.	LS	FAST
Quad, Non-Inverting	3S	243	X	X
Quad, Inverting	3S	242	X	X
Octal, Non-Inverting	3S	245	X	X
	3S	645	X	
	OC	621		
	3S	623	X	X
	OC	641	X	
Bus Pinout	3S	543		X
Octal, Inverting	3S	620		X
	OC	622		
	3S	640	X	X
	OC	642	X	
Octal, Inverting with Register Mux Latch	3S	544		X
	3S	657A		X
	3S	657B		X
	3S	1245		X

HTL/DTL Circuits

Motorola still supplies a large selection of HTL (High-Threshold Logic) and DTL (Diode-Transistor Logic) circuits. These are recommended primarily for replacement purposes. A list of available type numbers is given below.

DTL

Device Number	Function
MC830	Expandable NAND Gate
MC832	Expandable Buffer
MC833	Dual Expander
MC835	Hex Inverter (without output resistors)
MC836	Hex Inverter
MC837	Hex Inverter
MC838	Decade Counter
MC840	Hex Inverter (without input diodes)
MC841	Hex Inverter (without output resistors and input diodes)
MC844	Expandable Dual Power Gate
MC845	Clocked Flip-Flop
MC846	Quad 2-Input NAND Gate
MC848	Clocked Flip-Flop
MC849	Quad 2-Input NAND Gate
MC936	Hex Inverter
MC937	Hex Inverter
MC938	Decade Counter
MC940	Hex Inverter (without input diodes)
MC944	Expandable Dual Power Gate
MC945	Clocked Flip-Flop
MC946	Quad 2-Input NAND Gate
MC948	Clocked Flip-Flop
MC949	Quad NAND Gate
MC951	Monostable Multivibrator
MC952	Dual J-K Flip-Flop (common clock and CD Separate SD)
MC953	Dual J-K Flip-Flop (separate clock and SD, No CD)
MC955	Dual J-K Flip-Flop (common clock and CD, separate SD, 2 k pullup resistor)

HTL

Device Number	Function
MC660	Expandable Dual 4-Input Gate (active pullup)
MC661	Expandable Dual 4-Input Gate (passive pullup)
MC662	Expandable Dual 4-Input Line Driver
MC663	Dual J-K Flip-Flop
MC664	Master-Slave R-S Flip-Flop
MC667	Dual Monostable Multivibrator
MC668	Quad 2-Input Gate (passive pullup)
MC669	Dual 4-Input Expander
MC670	Triple 3-Input Gate (passive pullup)
MC671	Triple 3-Input Gate (active pullup)
MC672	Quad 2-Input Gate (active pullup)
MC675	Dual Pulse Stretcher
MC677	Hex Inverter With Strobe (active pullup)
MC678	Hex Inverter With Strobe (without output resistors)

Bipolar Logic Surface Mount

WHY SURFACE MOUNT?

Surface Mount Technology is now being utilized to offer answers to many problems that have been created in the use of insertion technology.

Limitations have been reached with insertion packages and PC board technology. Surface Mount Technology offers the opportunity to continue to advance the State-of-the-Art designs that cannot be accomplished with Insertion Technology.

Surface Mount Packages allow more optimum device performance with the smaller Surface Mount configuration. Internal lead lengths, parasitic capacitance and inductance that placed limitations on chip performance have been reduced.

The lower profile of Surface Mount Packages allows more boards to be utilized in a given amount of space. They are stacked closer together and utilize less total volume than insertion populated PC boards.

Printed circuit costs are lowered with the reduction of the number of board layers required. The elimination or reduction of the number of plated through holes in the board, contributes significantly to lower PC board prices.

Automatic placement equipment is available that can place Surface Mount components at the rate of a few thousand per hour to hundreds of thousands of components per hour.

Surface Mount Technology is cost effective, allowing the manufacturer the opportunity to produce smaller units and/or offer increased functions with the same size product.

Surface Mount assembly does not require the preparation of components that are common on insertion technology lines. Surface Mount components are sent directly to the assembly line, eliminating an intermediate step.

For additional surface mount information, order Surface Mount Products Selector Guide (SG127/D).

FAST TTL Devices Available in SOIC

MC74F00 Series (0 to +70°C)

Suffix: D = Narrow Body SOIC
DW = Wide Body SOIC

Device	Function	Pins	Suffix
F00	Quad 2-Input NAND Gate	14	D
F02	Quad 2-Input NOR Gate	14	D
F04	Hex Inverter	14	D
F08	Quad 2-Input AND Gate	14	D
F10	Triple 3-Input NAND Gate	14	D
F11	Triple 3-Input AND Gate	14	D
F13	Dual 4-Input NAND Schmitt Trigger	14	D
F14	Hex Inverter Schmitt Trigger	14	D
F20	Dual 4-Input NAND Gate	14	D
F21	Dual 4-Input AND Gate	14	D
F32	Quad 2-Input OR Gate	14	D
F37	Quad 2-Input NAND Buffer	14	D
F38	Quad 2-Input NAND Buffer OC	14	D
F40	Dual 4-Input NAND Buffer	14	D
F51	2 Wide 2-3 Input AND-OR INVERT Gate	14	D
F64	4-2-2-3 Input AND-OR-INVERT Gate	14	D
F74	Dual D Flip-Flop	14	D
F85	4-Bit Magnitude Comparator	16	D
F86	Quad Ex/OR Gate	14	D
F109	Dual J-K Flip-Flop w/Preset	16	D
F125	Quad Buffer, 3-State	14	D
F126	Quad Buffer, 3-State	14	D
F132	Quad 2-Input NAND Schmitt Trigger	14	D
F138	1-of-8 Decoder/Demultiplexer	16	D
F139	Dual 1-of-4 Decoder/Demultiplexer	16	D
F148	8-Line to 3-Line Priority Encoder	16	D
F151	8-Input Multiplexer	16	D
F153	Dual 4-Input Multiplexer	16	D
F157A	Quad 2-Input Multiplexer	16	D
F158A	Quad 2-Input Multiplexer	16	D
F160A	BCD Decade Counter, Asynchronous Reset	16	D
F161A	4-Bit Binary Counter, Asynchronous Reset	16	D
F162A	BCD Decade Counter, Synchronous Reset	16	D
F163A	4-Bit Binary Counter, Synchronous Reset	16	D
F164	8-Bit Ser. In-Ser. Out Shift Register	14	D
F168	Up/Down Decade Counter	16	D
F169	Up/Down Binary Counter	16	D
F174	Hex D Flip-Flop	16	D
F175	Quad D Flip-Flop	16	D
F182	Look Ahead Carry Generator	16	D
F194	Universal Shift Register	16	D
F195	Universal Shift Register	16	D
F240	Octal Bus/Line Driver/Inverting/3-State	20	DW
F241	Octal Bus/Line Driver/3-State	20	DW

Device	Function	Pins	Suffix
F242	Quad Bus Transceiver/Inverting/3-State	14	D
F243	Quad Bus Transceiver/Non-Inverting/ 3-State	14	D
F244	Octal Bus Driver/Non-Inverting/3-State	20	DW
F245	Octal Bus Transceiver	20	DW
F251	8-Input Multiplexer/3-State	16	D
F253	Dual 4-Input Multiplexer/3-State	16	D
F256	Dual 4-Bit Addressable Latch	16	D
F257A	Quad 2-Input Multiplexer/3-State	16	D
F258A	Quad 2-Input Multiplexer, Inverting/3-State	16	D
F259	8-Bit Addressable Latch	16	D
F269	8-Bit Bi-Directional Binary Counter	24	DW
F273	Octal D-F/F	20	DW
F280	9-Bit Odd/Even Parity Gen/Checker	14	D
F283	4-Bit Full Adder	16	D
F299	8-Bit Shift/Store Register	20	DW
F323	8-Bit Universal Shift Register	20	DW
F350	4-Bit Shifter/3-State	16	D
F352	Dual 4-Input Multiplexer	16	D
F353	Dual 4-Input Multiplexer/3-State	20	D
F365	Hex Buffer Driver Gated Enable Non-Inverting/3-State	16	D
F366	Hex Buffer Driver Gated Enable Inverting/ 3-State	16	D
F367	Hex Buffer Driver/4-2-Bit/Non-Inverting/ 3-State	16	D
F368	Hex Buffer Driver/4-2-Bit/Inverting/3-State	16	D
F373	Octal Transparent Latch/3-State	20	DW
F374	Octal D Flip-Flop/3-State	20	DW
F377	Octal D-F/F	20	DW
F378	Hex Parallel D Register w/Enable	16	D
F379	Quad Parallel Register w/Enable	16	D
F381	4-Bit ALU	20	DW
F398	Quad 2-Port Register	20	DW
F399	Quad 2-Port Register	16	D
F521	Octal Comparator	20	DW
F533	Octal Transparent Latch/3-State	20	DW
F534	Octal D Flip-Flop/3-State	20	DW
F543A	Octal Register Transceiver	24	DW
F568	Decade Up/Down Counter/3-State	20	DW
F569	Binary Up/Down Counter/3-State	20	DW
F657A	Octal Bus Transceiver	24	DW
F657B	Octal Bus Transceiver	24	DW
F803	Quad D-F/F w/Mtchd. Prop. Delays	14	D

LS TTL Devices Available in SOIC

SN74LS00 Series (0 to +70°C)

Suffix: D = Narrow Body SOIC
DW = Wide Body SOIC

Device	Function	Pins	Suffix
LS00	Quad 2-Input NAND Gate	14	D
LS01	Quad 2-Input NAND Gate, Open-Collector	14	D
LS02	Quad 2-Input NOR Gate	14	D
LS03	Quad 2-Input NAND Gate, Open-Collector	14	D
LS04	Hex Inverter	14	D
LS05	Hex Inverter, Open-Collector	14	D
LS08	Quad 2-Input AND Gate	14	D
LS09	Quad 2-Input AND Gate, Open-Collector	14	D
LS10	Triple 3-Input NAND Gate	14	D
LS11	Triple 3-Input AND Gate	14	D
LS12	Triple 3-Input NAND Gate, Open-Collector	14	D
LS13	Dual 4-Input Schmitt Trigger	14	D
LS14	Hex Schmitt Trigger	14	D
LS15	Triple 3-Input AND Gate, Open-Collector	14	D
LS20	Dual 4-Input NAND Gate	14	D
LS21	Dual 4-Input AND Gate	14	D
LS22	Dual 4-Input NAND Gate, Open-Collector	14	D
LS26	Quad 2-Input NAND, High Voltage	14	D
LS27	Triple 3-Input NOR Gate	14	D
LS28	Quad 2-Input NOR Buffer	14	D
LS30	8-Input NAND Gate	14	D
LS32	Quad 2-Input OR Gate	14	D
LS33	Quad 2-Input NOR Buffer, Open-Collector	14	D
LD37	Quad 2-Input NAND Buffer	14	D
LS38	Quad 2-Input NAND Buffer, Open-Collector	14	D
LS40	Dual 4-Input NAND Buffer	14	D
LS42	1-of-10 Decoder	16	D
LS47	BCD to 7-Segment Decoder/Driver, Open-Collector	16	D
LS51	Dual AND-OR-INVERT Gate	14	D
LS54	3-2-2-3 Input AND-OR-INVERT Gate	14	D
LS55	2-Wide 4-Input AND-OR-INVERT Gate	14	D
LS73A	Dual JK Flip-Flop	14	D
LS74A	Dual D Flip-Flop	14	D
LS75	4-Bit Bi-Stable Latch with Q and $\overline{Q}$	16	D
LS76A	Dual JK Flip-Flop	16	D
LS77	4-Bit Bi-Stable Latch	14	D
LS83A	4-Bit Full Adder	16	D
LS85	4-Bit Magnitude Comparator	16	D
LS86	Quad Exclusive OR Gate	14	D
LS90	Decade Counter	14	D
LS92	Divide-By-12 Counter	14	D
LS93	4-Bit Binary Counter	14	D

Device	Function	Pins	Suffix
LS95B	4-Bit Shift Register	14	D
LS107A	Dual JK Flip-Flop with Clear	14	D
LS109A	Dual JK Flip-Flop with Preset	16	D
LS112A	Dual JK Edge-Triggered Flip-Flop	16	D
LS113A	Dual JK Edge-Triggered Flip-Flop	14	D
LS114A	Dual JK Edge-Triggered Flip-Flop	14	D
LS122	Retriggerable Monostable Multivibrator	14	D
LS123	Dual Retriggerable Monostable Multivibrator	16	D
LS125A	Quad Buffer, Low Enable, 3-State	14	D
LS126A	Quad Buffer, High Enable, 3-State	14	D
LS132	Quad 2-Input Schmitt Trigger	14	D
LS133	13-Input NAND Gate	16	D
LS136	Quad Exclusive OR Gate, Open-Collector	14	D
LS137	3-Line to 8-Line Decoder/Demultiplexer	16	D
LS138	1-of-8 Decoder/Demultiplexer	16	D
LS139	Dual 1-of-4 Decoder/Demultiplexer	16	D
LS145	1-of-10 Decoder/Driver, Open-Collector	16	D
LS147	10-Line Decimal to 4-Line Priority Encoder	16	D
LS148	8-Input to 3-Line Priority Encoder	16	D
LS151	8-Input Multiplexer	16	D
LS153	Dual 4-Input Multiplexer	16	D
LS155	Dual 1-of-4 Decoder	16	D
LS156	Dual 1-of-4 Decoder, Open-Collector	16	D
LS157	Quad 2-Input Multiplexer, Non-Inverting	16	D
LS158	Quad 2-Input Multiplexer, Inverting	16	D
LS160A	BCD Decade Counter, Asynchronous Reset (9310 Type)	16	D
LS161A	4-Bit Binary Counter, Asynchronous Reset (9316 Type)	16	D
LS162A	BCD Decade Counter, Synchronous Reset	16	D
LS163A	4-Bit Binary Counter, Synchronous Reset	16	D
LS164	8-Bit Serial-In/Parallel-Out Shift Register	14	D
LS165	8-Bit Parallel-In/Serial-Out Shift Register	16	D
LS166	8-Bit Parallel-In/Serial-Out Shift Register	16	D
LS170	4 x 4 Register File, Open-Collector	16	D
LS173A	4-Bit D Register, 3-State	16	D
LS174	Hex D Flip-Flop with Clear	16	D
LS175	Quad D Flip-Flop with Clear	16	D
LS190	Up/Down Decade Counter	16	D
LS191	Up/Down Binary Counter	16	D
LS192	Up/Down Decade Counter with Clear	16	D
LS193	Up/Down Binary Counter with Clear	16	D
LS194A	4-Bit Right/Left Shift Register	16	D
LS195A	4-Bit Shift Register (9300 Type)	16	D
LS196	Decade Counter, Asynchronously Presettable	14	D
LS197	4-Bit Binary Counter, Asynchronously Presettable	14	D

LS TTL DEVICES AVAILABLE IN SOIC (continued)

Device	Function	Pins	Suffix
LS221	Dual One-Shot (Very Stable)	16	D
LS240	Octal Bus/Line Driver, Inverting 3-State	20	DW
LS241	Octal Bus/Line Driver, 3-State	20	DW
LS244	Octal Driver, Non-Inverting, 3-State	20	DW
LS245	Octal Bus Transceiver, Non-Inverting, 3-State	20	DW
LS247	BCD to 7-Segment Decoder/Driver, Open-Collector	16	D
LS251	8-Input Multiplexer, 3-State	16	D
LS253	Dual 4-Input Multiplexer, 3-State	16D	
LS256	Dual 4-Bit Addressable Latch	16	D
LS257A	Quad 2-Input Multiplexer, Non-Inverting, 3-State	16	D
LS258A	Quad 2-Input Multiplexer, Inverting 3-State	16	D
LS259	8-Bit Adressable Latch (9334)	16	D
LS260	Dual 5-Input NOR Gate	14	D
LS266	Quad Exclusive NOR Gate, Open-Collector	14	D
LS273	Octal D Flip-Flop with Clear	20	DW
LS279	Quad Set/Reset Latch	16	D
LS280	8-Bit Odd/Even Parity Generator/Checker	14	D
LS283	4-Bit Full Adder (Rotated LS83A)	16	D
LS290	Decade Counter (Divide By 2 and 5)	14	D
LS293	4-Bit Binary Counter	16	D
LS298	Quad 2-Multiplexer, with Output Register	16	D
LS299	8-Bit Shift/Storage Register, 3-State	20	DW
LS322A	8-Bit Shift Register with Sign Extend, 3-State	20	DW
LS323	8-Bit Shift/Storage Register, 3-State	20	DW
LS348	8-Input to 3-Line Priority Encoder, 3-State	16	D
LS352	Dual 4-Multiplexer (Inverting LS153)	16	D
LS353	Dual 4-Multiplexer (3-State LS352)	16	D
LS365A	Hex Buffer, Common Enable, 3-State	16	D
LS366A	Hex Inverter, Common Enable, 3-State	16	D

Device	Function	Pins	Suffix
LS367A	Hex Buffer, 4-Bit and 2-Bit, 3-State	16	D
LS368A	Hex Inverter, 4-Bit and 2-Bit, 3-State	16	D
LS373	Octal Transparent Latch, 3-State	20	DW
LS374	Octal D Flip-Flop, 3-State	20	DW
LS375	Quad Latch	16	D
LS377	Octal D Flip-Flop with Enable	20	DW
LS378	Hex D Flip-Flop with Enable	16	D
LS379	4-Bit D Flip-Flop with Enable	16	D
LS386	2-Input Quad/Exclusive OR Gate	14	D
LS390	Dual Decade Counter	16	D
LS393	Dual 4-Bit Binary Counter	14	D
LS395	4-Bit Shfit Register, 3-State	16	D
LS398	Quad 2-Input Multiplexer with Output Register	20	DW
LS399	Quad 2-Input Multiplexer with Output Register	16	D
LS540	Octal Buffer/Line Driver, 3-State	20	DW
LS541	Octal Buffer/Line Driver, 3-State	20	DW
LS569	Binary Up/Down Counter, 3-State	20	DW
LS623	Octal Transceiver with Storage, 3-State	20	DW
LS640	Octal Bus Transceiver, Inverting, 3-State	20	DW
LS641	Octal Bus Transceiver, Non-Inverting, Open-Collector	20	DW
LS642	Octal Bus Transceiver, Inverting, Open-Collector	20	DW
LS670	4 x 4 Register File, 3-State	16	D
LS682	8-Bit Magnitude Comparator	20	DW
LS684	8-Bit Magnitude Comparator	20	DW
LS688	8-Bit Magnitude Comparator	20	DW
LS795	Octal Buffer (81LS95), 3-State	20	DW
LS796	Octal Buffer (81LS96), 3-State	20	DW
LS797	Octal Buffer (81LS97), 3-State	20	DW
LS798	Octal Buffer (81LS98), 3-State	20	DW

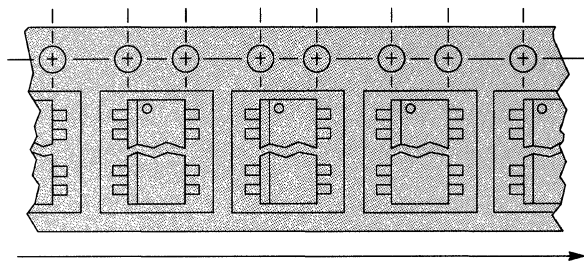
TAPE AND REEL

STANDARD BIPOLAR LOGIC INTEGRATED CIRCUITS

Motorola has now added the convenience of Tape and Reel packaging for our growing family of standard Integrated Circuit products. The packaging fully conforms to the latest EIA RS-481A specification. The antistatic embossed tape provides a secure cavity sealed with a peel-back cover tape.

MECHANICAL POLARIZATION

SOIC DEVICES



GENERAL INFORMATION

— Reel Size 13 inch (330 mm) Suffix: R2
— Tape Width 12 mm to 44 mm (see table)
— Units/Reel 1000 to 2500 (see table)

ORDERING INFORMATION

To order devices which are to be delivered in Tape and Reel, add the suffix R2 to the device number being ordered.

TABLE 2.1 TAPE AND REEL DATA

Device Type	Tape Width (mm)	Device/Reel	Reel Size (inch)	Min Lot Size Per Part No. Tape and Reel
SO-14	16	2,500	13	5,000
SO-16	16	2,500	13	5,000
SO-16 Wide	16	1,000	13	5,000
SO-20 Wide	24	1,000	13	5,000

What is Motorola FACT™?

Motorola FACT is a new advanced family of CMOS logic devices which offer designers a solution to the longstanding combined barrier they couldn't previously hurdle — high speed and low power in a standard product. In the past, they had to choose between the two — either high speed with large power consumption, or low power with slow speed. By exploiting the inherent low power requirements of CMOS in combination with micron scale processing capabilities, a best worlds technology is now available.

This selector guide provides a quick-glance summary of the initial offering of Motorola FACT devices. An ongoing program of product development will continue to enlarge the family offering.

Contents

Selector Guide Contents

This selector guide contains only devices in production at Motorola's Logic I.C. Division, accurate to the date of publication.

The Logic I.C. Division publishes a New Product Calendar quarterly that reflects any recent device releases and the approximate dates new devices are expected to be released.

There are many new devices in various stages of development on Motorola's Logic I.C. Division design schedule. Call your nearest Motorola sales office for the current status of any device not listed within this guide.

Facts About Motorola FACT

Advanced Technology

Motorola FACT is fabricated using a sub-two micron, silicon gate process. This process has been proven over the past couple of years in high performance gate arrays and is the basis of the product family for future logic systems.

Superior Speed

Not only is FACT faster than any previous CMOS technology, it even approaches the speed of advanced bipolar devices. This superior speed means that it can directly replace slower speed CMOS or bipolar products with the inherent capabilities of advanced CMOS.

High Output Drive

FACT is guaranteed to sink or source 24 mA, not only providing wide logic fanout but alternatively allowing it to drive a 50 ohm transmission line.

Low Power

Low power consumption is, of course, a major advantage of CMOS. Ranging from near zero during standby, FACT requires only a few milliwatts (per gate) at maximum frequencies.

Noise Immunity

A consistent, predictable, and wide margin input switching level is a feature of FACT that adds to the reliability of target product operation. No other logic family has wider margins.

Standardized Packages/Pinouts

FACT is initially available in either dual inline or small outline (SOIC) packages. Function pinouts adhere to industry standards for interchangeability and circuit layout.

Second Sources

Motorola FACT is directly interchangable and has identical performance specifications with FACT from National Semiconductor Corporation.

Logic Family Comparisons

General Characteristics (All Max Ratings)

Characteristics	Symbol	LS	ALS	HCMOS	FACT	Unit
Operating Voltage Range	$V_{CC/EE/DD}$	5 ± 5%	5 ± 10%	2.0 to 6.0	2.0 to 6.0	V
Operating Temperature	t_A 74 Series	0 to +70	0 to +70	–55 to +125	–40 to +85	°C
Input Voltage (limits)	V_{IH} (min)	2.0	2.0	3.15	3.15	V
	V_{IL} (max)	0.8	0.8	0.9	1.35	V
Output Voltage (limits)	V_{OH} (min)	2.7	2.7	V_{CC} – 0.1	V_{CC} – 0.1	V
	V_{OL} (max)	0.5	0.5	0.1	0.1	V
Input Current	I_{IH}	20	20	+1.0	+1.0	µA
	I_{IL}	–400	–200	–1.0	–1.0	µA
Output Current @ V_O (limit)	I_{OH}	–0.4	–0.4	–4.0 @ V_{CC} –0.8	–24 @ V_{CC} – 0.8	mA
	I_{OL}	8.0	8.0	4.0 @ 0.4 V	24 @ 0.4 V	mA
DC Noise Margin LOW/HIGH	DCM	0.3/0.7	0.4/0.7	0.8/1.25	1.25/1.25	V
DC Fanout (LSTTL)		20	20	10	60	

Speed/Power Characteristics (All Typical Ratings)

Characteristics	Symbol	LS	ALS	HCMOS	FACT	Unit
Quiescent Supply Current/Gate	I_G	0.4	0.2	0.0005	0.0005	mA
Power/Gate (Quiescent)	P_G	2.0	1.2	0.0025	0.0025	mW
Propagation Delay	t_P	7.0	5.0	8.0	4.8	ns
Speed Power Product	—	14	6.0	0.02	0.01	pJ
Clock Frequency D/FF	f_{max}	33	50	50	160	MHz

FACT CMOS Numeric Listing

MC74AC00 Series (–40 to +85°C)
Suffix: N = Plastic Dual In-line (all devices)

Device	Description	Pins
AC00	Quad 2-Input NAND Gate	14
AC02	Quad 2-Input NOR Gate	14
AC04	Hex Inverter	14
AC05	Hex Inverter w/Open Drain Output	14
AC08	Quad 2-Input AND Gate	14
AC10	Triple 3-Input NAND Gate	14
AC11	Triple 3-Input AND Gate	14
AC14	Hex Schmitt Trigger Inverter	14
AC20	Dual 4-Input NAND Gate	14
AC32	Quad 2-Input OR Gate	14
AC74	Dual D Flip-Flop	14
AC86	Quad 2-Input XOR Gate	14
AC109	Dual JK F/F Positive Edge Trigger w/Set & Clear	16
AC126	Quad Buffer 3-State	14
AC132	Quad 2-Input NAND Gate	14
AC138	1-of-8 Decoder/Demultiplexer	16
AC139	Dual 1-of-4 Decoder/Demultiplexer	16
AC153	Dual 4-Input Multiplexer	16
AC157	Quad 2-Input Multiplexer, Non-Inverting	16
AC158	Quad 2-Input Multiplexer, Inverting	16
AC162	4-Bit BCD Decade Counter	16
AC163	4-Bit Binary Counter, Sync. Reset	16
AC174	Hex D F/F w/Master Reset	16
AC190	4-Bit Up/Down Decade	16
AC194	4-Bit Bi-Directional Universal	16
AC240	Octal Buffer/Line Driver	20
AC241	Octal Buffer/Line Driver, 3-State	20
AC244	Octal Buffer/Line Driver	20
AC245	Octal Transceiver	20
AC251	8-Input Multiplexer, 3-State	16
AC253	Dual 4-Input Multiplexer w/3-State Outputs	16
AC256	Dual 4-Bit Addressable	16
AC257	Quad 2-Input Multiplexer Non-Inverting 3-State	16
AC258	Quad 2-Input Multiplexer Inverting 3-State	16

Device	Description	Pins
AC259	8-Bit Addressable	16
AC273	Octal D Flip-Flop	20
AC299	8-Input Universal Shift/Storage Register	20
AC350	4-Bit Shifter	16
AC352	Dual 4-Input Multiplexer	16
AC353	Dual 4-Input Multiplexer w/3-State Outputs	16
AC373	Octal D Latch	20
AC374	Octal D Latch	20
AC377	Octal D w/Clock Enable	20
AC378	6-Bit D-Input Storage	16
AC533	Octal Transparent Latch/3-State	20
AC540	Octal Buffer/Line Driver w/3-State Outputs	20
AC541	Octal Buffer/Line Driver	20
AC563	Octal D Latch w/3-State Outputs	20
AC564	Octal D Latch w/3-State Outputs	20
AC573	Octal D-Type Latch w/3-State Outputs	20
AC574	Octal D-Type Latch w/3-State Outputs	20
AC620	Octal Bus Transceiver Inverting 3-State	20
AC623	Octal Bus Transceiver Non-Inverting 3-State	20
AC640	Octal Bi-Directional Transceiver w/3-State Outputs	20
AC643	Octal Bus Transceiver w/3-State Outputs	20
AC646	Octal Bi-Directional Transceiver w/3-State Outputs Non-Inverting	24
AC648	Octal Transceiver/Register Inverting 3-State	24
AC810	Quad 2-Input XOR Inverting	14
AC4020	14-Stage Binary Ripple Counter	16
AC4040	12-Stage Binary Ripple Counter	16

TTL Compatible Devices

MC74ACT00 Series (–40 to +85°C)
Suffix: N = Plastic Dual In-line (all devices)

Device	Description	Pins
ACT00	Quad 2-Input NAND Gate	14
ACT02	Quad 2-Input NOR Gate	14
ACT04	Hex Inverter	14
ACT05	Hex Inverter w/Open Drain Output	14
ACT08	Quad 2-Input AND Gate	14
ACT10	Triple 3-Input NAND Gate	14
ACT11	Triple 3-Input AND Gate	14
ACT14	Hex Schmitt Trigger Inverting	14
ACT20	Dual 4-Input NAND Gate	14
ACT32	Quad 2-Input OR Gate	14
ACT74	Dual D Flip-Flop	14
ACT86	Quad 2-Input XOR Gate	14
ACT125	Quad Buffer 3-State	14
ACT126	Quad Buffer 3-State	14
ACT132	Quad 2-Input NAND Gate	14
ACT138	1-of-8 Decoder/Demultiplexer	16
ACT139	Dual 1-of-4 Decoder/Demultiplexer	16
ACT151	8-Input Data Selector/Multiplexer	16
ACT153	Dual 4-Input Multiplexer	16
ACT157	Quad 2-Input Multiplexer, Non-Inverting	16
ACT160	4-Bit BCD Decade Counter	16
ACT162	4-Bit BCD Decade Counter	16
ACT163	4-Bit Binary Counter, Sync. Reset	16
ACT174	Hex D Flip-Flop w/Master Reset	16
ACT194	4-Bit Bi-Directional Universal	16
ACT240	Octal Buffer/Line Driver	20
ACT241	Octal Buffer/Line Driver, 3-State	20
ACT244	Octal Buffer/Line Driver	20
ACT245	Octal Transceiver	20
ACT251	8-Input Multiplexer, 3-State	16
ACT253	Dual 4-Input Multiplexer w/3-State Outputs	16
ACT256	Dual 4-Bit Addressable	16
ACT258	Quad 2-Input Multiplexer Inverting 3-State	16
ACT259	8-Bit Addressable	16
ACT273	Octal D Flip-Flop	20

Device	Description	Pins
ACT350	4-Bit Shifter	16
ACT352	Dual 4-Input Multiplexer	16
ACT353	Dual 4-Input Multiplexer w/3-State Outputs	16
ACT373	Octal D Latch	20
ACT374	Octal D Latch	20
ACT377	Octal D w/Clock Enable	10
ACT378	6-Bit D-Input Storage	16
ACT521	8-Bit Identity Comparator	20
ACT533	Octal Transparent Latch/3-State	20
ACT534	Octal D Flip-Flop/3-State	20
ACT540	Octal Buffer/Line Driver w/3-State Outputs	20
ACT541	Octal Buffer/Line Driver	20
ACT563	Octal D Latch w/3-State Outputs	20
ACT564	Octal D Latch w/3-State Outputs	20
ACT573	Octal D-Type Latch w/3-State Outputs	20
ACT574	Octal D-Type Latch w/3-State Outputs	20
ACT620	Octal Bus Transceiver Inverting 3-State	20
ACT623	Octal Bus Transceiver Non-Inverting 3-State	20
ACT640	Octal Bi-Directional Transceiver w/3-State Outputs	20
ACT646	Octal Bi-Directional Transceiver w/3-State Outputs Non-Inverting	24
ACT648	Octal Transceiver/Register Inverting 3-State	24
ACT652	Octal Bus Transceiver/Register Non-Inverting 3-State	24
ACT810	Quad 2-Input XOR Inverting	14

Function Selection Guide

MC74AC(T)00 Series (–40 to +85°C)
Suffix: N = Plastic Dual In-line (all devices)

Device	Description
AND Gates	
08	Quad 2-Input AND Gate
11	Triple 3-Input AND Gate
NAND Gates	
00	Quad 2-Input NAND Gate
10	Triple 3-Input NAND Gate
20	Dual 4-Input NAND Gate
132	Quad 2-Input NAND Gate
OR/NOR/Exclusive-OR/NOR	
02	Quad 2-Input NOR Gate
32	Quad 2-Input OR Gate
86	Quad 2-Input XOR Gate
810	Quad 2-Input XOR Inverting
Inverters/Noninverters	
04	Hex Inverter
05	Hex Inverter
Multiplexers	
151	8-Input Data Selector/Multiplexer
153	Dual 4-Input Multiplexer
157	Quad 2-Input Multiplexer, Noninverting
158	Quad 2-Input Multiplexer, Inverting
251	8-Input Multiplexer, 3-State
253	Dual 4-Input Multiplexer w/3-State Outputs
257	Quad 2-Input Multiplexer Noninverting 3-State
258	Quad 2-Input Multiplexer Inverting 3-State
350	4-Bit Shifter
352	Dual 4-Input Multiplexer
353	Dual 4-Input Multiplexer w/3-State Outputs
Decoders/Demultiplexers	
138	1-of-8 Decoder/Demultiplexer
139	Dual 1-of-4 Decoder/Demultiplexer
Schmitt Triggers	
14	Hex Schmitt Trigger Inverter
Flip-Flops	
74	Dual D Flip-Flop
109	Dual JK F/F Pos. Edge Trig. w/Set & Clear
113	Dual JK F/F Neg. Edge Trig.
174	Hex D Flip-Flop w/Master Reset
273	Octal D Flip-Flop
374	Octal D Latch
377	Octal D w/Clock Enable
534	Octal D Flip-Flop/3-State
574	Octal D-Type Latch w/3-State Outputs
821	10-Bit Bus Interface Flip-Flop w/3-State
823	9-Bit Bus Interface Flip-Flop w/3-State
825	8-Bit Bus Interface Flip-Flop w/3-State

Device	Description
Latches	
256	Dual 4-Bit Addressable
259	8-Bit Addressable
373	Octal D Latch
533	Octal Transparent Latch/3-State
563	Octal D Latch w/3-State Ouputs
564	Octal D Latch w/3-State Outputs
573	Octal D-Type Latch w/3-State Outputs
841	10-Bit D Transparent Latch
843	9-Bit D Transparent Latch
845	8-Bit D Transparent Latch
Counters	
160	4-Bit BCD Decade Counter
162	4-Bit BCD Decade Counter
163	4-Bit Binary Counter, Sync. Reset
190	4-Bit Up/Down Decade
568	4-Bit Up/Down Decade Counter
569	4-Bit Up/Down Binary Counter
4020	14-Stage Binary Ripple Counter
4040	12-Stage Binary Ripple Counter
Shift Registers	
194	4-Bit Bi–Directional Universal
299	8-Input Universal Shift/Storage Register
378	6-Bit D-Input Storage
Buffers/Line Drivers	
125	Quad Buffer 3-State
126	Quad Buffer 3-State
240	Octal Buffer/Line Driver
241	Octal Buffer/Line Driver, 3-State
244	Octal Buffer/Line Driver
540	Octal Buffer/Line Driver w/3-State Outputs
541	Octal Buffer/Line Driver
Transceivers/Registered Transceivers	
245	Octal Transceiver
620	Octal Bus Transceiver Inverting 3-State
623	Octal Bus Transceiver Noninverting 3-State
640	Octal Bi-Directional Transceiver w/3-State Outputs
643	Octal Bus Transceiver w/3-State Outputs
646	Octal Bi-Directional Transceiver w/3-State Outputs Noninverting
648	Octal Transceiver/Register Inverting 3-State
652	Octal Bus Transceiver/Register Noninverting 3-State
657	Oct. Bi-Directional Transceiver w/8-Bit Parity Gen./Check 3-State
Identity Comparators	
521	8-Bit Identity Comparator

CMOS Logic Surface Mount

Why Surface Mount?

Surface Mount Technology is now being utilized to offer answers to many problems that have been created in the use of insertion technology.

Limitations have been reached with insertion packages and PC board technology. Surface Mount Technology offers the opportunity to continue to advance the State-of-the-Art designs that cannot be accomplished with Insertion Technology.

Surface Mount Packages allow more optimum device performance with the smaller Surface Mount configuration. Internal lead lengths, parasitic capacitance and inductance that placed limitations on chip performance have been reduced.

The lower profile of Surface Mount Packages allows more boards to be utilized in a given amount of space. They are stacked closer together and utilize less total volume than insertion populated PC boards.

Printed circuit costs are lowered with the reduction of the number of board layers required. The elimination or reduction of the number of plated through holes in the board, contributes significantly to lower PC board prices.

Automatic placement equipment is available that can place Surface Mount components at the rate of a few thousand per hour to hundreds of thousands of components per hour.

Surface Mount Technology is cost effective, allowing the manufacturer the opportunity to produce smaller units and/or offer increased functions with the same size product.

Surface Mount assembly does not require the preparation of components that are common on insertion technology lines. Surface Mount components are sent directly to the assembly line, eliminating an intermediate step.

For additional surface mount information, order Surface Mount Products Selector guide (SG127/D).

FACT CMOS SOIC Numeric Listing

MC74AC(T)00 Series (–40 to +85°C)
Suffix: D = Narrow Body SOIC
DW = Wide Body SOIC

Device	Description	Pins	Suffix
AC00	Quad 2-Input NAND Gate	14	D
AC02	Quad 2-Input NOR Gate	14	D
AC04	Hex Inverter	14	D
AC05	Hex Inverter w/Open Drain Output	14	D
AC08	Quad 2-Input AND Gate	14	D
AC10	Triple 3-Input NAND Gate	14	D
AC11	Triple 3-Input AND Gate	14	D
AC14	Hex Schmitt Trigger Inverter	14	D
AC32	Quad 2-Input OR Gate	14	D
AC74	Dual D Flip-Flop		
AC86	Quad 2-Input XOR	14	D
AC109	Dual J-K F/F	16	D
AC132	Quad 2-Input NAND	14	D
AC138	1-of-8 Decoder/Demultiplexer	16	D
AC139	Dual 1-of-4 Decoder/Demultiplexer	16	D
AC151	8-Input Data Selector/Multiplexer	16	D
AC153	Dual 4-Input Multiplexer	16	D
AC157	Quad 2-Input Multiplexer	16	D
AC163	4-Bit Binary Counter, Sync. Reset	16	D
AC174	Hex D Flip-Flop w/Master Reset	16	D
AC190	4-Bit Up/Down Dec. Cntr.	16	D
AC240	Octal Buffer/Line Driver	20	DW
AC241	Octal Buffer/Line	20	DW
AC244	Octal Buffer/Line Driver	20	DW
AC245	Octal Transciever	20	DW
AC253	Dual 4-Input MUX	16	D
AC256	Dual 4-Bit Addressable Latch	16	D
AC258	Quad 2-Input Inverting 3-State MUX	16	D
AC273	Octal D Flip-Flop	20	DW
AC299	Univ. Ship/Storage	20	DW
AC352	Dual A-Input Multiplexer	16	D
AC353	Dual 4-Input MUX	16	D
AC373	Octal D Latch	20	DW
AC374	Octal D Latch	20	DW
AC377	Octal D-F/F	20	DW
AC378	6-Bit D-Input Register	16	D
AC251	8-Bit Identity Comparator	20	DW
AC540	Octal Inverter Buffer	20	DW
AC541	Octal Buffer/Line Driver	20	DW
AC563	Octal Transparator Latch	20	DW
AC564	Octal D-F/F 3-State	20	DW
AC573	Octal D Latch	20	DW
AC574	Octal D-F/F Broadside	20	DW
AC640	Octal Transceiver	20	DW
AC646	Octal Transceiver Register	24	DW
AC810	Quad 2-Input XNOR	14	D
AC4020	14-State Binary Ripple Counter	16	D
AC4040	12-State Binary Ripple Counter	16	D

TTL Compatible Devices

Device	Description	Pins	Suffix
ACT00	Quad 2-Input NAND Gate	14	D
ACT02	Quad 2-Input NOR Gate	14	D
ACT04	Hex Inverter	14	D
ACT05	Hex Inverter	14	D
ACT08	Quad 2-Input AND Gate	14	D
ACT10	Triple 3-Input NAND	14	D
ACT11	Triple 3-Input AND Gate	14	D
ACT14	Hex Schmitt Trigger Inverting	14	D
ACT32	Quad 2-Input NOR Gate	14	D
ACT74	Dual D Flip-Flop	14	D
ACT86	Quad 2-Input XOR	14	D
ACT109	Dual J-K F/F	16	D
ACT132	Quad 2-Input NAND	14	D
ACT138	1-of-8 Decoder/Demultiplexer	16	D
ACT139	Dual 1-of-4 Decoder/Demultiplexer	16	D
ACT151	8-Input Data Selector/Multiplexer	16	D
ACT153	Dual 4-Input Multiplexer	16	D
ACT157	Quad 2-Input Multiplexer	16	D
ACT160	BCD Decade Counter	16	D
ACT162	BCD Decade Counter	16	D
ACT240	Octal Buffer/Line Driver	20	DW
ACT241	Octal Buffer/Line	20	DW
ACT244	Octal Buffer/Line Driver	20	DW
ACT245	Octal Transceiver	20	DW
ACT251	8-Input Multiplexer	16	D
ACT253	Dual 4-Input MUX	16	DW
ACT256	Dual 4-Bit Addressable Latch	16	D
ACT258	Quad 2-Input Inverting 3-State MUX	16	D
ACT273	Octal D Flip-Flop	20	DW
ACT352	Dual A-Input Multiplexer	20	DW
ACT353	Dual 4-Input MUX	16	D
ACT373	Octal D Latch	20	DW
ACT374	Octal D Latch	20	DW
ACT377	Octal D-F/F	20	DW
ACT378	6-Bit D-Input Register	16	D
ACT521	8-Bit Identity Comparator	20	DW
ACT540	Octal Inverter Buffer	20	DW
ACT541	Octal Buffer	20	DW
ACT563	Octal Transparator Latch	20	DW
ACT564	Octal D-F/F 3-State	20	DW
ACT573	Octal D Latch	20	DW
ACT574	Octal D-F/F Broadside	20	DW
ACT640	Octal Transceiver	20	DW
ACT810	Quad 2-Input XNOR	14	D

Function Selector Guide and Compatibility Cross Reference

High Speed CMOS Logic

Motorola's HIGH-SPEED CMOS logic family consists of a full line of products that are pinout compatible with many LSTTL and MC14000B standard CMOS series devices.

Use of the latest silicon-gate processing technology allows the HIGH-SPEED CMOS family to combine the switching speeds and operating frequencies of LSTTL with the lower-power consumption and high-noise immunity advantages of CMOS.

- Wide Operating Voltage Range —
  HC/HCU: 2–6 V Recommended
  HCT: 5 V ±10% Recommended
- High Noise Immunity
- High Fanout —
  Sandard Outputs Drive 10 LSTTL Load (4 mA)
  Bus Outputs Drive 15 LSTTL Loads (6 mA)
- Wide Operating Temperature Range: –55 to 125°C
- Low Input Current
- Low Power Dissipation
- Improved ESD and Latch-Up Performance
- Direct Pin Compatibility with LSTTL Parts (HCXXX or HCTXXX) and CMOS Parts (HC4XXX)

CONTENTS

Selector Guide Contents

This selector guide contains only devices in production at Motorola's Logic I.C. Division, accurate to the date of publication.

The Logic I.C. Division publishes a New product Calendar quarterly that reflects any recent device releases and the approximate dates new devices are expected to be released.

There are many new devices in various stages of development on Motorola's Logic I.C. Division design schedule. Call your nearest Motorola sales office for the current status of any device not listed within this guide

- Input Logic Compatible with CMOS Parts (HCXXX or HC4XXX) and/or LSTTL Parts (HCTXXX)
- Surface Mount (SOIC) Product Available
- Proven Reliability and Process — Reliability Report Available From Your Local Motorola Sales Office

DEVICE NOMENCLATURE

MC VV WWW XXXX Y

Example:

Motorola Circuit Identifier — MC

Family — VV
- **74 Series (–55 to +125°C)**
- **54 Series (–55 to +125°C)**

High-Speed CMOS Specification Identifier — WWW
- **HC for Buffered High-Speed CMOS**
- **HCU for Unbuffered High-Speed CMOS***
- **HCT for TTL Input Compatible CMOS***

Basic Device Type — XXXX
- **XX(X) Same Function and Pin Configuration as LSTTL**
- **4XXX Same Function and Pin Configuration as CMOS 14000**
- **7XX(X) Variation of LSTTL or CMOS 14000 Device**

Package Type — Y
- **N for Plastic (74 Series Only)**
- **J for Ceramic (54 Series Only)**
- **D for 150 mil Plastic SOIC (74 Series Only)**
- **DW for 300 mil Plastic SOIC (74 Series Only)**

***Not Available On All Devices**

Numerical Index

MC54/74HC00 Series (–55 to +125°C)

Device Number	Function	Pins
HC00A	Quad 2-Input NAND Gate	14
HC02A	Quad 2-Input NOR Gate	14
HC03A	Quad 2-Input NAND Gate with Open-Drain Outputs	14
HC04A	Hex Inverter	14
HCU04	Hex Unbuffered Inverter	14
HC08A	Quad 2-Input AND Gate	14
HC10	Triple 3-Input NAND Gate	14
HC11	Triple 3-Input AND Gate	14
HC14A	Hex Schmitt Trigger Inverter	14
HC20	Dual 4-Input NAND Gate	14
HC27	Triple 3-Input NOR	14
HC30	8-Input NAND Gate	14
HC32A	Quad 2-Input OR Gate	14
HC42	1-of-10 Decoder	16
HC51	2 x 2-Input, 2 x 3-Input AND-NOR Gate	14
HC58	2 x 2-Input, 2 x 3-Input AND-OR Gate	14
HC73	Dual J-K Flip/Flop with Reset	14
HC74A	Dual D Flip-Flop with Set and Reset	14
HC75	Dual 2-Bit Transparent Latch	16
HC76	Dual J-K Flip/Flop with Set and Reset	16
HC85	4-Bit Magnitude Comparator	16
HC86	Quad 2-Input Exclusive OR Gate	14
HC107	Dual J-K Flip-Flop with Reset	14
HC109	Dual J-K Flip-Flop with Set and Reset	16
HC112	Dual J-K Flip-Flop with Set and Reset	16
HC113	Dual J-K Flip-Flop with Set	14
HC125A	Quad 3-State Noninverting Buffer	14
HC126A	Quad 3-State Noninverting Buffer	14
HC132A	Quad 2-Input NAND Gate with Schmitt Triggered Inputs	14
HC133	13-Input NAND Gate	16
HC137	1-of-8 Decoder/Demultiplexer with Address Latch	16
HC138A	1-of-8 Decoder/Demultiplexer	16
HC139A	Dual 1-of-4 Decoder/ Demultiplexer	16
HC147	Decimal-to-BCD Decoder	16
HC151	8-Input Data Selector/ Multiplexer	16
HC153	Dual 4-Input Data Selector/ Multiplexer	16
HC154	1-of-16 Decoder/ Demultiplexer	24
HC157A	Quad 2-Input Noninverting Data Selector/Multiplexer	16
HC160	Presettable BCD Counter with Asynchronous Reset	16
HC161A	Presettable 4-Bit Binary Counter with Asynchronous Reset	16
HC162	Presettable BCD Counter with Synchronous Reset	16
HC163A	Presettable 4-Bit Counter with Synchronous Reset	16
HC164	8-Bit Serial-Input/Parallel-Output Shift Register	14
HC165	8-Bit Serial or Parallel-Input/ Serial-Output Shift Register	16
HC173	Quad 3-State D Flip-Flop with Common Clock and Reset	16
HC174A	Hex D Flip-Flop with Common Clock and Reset	16
HC175	Quad D Flip-Flop with Common Clock and Reset	16
HC194	4-Bit Bidirectional Universal Shift Register	16
HC195	4-Bit Universal Shift Register	16
HC237	1-of-8 Decoder/Demultiplexer with Address Latch	16
HC240A	Octal 3-State Inverting Buffer/Line Driver/Line Receiver	20
HC241A	Octal 3-State Noninverting Buffer/Line Driver/Receiver	20
HC242	Quad 3-State Inverting Bus Transceiver	14
HC244A	Quad 3-State Noninverting Buffer/Line Driver/Receiver	20
HC245A	Octal 3-State Noninverting Bus Transceiver	20
HC251	8-Input Data Selector/ Multiplexer with 3-State Outputs	16
HC253	Dual 4-Input Data Selector/ Multiplexer with 3-State Outputs	16

HIGH-SPEED CMOS LOGIC — NUMERICAL INDEX (continued)

Device Number	Function	Pins
HC257	Quad 2-Input Data Selector/ Multiplexer with 3-State Outputs	16
HC259	8-Bit Addressable Latch/1-of-8 Decoder	16
HC273A	Octal D Flip-Flop with Common Clock and Reset	20
HC280	9-Bit Odd/Even Parity Generator/Checker	14
HC299	8-Bit Bidirectional Universal Shift Register with Parallel I/O	20
HC354	8-Input Data Selector/ Multiplexer with Data/Address Latches and 3-State Output	20
HC365	Hex 3-State Noninverting Buffer with Common Enables	16
HC366	Hex 3-State Inverting Buffer with Common Enables	16
HC367	Hex 3-State Noninverting Buffer with Separate 2-Bit/4-Bit Sections	16
HC368	Hex 3-State Inverting Buffer with Separate 2-Bit/4-Bit Sections	16
HC373A	Octal 3-State Noninverting Transparent Latch	20
HC374A	Octal 3-State Noninverting D Flip-Flop	20
HC390	Dual 4-Stage Binary Ripple Counter with ±2 and ±5 Sections	16
HC393	Dual 4-Stage Binary Ripple Counter	14
HC533A	Octal 3-State Inverting Transparent Latch	20
HC534A	Octal 3-State Inverting D Flip-Flop	20
HC540	Octal 3-State Inverting Buffer/Line Driver/Receiver	20
HC541	Octal 3-State Noninverting Buffer/Line Driver/Receiver	20
HC563	Octal 3-State Inverting Transparent Latch	20
HC564	Octal 3-State Inverting D Flip-Flop	20
HC573A	Octal 3-State Noninverting Transparent Latch	20
HC574A	Octal 3-State Noninverting D Flip-Flop	20
HC589	8-Bit Serial/Parallel-Input/Serial-Output Shift Register 3-State	16
HC595A	8-Bit Serial/Parallel-Input/Serial-Output Shift Register Latched 3-State	16
HC597	8-Bit Serial/Parallel-Input/Serial-Output Shift Register with Input Latch	16

Device Number	Function	Pins
HC640A	Octal 3-State Inverting Bus Transceiver	20
HC646	Octal 3-State Noninverting Bus Transceiver and D Flip-Flop	24
HC648	Octal 3-State Inverting Bus Transceiver and D Flip-Flop	24
HC688	8-Bit Equality Comparator	20
HC4002	Dual 4-Input NOR Gate	14
HC4016	Quad Analog Switch/ Multiplexer/Demultiplexer	14
HC4017	Decade Counter	16
HC4020A	14-Stage Binary Ripple Counter	16
HC4024	7-Stage Binary Ripple Counter	14
HC4040	12-Stage Binary Ripple Counter	16
HC4046A	Phase-Locked-Loop with VCO	16
HC4049	Hex Inverting Buffer/Logic-Level Down Converter	16
HC4050	Hex Noninverting Buffer/Logic-Level Down Converter	16
HC4051	8-Channel Analog Multiplexer/ Demultiplexer	16
HC4052	Dual 4-Channel Analog Multiplexer/Demultiplexer	16
HC4053	Triple 2-Channel Analog Multiplexer/Demultiplexer	16
HC4060A	14-Stage Binary Ripple Counter	16
HC4066	Quad Analog Switch/ Multiplexer/Demultiplexer	14
HC4075	Triple 3-Input OR Gate	14
HC4078	8-Input NOR/OR Gate	14
HC4316	Quad Analog Switch/ Multiplexer/Demultiplexer with Separate Analog Digital Power Supplies	16
HC4351	8-Channel Analog Multiplexer/ Demultiplexer with Address Latch	20
HC4352	Dual 4-Channel Analog Multiplexer/Demultiplexer with Address Latch	20
HC4353	Triple 2-Channel Analog Multiplexer/Demultiplexer with Address Latch	20
HC4511	BCD-to-7 Segment Latch/ Decoder/Display/Driver	16
HC4514	1-of-16 Decoder/Demultiplexer with Address Latch	24
HC4538A	Dual Precision Monostable Multivibrator (Retriggerable, Resettable)	16
HC7266	Quad 2-Input Exclusive NOR Gate	14

TTL Compatible Devices

MC54/74 HCT00 Series (–55° to +125° C)

Device Number	Function	Pins
HCT00A	Quad 2-Input NAND Gate	14
HCT04A	Hex Inverter	14
HCT08A	Quad 2-Input AND Gate	14
HCT14A	Hex Schmitt Trigger Inverter	14
HCT32A	Quad 2-Input OR Gate	14
HCT74A	Dual D Flip-Flop with Set and Reset	14
HCT138A	1-of-8 Decoder/Demultiplexer	16
HCT157A	Quad 2-Input Noninverting Data Selector/Multiplexer	16
HCT158A	Quad 2-Input Inverting Data Selector/Multiplexer	16
HCT161A	Presettable 4-Bit Binary Counter with Asynchronous Reset	16
HCT163A	Presettable 4-Bit Counter with Synchronous Reset	16
HCT174A	Hex D Flip-Flop with Common Clock and Reset	16
HCT240A	Octal 3-State Inverting Buffer/ Line Driver/Receiver	20
HCT241A	Octal 3-State Noninverting Buffer/Line Driver/Receiver	20
HCT244A	Quad 3-State Noninverting Buffer/Line Driver/Receiver	20

Device Number	Function	Pins
HCT245A	Octal 3-State Noninverting Bus Transceiver	20
HCT273A	Octal D Flip-Flop with Common Clock and Reset	20
HCT373A	Octal 3-State Noninverting Transparent Latch	20
HCT374A	Octal 3-State Noninverting D Flip-Flop	20
HCT533A	Octal 3-State Inverting Transparent Latch	20
HCT534A	Octal 3-State Inverting D Flip-Flop	20
HCT540	Octal 3-State Inverting Buffer/ Line Driver/Receiver	20
HCT541	Octal 3-State Noninverting Buffer/Line Driver/Receiver	20
HCT573A	Octal 3-State Noninverting Transparent Latch	20
HCT574A	Octal 3-State Noninverting D Flip-Flop	20
HCT640A	Octal 3-State Inverting Bus Transceiver	20

Bus Compatible Devices

Device Number	Function
HC125A	Buffers/Inverters
HC126A	Buffers/Inverters
HC173	Flip-Flops
HC240A	Buffers/Inverters
HCT240A	Buffers/Inverters
HC241A	Buffers/Inverters
HCT241A	Buffers/Inverters
HC242	Bus Transceivers, Buffers/Inverters
HC244A	Buffers/Inverters
HCT244A	Buffers/Inverters
HC245A	Bus Transceivers, Buffers/Inverters
HCT245A	Bus Transceivers, Buffers/Inverters
HC251	Digital Data Selectors/Multiplexers
HC253	Digital Data Selectors/Multiplexers
HC257	Digital Data Selectors/Multiplexers
HC299	Shift Registers
HC354	Digital Data Selectors/Multiplexers
HC365	Buffers/Inverters
HC366	Buffers/Inverters
HC367	Buffers/Inverters
HC368	Buffers/Inverters
HC373A	Latches
HCT373A	Latches

Device Number	Function
HC374A	Flip-Flops
HCT374A	Flip-Flops
HC533A	Latches
HCT533A	Latches
HC534A	Flip-Flops
HCT534A	Flip-Flops
HC540	Buffers/Inverters
HCT540	Buffers/Inverters
HC541	Buffers/Inverters
HCT541	Buffers/Inverters
HC563	Latches
HC564	Flip-Flops
HC573A	Latches
HCT573A	Latches
HC574A	Flip-Flops
HCT574A	Flip-Flops
HC589	Shift Registers
HC595A	Shift Registers
HC640A	Bus Transceivers, Buffers/Inverters
HCT640A	Bus Transceivers, Buffers/Inverters
HC646	Bus Transceivers, Flip-Flops
HC648	Bus Transceivers, Flip-Flops

Selector Guide by Function

Basic Device Type	Function	Functional Equivalent (1) CMOS Device MC1XXXX or CDXXXX
BUFFERS/INVERTERS		
04	Hex Inverter	*4069
14	Hex Schmitt-Trigger Inverter	4584
125	Quad 3-State Noninverting Buffer	
126	Quad 3-State Noninverting Buffer	
240	Octal 3-State Inverting Buffer/Line Driver/Line Receiver	
241	Octal 3-State Noninverting Buffer/Line Driver/Line Receiver	
242	Quad 3-State Inverting Bus Transceiver	
244	Octal 3-State Noninverting Buffer/Line Driver/Line Receiver	
245	Octal 3-State Noninverting Bus Transceiver	
365	Hex 3-State Noninverting Buffer with Common Enables	
366	Hex 3-State Inverting Buffer with Common Enables	
367	Hex 3-State Noninverting Buffer with Separate 2-Bit and 4-Bit Sections	4503
368	Hex 3-State Inverting Buffer with Separate 2-Bit and 4-Bit Sections	
540	Octal 3-State Inverting Buffer/Line Driver/Line Receiver	
541	Octal 3-State Noninverting Buffer/Line Driver/Line Receiver	
640	Octal 3-State Inverting Bus Transceiver	
4049	Hex Inverting Buffer/Logic-Level Down Converter	4049
4050	Hex Noninverting Buffer/Logic-Level Down Converter	4050
GATES		
00	Quad 2-Input NAND Gate	4011
02	Quad 2-Input NOR Gate	4001
03	Quad 2-Input NAND Gate with Open-Drain Outputs	*4011
08	Quad 2-Input AND Gate	4081
10	Triple 3-Input NAND Gate	4023
11	Triple 3-Input AND Gate	4073
20	Dual 4-Input NAND Gate	4012
27	Triple 3-Input NOR Gate	4025
30	8-Input NAND Gate	4068
32	Quad 2-Input OR Gate	4071
51	2-Wide, 2-Input/2-Wide, 3-Input AND-NOR Gates	*4506
58	2-Wide, 2-Input/2-Wide, 3-Input AND-OR Gates	*4506
86	Quad 2-Input Exclusive OR Gate	4070
132	Quad 2-Input NAND Gate with Schmitt-Trigger Inputs	4093
133	13-Input NAND Gate	
386	Quad 2-Input Exclusive OR Gate	
4002	Dual 4-Input NOR Gate	4002
4075	Triple 3-Input OR Gate	4075
4078	8-Input NOR/OR Gate	4078
7266	Quad 2-Input Exclusive NOR Gate	4077
SCHMITT TRIGGERS		
14	Hex Schmitt-Trigger Inverter	4584
132	Quad 2-Input NAND Gate with Schmitt-Trigger Inputs	4093

(1) Parts shown are functional equivalent *except* when preceded by an asterisk (*), indicating a suggested alternative.

HIGH-SPEED CMOS LOGIC — SELECTOR GUIDE (continued)

Basic Device Type	Function	Functional Equivalent (1) CMOS Device MC1XXXX or CDXXXX

BUS TRANSCEIVERS

242	Quad 3-State Inverting Bus Transceiver	
245	Octal 3-State Noninverting Bus Transceiver	
640	Octal 3-State Inverting Bus Transceiver	
646	Octal 3-State Noninverting Bus Transceiver and D Flip-Flop	
648	Octal 3-State Inverting Bus Transceiver and D Flip-Flop	

LATCHES

75	Dual 2-Bit Transparent Latch	
259	8-Bit Addressable Latch/1-of-8 Decoder	
373	Octal 3-State Noninverting Transparent Latch	
533	Octal 3-State Inverting Transparent Latch	
563	Octal 3-State Inverting Transparent Latch	
573	Octal 3-State Noninverting Transparent Latch	

FLIP-FLOPS

73	Dual J-K Flip-Flop with Reset	*4027
74	Dual D Flip-Flop with Set and Reset	*4013
76	Dual J-K Flip-Flop with Set and Reset	*4027
107	Dual J-K Flip-Flop with Reset	*4027
109	Dual J-$\overline{K}$ Flip-Flop with Set and Reset	*4027
112	Dual J-K Flip-Flop with Set and Reset	*4027
113	Dual J-K Flip-Flop with Set	*4027
173	Quad 3-State D Flip-Flop with Common Clock and Reset	4076
174	Hex D Flip-Flop with Common Clock and Reset	4174
175	Quad D Flip-Flop with Common Clock and Reset	4175
273	Octal D Flip-Flop with Common Clock and Reset	
374	Octal 3-State Noninverting D Flip-Flop	
534	Octal 3-State Inverting D Flip-Flop	
564	Octal 3-State Inverting D Flip-Flop	
574	Octal 3-State Noninverting D Flip-Flop	
646	Octal 3-State Noninverting Bus Transceiver and D Flip-Flop	
648	Octal 3-State Inverting Bus Transceiver and D Flip-Flop	

DIGITAL DATA SELECTORS/MULTIPLEXERS ENCODERS

147	Decimal-to-BCD Encoder	
151	8-Input Data Selector/Multiplexer	*4512
153	Dual 4-Input Data Selector/Multiplexer	4539
157	Quad 2-Input Noninverting Data Selector/Multiplexer	*4519
158	Quad 2-Input Inverting Data Selector/Multiplexer	*4519
251	8-Input Data Selector/Multiplexer with 3-State Outputs	*4512
253	Dual 4-Input Data Selector/Multiplexer with 3-State Outputs	*4539
257	Quad 2-Input Data Selector/Multiplexer with 3-State Outputs	*4519
354	8-Input Data Selector/Multiplexer with Data and Address Latches and 3-State Outputs	*4512

DECODERS/DEMULTIPLEXERS/DISPLAY DRIVERS

42	1-of-10 Decoder	*4028
137	1-of-8 Decoder/Demultiplexer with Address Latch	*4028
138	1-of-8 Decoder/Demultiplexer	*4028
139	Dual 1-of-4 Decoder/Demultiplexer	4556
154	1-of-16 Decoder/Demultiplexer	*4515
237	1-of-8 Decoder/Demultiplexer with Address Latch	*4028
259	8-Bit Addressable Latch/1-of-8 Decoder	
4511	BCD-to-Seven-Segment Latch/Decoder/Display Driver	4511
4514	1-of-16 Decoder/Demultiplexer with Address Latch	4514, *4515

(1) Parts shown are functional equivalent *except* when preceded by an asterisk (*), indicating a suggested alternative.

HIGH-SPEED CMOS LOGIC — SELECTOR GUIDE (continued)

Basic Device Type	Function	Functional Equivalent (1) CMOS Device MC1XXXX or CDXXXX
ANALOG SWITCHES/MULTIPLEXERS/DEMULTIPLEXERS		
4016	Quad Analog Switch	
4051	8-Channel Analog Multiplexers/Demultiplexers	4051
4052	Dual 4-Channel Analog Multiplexer/Demultiplexer	4052
4053	Triple 2-Channel Analog Multiplexer/Demultiplexer	4053
4066	Quad Analog Switch/Multiplexer/Demultiplexer	4066, 4016
4316	Quad Analog Switch/Multiplexer/Demultiplexer with Separate Analog and Digital Power Supplies	*4016
4351	8-Channel Analog Multiplexer/Demultiplexer with Address Latch	*4051
4352	Dual 4-Channel Analog Multiplexer/Demultiplexer with Address Latch	*4052
4353	Triple 2-Channel Analog Multiplexer/Demultiplexer with Address Latch	*4053
SHIFT REGISTERS		
164	8-Bit Serial-Input/Parallel-Output Shift Register	*4034
165	8-Bit Serial- or Parallel-Input/Serial-Output Shift Register	*4021
194	4-Bit Bidirectional Universal Shift Register	4194
195	4-Bit Universal Shift Register	*4035
299	8-Bit Bidirectional Universal Shift Register with Parallel I/O	
589	8-Bit Serial- or Parallel-Input/Serial-Output Shift Register with 3-State Output	
595	8-Bit Serial-Input/Serial- or Parallel-Output Shift Register with Latched 3-State Outputs	*4034
597	8-Bit Serial- or Parallel-Input/Serial-Output Shift Register with Input Latch	
COUNTERS		
160	Presettable BCD Counter with Asynchronous Reset	4160
161	Presettable 4-Bit Binary Counter with Asynchronous Reset	4161
162	Presettable BCD Counter with Synchronous Reset	4162
163	Presettable 4-Bit Binary Counter with Synchronous Reset	4163
390	Dual 4-Stage Binary Ripple Counter with ÷2 and ÷5 Sections	
393	Dual 4-Stage Binary Ripple Counter	*4520
4017	Decade Counter	4017
4024	7-Stage Binary Ripple Counter	4024
MISCELLANEOUS DEVICES		
85	4-Bit Magnitude Comparator	*4585
123	Dual Retriggerable Monostable Multivibrator with Reset	
221	Dual Monostable Multivibrator	
280	9-Bit Odd/Even Parity Generator/Checker	*4531
423	Dual Monostable Multivibrator	
688	8-Bit Equality Comparator	
4538	Dual Precision Monostable Multivibrator (Retriggerable, Resettable)	4538, 4528
4046	Phase-Locked-Loop with VCO	

(1) Parts shown are functional equivalent *except* when preceded by an asterisk (*), indicating a suggested alternative.

54/74 Series Cross-Reference

This cross-reference is intended to serve as a guide for replacement of competitive devices with Motorola devices. The left hand column is arranged in alphanumeric sequence by various manufacturers' prefixes. The right column contains what is believed to be the Motorola functional equivalent.

Motorola does not assume any liability arising out of the application or use of any product listed and suggests that data sheets be consulted to assure compatibility.

Part Number	Motorola Replacement
CD54HCxxxF	**MC54HCxxxJ**
CD54HCTxxxF	**MC54HCTxxxJ**
CD54HCUxxxF	**MC54HCUxxxJ**
CD74HCxxxE	**MC74HCxxxN**
CD74HCxxxM*	**MC74HCxxxD/DW**
CD74HCTxxxE	**MC74HCTxxxN**
CD74HCTxxxM*	**MC74HCTxxxD/DW**
CD74HCUxxxE	**MC74HCUxxxN**
CD74HCUxxxM*	**MC74HCUxxxD/DW**
HD74HCxxxFP*	**MC74HCxxxD/DW**
HD74HCxxxP	**MC74HCxxxN**
HD74HCTxxxFP*	**MC74HCTxxxD/DW**
HD74HCTxxxP	**MC74HCTxxxN**
HD74HCUxxxFP	**MC74HCUxxxD/DW**
HD74HCUxxxP	**MC74HCUxxxN**
KS54HCTLSxxxJ	**MC54HCTxxxJ**
KS74HCTLSxxxN	**MC74HCTxxxN**
M54HCxxxF1	**MC54HCxxxJ**
M54HCTxxxF1	**MC54HCTxxxJ**
M54HCUxxxF1	**MC54HCUxxxJ**
MC74HCxxxB1	**MC74HCxxxN**
M74HCxxxC1**	**MC74HCxxxD/DW**
M74HCTxxxB1	**MC74HCxxxN**
M74HCTxxxC1**	**MC74HCTxxxD/DW**
M74HCUxxxB1	**MC74HCUxxxN**
M74HCUxxxC1**	**MC74HCUxxxD/DW**
MD74HCTxxxRE	**MC74HCTxxxN**
MM54HCxxxJ	**MC54HCxxxJ**
MM54HCTxxxJ	**MC54HCTxxxJ**
MM54HCUxxxJ	**MC54HCUxxxJ**
MM74HCxxxM*	**MC74HCxxxD/DW**
MM74HCxxxN	**MC74HCxxxN**
MM74HCTxxxM*	**MC74HCTxxxD/DW**
MM74HCTxxxN	**MC74HCTxxxN**
MM74HCUxxxM*	**MC74HCUxxxD/DW**

Part Number	Motorola Replacement
MM74HCUxxxN	**MC74HCUxxxN**
MN74HCxxx	**MC74HCxxxN**
MN74HCxxxS*	**MC74HCxxxD/DW**
PC74HCxxxP	**MC74HCxxxN**
PC74HCxxxT*	**MC74HCxxxD/DW**
PC74HCTxxxP	**MC74HCTxxxN**
PC74HCTxxxT*	**MC74HCTxxxD/DW**
PC74HCUxxxP	**MC74HCUxxxN**
PC74HCUxxxT*	**MC74HCUxxxD/DW**
PC74HCxxxP	**MC74HCxxxN**
PC74HCxxxT*	**MC74HCxxxD/DW**
PC74HCTxxxP	**MC74HCTxxxN**
PC74HCTxxxT*	**MC74HCTxxxD/DW**
PC74HCUxxxP	**MC74HCUxxxN**
PC74HCUxxxT*	**MC74HCUxxxD/DW**
SI74HCTxxxC**	**MC74HCTxxxD/DW**
SI74HCTxxxP	**MC74HCTxxxN**
SN54HCTxxxJ/JT	**MC54HCTxxxJ**
SN54HCUxxxJ/JT	**MC54HCUxxxJ**
SN74HCxxxD/DW*	**MC74HCxxxD/DW**
SN74HCxxxN/NT	**MC74HCxxxN**
SN74HCTxxxD/DW*	**MC74HCTxxxD/DW**
SN74HCTxxxN/NT	**MC74HCTxxxN**
SN74HCUxxxD/DW*	**MC74HCUxxxD/DW**
SN74HCUxxxN/NT	**MC74HCUxxxN**
TC74HCxxxF*	**MC74HCxxxD/DW**
TC74HCxxxP	**MC74HCxxxN**
TC74HCTxxxF*	**MC74HCTxxxD/DW**
TC74HCTxxxP	**MC74HCTxxxN**
TC74HCUxxxF*	**MC74HCUxxxD/DW**
TC74HCUxxxP	**MC74HCUxxxN**
ZX74HCTLSxxxN	**MC74HCTxxxN**

*SO package dimensions may not be the same. Consult manufacturers' data sheet.
**SO package substituted for chip carrier type package.

Standard 14000 Series CMOS Logic

DEVICE NOMENCLATURE

MC1 4xxx Y ZZ

Motorola Circuit Identifier

Basic Device Type

Identifier (per JEDEC Standard)
- B — Buffered Outputs
- UB — Unbuffered Outputs

Package and Temperature Range
- CL Cerdip (Frit-Seal Ceramic) –55°C to +125°C
- CP Epoxy (Plastic) –55°C to +125°C
- D/DW Small Outline Package (Plastic) –55°C to +125°C

Numerical Index

MC14000 Series (–55°C to +125°C)

Device	Function	Pins
MC14000U	Dual 3-Input NOR Gate plus Inverter	14
MC14001	Quad 2-Input NOR Gate	14
MC14001U	Quad 2-Input NOR Gate	14
MC14002	Dual 4-Input NOR Gate	14
MC14002U	Dual 4-Input NOR Gate	14
MC14006	18-Bit Static Shift Register	14
MC14007U	Dual Complementary Pair plus Inverter	14
MC14008	4-Bit Full Adder	16
MC14011	Quad 2-Input NAND Gate	14
MC14011U	Quad 2-Input NAND Gate	14
MC14012	Dual 4-Input NAND Gate	14
MC14012U	Dual 4-Input NAND Gate	14
MC14013	Dual D Flip-Flop	14
MC14014	8-Bit Static Shift Register	16
MC14015	Dual 5-Bit Static Shift Register	16
MC14016	Quad Analog Switch Quad Multiplexer	14
MC14017	Decade Counter Divider	16
MC14018	Presettable Divide-by-N Counter	16
MC14020	14-Bit Binary Counter	16
MC14021	8-Bit Static Shift Register	16
MC14022	Octal Counter Divider	16
MC14023	Triple 3-Input NAND Gate	14
MC14023U	Triple 3-Input NAND Gate	14
MC14024	7-Stage Ripple Counter	14
MC14025	Triple 3-Input NOR Gate	14
MC14025U	Triple 3-Input NOR Gate	14
MC14027	Dual J-K Flip-Flop	16
MC14028	BCD-to-Decimal Decoder	16
MC14029	4-Bit Presettable Up Down Counter	16
MC14032	Triple Serial Adder (Positive Logic)	16
MC14034	8-Bit Universal Bus Register	24

Device	Function	Pins
MC14035	4-Bit Shift Register	16
MC14038	Triple Serial Adder (Negative Logic)	16
MC14040	12-Bit Binary Counter	16
MC14042	Quad Latch	16
MC14043	Quad NOR R-S Latch	16
MC14044	Quad NAND R-S Latch	16
MC14046	Phase-Locked Loop	16
MC14049	Hex Inverter/Buffer	16
MC14049U	Hex Inverter/Buffer	16
MC14050	Hex Buffer	16
MC14051	8-Channel Analog Multiplexer	16
MC14052	Dual 4-Channel Analog Multiplexer	16
MC14053	Triple 2-Channel Analog Multiplexer	16
MC14060	14-Bit Binary Counter and Osc.	16
MC14066	Quad Analog Switch	14
MC14067	Analog Mux/Demux 16-Channel	24
MC14068	8-Input NAND Gate	14
MC14069U	Hex Inverter	14
MC14070	Quad Exclusive OR Gate	14
MC14071	Quad 2-Input OR Gate	14
MC14072	Dual 4-Input OR Gate	14
MC14073	Triple 3-Input AND Gate	14
MC14075	Triple 3-Input OR Gate	14
MC14076	Quad D-Type Register	16
MC14077	Quad Exclusive NOR Gate	14
MC14078	8-Input NOR Gate	14
MC14081	Quad 2-Input AND Gate	14
MC14082	Dual 4-Input AND Gate	14
MC14093	Quad 2-Input NAND Schmitt Trigger	14
MC14094	8-Bit Bus-Compatible Shift Store Latch	16
MC14097	Analog Mux/Demux 8-Channel	24
MC14099	8-Bit Addressable Latch	16
MC14106	Hex Schmitt Trigger	14
MC14160	Decade Counter (Asynchronous Clear)	16
MC14161	Binary Counter (Asynchronous Clear)	16
MC14162	Decade Counter (Synchronous Clear)	16
MC14163	Binary Counter (Synchronous Clear)	16
MC14174	Hex D Flip-Flop	16
MC14175	Quad D Flip-Flop	16
MC14194	4-Bit Universal Shift Register	16
MC14415	Quad Precision Timer Driver	16
MC14490	Hex Contact Bounce Eliminator	16
MC14500	Industrial Control Unit	16
MC14501U	Triple Gate	16
MC14502	Strobed Hex Inverter Buffer	16
MC14503	Hex 3-State Buffer	16
MC14504	Hex TTL or CMOS to CMOS Level Shifter	16
MC14506U	Dual Expandable AOI Gate	16
MC14508	Dual 4-Bit Latch	24
MC14510	BCD Up Down Counter	16
MC14511	BCD-to-7-Segment Latch/Decoder/Driver	16

STANDARD 14000 SERIES CMOS LOGIC — NUMERICAL INDEX (continued)

Device	Function	Pins
MC14512	8-Channel Data Selector	16
MC14513	BCD-to-7-Segment Latch/Decoder/Driver	18
MC14514	4-Bit Latch 4-to-16 Line Decoder (High)	24
MC14515	4-Bit Latch 4-to-16 Line Decoder (Low)	24
MC14516	Binary Up Down Counter	16
MC14517	Dual 64-Bit Static Shift Register	16
MC14518	Dual BCD Up Counter	16
MC14519	4-Bit AND OR Selector	16
MC14520	Dual Binary Up Counter	16
MC14521	24-Stage Frequency Divider	16
MC14522	Programmable BCD Divide-by-N Counter	16
MC14526	Programmable Binary Divide-by-N Counter	16
MC14527	BCD Rate Multiplier	16
MC14528	Dual Monostable Multivibrator	16
MC14529	Dual 4-Channel Analog Data Selector	16
MC14530	Dual 5-Input Majority Logic Gate	16
MC14531	12-Bit Parity Tree	16
MC14532	8-Bit Priority Encoder	16
MC14534	Real Time 5-Decade Counter	24
MC14536	Programmable Timer	16
MC14538	Dual Precision Monostable Multivibrator	16
MC14539	Dual 4-Channel Data Selector Multiplexer	16
MC14541	Programmable Oscillator-Timer	14
MC14543	BCD-to-7-Segment Latch/Decoder (LCD)	16
MC14544	BCD-to-7-Segment Latch/Decoder/Driver	18
MC14547	High-Current BCD-to-7-Segment Decoder/Driver	16
MC14549	Successive Approximation Register	16
MC14551	Quad 2-Channel Analog MUX	16
MC14553	3-Digit BCD Counter	16
MC14554	2 x 2-Bit Parallel Binary Multiplier	16
MC14555	Dual Binary to 1-of-4 Decoder	16
MC14556	Dual Binary to 1-of-4 Decoder (Inverting)	16
MC14557	1-to-64-Bits Variable Length Shift Register	16
MC14558	BCD-to-7-Segment Decoder	16
MC14559	Successive Approximation Register	16
MC14560	NBCD Adder	16
MC14561	9's Complementer	14
MC14562	128-Bit Static Shift Register	14
MC14566	Industrial Time Base Generator	16
MC14568	Phase Comparator Programmable Counter	16
MC14569	Dual Programmable BCD Binary Counter	16
MC14572U	Hex Gate	16
MC14580	4 x 4 Multiport Register	24
MC14581	4-Bit Arithmetic Logic Unit	24
MC14582	Look-Ahead Carry Block	16
MC14583	Dual Schmitt Trigger	16
MC14584	Hex Schmitt Trigger	14
MC14585	4-Bit Magnitude Comparator	16
MC14597	8-Bit Bus Compatible Counter/Latch	16
MC14598	8-Bit Bus Compatible Addressable Latch	18
MC14599	8-Bit Addressable Latch	18

Selector Guide by Function

Device	Function
NAND Gates	
14011	Quad 2-Input NAND Gate
14093	Quad 2-Input NAND Schmitt Trigger
14023	Triple 3-Input NAND Gate
14012	Dual 4-Input NAND Gate
14068	8-Input NAND Gate
NOR Gates	
14001	Quad 2-Input NOR Gate
14025	Triple 3-Input NOR Gate
14000	Dual 3-Input NOR Gate plus Inverter
14002	Dual 4-Input NOR Gate
14078	8-Input NOR Gate
AND Gates	
14081	Quad 2-Input AND Gate
14073	Triple 3-Input AND Gate
14082	Dual 4-Input AND Gate
OR Gates	
14071	Quad 2-Input OR Gate
14075	Triple 3-Input OR Gate
14072	Dual 4-Input OR Gate
Complex Gates	
14070	Quad Exclusive OR Gate
14077	Quad Exclusive NOR Gate
14501	Triple Gate (Dual 4-Input NAND Gate and 2-Input NOR/OR Gate or 8-Input AND/NAND Gate)
14506	Dual Expandable AND-OR-INVERT Gate (superseded by 14506B)
14519	4-Bit AND/OR Selector (Quad 2-Channel Data Selector or Quad Exclusive NOR Gate)
14530	Dual 5-Input Majority Logic Gate
14572	Hex Gate (Quad Inverter plus 2-Input NOR Gate plus 2-Input NAND Gate)
Inverters/Buffers/Level Translator	
14007	Dual Complementary Pair plus Inverter
14049	Hex Inverting Buffer
14050	Hex Noninverting Buffer
14069	Hex Inverter
14502	Strobed Hex Inverter/Buffer
14503	Hex 3-State Buffer
14504	TTL or CMOS to CMOS Hex Level Shifter
14584	Hex Schmitt Trigger
Decoders/Encoders	
14028	BCD-to-Decimal/Binary-to-Octal Decoder
14514	4-Bit Latch/4-to-16 Line Decoder (High)
14515	4-Bit Latch/4-to-16 Line Decoder (Low)
14532	8-Bit Priority Encoder
14555	Dual Binary to 1-of-4 Decoder/Demultiplexer
14556	Dual Binary to 1-of-4 Decoder/Demultiplexer (Inverting)
14511	BCD-to-7-Segment Latch/Decoder/Driver
14513	BCD-to-7-Segment Latch/Decoder/Driver with Ripple Blanking

STANDARD 14000 SERIES CMOS LOGIC — SELECTOR GUIDE (continued)

Device	Function
Decoders/Encoders (cont.)	
14543	BCD-to-7-Segment Latch/Decoder/Driver for Liquid Crystals
14544	BCD-to-7-Segment Latch/Decoder/Driver with Ripple Blanking
14547	High-Current BCD-to-7-Segment Decoder/Driver
14558	BCD-to-7-Segment Decoder
Multiplexers/Demultiplexers/Bilateral Switches	
14016	Quad Analog Switch/Quad Multiplexer
14066	Quad Analog Switch/Quad Multiplexer
14053	Triple 2-Channel Analog Multiplexer/Demultiplexer
14052	Dual 4-Channel Analog Multiplexer/Demultiplexer
14529	Dual 4-Channel Analog Data Selector
14539	Dual 4-Channel Data Selector/Multiplexer
14051	8-Channel Analog Multiplexer/Demultiplexer
14512	8-Channel Data Selector
14097	Dual 8-Channel Analog Multiplexer/Demultiplexer
14067	16-Channel Analog Multiplexer/Demultiplexer
14519	4-Bit AND/OR Selector
14551	Quad 2-Channel Analog Multiplexer/Demultiplexer
Schmitt Triggers	
14093	Quad 2-Input NAND Schmitt Trigger
14583	Dual Schmitt Trigger
14106	Hex Schmitt Trigger
14584	Hex Schmitt Trigger
Flip-Flops/Latches	
14013	Dual Type D Flip-Flop
14027	Dual J-K Flip-Flop
14042	Quad Transparent Latch
14043	Quad NOR R-S Latch
14044	Quad NAND R-S Latch
14076	Quad D-Type Register
14175	Quad Type D Flip-Flop
14508	Dual 4-Bit Latch
14174	Hex Type D Flip-Flop
14099	8-Bit Addressable Latch
14597	8-Bit Bus-Compatible 3-State Latches — Internal Counter
14598	8-Bit Bus-Compatible 3-State Latches — Binary Address
14599	8-Bit Addressable Latch with Bidirectional Port
Shift Registers	
14035	4-Bit Parallel-In/Parallel-Out Shift Register
14194	4-Bit Bidirectional Universal Shift Register
14015	Dual 4-Bit Static Shift Register
14014	8-Bit Static Shift Register
14021	8-Bit Static Shift Register
14034	8-Bit Universal Bus Register
14094	8-Stage Shift/Store Register
14006	18-Bit Static Shift Register
14557	1-to-64 Bit Variable Length Shift Register
14517	Dual 64-Bit Static Shift Register
14562	128-Bit Static Shift Register
14549	Successive Approximation Register
14559	Successive Approximation Register
Counters	
14024	Seven-Stage Ripple Counter
14017	Decade Counter
14018	Presettable Divide-by-N Counter

Device	Function
Counters (cont.)	
14160	Presettable BCD Counter (Asynchronous Clear)
14162	Presettable BCD Counter (Synchronous Clear)
14029	Presettable Binary/BCD Up/Down Counter
14510	Presettable BCD Up/Down Counter
14522	Programmable BCD Down Counter
14040	12-Bit Binary Counter
14020	14-Bit Binary Counter
14060	14-Bit Binary Counter and Oscillator
14022	Octal Counter
14161	Presettable 4-Bit Binary Counter (Asynchronous Clear)
14163	Presettable 4-Bit Binary Counter (Synchronous Clear)
14516	Presettable Binary Up/Down Counter
14526	Programmable 4-Bit Binary Down Counter
14518	Dual BCD Up Counter
14520	Dual Binary Up Counter
14569	Programmable Dual Binary/BCD Counter
14553	Three-Digit BCD Counter
14534	5 Cascaded BCD Counters
14566	Industrial Time Base Generator
14568	Phase Comparator and Programmable Counter
Oscillators/Timers	
14060	14-Bit Binary Counter and Oscillator
14521	24-Stage Frequency Divider
14536	Programmable Timer
14541	Programmable Oscillator/Timer
Multivibrators	
14528	Dual Retriggerable/Resettable Monostable Multivibrator
14538	Dual Precision Retriggerable/Resettable Monostable Multivibrator
Adders/Comparators	
14008	4-Bit Full Adder
14032	Triple Serial Adder (Positive Logic)
14038	Triple Serial Adder (Negative Logic)
14560	NBCD Adder
14561	9's Complementer
14582	Look-Ahead Carry Block
14585	4-Bit Magnitude Comparator
ALU/Rate Multipliers	
14527	BCD Rate Multiplier
14554	2 x 2-Bit Parallel Binary Multiplier
14581	4-Bit Arithmetic Logic Unit
Parity Checker	
14531	12-Bit Parity Tree
Memory	
14580	4 x 4 Multiport Register
Microprocessor/Industrial Control	
14500	Industrial Control Unit
Other Complex Functions	
14046	Phase-Locked Loop
14415	Quad Precision Timer/Driver
14490	Hex Contact Bounce Eliminator

Cross-Reference Guide

This cross-reference is intended to serve as a guide for replacement of competitive devices with Motorola devices.

The left hand column is arranged in alphanumeric sequence by various manufacturers' prefixes. The right column contains what is believed to be the Motorola functional equivalent.

Motorola does not assume any liability arising out of the application or use of any product listed and suggests that data sheets be consulted to assure compatibility.

Part Number	Motorola Replacement	Part Number	Motorola Replacement	Part Number	Motorola Replacement
CD4xxxAD*	**MC14xxxBCL**	CD4xxxUBE	**MC14xxxUBCP**	HEF4xxxUB	**MC14xxxUBCP**
CD4xxxAE	**MC14xxxBCP**	CD4xxxUBF	**MC14xxxUBCL**	HEF4xxxUBTD	**MC14xxxUBD**
CD4xxxAF	**MC14xxxBCL**	CD4xxxUBM**	**MC14xxxUBD**	MN4xxxB	**MC14xxxBCP**
CD4xxxBCJ	**MC14xxxBCL**	F4xxxBDC	**MC14xxxBCL**	MN4xxxBS**	**MC14xxxBCP**
CD4xxxBCN	**MC14xxxBCP**	F4xxxBDM	**MC14xxxBCL**	MN4xxxUB	**MC14xxxUBD**
CD4xxxBD*	**MC14xxxBCL**	F4xxxBPC	**MC14xxxBCP**	MN4xxxUBS**	**MC14xxxUBCP**
CD4xxxBE	**MC14xxxBCP**	F4xxxUBDC	**MC14xxxUBCL**	SLC4xxxABC	**MC14xxxBCL**
CD4xxxBF	**MC14xxxBCL**	F4xxxUBDM	**MC14xxxUBCL**	SCL4xxxABD*	**MC14xxxBCL**
CD4xxxBM**	**MC14xxxBD**	F4xxxUBPC	**MC14xxxUBCP**	SCL4xxxABE	**MC14xxxBCP**
CD4xxxBMD*	**MC14xxxBCL**	HCF4xxxBD*	**MC14xxxBCL**	SCL4xxxBC	**MC14xxxBCL**
CD4xxxBMJ	**MC14xxxBCL**	HCF4xxxBE	**MC14xxxBCP**	SCL4xxxBD*	**MC14xxxBCL**
CD4xxxCJ	**MC14xxxUBCL**	HCF4xxxBF	**MC14xxxBCL**	SCL4xxxBE	**MC14xxxBCP**
CD45xxCJ	**MC145xxBCL**	HCF4xxxBM**	**MC14xxxBD**	SCL4xxxUBC	**MC14xxxUBCL**
CD4xxxCM**	**MC14xxxUBD**	HCF4xxxUBD*	**MC14xxxUBCL**	SCL4xxxUBD*	**MC14xxxUBCL**
CD45xxCM**	**MC14xxxBD**	HCF4xxxUBE	**MC14xxxUBCP**	SCL4xxxUBE	**MC14xxxUBCP**
CD4xxxCN	**MC14xxxUBCP**	HCF4xxxUBF	**MC14xxxUBCL**	TC4xxxBF**	**MC14xxxBD**
CD45xxCN	**MC145xxBCP**	HCF4xxxUBM**	**MC14xxxUBD**	TC4xxxBP	**MC14xxxBCP**
CD4xxxMD*	**MC14xxxUBCL**	HD145xxB	**MC14xxxBCP**	TC4xxxUBF**	**MC14xxxUBD**
CD45xxMD*	**MC145xxBCL**	HD145xxBFP**	**MC14xxxBD**	TC4xxxUBP	**MC14xxxUBCP**
CD4xxxMJ	**MC14xxxUBCL**	HEF4xxxB	**MC14xxxBCP**	µPD4xxx**	**MC14xxxBD**
CD45xxMJ	**MC145xxBCL**	HEF4xxxBD	**MC14xxxBCP**	µPD4xxxC	**MC14xxxBCP**
CD4xxxUBD*	**MC14xxxUBCL**	HEF4xxxBTD*	**MC14xxxBD**		

*Welded-seal (side-brazed) package crossed to a frit-seal ceramic package.
**SO package dimensions may not be the same. Consult manufacturers' data sheet.

BiCMOS Devices

Descriptions and Family Characteristics

Logic

Motorola BiCMOS logic offers a combination of high speed, low power dissipation high noise immunity, wide fanout capability, and high reliability. This data book describes the product line with device specifications.

Characteristics

- High Operating Speed
- Industry Standard Functions and Pinouts
- Low Power Dissipation
- TTL Compatible Inputs and Outputs
- Output Sinks Currents up to 48 mA
- Operation from 5.0 Volts ±10%
- Temperature Range –40°C to +85°C (Commercial)

Interfacing

BiCMOS bus drivers and transceivers have sufficient current drive to interface with most of today's bus requirements. The device inputs are designed to interface with TTL outputs operating with a V_{CC} = 5.0 V ± 0.5 V with V_{OH} = 2.4 V and V_{OL} = 0.5 V.

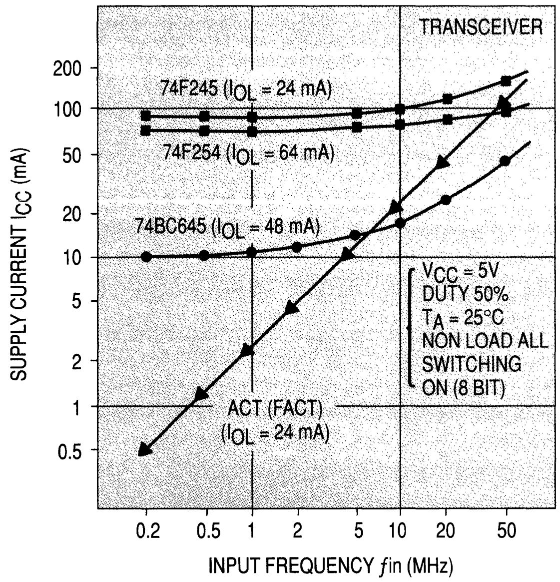


Figure 1. I_{CC} versus Frequency

Low Power Operation

BiCMOS draws less power than the equivalent AS, ALS or FAST TTL device. This enhances system reliability.

Figure 1 illustrates the effects of I_{CC} versus frequency for a typical device. BiCMOS is normally lower than FAST and even lower than advanced CMOS at high frequencies.

DEVICE NOMENCLATURE

MC74BC XXX P R

Temperature Range Family
MC74BC = Commercial BiCMOS

Device Type

Package Code
P = Plastic DIP
D = Narrow SOIC
DW = Wide SOIC

Temperature Range
Blank = Commercial (–40°C to +85°C)

Special Suffixes
R2 = Devices shipped in 13″ reels
Blank = Magazines (Rails)

Numerical Index

MC74BC00 Series (–40 to +85°C)
Suffix: N = Plastic Dual In-Line (All Devices)

Device	Description	Pins
MC74BC00	Quad 2-Input NAND Gate	14
MC74BC08	Quad 2-Input AND Gate	14
MC74BC32	Quad 2-Input OR Gate	14
MC74BC230	Octal Bus Buffer, 3-State, Inverting/Noninverting	20
MC74BC231	Octal Bus Buffer, 3-State, Inverting	20
MC74BC240	Octal Bus Buffer, 3-State, Inverting	20
MC74BC241	Octal Bus Buffer, 3-State, Noninverting	20
MC74BC242	Octal Bus Transceiver, 3-State, Inverting	20
MC74BC243	Octal Bus Transceiver, 3-State, Inverting	20
MC74BC244	Octal Bus Buffer, 3-State, Noninverting	20
MC74BC365	Hex Bus Buffer, 3-State, Noninverting	20
MC74BC366	Hex Bus Buffer, 3-State, Inverting	20
MC74BC367	Hex Bus Buffer, 3-State, Noninverting	20
MC74BC368	Hex Bus Buffer, 3-State, Inverting	20
MC74BC373	Octal D-Type Latch, 3-State, Noninverting	20
MC74BC374	Octal D-Type Flip-Flop, 3-State, Noninverting	20
MC74BC533	Octal D-Type Latch, 3-State, Inverting	20
MC74BC534	Octal D-Type Flip-Flop, 3-State, Inverting	20
MC74BC540	Octal Bus Buffer, 3-State, Inverting	20
MC74BC541	Octal Bus Buffer, 3-State, Noninverting	20
MC74BC563	Octal D-Type Latch, 3-State, Inverting	20
MC74BC564	Octal D-Type Flip-Flop, 3-State, Inverting	20
MC74BC573	Octal D-Type Flip-Flop, 3-State, Noninverting	20
MC74BC574	Octal D-Type Flip-Flop, 3-State, Noninverting	20
MC74BC575	Octal D-Type Flip-Flop, Noninverting	20
MC74BC620	Octal Bus Transceiver, 3-State, Inverting	20
MC74BC623	Octal Bus Transceiver, 3-State, Noninverting	20
MC74BC640	Octal Bus Transceiver, 3-State, Inverting	20
MC74BC643	Octal Bus Transceiver, 3-State, Inverting/Noninverting	20
MC74BC645	Octal Bus Transceiver, 3-State, Noninverting	20

Selector Guide by Function

Abbreviations:

S = Synchronous
A = Asynchronous
B = Both Synchronous and Asynchronous

2S = 2-State Output
3S = 3-State Output

AND Gates

Description	Type of Output	No.
Quad 2-Input	2S	08

NAND Gates

Description	Type of Output	No.
Quad 2-Input	2S	00

OR Gates

Description	Type of Output	No.
Quad 2-Input	2S	32

Latches

Description	No. of Bits	Type of Output	No.
Transparent, Noninverting	8	3S	373
	8	3S	574
	8	3S	575
Transparent, Inverting	8	3S	533
	8	3S	563
	8	3S	564

Bus Drivers

Description	Type of Output	No.
Octal, Noninverting	3S	241
	3S	244
	3S	365
	3S	367
	3S	541
	3S	573
Octal, Inverting/Noninverting	3S	230
Octal, Inverting	3S	231
	3S	240
	3S	366
	3S	368
	3S	540

Transceivers

Description	Type of Output	No.
Octal, Inverting	3S	242
	3S	243
Octal, Noninverting	3S	623
	3S	645
Octal, Inverting/Noninverting	3S	643
Octal, Inverting with Register Mux Latch	3S	620
	3S	640

MSI Flip-Flops/Registers

Description	No. of Bits	Type of Output	Set or Reset	Clock Enable	No.
D-Type, Noninverting	8	3S			374
D-Type, Inverting	8	3S			534

CMOS Logic Surface Mount

Why Surface Mount?

Surface Mount Technology is now being utilized to offer answers to many problems that have been created in the use of insertion technology.

Limitations have been reached with insertion packages and PC board technology. Surface Mount Technology offers the opportunity to continue to advance the State-of-the-Art designs that cannot be accomplished with Insertion Technology.

Surface Mount Packages allow more optimum device performance with the smaller Surface Mount configuration. Internal lead lengths, parasitic capacitance and inductance that placed limitations on chip performance have been reduced.

The lower profile of Surface Mount Packages allows more boards to be utilized in a given amount of space. They are stacked closer together and utilize less total volume than insertion populated PC boards.

Printed circuit costs are lowered with the reduction of the number of board layers required. The elimination or reduction of the number of plated through holes in the board, contribute significantly to lower PC board prices.

Automatic placement equipment is available that can place Surface Mount components at the rate of a few thousand per hour to hundreds of thousands of components per hour.

Surface Mount Technology is cost effective, allowing the manufacturer the opportunity to produce smaller units and/or offer increased functions with the same size product.

Surface Mount assembly does not require the preparation of components that are common on insertion technology lines. Surface Mount components are sent directly to the assembly line, eliminating an intermediate step.

For Additional Surface Mount Information, order Surface Mount Products Selector Guide (SG-127/D)

High-Speed CMOS Logic

MC74HC/HCT00 Series (–55 to +125°C)
D = Narrow Body SOIC
DW = Wide Body SOIC

Device	Function	Pins	Suffix
HC00A	Quad 2-Input NAND Gate	14	D
HCT00A	Quad 2-Input NAND Gate	14	D
HC02A	Quad 2-Input NOR Gate	14	D
HCT02A	Quad 2-Input NOR Gate	14	D
HC03A	Quad 2-Input NAND, Open Drain Outputs	14	D
HC04A	Hex Inverter	14	D
HCT04A	Hex Inverter	14	D
HCU04	Hex Unbuffered Inverter	14	D
HC08A	Quad 2-Input AND Gate	14	D
HCT08A	Quad 2-Input AND Gate	14	D
HC10	Triple 3-Input NAND Gate	14	D
HC11	Triple 3-Input AND Gate	14	D
HC14A	Hex Schmitt-Trigger Inverter	14	D
HCT14A	Hex Schmitt-Trigger Inverter	14	D
HC20	Dual 4-Input NAND Gate	14	D
HC27	Triple 3-Input NOR Gate	14	D
HC30	8-Input NAND Gate	14	D
HC32A	Quad 2-Input OR Gate	14	D
HCT32A	Quad 2-Input OR Gate	14	D
HC42	BCD to 1-of-10 Decoder	16	D
HC51	2-Wide, 2-Input/2-Wide, 3-Input AND-OR-INVERT Gates	14	D
HC58	2-Wide, 2-Input/2-Wide, 3-Input AND-OR Gates	14	D
HC73	Dual J-K Flip-Flop with Reset	14	D
HC74A	Dual D-Type Flip-Flop w/Set/Reset, Pos-Edge Triggered	14	D
HCT74A	Dual D-Type Flip-Flop w/Set/Reset, Pos-Edge Triggered	14	D
HC75	4-Bit D-Type Latch	16	D
HC76	Dual J-K Flip-Flop with Set and Reset	16	D
HC86	Quad 2-Input Exclusive OR Gate	14	D
HC107	Dual J1–K Flip-Flop with Reset	14	D
HC109	Dual J-K Flip-Flop w/Set/Reset, Pos-Edge Triggered	16	D
HC112	Dual J-K Flip-Flop with Set and Reset	16	D
HC113	Dual J-K Flip-Flop with Set	14	D
HC125A	Quad 3-State Buffer	14	D
HC126A	Quad 3-State Buffer	14	D
HC132A	Quad 2-Input Schmitt-Trigger NAND Gate	14	D
HC133	13-Input NAND Gate	16	D
HC137	1-of-8 Decoder/Demux w/Latched Inputs, Inverting Output	16	D
HC138A	1-of-8 Decoder/Demultiplexer	16	D
HCT138A	1-of-8 Decoder/Demultiplexer	16	D
HC139A	Dual 1-of-4 Decoder (Active-Low Outputs)	16	D

Device	Function	Pins	Suffix
HC151	8-Channel Digital Multiplexer	16	D
HC153	Dual 4-Channel Digital Multiplexer	16	D
HC157A	Quad 2-Input Data Selector/Multiplexer	16	D
HCT157A	Quad 2-Input Data Selector/Multiplexer	16	D
HC158A	Quad 2-Input Data Sel/Mux, Inv Output	16	D
HCT158A	Quad 2-Input Data Sel/Mux, Inv Output	16	D
HC160	Programmable Decade Counter, Asynchronous Reset	16	D
HC161A	Programmable 4-Bit Binary Counter, Asynchronous Reset	16	D
HCT161A	Programmable 4-Bit Binary Counter, Asynchronous Reset	16	D
HC162	Programmable Decade Counter, Synchronous Reset	16	D
HC163A	Programmable 4-Bit Binary Counter, Synchronous Reset	16	D
HCT163A	Programmable 4-Bit Binary Counter, Synchronous Reset	16	D
HC165	8-Bit Serial or Parallel Input/Serial Output Shift Reg	16	D
HC173	4-Bit D-Type Flip-Flop with Common Clock and Reset, 3-State	16	D
HC174A	Hex D-Type Flip-Flop with Common Clock and Reset	16	D
HCT174A	Hex D-Type Flip-Flop with Common Clock and Reset	16	D
HC175	Quad D-Type Flip-Flop	16	D
HC237	1-of-8 Decoder/Demultiplexer with Latched Inputs	16	D
HC240A	Octal Buffer/Line Driver/Line Receiver, 3-State, Inv Output	20	DW
HCT240A	Octal Buffer/Line Driver/Line Receiver, 3-State, Inverting Output, TTL Logic Level	20	DW
HC241A	Octal Buffer/Line Driver/Line Receiver, 3-State	20	DW
HCT241A	Octal Buffer/Line Driver/Line Receiver, 3-State, TTL Logic Level	20	DW
HC244A	Octal Buffer/Line Driver/Line Receiver, 3-State	20	DW
HCT244A	Octal Buffer/Line Driver/Line Receiver, 3-State, TTL Logic Level	20	DW
HC245A	Octal Bus Transceiver, 3-State	20	DW
HCT245A	Octal Bus Transceiver, 3-State, TTL Logic Level	20	DW

HIGH-SPEED LOGIC (continued)

MC74HC/HCT00 Series — continued

Device	Function	Pins	Suffix
HC251	8-Input Multiplexer, 3-State	16	D
HC253	Dual 4-Input Multiplexer, 3-State	16	D
HC257	Quad 2-Input Data Sel/Mux, 3-State	16	D
HC259	8-Bit Addressable Latch	16	D
HC266	Quad 2-Input Exclusive NOR Gate, Open Drain Output	14	D
HC273A	Octal D-Type Flip-Flop with Common Clock/Reset	20	DW
HCT273A	Octal D-Type Flip-Flop with Common Clock/Reset	20	DW
HC280	9-Bit Odd/Even Parity Generator/Checker	14	D
HC299	8-Bit Universal Shift/Store Register, 3-State	20	DW
HC354	8-Input Multiplexer, 3-State	20	DW
HC356	8-Input Multiplexer, 3-State	20	DW
HC373A	Octal D-Type Transparent Latch, 3-State	20	DW
HCT373A	Octal D-Type Transparent Latch, 3-State, TTL Logic Level	20	DW
HC374A	Octal D-Type Flip-Flop, 3-State	20	DW
HCT374A	Octal D-Type Flip-Flop, 3-State, TTL Logic Level	20	DW
HC386	Quad 2-Input Exclusive OR Gate	14	D
HC390	Dual 4-Stage Binary Ripple Counter with ±2 and ±5 Sections	16	D
HC393	Dual 4-Stage Binary Ripple Counter	14	D
HC533A	Octal D-Type Transparent Latch, 3-State, Inverting Output	20	DW
HCT533A	Octal D-Type Transparent Latch, 3-State, Inverting Output	20	DW
HC534A	Octal D-Type Flip-Flop, 3-State, Inverting Output	20	DW
HCT534A	Octal D-Type Flip-Flop, 3-State, Inv Output, TTL Logic Level	20	DW
HC540	Octal Buffer/Line Driver/Line Rec, 3-State, Inv Output	20	DW
HCT540	Octal 3-State Buffer/Line Driver/Line Receiver, Inverting Output, TTL Logic Level	20	DW
HC541	Octal Buffer/Line Driver/Line Receiver, 3-State	20	DW
HCT541	Octal 3-State Buffer/Line Driver/Line Receiver, TTL Logic Level	20	DW
HC563	Octal Transparent Latch, 3-State, Inverting Output	20	DW
HC564	Octal D-Type Flip-Flop, 3-State, Inverting Output	20	DW

Device	Function	Pins	Suffix
HC573A	Octal Transparent Latch, 3-State	20	DW
HCT573A	Octal Transparent Latch, 3-State	20	DW
HC574A	Octal D-Type Flip-Flop, 3-State	20	DW
HCT574A	Octal D-Type Flip-Flop, 3-State	20	DW
HC589	8-Bit Parallel-to-Serial Shift Register with Input Latches, 3-State	16	D
	8-Bit Serial-to-Parallel Shift Register	16	D
HC597	8-Bit Parallel-to-Serial Shift Register with Input Latches	16	D
HC640A	Octal Bus Transceiver, 3-State	20	DW
HCT640A	Octal Bus Transceiver, 3-State, Inverting Output, TTL Logic Level	20	DW
HC646	Octal Bus Transceiver, 3-State	24	DW
HC648	Octal Bus Transceiver, 3-State	24	DW
HCT646	Octal Bus Transceiver, 3-State, TTL Logic Level	20	DW
HC4002	Dual 4-Input NOR Gate	14	D
HC4016	Quad Analog Switch	14	D
HC4017	Decade Counter/Divider	16	D
HC4024	7-Stage Binary Ripple Counter	14	D
HC4049	Hex Inverting Buffer/Logic Level Down Converter	16	D
HC4050	Hex Buffer/Logic Level Down Converter	16	D
HC4051	8-Channel Analog Multiplexer/Demultiplexer	16	DW
HC4052	8-Channel Analog Multiplexer/Demultiplexer	16	DW
HC4053	8-Channel Analog Multiplexer/Demultiplexer	16	DW
HC4066	Quad Analog Switch	14	D
HC4075	Triple 3-Input OR Gate	14	D
HC4078	8-Input NOR Gate	14	D
HC4351	Quad Analog Mux/Demux w/Latched Select Inputs	20	DW
HC4352	Dual 4-Channel Analog Multiplexer/Demultiplexer with Latched Select Inputs	20	DW
HC4353	Triple 2-Channel Analog Multiplexer/Demultiplexer with Latched Select Inputs	20	DW
HC4511	BCD-to-7 Segment Latch/Decoder/Driver	16	D
HC4543	BCD-to-7 Segment Latch/Decoder/Driver for CDs	14	D
HC7266	Quad 2-Input Exlcusive NOR Totem Pole Outputs	16	D

CMOS Standard Logic

MC14XXX Series (–55°C to +125°C)
Suffix: D = Narrow Body SOIC
DW = Wide Body SOIC

Device	Function	Pins	Suffix
MC14000	Dual 3-Input NOR Gate plus Inverter	14	D
MC14001	Quad 2-Input NOR Gate	14	D
MC14002	Dual 4-Input NOR Gate	14	D
MC14006	18-Bit Static Shift Register	14	D
MC14007	Dual Complementary Pair plus Inverter	14	D
MC14008	4-Bit Full Adder	16	D
MC14011	Quad 2-Input NAND Gate	14	D
MC14012	Dual 4-Input NAND Gate	14	D
MC14013	Dual D Flip-Flop	14	D
MC14014	8-Bit Static Shift Register	16	D
MC14015	Dual 5-Bit Static Shift Register	16	D
MC14016	Quad Analog Switch/Quad Multiplexer	14	D
MC14017	Decade Counter/Divider	16	D
MC14018	Presettable Divide-by-N Counter	16	D
MC14020	14-Bit Binary Counter	16	D
MC14021	8-Bit Static Shift Register	16	D
MC14022	Octal Counter/Divider	16	D
MC14023	Triple 3-Input NAND Gate	14	D
MC14024	7-Stage Ripple Counter	14	D
MC14025	Triple 3-Input NOR Gate	14	D
MC14027	Dual J-K Flip-Flop	16	D
MC14028	BCD-to-Decimal Decoder	16	D
MC14029	4-Bit Presettable Up/Down Counter	16	D
MC14032	Triple Serial Adder (Positive Logic)	16	D
MC14035	4-Bit Shift Register	16	D
MC14038	Triple Serial Adder (Negative Logic)	16	D
MC14040	12-Bit Binary Counter	16	D
MC14042	Quad Latch	16	D
MC14043	Quad NOR R-S Latch	16	D
MC14044	Quad NAND R-S Latch	16	D
MC14046	Phase-Locked Loop	16	DW
MC14049	Hex Inverter/Buffer	16	D
MC14050	Hex Buffer	16	D
MC14051	8-Channel Analog Multiplexer	16	D
MC14052	Dual 4-Channel Analog Multiplexer	16	D
MC14053	Triple 2-Channel Analog Multiplexer	16	D
MC14060	14-Bit Binary Counter and Osc.	16	D
MC14066	Quad Analog Switch	14	D
MC14068	8-Input NAND Gate	14	D
MC14069	Hex Inverter	14	D
MC14070	Quad Exclusive OR Gate	14	D
MC14071	Quad 2-Input OR Gate	14	D
MC14072	Dual 4-Input OR Gate	14	D
MC14073	Triple 3-Input AND Gate	14	D
MC14075	Triple 3-Input OR Gate	14	D
MC14076	Quad D-Type Register	16	D
MC14077	Quad Exclusive NOR Gate	14	D
MC14078	8-Input NOR Gate	14	D

List includes "B" or "UB" series parts. Packages are the same.

Device	Function	Pins	Suffix
MC14081	Quad 2-Input AND Gate	14	D
MC14082	Dual 4-Input AND Gate	14	D
MC14093	Quad 2-Input NAND Schmitt Trigger	14	D
MC14094	8-Bit Bus-Compatible Shift Store Latch	16	D
MC14099	8-Bit Addressable Latch	16	DW
MC14106	Hex Schmitt Trigger	14	D
MC14160	Decade Counter (Asynchronous Clear)	16	D
MC14161	Binary Counter (Asynchronous Clear)	16	D
MC14162	Decade Counter (Synchronous Clear)	16	D
MC14163	Binary Counter (Synchronous Clear)	16	D
MC14174	Hex D Flip-Flop	16	D
MC14175	Quad D Flip-Flop	16	D
MC14194	4-Bit Universal Shift Register	16	D
MC14415	Quad Precision Timer/Driver	16	DW
MC14490	Hex Contact Bounce Eliminator	16	DW
MC14500	Industrial Control Unit	16	DW
MC14501	Triple Gate	16	D
MC14502	Strobed Hex Inverter/Buffer	16	DW
MC14503	Hex 3-State Buffer	16	D
MC14504	Hex TTL or CMOS to CMOS Level Shifter	16	D
MC14506	Dual Expandable AOI Gate	16	D
MC14510	BCD Up/Down Counter	16	D
MC14512	8-Channel Data Selector	16	D
MC14516	Binary Up/Down Counter	16	D
MC14517	Dual 64-Bit Static Shift Register	16	DW
MC14518	Dual BCD Up Counter	16	DW
MC14519	4-Bit AND/OR Selector	16	D
MC14520	Dual Binary Up Counter	16	DW
MC14521	24-Stage Frequency Divider	16	D
MC14522	Programmable BCD Divide-by-N Counter	16	DW
MC14526	Programmable Binary Divide-by-N Counter	16	DW
MC14527	BCD Rate Multiplier	16	DW
MC14528	Dual Monostable Multivibrator	16	D
MC14529	Dual 4-Channel Analog Data Selector	16	D
MC14530	Dual 5-Input Majority Logic Gate	16	D
MC14531	12-Bit Parity Tree	16	D
MC14532	8-Bit Priority Encoder	16	D
MC14536	Programmable Timer	16	DW
MC14538	Dual Precision Monostable Multivibrator	16	DW
MC14539	Dual 4-Channel Data Selector/Multiplexer	16	D

CMOS STANDARD LOGIC (continued)

MC14XXX Series — continued

Device	Function	Pins	Suffix
MC14541	Programmable Oscillator-Timer	14	D
MC14551	Quad 2-Channel Analog MUX	16	D
MC14553	3-Digit BCD Counter	16	DW
MC14554	2 x 2-Bit Parallel Binary Multiplier	16	D
MC14555	Dual Binary to 1-of-4 Decoder	16	D
MC14556	Dual Binary to 1-of-4 Decoder (Inverting)	16	D
MC14557	1-to-64-Bit Variable Length Shift Register	16	DW
MC14560	NBCD Adder	16	D
MC14561	9's Complementer	14	D

List includes "B" or "UB" series parts. Packages are the same.

Device	Function	Pins	Suffix
MC14566	Industrial Time Base Generator	16	D
MC14568	Phase Comparator Programmable Counter	16	D
MC14569	Dual Programmable BCD Binary Counter	16	DW
MC14572	Hex Gate	16	D
MC14582	Look-Ahead Carry Block	16	N
MC14583	Dual Schmitt Trigger	16	D
MC14584	Hex Schmitt Trigger	14	D
MC14585	4-Bit Magnitude Comparator	16	D
MC14597	8-Bit Bus Compatible Counter/Latch	16	DW

BiCMOS Devices Available in SOIC

MC74BC00 Series (–40 to +85°C)
Suffix: D . . . Narrow Body SOIC
DW . . . Wide Body SOIC

Device	Description	Pins	Suffix
MC74BC00	Quad 2-Input NAND Gate	14	D
MC74BC08	Quad 2-Input AND Gate	14	D
MC74BC32	Quad 2-Input OR Gate	14	D
MC74BC230	Octal Bus Buffer, 3-State, Inverting/Noninverting	20	DW
MC74BC231	Octal Bus Buffer, 3-State, Inverting	20	DW
MC74BC240	Octal Bus Buffer, 3-State, Inverting	20	DW
MC74BC241	Octal Bus Buffer, 3-State, Noninverting	20	DW
MC74BC242	Octal Bus Transceiver, 3-State, Inverting	20	DW
MC74BC243	Octal Bus Transceiver, 3-State, Inverting	20	DW
MC74BC244	Octal Bus Buffer, 3-State, Noninverting	20	DW
MC74BC365	Hex Bus Buffer, 3-State, Noninverting	20	DW
MC74BC366	Hex Bus Buffer, 3-State, Inverting	20	DW
MC74BC367	Hex Bus Buffer, 3-State, Noninverting	20	DW
MC74BC368	Hex Bus Buffer, 3-State, Inverting	20	DW
MC74BC373	Octal D-Type Latch, 3-State, Noninverting	20	DW
MC74BC374	Octal D-Type Flip-Flop, 3-State, Noninverting	20	DW
MC74BC533	Octal D-Type Latch, 3-State, Inverting	20	DW
MC74BC534	Octal D-Type Flip-Flop, 3-State, Inverting	20	DW
MC74BC540	Octal Bus Buffer, 3-State, Inverting	20	DW
MC74BC541	Octal Bus Buffer, 3-State, Noninverting	20	DW
MC74BC563	Octal D-Type Latch, 3-State, Inverting	20	DW
MC74BC564	Octal D-Type Flip-Flop, 3-State, Inverting	20	DW
MC74BC573	Octal D-Type Flip-Flop, 3-State, Noninverting	20	DW
MC74BC574	Octal D-Type Flip-Flop, 3-State, Noninverting	20	DW
MC74BC575	Octal D-Type Flip-Flop, Non-Inverting	20	DW
MC74BC620	Octal Bus Transceiver, 3-State, Inverting	20	DW
MC74BC623	Octal Bus Transceiver, 3-State, Noninverting	20	DW
MC74BC640	Octal Bus Transceiver, 3-State, Inverting	20	DW
MC74BC643	Octal Bus Transceiver, 3-State, Inverting/Noninverting	20	DW
MC74BC645	Octal Bus Transceiver, 3-State, Noninverting	20	DW

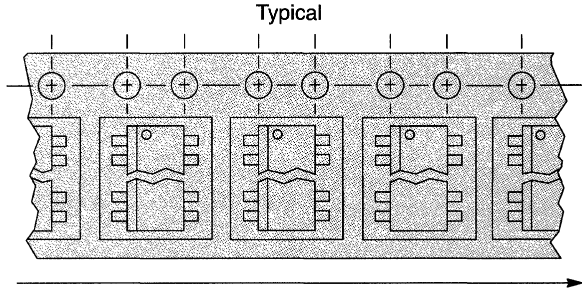
Tape and Reel

CMOS Logic Integrated Circuits

Motorola has now added the convenience of Tape and Reel packaging for our growing family of standard Integrated Circuit products. The packaging fully conforms to the latest EIA RS-481A specification. The antistatic embossed tape provides a secure cavity sealed with a peel-back cover tape.

MECHANICAL POLARIZATION

SOIC Devices



General Information

— Reel Size	13 inch (330 mm) Suffix: R2	— Units/Reel	1000 to 2500 (see table)
— Tape Width	16 mm to 24 mm (see table)		

No Partial Reel Counts Available and Minimum Lot Size is Per Table

Ordering Information

To order devices which are to be delivered in Tape and Reel, add the suffix R2 to the device number being ordered.

Tape and Reel Data

Device Type	Tape Width (mm)	Device/Reel	Reel Size (inch)	Min Lot Size Per Part No. Tape and Reel
SO-14	16	2,500	13	5,000
SO-16	16	2,500	13	5,000
SO-16 Wide	16	1,000	13	5,000
SO-20 Wide	24	1,000	13	5,000

Winner 1988 Malcolm Baldrige National Quality Award

Linear and Interface Integrated Circuits

In Brief . . .

Motorola linear and interface integrated circuits cover a much broader range of products than the traditional "op amps, regulators and consumer-image" associated with linear suppliers. Linear circuit technology currently influences the design and architecture of equipment for all major markets. As with other integrated circuit technologies, linear circuit design techniques and processes have been continually refined and updated to meet the needs of these diversified markets.

Operational amplifiers have utilized JFET inputs for improved performance, plus innovative design and trimming concepts have evolved for improved high performance and precision characteristics. In linear power ICs, basic voltage regulators have been refined to include higher current levels and more precise three-terminal fixed and adjustable voltages. The power area continues to expand into switching regulators, power supply control and supervisory circuits, and motor controllers.

Linear designs also offer a wide array of line drivers, receivers and transceivers for many of the EIA, European, IEEE and IBM interface standards. Peripheral drivers for a variety of devices are also offered. In addition to these key interface functions, a variety of magnetic and semiconductor memory read, write, sense and RAM control circuits are also available.

In data conversion, the original A-D and D-A converters have been augmented with high performance video speed and multiplying designs. Linear circuit technology has also provided precision low-voltage references for use in data conversion and other low temperature drift applications.

A host of special purpose linear devices have also been developed. These circuits find applications in telecom, radio, television, automotive, RF communications, and data transmission. These products have reduced the cost of RF communications, and have provided capabilities in telecommunications which make the telephone line convenient for both voice and data communications. Linear developments have also reduced the many discrete components formerly required for consumer functions to a few IC packages, and have made significant contributions to the rapidly growing market for electronics in automotive applications.

The table of contents provides a perspective of the many markets served by linear/interface ICs and of Motorola's involvement in these areas.

Page

Amplifiers and Comparators

In Brief . . .

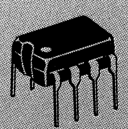
For over two decades, Motorola has continually refined and updated integrated circuit technologies, analog circuit design techniques and processes in response to the needs of the market place. The enhanced performance of newer operational amplifiers and comparators has come through innovative application of these technologies, designs and processes. Some early designs are still available but are giving way to the new, higher performance operational amplifier and comparator circuits. Motorola has pioneered in JFET inputs, low temperature coefficient input stages, Miller loop compensation, all NPN output stages, dual-doublet frequency compensation and analog "in-the-package" trimming of resistors to produce superior high performance operational amplifiers and comparators, operating in many cases from a single supply with low input offset, low noise, low power, high output swing, high slew rate and high gain-bandwidth product at reasonable cost to the customer.

Present day operational amplifiers and comparators find application in all market segments including motor controls, instrumentation, aerospace, automotive, telecommunication, medical and consumer products.

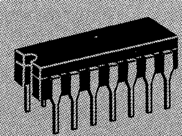
Amplifiers and Comparators

Operational Amplifiers

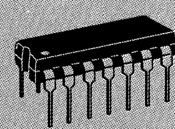
Motorola offers a broad line of bipolar operational amplifiers to meet a wide range of applications. From low-cost industry-standard types to high precision circuits, the span encompasses a large range of performance capabilities. These linear integrated circuits are available as single, dual and quad monolithic devices in a variety of temperature ranges and package styles. Most devices may be obtained in unencapsulated "chip" form as well. For price and delivery information on chips, please contact your Motorola Sales Representative or Distributor.



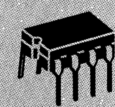
CASE 626
PLASTIC
N, P OR P1 SUFFIX



CASE 632
CERAMIC
J, L SUFFIX



CASE 646
PLASTIC
N, N-14, P SUFFIX



CASE 693
CERAMIC
J OR J-8, U, JG SUFFIX

Single Operational Amplifiers

Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
Noncompensated											
Commercial Temperature Range (0°C to +70°C)											
LM301A	0.25	7.5	10	50	25	1.0	0.5	±3.0	±18	General Purpose	N/626, J/693
LM308A	7.0	0.5	5.0	1.0	80	1.0	0.3	±3.0	±18	Precision	N/626
MC1748C	0.5	6.0	15	200	20	1.0	0.5	±3.0	±18	General Purpose	P1
Industrial Temperature Range (–25°C to +85°C)											
LM201A	0.075	2.0	10	10	50	1.0	0.5	±3.0	±22	General Purpose	N/626, J/693
Military Temperature Range (–55°C to +125°C)											
LM101A	0.075	2.0	10	10	50	1.0	0.5	±3.0	±22	General Purpose	J/693

OPERATIONAL AMPLIFIERS (continued)

Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW ($A_V = 1$) MHz Typ	SR ($A_V = 1$) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package

Internally Compensated

Commercial Temperature Range (0°C to +70°C)

Device	I_{IB}	V_{IO}	TC_{VIO}	I_{IO}	A_{vol}	BW	SR	Min	Max	Description	Suffix/ Package
LF351	200 pA	10	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	N/626
LF356	200 pA	10	5.0	50 pA	50	2.0	15	± 5.0	± 18	JFET Input	J/693
LF356B	100 pA	5.0	5.0	20 pA	50	5.0	12	± 5.0	± 22	JFET Input	J/693
LF357	200 pA	10	5.0	50 pA	50	3.0	75	± 5.0	± 18	Wideband FET Input	J/693
LF357B	100 pA	5.0	5.0	20 pA	50	20	50	± 5.0	± 22	JFET Input	J/693
LF441C	100 pA	5.0	10	50 pA	25	2.0	6.0	± 5.0	± 18	Low Power JFET Input	N/626
LM11C	100 pA	0.6	2.0	10 pA	250	1.0	0.3	± 3.0	± 20	Precision	N/626
LM11CL	200 pA	5.0	3.0	25 pA	50	1.0	0.3	± 3.0	± 20	Precision	N/626
LM307	0.25	7.5	10	50	25	1.0	0.5	± 3.0	± 18	General Purpose	N/626
MC1436	0.04	10	12	10	70	1.0	2.0	± 15	± 34	High Voltage	U
MC1741C	0.5	6.0	15	200	20	1.0	0.5	± 3.0	± 18	General Purpose	P1, U
MC1776C	0.003	6.0	15	3.0	100	1.0	0.2	± 1.2	± 18	µPower, Programmable	P1, U
MC3476	0.05	6.0	15	25	50	1.0	0.2	± 1.5	± 18	Low Cost µPower, Programmable	P1, U
MC34001	200 pA	10	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	P/626, U
MC34001B	200 pA	5.0	10	100 pA	50	4.0	13	± 5.0	± 18	JFET Input	P/626, U
MC34071	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	P/626, U
MC34071A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	P/626, U
MC34080	200 pA	1.0	10	100 pA	25	16	55	± 5.0	± 22	Decompensated	P/626, U
MC34081	200 pA	1.0	10	100 pA	25	8.0	30	± 5.0	± 22	High Speed JFET Input	P/626, U
MC34181	0.1 nA	2.0	10	0.05	25	4.0	10	± 2.5	± 18	Low Power JFET Input	P/626
TL071AC	200 pA	6.0	10	50 pA	50	4.0	13	± 5.0	± 18	Low Noise JFET Input	P/626, JG
TL071C	200 pA	10	10	50 pA	25	4.0	13	± 5.0	± 18	Low Noise JFET Input	P/626, JG
TL081AC	200 pA	6.0	10	100 pA	50	4.0	13	± 5.0	± 18	JFET Input	P/626, JG
TL081C	400 pA	15	10	200 pA	25	4.0	13	± 5.0	± 18	JFET Input	P/626, JG

Automotive Temperature Range (–40°C to +85°C)

Device	I_{IB}	V_{IO}	TC_{VIO}	I_{IO}	A_{vol}	BW	SR	Min	Max	Description	Suffix/ Package
MC33071	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	P/626, U
MC33071A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	P/626, U
MC33171	0.1	4.5	10	20	50	1.8	2.1	+ 3.0	+ 44	Low Power Single Supply	P/626
MC33181	0.1 nA	2.0	10	0.05	25	4.0	10	± 2.5	± 18	Low Power JFET Input	P/626

Military Temperature Range (–55°C to +125°C)

Device	I_{IB}	V_{IO}	TC_{VIO}	I_{IO}	A_{vol}	BW	SR	Min	Max	Description	Suffix/ Package
MC1536	0.02	5.0	10	3.0	100	1.0	2.0	± 15	± 40	High Voltage	U
MC1741	0.5	5.0	15	200	50	1.0	0.5	± 3.0	± 22	General Purpose	U
MC1776	0.0075	5.0	15	3.0	200	1.0	0.2	± 1.2	± 18	µPower, Programmable	L
MC35001B	100 pA	5.0	10	50 pA	50	4.0	13	± 5.0	± 22	JFET Input	U
MC35071	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	U
MC35071A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	U
MC35080	200 pA	1.0	10	100 pA	25	16	55	± 5.0	± 22	Decompensated	U
MC35081	200 pA	1.0	10	100 pA	25	8.0	30	± 5.0	± 22	High Speed JFET Input	U
MC35171	0.1	4.5	10	20	50	1.8	2.1	+ 3.0	+ 44	Low Power Single Supply	U
TL081M	200 pA	9.0	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	JG

Dual Operational Amplifiers

Internally Compensated

Commercial Temperature Range (0°C to +70°C)

Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
LF353	200 pA	10	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	N/626
LF422C	100 pA	5.0	10	50 pA	25	2.0	6.0	± 5.0	± 18	Low Power JFET Input	N/626
LM358	0.25	6.0	7.0	50	25	1.0	0.6	± 1.5	± 18	Single Supply,	N/626, J/693
								+ 3.0	+ 36	Low Power Consumption	
LM833	1.0	5.0	2.0	200	31.6	15	7.0	± 2.5	± 18	Low Noise, Audio	N/626
MC1458	0.5	6.0	10	200	20	1.1	0.8	± 3.0	± 18	Dual MC1741	P1, U
MC1458C	0.7	10	10	300	20	1.1	0.8	± 3.0	± 18	General Purpose	P1
MC1747C	0.5	6.0	10	200	25	1.0	0.5	± 3.0	± 18	Dual MC1741	L, P2
MC3458	0.5	10	7.0	50	20	1.0	0.6	± 1.5	± 18	Split Supplies	P1, U
								+ 3.0	+ 36	Single Supply	
										Low Crossover Distortion	
MC4558AC	0.5	5.0	10	200	50	2.8	1.6	± 3.0	± 22	High Frequency	P1
MC4558C	0.5	6.0	10	200	20	2.8	1.6	± 3.0	± 18	High Frequency	P1, U
MC34002	100 pA	10	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	P/626, U
MC34002B	100 pA	5.0	10	70 pA	25	4.0	13	± 5.0	± 18	JFET Input	P/626
MC34072	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	P/626, U
MC34072A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	P/626, U
MC34082	200 pA	3.0	10	100 pA	25	8.0	30	± 5.0	± 22	High Speed JFET Input	P/626, U
MC34083	200 pA	3.0	10	100 pA	25	16	55	± 5.0	± 22	Decompensated	P/626, U
MC34182	0.1 nA	3.0	10	0.05	25	4.0	10	± 2.5	± 18	Low Power JFET Input	P/626
TL062AC	200 pA	6.0	10	100 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	P/626
TL062C	200 pA	15	10	200 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	P/626
TL072AC	200 pA	6.0	10	50 pA	50	4.0	13	± 5.0	± 18	Low Noise JFET Input	P/626, JG/693
TL072C	200 pA	10	10	50 pA	25	4.0	13	± 5.0	± 18	Low Noise JFET Input	P/626, JG/693
TL082AC	200 pA	6.0	10	100 pA	50	4.0	13	± 5.0	± 18	JFET Input	P/626, JG/693
TL082C	400 pA	15	10	200 pA	25	4.0	13	± 5.0	± 18	JFET Input	P/626, JG/693

Industrial Temperature Range (–25°C to +85°C)

Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
LM258	0.15	5.0	10	30	50	1.0	0.6	± 1.5	± 18	Split or Single	N/626, J/693
								+ 3.0	+ 36	Supply Op Amp	

Automotive Temperature Range (–40°C to +85°C)

Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
LM2904	0.25	7.0	7.0	50	100	1.0	0.6	± 1.5	± 13	Split Supplies	N/626, J/693
					typ			+ 3.0	+ 26	Single Supply	
MC3358	5.0	8.0	10	75	20	1.0	0.6	± 1.5	± 18	Split Supplies	P1/626
								+ 3.0	+ 36	Single Supply	
MC33072	0.50	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	P/626, U
MC33072A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	P/626, U
MC33077	1.0	1.0	2.0	180	150	37	11	± 2.5	± 18	Low Noise	P/626
MC33078	750 nA	2.0	2.0	150	31.6	16	7.0	± 5.0	± 18	Low Noise	N/626
MC33172	0.10	4.5	10	20	50	1.8	2.1	+ 3.0	+ 44	Low Power Single Supply	P/626
MC33182	0.1 nA	3.0	10	0.05	25	4.0	10	± 2.5	± 18	Low Power JFET Input	P/626
MC33282	100 pA	200µV	5.0	50 pA	50	30	12	± 2.5	± 18	Low Input Offset JFET	P/646
TL062V	200 pA	6.0	10	100 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	P/626

OPERATIONAL AMPLIFIERS (continued)

Military Temperature Range (–55°C to +125°C)

Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
LM158	0.15	5.0	10	30	50	1.0	0.6	± 1.5	± 18	Split Supplies	J/693
								+ 3.0	+ 36	Single Supply	
										Low Power Consumption	
MC1558	0.5	5.0	10	200	50	1.1	0.8	± 3.0	± 22	Dual MC1741	U
MC1747	0.5	5.0	10	200	50	1.0	0.5	± 3.0	± 22	Dual MC1741	L
MC3558	0.5	5.0	10	50	50	1.0	0.6	± 1.5	± 18	Split Supplies	U
								+ 3.0	+ 36	Single Supply	
MC4558	0.5	5.0	10	200	50	2.8	1.6	± 3.0	± 22	High Frequency	U
MC35002	100 pA	10	10	100 pA	25	4.0	13	± 5.0	± 22	JFET Input	U
MC35002B	100 pA	5.0	10	50 pA	50	4.0	13	± 5.0	± 22	JFET Input	U
MC35072	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	U
MC35072A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	U
MC35172	0.1	4.5	10	20	50	1.8	2.1	+ 3.0	+ 44	Low Power Single Supply	U
TL062M	200 pA	6.0	10	100 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	JG
TL072M	200 pA	6.0	10	50 pA	35	4.0	13	± 5.0	± 18	Low Noise JFET Input	JG
TL082M	200 pA	6.0	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	JG

Quad Operational Amplifiers

Internally Compensated

Commercial Temperature Range (0°C to +70°C)

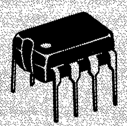
Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
LF347	200 pA	10	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	N/646
LF347B	200 pA	5.0	10	100 pA	50	4.0	13	± 5.0	± 18	JFET Input	N/646
LF444C	100 pA	10	10	50 pA	25	2.0	6.0	± 5.0	± 18	Low Power JFET Input	N/646
LM324	0.25	6.0	7.0	50	25	1.0	0.6	± 1.5	± 16	Low Power	J/632, N/646
								+ 3.0	+ 32	Consumption	
LM348	0.2	6.0	—	50	25	1.0	0.5	± 3.0	± 18	Quad MC1741	J/632, N/646
MC3401/ LM3900	0.3	—	—	—	1.0	5.0	0.6	± 1.5	± 18	Norton Input	J/632, N/646
								+ 3.0	+ 36		
MC3403	0.5	10	7.0	50	20	1.0	0.6	± 1.5	± 18	No Crossover	L, P/646
								+ 3.0	+ 36	Distortion	
MC4741C	0.5	6.0	15	200	20	1.0	0.5	± 3.0	± 18	Quad MC1741	L, P/646
MC34004	200 pA	10	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	L, P/646
MC34004B	200 pA	5.0	10	100 pA	50	4.0	13	± 5.0	± 18	JFET Input	L, P/646
MC34074	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance,	L, P/646
MC34074A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	Single Supply	L, P/646
MC34084	200 pA	12	10	100 pA	25	8.0	30	± 5.0	± 22	High Speed JFET Input	P/646
MC34085	200 pA	12	10	100 pA	25	16	55	± 5.0	± 22	Decompensated	P/646
MC34184	0.1 nA	10	10	0.05	25	4.0	10	± 2.5	± 18	Low Power JFET Input	P/646
TL064AC	200 pA	6.0	10	100 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	N/646
TL064C	200 pA	15	10	200 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	N/646
TL074AC	200 pA	6.0	10	50 pA	50	4.0	13	± 5.0	± 18	Low Noise JFET Input	J/632, N/646
TL074C	200 pA	10	10	50 pA	25	4.0	13	± 5.0	± 18	Low Noise JFET Input	J/632, N/646
TL084AC	200 pA	6.0	10	100 pA	50	4.0	13	± 5.0	± 18	JFET Input	J/632, N/646
TL084C	400 pA	15	10	200 pA	25	4.0	13	± 5.0	± 18	JFET Input	J/632, N/646

OPERATIONAL AMPLIFIERS (continued)

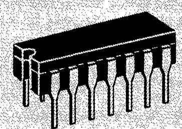
Device	I_{IB} µA Max	V_{IO} mV Max	TC_{VIO} µV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW (A_V = 1) MHz Typ	SR (A_V = 1) V/µs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Suffix/ Package
Industrial Temperature Range (–25°C to +85°C)											
LM224	0.15	5.0	7.0	30	50	1.0	0.6	± 1.5	± 16	Split Supplies	J/632, N/646
								+ 3.0	+ 32	Single Supply	
LM248	0.2	6.0	—	50	25	1.0	0.5	± 3.0	± 18	Quad MC1741	J/632, N/646
Automotive Temperature Range (–40°C to +85°C)											
MC3301/	0.3	—	—	—	1.0	4.0	0.6	± 2.0	± 15	Norton Input	P/646
LM2900								+ 4.0	+ 28		N/646
LM2902	0.5	10	—	50	—	1.0	0.6	± 1.5	± 13	Differential Low Power	J/632, N/646
								+ 3.0	+ 26		
MC3303	0.5	8.0	10	75	20	1.0	0.6	± 1.5	± 18	Differential	P/646
								+ 3.0	+ 36	General Purpose	
MC33074	0.5	4.5	10	75	25	4.5	10	+ 3.0	+ 44	High Performance, Single Supply	L, P/646
MC33074A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	High Performance	L, P/646
MC33079	750 nA	2.5	2.0	150	31.6	9.0	7.0	± 5.0	± 18	Low Noise	N/646
MC33174	0.1	4.5	10	20	50	1.8	2.1	+ 3.0	+ 44	Low Power Single Supply	P/646
MC33184	0.1 nA	10	10	0.05	25	4.0	10	± 2.5	± 18	Low Power JFET Input	P/646
MC33274	650 nA	1.0	0.56	25 nA	31.6	5.5	11.5	± 1.5	± 18	High Performance	P/626
MC33284	100 pA	2.0	5.0	50 pA	50	30	12	± 2.5	± 18	Low Input Offset JFET	P/646
TL064V	200 pA	9.0	10	100 pA	4.0	2.0	6.0	± 2.5	±18	Low Power JFET Input	N/646
Telecommunications Temperature Range (–40°C to +85°C)											
MC143403	1.0 nA	30	—	200 pA	45 dB	0.8	1.5	4.75	12.6	CMOS Low Power, Drives Low-Impedance Loads	L, P/646
MC143404	1.0 nA	30	—	200 pA	60 dB	0.8	1.0	4.75	12.6	CMOS Very Low Power	L, P/646
Military Temperature Range (–55°C to +125°C)											
LM124	0.15	5.0	7.0	30	50	1.0	0.6	± 1.5	± 16	Low Power	J/632, N/646
								+ 3.0	+ 32	Consumption	
MC3503	0.5	5.0	7.0	50	50	1.0	0.6	± 1.5	± 18	General Purpose,	L, P/646
								+ 3.0	+ 36	Low Power	
MC4741	0.5	5.0	15	200	50	1.0	0.5	± 3.0	± 22	Quad MC1741	L
MC35004	100 pA	10	10	100 pA	25	4.0	13	± 5.0	± 22	JFET Input	L
MC35004B	100 pA	5.0	10	50 pA	50	4.0	13	± 5.0	± 22	JFET Input	L
MC35074	0.5	5.0	10	75	25	4.5	10	+ 3.0	+ 44	High Performance, Single Supply	L
MC35074A	500 nA	3.0	10	50	50	4.5	10	+ 3.0	+ 44	High Performance	L
MC35084	200 pA	12	10	100 pA	25	8.0	30	± 5.0	± 22	High Speed JFET Input	L
MC35085	200 pA	12	10	100 pA	25	16	55	± 5.0	± 22	Decompensated	L
MC35174	0.1	4.5	10	20	50	1.8	2.1	+ 3.0	+ 44	Low Power, Single Supply	L
TL064M	200 pA	9.0	10	100 pA	4.0	2.0	6.0	± 2.5	± 18	Low Power JFET Input	J/632
TL074M	200 pA	9.0	10	50 pA	35	4.0	13	± 5.0	± 18	Low Noise JFET Input	J/632
TL084M	200 pA	9.0	10	100 pA	25	4.0	13	± 5.0	± 18	JFET Input	J/632

High Frequency Amplifiers

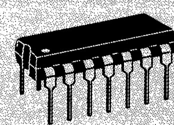
A variety of high frequency circuits with features ranging from low cost simplicity to multi-function versatility marks Motorola's line of integrated amplifiers. Devices described here are intended for industrial and communications applications. For devices especially dedicated to consumer products, i.e., TV and entertainment radio, see the "Consumer Electronics" section.



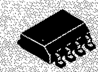
CASE 626
PLASTIC
P SUFFIX



CASE 632
CERAMIC
F, L SUFFIX



CASE 646
PLASTIC
N, P SUFFIX



CASE 751
PLASTIC
D SUFFIX

AGC Amplifiers

MC1490P Family Wideband General Purpose Amplifiers

The MC1490 and MC1350 family are basic building blocks — AGC (Automatic Gain Controlled) RF/Video Amplifiers. These parts are recommended for applications up through 70 MHz. The best high frequency performance may be obtained by using the physically smaller SOIC version (shorter leads) — MC1350D. There are currently no other RF ICs like these, because other manufacturers have dropped their copies. Applications include variable gain video and instrumentation amplifiers, IF (Intermediate Frequency) amplifiers for radio and TV receivers, and transmitter power output control. Many uses will be found in medical instrumentation, remote monitoring, video/graphics processing, and a variety of communications equipment. The family of parts using the same basic die (identical circuit with slightly different test parameters) is listed in the following table.

MC1545/1445 Gated 2-Channel Input

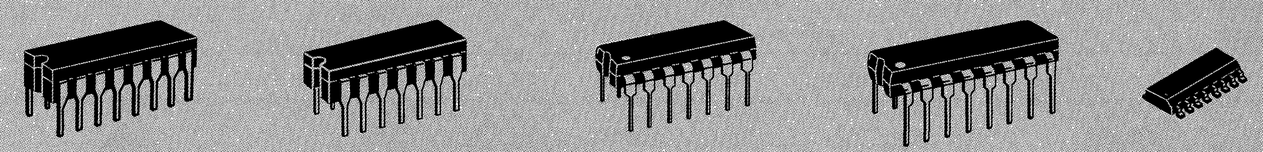
Differential input and output amplifier with gated 2-channel input provides for a wide variety of switching purposes. Typical 50 MHz bandwidth makes it suitable for high frequency applications such as video switching, FSK circuits, multiplexers, etc. Gating circuit is useful for AGC control.

High-Frequency Amplifier Specifications

Operating Temperature Range			A_V dB	Bandwidth @ MHz	V_{CC}/V_{EE} Vdc		Suffix/ Package
–55° to +125°C	–40° to +85°C	0° to +70°C	Typ		Min	Max	
—	—	MC1350	50 50	45 45	+ 6.0	+ 18	P/626, D/751
—	MC1490	—	50 35	10 100	+ 6.0	+ 18	P/626
MC1545	—	MC1445	19	50	± 4.0	± 12	L/632

Miscellaneous Amplifiers

Motorola provides several bipolar and CMOS special purpose amplifiers which fill specific needs. These devices range from low power CMOS programmable amplifiers and comparators to variable-gain bipolar power amplifiers.

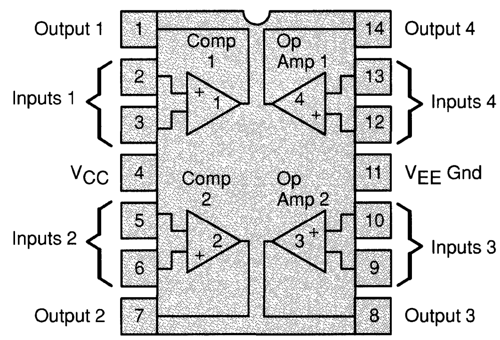


CASE 620	CASE 632	CASE 646	CASE 648	CASE 751B
CERAMIC	CERAMIC	PLASTIC	PLASTIC	PLASTIC
L SUFFIX	**L SUFFIX**	**P SUFFIX**	**P SUFFIX**	**D SUFFIX**

Bipolar

MC3405/MC3505 Dual Operational Amplifier and Dual Voltage Comparator

This device contains two Differential Input Operational Amplifiers and two Comparators; each set capable of single supply operation. This operational amplifier-comparator circuit will find its applications as a general purpose product for automotive circuits and as an industrial "building block."



Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} nA Max	A_{vol} V/mV Min	Response µs Typ	Supply Voltage Single	Supply Voltage Dual	Suffix/ Package
MC3405	0.5	10	50	20	1.3	3.0 to 36	± 1.5 to ± 18	L/632, P/646
MC3505		5.0						L/632

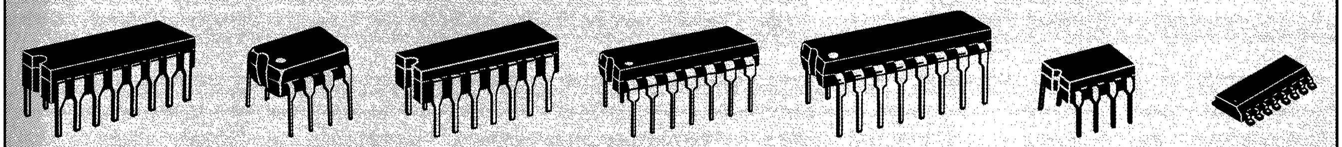
CMOS

MC14573 Quad Programmable Operational Amplifier
MC14576A/MC14577A Dual Video Amplifiers
MC14575 Dual Programmable Operational Amplifier and Dual Programmable Comparator

Function	Quantity Per Package	Single Supply Voltage Range	Dual Supply Voltage Range	Frequency Range	Device Number	Suffix/ Package
Operational Amplifiers	4	3 to 15 V	± 1.5 to ± 7.5 V	DC to 1 MHz	**MC14573**	D/751B,P/648
Video Amplifiers	2	5 to 12 V*	± 2.5 to ± 6 V♦	up to 10 MHz	**MC14576A** **MC14577A**	P/626 TBD**
Operational Amplifiers and Comparators	2 and 2	3 to 15 V	± 1.5 to ± 7.5 V	DC to 1 MHz	**MC14575**	D/751B, P/648

*5 to 10 V for surface mount package
♦± 2.5 to ± 5 V for surface mount package
**To Be Determined

Comparators



CASE 620 CERAMIC **L SUFFIX** | CASE 626 PLASTIC **N SUFFIX** | CASE 632 CERAMIC **J SUFFIX** | CASE 646 PLASTIC **N, P SUFFIX** | CASE 648 PLASTIC **P SUFFIX** | CASE 693 CERAMIC **J-8 SUFFIX** | CASE 751B PLASTIC **D SUFFIX**

Single

BIPOLAR

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_{IO} mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range °C	Suffix/ Package
LM111	0.1	3.0	0.01	200 k	8.0	200	+ 15, – 15	With strobe, will operate from single supply	– 55 to + 125	J-8
LM211	0.1	3.0	0.01	200 k	8.0	200	+ 15, – 15		– 25 to + 85	J-8
LM311	0.25	7.5	0.05	200 k	8.0	200	+ 15, – 15		0 to + 70	N/626, J-8

CMOS

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_{IO} mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range °C	Suffix/ Package
MC14578	1.0 pA	50	—	—	1.1	—	3.5 to 14	Requires only 10 µA from single-ended supply	– 30 to + 70	P/648 D

Dual

BIPOLAR

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_{IO} mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range °C	Suffix/ Package
LM393	0.25	5.0	0.05	200 k	6.0	1300	± 1.5 to ± 18 or 3.0 to 36	Designed for single or split supply operation, input common mode includes ground (negative supply)	0 to + 70	N/626
LM393A	0.25	2.0	0.05	200 k	6.0	1300			0 to + 70	N/626
LM2903	0.25	7.0	0.05	200 k	6.0	1500			– 40 to + 85	N/626
MC3405	0.5	10	0.05	200 k	6.0	1300	± 1.5 to ± 7.5 or 3.0 to 15	This device contains 2 op amps and 2 comparators in a single package	0 to + 70	L, P/646
MC3505	0.5	5.0	0.05	200 k	6.0	1300			– 55 to + 125	L

CMOS

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_{IO} mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range °C	Suffix/ Package
MC14575	0.001	30	0.0001	20 k	3.0	1000	± 1.5 to ± 7.5 or 3.0 to 15	This device contains 2 op amps and 2 comparators in a single package	– 40 to + 85	P/648 D

Quad

BIPOLAR

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_{IO} mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range °C	Suffix/ Package
LM139	0.1	5.0	0.025	200 k	6.0	1300	± 1.5 to ± 18 or 3.0 to 36	Designed for single or split supply operation, input common mode includes ground (negative supply)	– 55 to + 125	J
LM139A	0.1	2.0	0.025	200 k	6.0	1300			– 55 to + 125	J
LM239	0.25	5.0	0.05	200 k	6.0	1300			– 25 to + 85	J, N/646
LM239A	0.25	2.0	0.05	200 k	6.0	1300			– 25 to + 85	J, N/646
LM339	0.25	5.0	0.05	200 k	6.0	1300			0 to + 70	J, N/646
LM339A	0.25	2.0	0.05	200 k	6.0	1300			0 to + 70	J, N/646
LM2901	0.25	7.0	0.05	100 k	6.0	1300			– 40 to + 85	N/646
MC3302	0.5	20	0.5	30 k	6.0	1300			– 40 to + 85	P/646
MC3430	40	6.0	1.0 Typ	1.2 k	16	33	+ 5.0, – 5.0	High speed comparator/ sense-amplifier	0 to + 70	L, P/648
MC3431	40	10	1.0 Typ	1.2 k	16	33	+ 5.0, – 5.0		0 to + 70	L, P/648
MC3432	40	6.0	1.0 Typ	1.2 k	16	40	+ 5.0, – 5.0		0 to + 70	L, P/648
MC3433	40	10	1.0 Typ	1.2 k	16	40	+ 5.0, – 5.0		0 to + 70	L, P/648

CMOS

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_{IO} mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range °C	Suffix/ Package
MC14574	0.001	30	0.0001	20 k	3.0	1000	± 1.5 to ± 7.5 or 3.0 to 15	Externally programmable power dissipation with 1 or 2 resistors	– 40 to + 85	P/648 D

Power Supply Circuits

In Brief . . .

In most electronic systems some form of voltage regulation is required. In the past, the task of voltage regulator design was tediously accomplished with discrete devices, and the results were quite often complex and costly. Today, with bipolar monolithic regulators, this task has been significantly simplified. The designer now has a wide choice of fixed, low V_{diff}, adjustable, and tracking series-type voltage regulators. These devices incorporate many built-in protection features, making them virtually immune to the catastrophic failures encountered in older discrete designs.

The Switching Power Supply continues to increase in popularity and is one of the fastest growing markets in the world of power conversion. They offer the designer several important advantages over linear series-pass regulators. These advantages include significant advancements in the areas of size and weight reduction, improved efficiency, and the ability to perform voltage step-up and voltage-inverting functions. Motorola offers a diverse portfolio of full featured switching regulator control circuits which meet the needs of today's modern compact electronic equipment.

Page

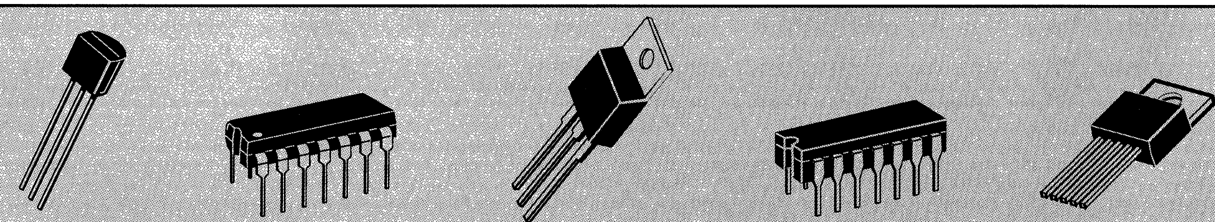
Power Supply Circuits

Linear Voltage Regulators

Fixed Output

These low cost monolithic circuits provide positive and/or negative regulation at currents from 100 mA to 3.0 A. They are ideal for on-card regulation employing current limiting and thermal shutdown. Low V_{diff} devices are offered for battery powered systems.

Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.



CASE 29 PLASTIC **P, Z SUFFIX** | CASE 646 PLASTIC **CP SUFFIX** | CASE 221A PLASTIC POWER **T, KC SUFFIX** | CASE 632 CERAMIC **CL, L SUFFIX** | CASE 314D PLASTIC **T SUFFIX**

Fixed-Voltage, 3-Terminal Regulators for Positive or Negative Polarity Power Supplies

V_{out} V	Tol.* V	I_O mA Max	Output Device Positive	Output Device Negative	V_{in} Min/Max	Reg_{line} mV	Reg_{load} mV	$\Delta V_O/\Delta T$ mV/°C Typ	Suffix/ Package
5.0	±0.5	100	LM2931-5.0	—	5.6/40	30	50	1.0	Z,T
			MC78L05C	MC79L05C	6.7/30	200	60		P
	±0.25		LM2931A-5.0	—	5.6/40	30	50		Z, T
			MC78L05AC	MC79L05AC	6.7/30	150	60		P
		500	MC78M05C	MC79M05C	7.0/35	100	100		T
	±0.5	750, 10	LM2935	—	5.6/26	30	50		T/314D
	±0.25	1500	MC7805B#	—	8.0/35	100	100	1.0	T
			MC7805C	MC7905C	7.0/35				
	±0.2		MC7805AC	MC7905AC	7.5/35	10		0.6	
	±0.25		LM340-5	—	7.0/35	50	50		
	±0.2		LM340A-5	—		10	25		
	±0.1		TL780-05C	—		5.0		0.06	KC
	±0.25	3000	MC78T05C	—	7.3/35	25	30	0.1	T
	±0.2		MC78T05AC	—		10	25		
	±0.25		LM323	—	7.5/20	25	100		
	±0.2		LM323A	—		15	50		
5.2	±0.26	1500	—	MC7905.2C	7.2/35	105	105	1.0	T

#T_J = −40° to +125°C

*Output Voltage Tolerance for Worst Case

Fixed Output Voltage Regulators (continued)

V_{out} V	Tol.* V	I_O mA Max	Output Device Positive	Output Device Negative	V_{in} Min/Max	Reg_{line} mV	Reg_{load} mV	$\Delta V_O/\Delta T$ mV/°C Typ	Suffix/ Package
6.0	±0.3	500	MC78M06C	—	8.0/35	100	120	1.0	T
		1500	MC7806B#	—	9.0/35	120		0.7	
			MC7806C	MC7906C	8.0/35				
	±0.24		MC7806AC	—	8.6/35	11	100		
	±0.3		LM340-6	—	8.0/35	60	60		
8.0	±0.8	100	MC78L08C	—	9.7/30	200	80	—	P
			MC78L08AC	—		175			
	±0.4	500	MC78M08C	—	10/35	100	160	1.0	T
		1500	MC7808B#	—	11.5/35	160			
			MC7808C	MC7908C	10.5/35				
	±0.3		MC7808AC	—	10.6/35	13	100		
	±0.4		LM340-8	—	10.5/35	80	80		
		3000	MC78T08C	—	10.4/35	35	30	0.16	
9.0	±0.39	1500	MC7809C	—	11.5/35	50	50	1.0	T
12	±1.2	100	MC78L12C	MC79L12C	13.7/35	250	100	—	P
	±0.6		MC78L12AC	MC79L12AC					
		500	MC78M12C	MC79M12C	14/35	100	240	1.0	T
		1500	MC7812B#	—	15.5/35	240		1.5	
			MC7812C	MC7912C	14.5/35				
	±0.5		MC7812AC	—	14.8/35	18	100		
	±0.6		LM340-12	—	14.5/35	120	120		
	±0.5		LM340A-12	—		18	32		
	±0.24		TL780-12C	—		5.0		0.15	KC
	±0.6	3000	MC78T12C	—		45	30	0.24	T
	±0.5		MC78T12AC	—		18	25		
15	±1.5	100	MC78L15C	MC79L15C	16.7/35	300	150	—	P
	±0.75		MC78L15AC	MC79L15AC					
		500	MC78M15C	MC79M15C	17/35	100	300	1.0	T
		1500	MC7815B#	—	18.5/35	300		1.8	
			MC7815C	MC7915C	17.5/35				
	±0.6		MC7815AC	—	17.9/35	22	100		
	±0.75		LM340-15	—	17.5/35	150	150		
	±0.6		LM340A-15	—		22	35		
	±0.3		TL780-15C	—		15	60	0.18	KC
	±0.75	3000	MC78T15C	—	17.5/40	55	30	0.3	T
	±0.6		MC78T15AC	—		22	25		
18	±1.8	100	MC78L18C	MC79L18C	19.7/35	325	170	—	P
	±0.9		MC78L18AC	MC79L18AC					
		500	MC78M18C	—	20/35	100	360	1.0	T
		1500	MC7818B#	—	22/35	360		2.3	
	±0.7		MC7818C	MC7918C	21/35				
			MC7818AC	—		31	100		
	±0.9		LM340-18	—		180	180		

#T_J = −40° to +125°C

*Output Voltage Tolerance for Worst Case

(continued)

Fixed Output Voltage Regulators (continued)

V_{out} V	Tol.* V	I_O mA Max	Output Device Positive	Output Device Negative	V_{in} Min/Max	Reg_{line} mV	Reg_{load} mV	$\Delta V_O/\Delta T$ mV/°C Typ	Suffix/ Package
20	± 1.0	500	MC78M20C	—	22/40	10	400	1.1	T
24	± 2.4	100	MC78L24C	MC79L24C	25.7/40	350	200	—	P
	± 1.2		MC78L24AC	MC79L24AC		300			
		500	MC78M24C	—	26/40	100	480	1.2	T
		1500	MC7824B#	—	28/40	480		3.0	
			MC7824C	MC7924C	27/40				
	± 1.0		MC7824AC	—	27.3/40	36	100		
	± 1.2		LM340-24	—		240	240		

#T_J = −40° to +125°C

*Output Voltage Tolerance for Worst Case

Adjustable Output Voltage Regulators

Motorola offers a broad line of adjustable output voltage regulators with a variety of output current capabilities. Adjustable voltage regulators provide users the capability of stocking a single integrated circuit offering a wide range of output voltages for industrial and communications applications. The three-terminal devices require only two external resistors to set the output voltage.

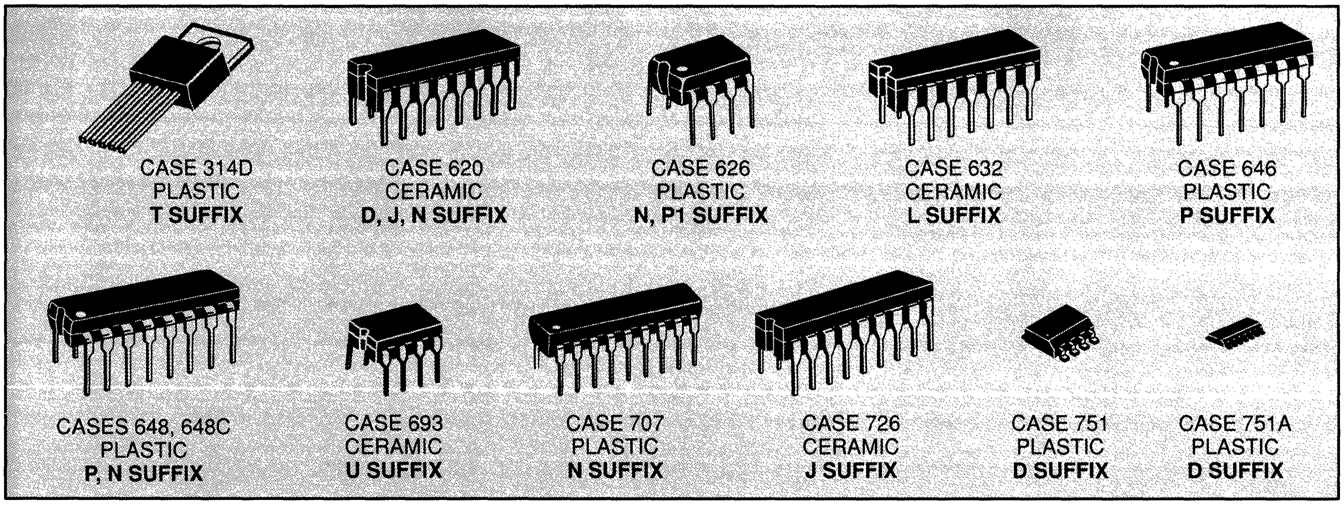
Adjustable Positive Output Regulators

I_O mA Max	Device	V_{out} V Min	V_{out} V Max	V_{in} V Min	V_{in} V Max	$V_{in} - V_{out}$ Differential V Min	P_D W Max T_A = 25°C	P_D W Max T_C = 25°C	Regulation % V_{out} @ T_A = 25°C Max Line	Regulation % V_{out} @ T_A = 25°C Max Load	T_C V_{out} Typ %/°C	T_J = °C Max	Suffix/ Package
100	LM317L	1.2	37	5.0	40	3.0	Internally Limited		0.04	0.5	0.006	125	Z
	LM2931C	3.0	24	3.16		0.6			0.15	1.0	—		T/314D
150	MC1723	2.0	37	9.5		3.0	1.25	—	0.1	0.3	0.003	150	CP
							1.5	—				175	CL
								—			0.002		L
500	LM317M	1.2		5.0			Internally Limited		0.04	0.5	0.0056	125	T
1500	LM317										0.006		
3000	LM350		33		36				0.03		0.008		

Adjustable Negative Output Regulators

I_O mA Max	Device	V_{out} V Min	V_{out} V Max	V_{in} V Min	V_{in} V Max	$V_{in} - V_{out}$ Differential V Min	P_D W Max T_A = 25°C	P_D W Max T_C = 25°C	Regulation % V_{out} @ T_A = 25°C Max Line	Regulation % V_{out} @ T_A = 25°C Max Load	T_C V_{out} Typ %/°C	T_J = °C Max	Suffix/ Package
500	LM337M	−1.2	−37	5.0	4.0	3.0	Internally Limited		0.04	1.0	0.0048	125	T
1500	LM337												

Special Regulators



Floating Voltage and Current Regulator

Designed for laboratory type power supplies, voltage is limited only by the breakdown voltage of associated, external, series-pass transistors.

Device	V_{out} V Min	V_{out} V Max	I_O mA Max	V_{aux} V Min	V_{aux} V Max	P_D W Max	$\Delta V_{ref}/V_{ref}$ % Line	$\Delta V_{ref}/V_{ref}$ % Load	$\Delta L_L/L_L$ % Max	T_C V_{out} %/°C Typ	Suffix/ Package
MC1466	0	*	*	21	30	0.75	0.015	0.015	0.2	0.01	L

*Dependent on characteristics of external series-pass elements.

Dual ± 15 V Tracking Regulators

Internally, the device is set for ± 15 V, but an external adjustment can change both outputs simultaneously, from 8.0 V to 20 V.

Device	V_{out} V Min	V_{out} V Max	I_O mA Max	V_{in} V Min	V_{in} V Max	P_D W Max	Reg_{line} mV	Reg_{load} mV	T_C %/°C (T_{low} to T_{high}) Typ	T_A °C	Suffix/ Package
MC1468	14.5	15.5	± 100	– 17	30	1.0	10	10	3.0	0 to + 75	L
MC1568										–55 to + 125	

Microprocessor Voltage Regulator/Supervisory Circuit

A 5.0 V fixed output with many monitoring functions required in microprocessor-based systems.

Device	V_{out}, V_{ref} V Min	V_{out}, V_{ref} V Max	I_{sink} mA Max	V_{in} V Min	V_{in} V Max	Reg_{line} mV Max	Reg_{load} mV Max	T_A °C	Suffix/ Package
MC34160	4.75	5.25	100	7.0	40	40	50	0 to + 70	P/648C
MC33160	2.47	2.73	2.0	5.0		20	30	–40 to + 85	

Switching Regulator Control Circuits

These devices contain the primary building blocks which are required to implement a variety of switching power supplies. The product offerings fall into three major categories consisting of single-ended and double-ended controllers, plus single-ended ICs with on-chip power switch transistors. These circuits operate in voltage, current or resonant modes and are designed to drive many of the standard switching topologies. The single-ended configurations include buck, boost, flyback and forward converters. The double-ended devices control push-pull, half bridge and full bridge configurations.

Single-Ended Controllers

These single-ended voltage and current mode controllers are designed for use in buck, boost, flyback, and forward converters. They are cost effective in applications that range from 0.1 to 200 watts power output.

I_O mA Max	Minimum Operating Voltage Range V	Operating Mode	Reference V	Maximum Useful Oscillator Freq. (kHz)	Device	Suffix	T_A °C	Package
250	7.0 to 40	Voltage	5.0 ± 5.0%	200	MC34060	P	0 to + 70	646
						L		632
					MC35060	L	–55 to + 125	
500			5.0 ± 1.5%		MC34060A	D	0 to + 70	751A
						P		646
					MC33060A	D	–40 to + 85	751A
						P		646
					MC35060A	L	–55 to + 125	632
1000	4.2 to 12	Current	1.25 ± 2.0%	300	MC34129	D	0 to + 70	751A
						P		646
					MC33129	D	–40 to + 85	751A
						P		646
	11.5 to 30		5.0 ± 2.0%	500	UC3842A	D	0 to + 70	751A
						N		626
	11 to 30		5.0 ± 1.0%		UC2842A	D	–25 to + 85	751A
						J		693
						N		626
	8.2 to 30		5.0 ± 2.0%		UC3843A	D	0 to + 70	751A
						N		626
			5.0 ± 1.0%		UC2843A	D	–25 to + 85	751A
						J		693
						N		626
	11.5 to 30		5.0 ± 2.0%		UC3844	D	0 to + 70	751A
						N		626
	11 to 30		5.0 ± 1.0%		UC2844	D	–25 to + 85	751A
						J		693
						N		626
	8.2 to 30		5.0 ± 2.0%		UC3845	D	0 to + 70	751A
						N		626
			5.0 ± 1.0%		UC2845	D	–25 to + 85	751A
						J		693
						N		626

Single-Ended Controllers With On-Chip Power Switch

These monolithic power switching regulators contain all the active functions required to implement standard DC-to-DC converter configurations with a minimum number of external components.

I_O mA Max	Minimum Operating Voltage Range V	Operating Mode	Reference V	Maximum Useful Oscillator Freq. (kHz)	Device	Suffix	T_A °C	Package
1500	2.5 to 40	Voltage	1.25 ± 5.2%#	100	μA78S40	PC	0 to + 70	648
						DC		620
						PV	–40 to + 85	648
						DM	–55 to + 125	620
			1.25 ± 2.0%		MC34063A	D	0 to + 70	751
						P1		626
					MC33063A	D	–40 to + 85	751
						P1		626
					MC35063A	U	–55 to + 125	693
3400			1.25 ± 2.0% and 5.05 ± 3.0%		MC34163	P	0 to + 70	648C
					MC33163		–40 to + 85	
3500§	6.8 to 40		5.05 ± 2.0%	72 ± 12% Internally Fixed	MC34166	T	0 to + 70	314D
					MC33166		–40 to + 85	

Double-Ended Controllers

These double-ended voltage and resonant mode controllers are designed for use in push-pull, half-bridge, and full-bridge converters. The are cost effective in applications that range from 100 to 2000 watts power output.

I_O mA Max	Minimum Operating Voltage Range V	Operating Mode	Reference V	Maximum Useful Oscillator Freq. (kHz)	Device	Suffix	T_A °C	Package
500	7.0 to 40	Voltage	5.0 ± 5.0%#	200	TL494	CN	0 to + 70	648
						CJ		620
						IN	–25 to + 85	648
						IJ		620
						MJ	–55 to + 125	
			5.0 ± 1.5%	300	TL594	CN	0 to + 70	648
						IN	–25 to + 85	
						MJ	–55 to + 125	620
± 500	8.0 to 40		5.1 ± 2.0%	400	SG3525A	N	0 to + 70	648
						J		620
					SG3527A	N		648
						J		620
± 200			5.0 ± 2.0%		SG3526	N	0 to +125*	707
						J		726
± 1500	9.6 to 20	Resonant	5.1 ± 2.0%	1000	MC34066	DW	0 to + 70	751G
						P		648
					MC33066	DW	–40 to + 85	751G
						P		648

Tolerance applies over the specified operating temperature range.
* Junction Temperature Range.
§ Guaranteed minimum, typically 4300 mA.

Special Switching Regulator Controllers

Dual Channel Current Mode Controllers

These high performance dual channel controllers are optimized for off-line AC-to-DC power supplies and DC-to-DC converters in the flyback topology. Applications include desktop computers, peripherals, televisions, games, and various consumer appliances.

I_O mA Max	Minimum Operating Voltage Range V	Operating Mode	Reference V	Maximum Useful Oscillator Freq. (kHz)	Device	Suffix	T_A °C	Package
± 1000	11 to 15.5	Current	5.0 ± 2.0%	500	MC34065	DW	0 to + 70	751G
						P		648
					MC33065	DW	–40 to + 85	751G
						P		648

Universal Microprocessor Power Supply Controller

A versatile power supply control circuit for microprocessor-based systems, this device is mainly intended for automotive applications and battery powered instruments. The circuit provides a power-on Reset delay and a Watchdog feature for orderly microprocessor operation.

Regulated Outputs	Output Current mA	V_{CC} Volts Min	V_{CC} Volts Max	Device	T_A °C	Reference V	Key Supervisory Features	Package
E^2PROM Programmable Output: 24 V (Write Mode) 5.0 V (Read Mode)	150 peak	6.0	35	TCF5600	–40 to + 85	2.5 ± 3.2%	MPU Reset and Watchdog Circuit	707
Fixed Linear Output: 5.0 Volts	10 to external buffer transistor			TCA5600	0 to + 75			

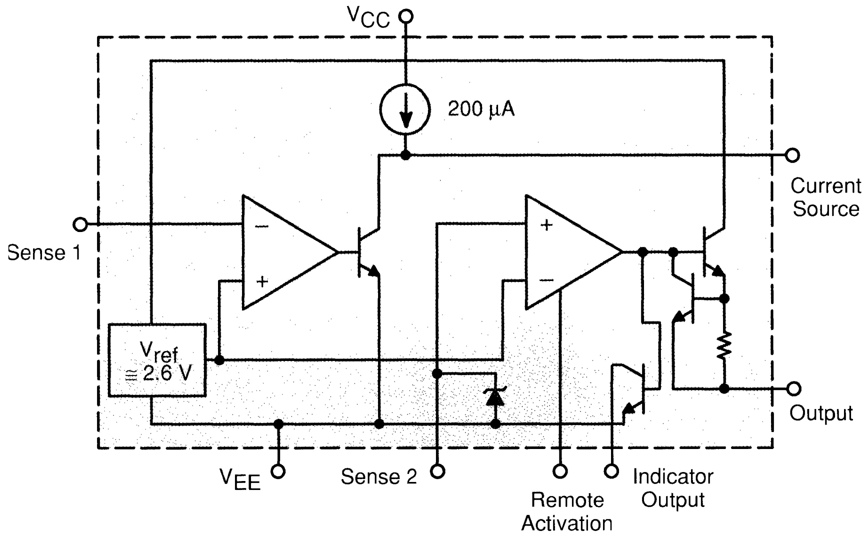
Power Supervisory Circuits

A variety of Power Supervisory Circuits are offered. Overvoltage sensing circuits which drive "crowbar" SCRs are provided in several configurations from a low cost three-terminal version to 8-pin devices which provide pin-programmable trip-voltages or additional features, such as an indicator output drive and remote activation capability. An over/undervoltage protection circuit is also offered.

Overvoltage "Crowbar" Sensing Circuit

MC3523U T_A = –55° to +125°C, Case 693
MC3423P1,U T_A = 0° to +70°C, Case 626, 693

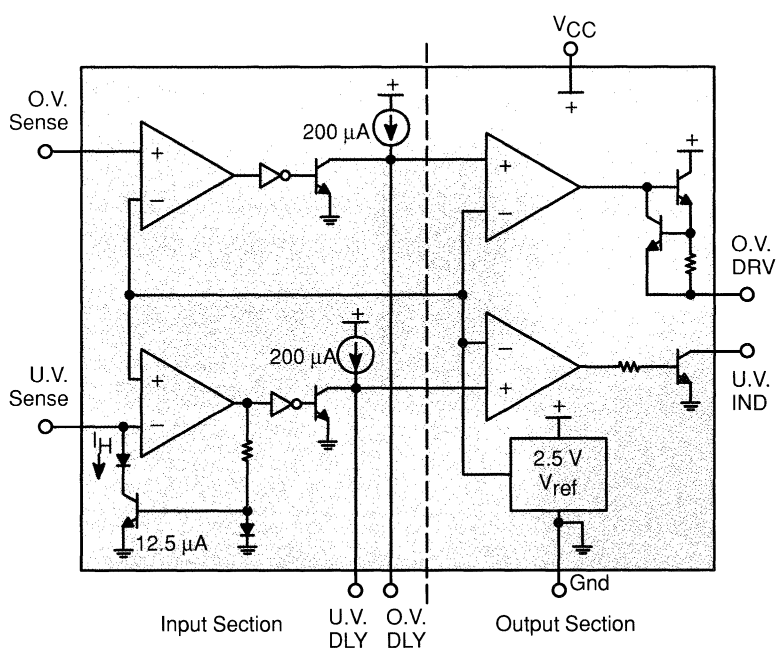
This device can protect sensitive circuitry from power supply transients or regulator failure when used with an external "Crowbar" SCR. The device senses voltage and compares it to an internal 2.6 V reference. Overvoltage trip is adjustable by means of an external resistive voltage divider. A minimum duration before trip is programmable with an external capacitor. Other features include a 300 mA high current output for driving the gate of a "Crowbar" SCR, an open-collector indicator output and remote activation capability.



Over/Undervoltage Protection Circuit

MC3425P1 T_A = 0° to +70°C, Case 626

The MC3425 is a power supply supervisory circuit containing all the necessary functions required to monitor over and undervoltage fault conditions. This device features dedicated over and undervoltage sensing channels with independently programmable time delays. The overvoltage channel has a high current Drive Output for use in conjunction with an external SCR "Crowbar" for shutdown. The undervoltage channel input comparator has hysteresis which is externally programmable, and an open-collector output for fault indication.



Undervoltage Sensing Circuit

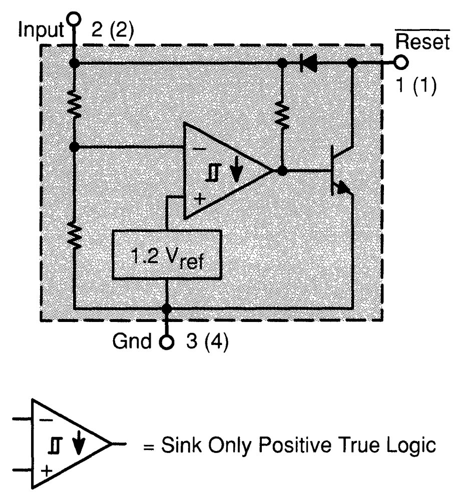
MC34064P-5, D-5 T_A = 0° to +70°C, Case 29, 751
MC33064P-5, D-5 T_A = –40° to +85°C, Case 29, 751
MC34164P-3, P-5, D-3, D-5 T_A = –0° to +70°C, Case 29, 751
MC33164P-3, P-5, D-3, D-5 T_A = –40° to +85°C, Case 29, 751

The MC34064 and MC34164 are two families of undervoltage sensing circuits specifically designed for use as reset controllers in microprocessor-based systems. They offer the designer an economical solution for low voltage detection with a single external resistor. Both parts feature a trimmed bandgap reference, and a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation.

The two families of undervoltage sensing circuits taken together, cover the needs of the most commonly specified power supplies used in MCU/MPU systems. Key parameter specifications of the MC34164 family were chosen to complement the MC34064 series. The table summarizes critical parameters of both families. The MC34064 fulfills the needs of a 5.0 V ± 5% system and features a tighter hysteresis specification. The MC34164 series covers 5.0V ± 10% and 3.0 V ± 5% power supplies with significantly lower power consumption, making them ideal for applications where extended battery life is required such as consumer products or hand held equipment.

Applications include direct monitoring of the MPU/logic power supply used in appliance, automotive, consumer, and industrial equipment.

The MC34164 is specifically designed for battery powered applications where low bias current (1/25th of the MC34064's) is an important characteristic.



Pin numbers adjacent to terminals are for the 3 pin TO-92 package.
Pin numbers in parenthesis are for the D suffix SO-8 package.

Undervoltage Sense/Reset Controllers Features

Device	Suffix	Standard Power Supply Supported	Typical Threshold Voltage (V)	Typical Hysteresis Voltage (V)	Minimum Output Sink Current (mA)	Power Supply Input Voltage Range (V)	Maximum Quiescent Input Current	Package Type
MC34064/MC33064	P-5	5.0V ± 5%	4.6	0.02	10	1.0 to 10	500 μA @ V_{in} = 5.0V	TO-92
	D-5							SO-8
MC34164/MC33164	P-5	5.0V ± 10%	4.3	0.09	7.0	1.0 to 12	20 μA @ V_{in} = 5.0V	TO-92
	D-5							SO-8
	P-3	3.0V ± 5%	2.7	0.06	6.0		15 μA @ V_{in} = 3.0V	TO-92
	D-3							SO-8

Note: MC34X64 devices are specified to operate from 0° to +70°C, and MC33X64 devices operate from –40° to +85°C.

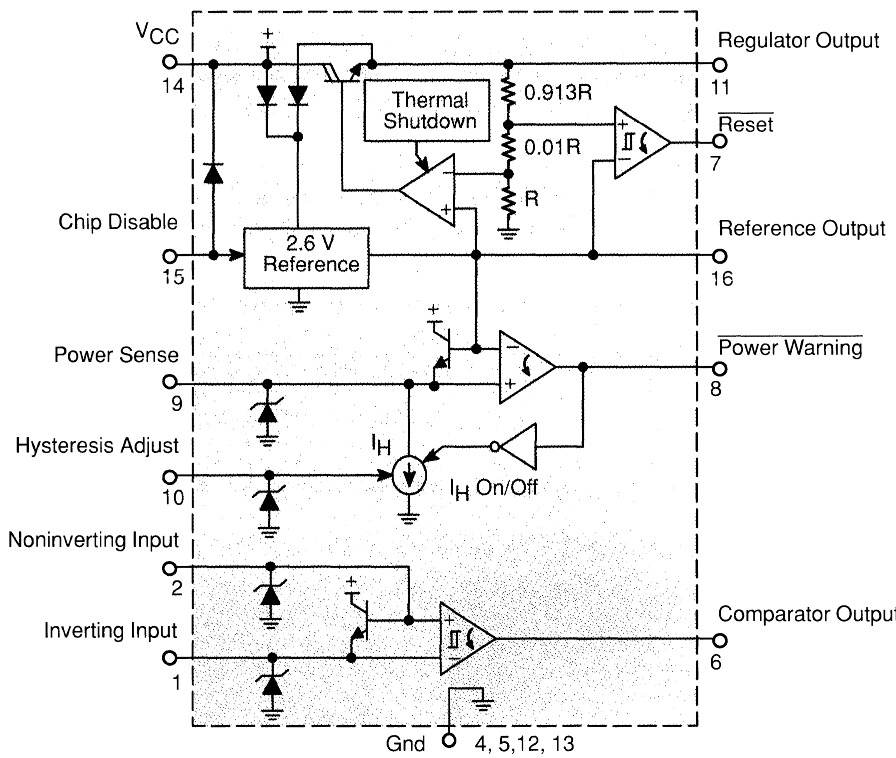
Microprocessor Voltage Regulator and Supervisory Circuit

MC34160P T_A = 0° to +70°C, Case 648C
MC33160P T_A = –40° to +85°C, Case 648C

The MC34160 Series is a voltage regulator and supervisory circuit containing many of the necessary monitoring functions required in microprocessor based systems. It is specifically designed for appliance and industrial applications offering the designer a cost effective solution with minimal external components. These integrated circuits feature a 5.0 V, 100 mA regulator with short circuit current limiting, pinned out 2.6 V bandgap reference, low voltage reset comparator, power warning comparator with programmable hysteresis, and an uncommitted comparator ideally suited for microprocessor line synchronization.

Additional features include a chip disable input for low standby current, and internal thermal shutdown for over temperature protection.

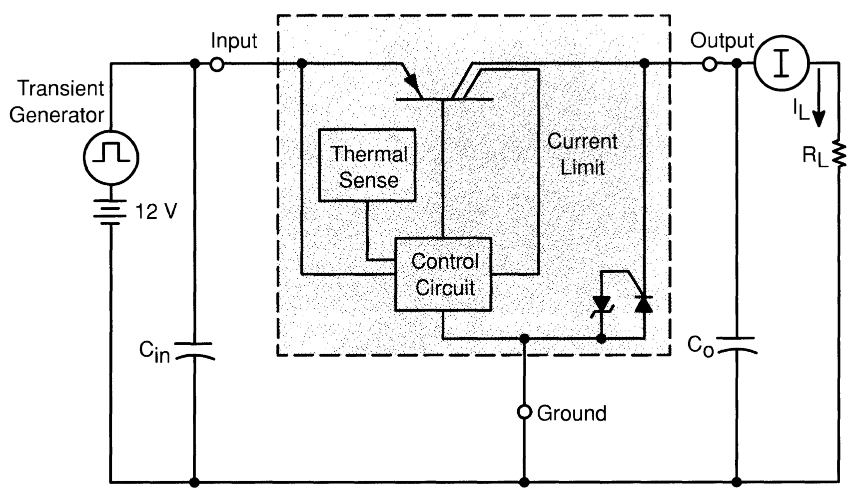
These devices are contained in a 16 pin dual-in-line heat tab plastic package for improved thermal conduction.



Series Switch Transient Protection Circuit

MC3397T T_J = –40° to +125°C, Case 221A

This device acts as a saturated series pass element with a very low voltage drop for load currents in excess of 750 mA. In the event of an overvoltage condition (≥ 7.5 V typically) or high voltage transient of either positive or negative polarity, the MC3397T instantaneously switches to an open circuit (OFF) state, interrupting power to the load and protecting the load during this potentially destructive condition. The device will immediately recover to an ON state when supply voltages fall within the normal operating range.



Winner 1988 Malcolm Baldrige National Quality Award

Power/Motor Control Circuits

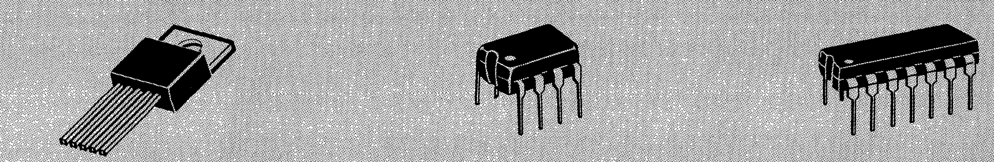
In Brief . . .

With the expansion of electronics into more and more mechanical systems there comes an increasing demand for simple but intelligent circuits that can blend these two technologies. In the past, the task of power/motor control was once accomplished with discrete devices. But today this task is being performed by bipolar IC technology due to cost, size, and reliability constraints. Motorola offers integrated circuits designed to anticipate the requirements for both simple and sophisticated control systems, while providing cost effective solutions to meet the needs of the applications.

Power/Motor Control Circuits

Power Controllers

An assortment of battery and ac line-operated control ICs for specific applications is shown. They are designed to enhance system performance and reduce complexity in a wide variety of control applications.



CASE 314D
PLASTIC
S, T SUFFIX

CASE 626
PLASTIC
B SUFFIX

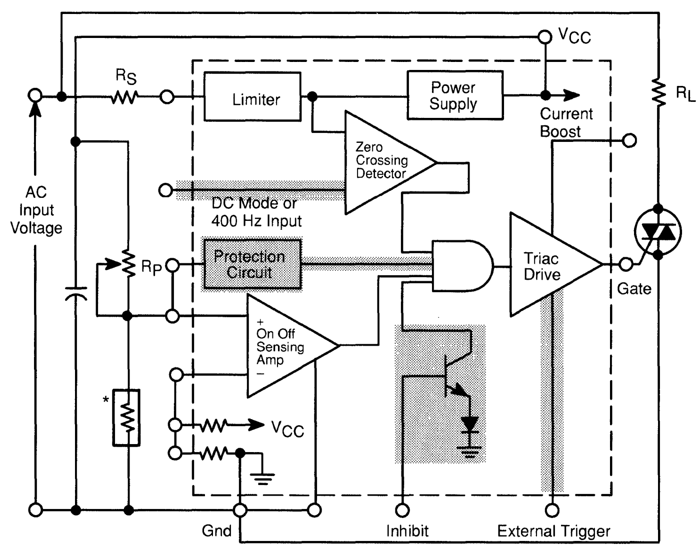
CASE 646
PLASTIC

Zero Voltage Switches

CA3079/CA3059 T_A = –40° to +85°C, Case 646

These devices are designed for thyristor control in a variety of AC power switching applications for AC input voltages of 24 V, 120 V, 208/230 V, and 227 V @ 50/60 Hz. Features include:

- Limiter-Power Supply — Allows operation directly from an AC line.
- Differential On/Off Sensing Amplifier — Tests for condition of external sensors or input command signals. Proportional control capability or hysteresis may be implemented.
- Zero-Crossing Detector — Synchronizes the output pulses to the zero voltage point of the AC cycle. Eliminates RFI when used with resistive loads.
- Triac Drive — Supplies high-current pulses to the external power controlling thyristor.
- Protection Circuit (CA3059 only) — A built-in circuit may be actuated, if the sensor opens or shorts, to remove the drive circuit from the external triac.
- Inhibit Capability (CA3059 only) — Thyristor firing may be inhibited by the action of an internal diode gate.
- High Power DC Comparator Operation (CA3059 only) — Operation in this mode is accomplished by connecting Pin 7 to Pin 12 (thus overriding the action of the zero-crossing detector).



*NTC Sensor
NOTE: Shaded Area Not Included with CA3079.

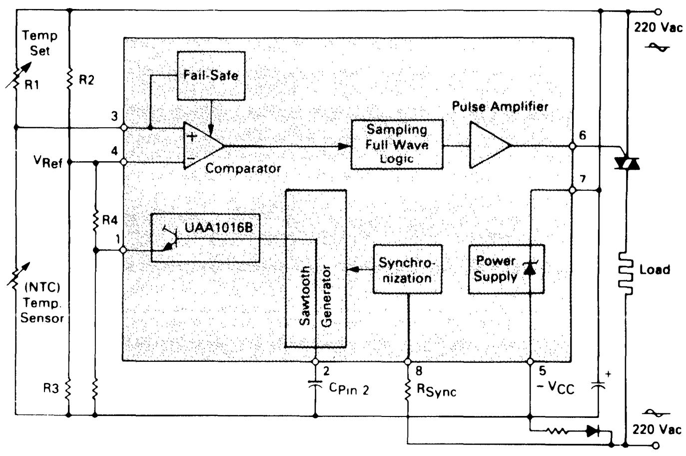
Zero Voltage Controller

UAA1016B T_A = –20° to +100°C, Case 626

This device is designed to drive triacs with the Zero Voltage technique which allows RFI free power regulation of resistive loads. They provide the following features:

- Proportional Temperature Control Over an Adjustable Band
- Adjustable Burst Frequency (to Comply with Standards)
- Sensor Fail-Safe
- No DC Current Component Through the Main Line (to Comply with Standards)
- Negative Output Current Pulses (Triacs Quadrants 2 and 3)
- Direct ac Line Operation
- Low External Components Count

UAA1016B

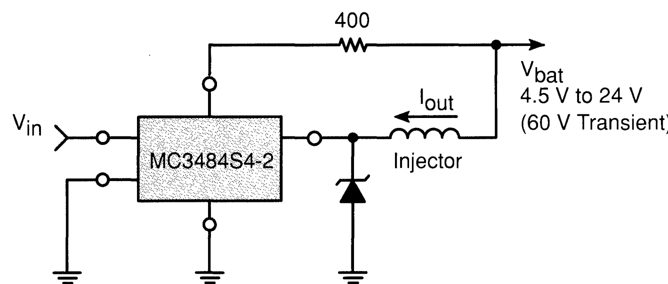


Integrated Solenoid Driver

MC3484S2-2,S4-2 T_J = –40° to +125°C, Case 314D

The MC3484 is an integrated monolithic solenoid driver. Its typical function is to apply full battery voltage to fuel injector(s) for rapid current rise, in order to produce positive injector opening. When load current reaches a preset level (4.0 A in MC3484S4-2 or 2.4 A in MC3484S2-2) the injector driver reduces the load current by a 4-to-1 ratio and operates as a constant current supply. This condition holds the injector open and reduces system dissipation.

MC3484



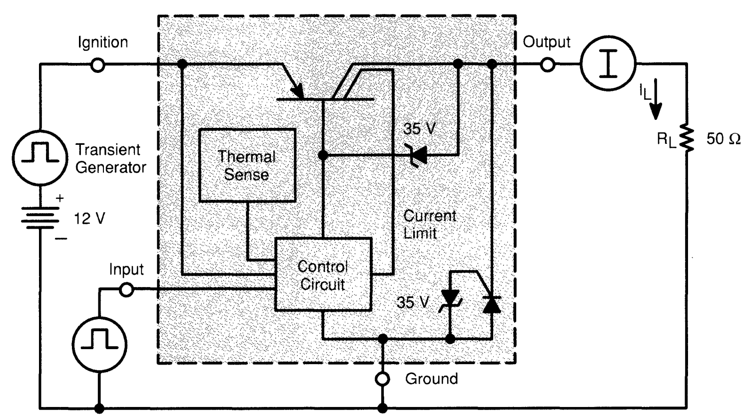
High-Side Driver Switch

MC3399T T_J = –40° to +150°C, Case 314D

The MC3399T is a High-Side Driver Switch that is designed to drive loads from the positive side of the power supply. The output is controlled by a TTL compatible Enable pin. In the ON state, the device exhibits very low saturation voltages for load currents in excess of 750 mA. The device also protects the load from positive or negative-going high voltage transients by becoming an open circuit and isolating the transient for its duration from the load.

The MC3399T is fabricated on a power BiMOS process which combines the best features of Bipolar and MOS technologies. The mixed technology provides higher gain PNP output devices and results in Power Integrated Circuits with reduced quiescent current.

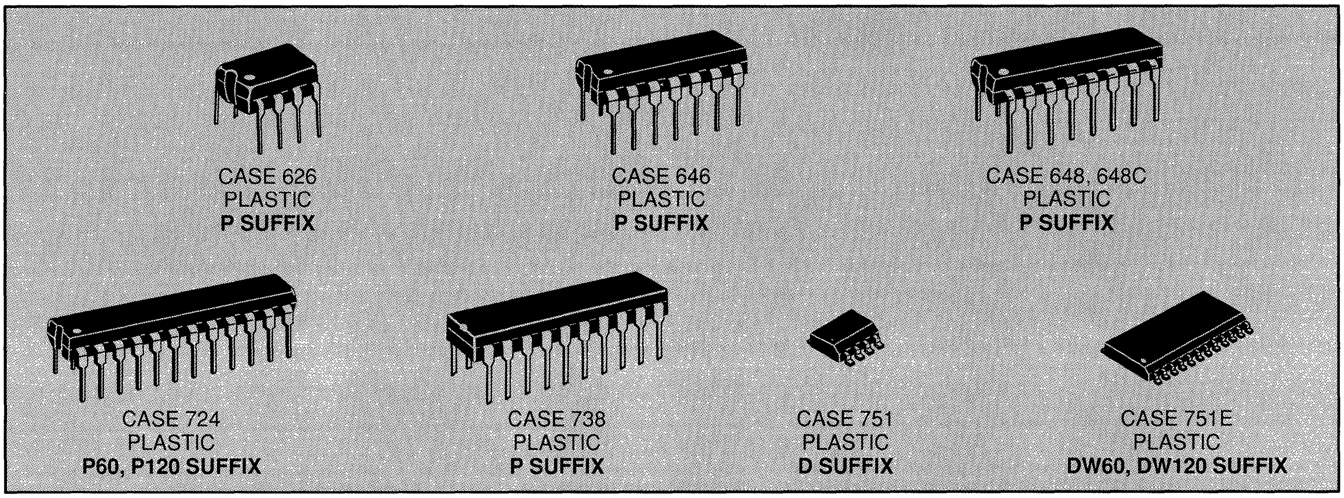
MC3399T



Power/Motor Control Circuits

Motor Controllers

This section contains integrated circuits designed for cost effective control of specific motor families. Included are controllers for brushless, dc servo, stepper, and universal type motors.



Brushless DC Motor Controllers

Advances in magnetic materials technology and integrated circuits have contributed to the unprecedented rise in popularity of brushless DC motors. Linear control ICs are making the many features and advantages of brushless motors available at a much more economical price. Motorola offers a family of monolithic integrated brushless DC motor controllers. These ICs provide a choice of control functions which allow many system features to be easily implemented at a fraction of the cost of discrete solutions. The following table summarizes and compares the features of Motorola's brushless motor controllers.

Features Summary for Motorola Brushless DC Motor Controllers

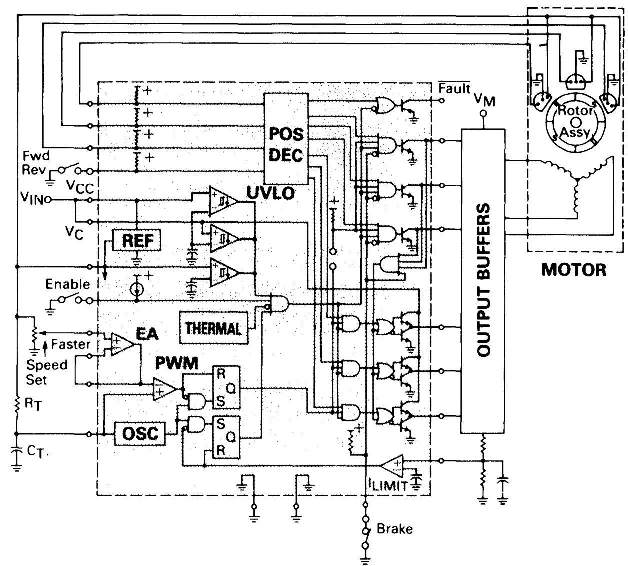
	Operating Voltage Range (V)							Output Drivers									
Device	V_{CC}	V_C	Undervoltage Lockout	Internal Thermal Shutdown	Fwd/Rev Control	Sensor Electrical Phasing	Output Enable	Totem Pole (Bottom)	Open Collector (Top)	6.25 V Reference Output	Current Sense Comparator Input(s)	Error Amplifier	$\overline{\text{FAULT}}$ Output	Separate Drive Ground	Separate Drive VC	Brake Input	Case
MC33033P	10-30		✓	✓	✓	60°/300° and 120°/240°	✓	✓	✓	✓	Noninv. Only	✓					738
MC33034P60	10-40	10-40	✓	✓	✓	60°/300°	✓	✓	✓	✓		✓	✓	✓	✓	✓	724
MC33034P120			✓	✓	✓	120°/240°	✓	✓	✓	✓		✓	✓	✓	✓	✓	
MC33035P		10-30	✓	✓	✓	60°/300° and 120°/240°	✓	✓	✓	✓	Noninv. and Inv.	✓	✓		✓	✓	

MC33034P60, P120, DW60, DW120

$T_A = -40°$ to $+85°C$, Case 724, 751E

The MC33034 series is a first generation high performance brushless motor controller containing all of the active functions required to implement a full featured open-loop three or four phase motor control system. These devices consist of: a rotor position decoder for proper commutation sequencing; a temperature compensated 6.25 V reference capable of supplying sensor power; frequency programmable sawtooth oscillator; a fully accessible error amplifier; pulse width modulator comparator; three open collector top drivers; and three high current totem pole bottom drivers ideally suited for driving power MOSFETs. Inputs are provided for speed control, forward/reverse, run enable, and dynamic braking functions. Cycle-by-cycle current limiting, undervoltage lockout, and internal thermal shutdown protection are also provided.

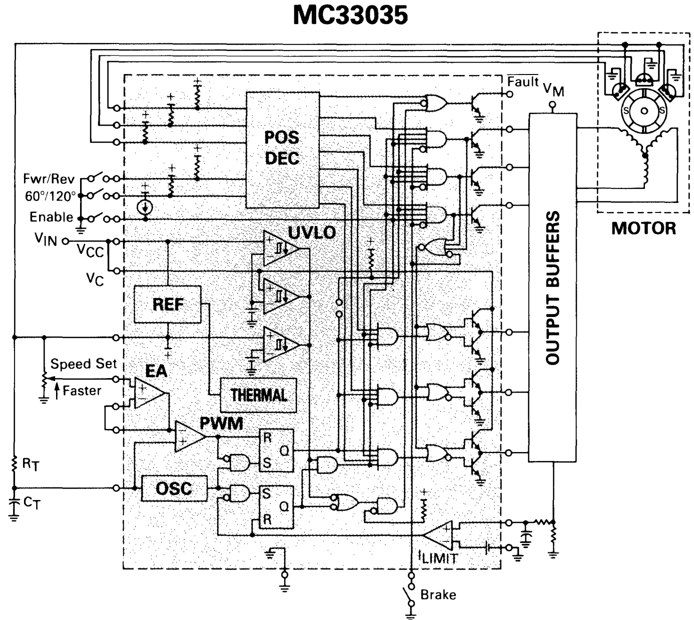
MC33034



MC33035P, DW $T_A = -40°$ to $+85°C$, Case 724, 751E

The MC33035 is a second generation high performance brushless DC motor controller which contains all of the active functions required to implement a full featured open-loop motor control system. While being pin-compatible with its MC33034 predecessor, the MC33035 offers additional features at a lower price. The two additional features provided by the MC33035 are a pin which allows the user to select 60°/300° or 120°/240° sensor electrical phasings, and access to both inverting and noninverting inputs of the current sense comparator. The earlier devices had two part numbers which were needed to support the different sensor phasings, and the inverting input to the current sense comparator was internally grounded. All of the control and protection features of the MC33034 are also provided in the newer MC33035.

MC33035

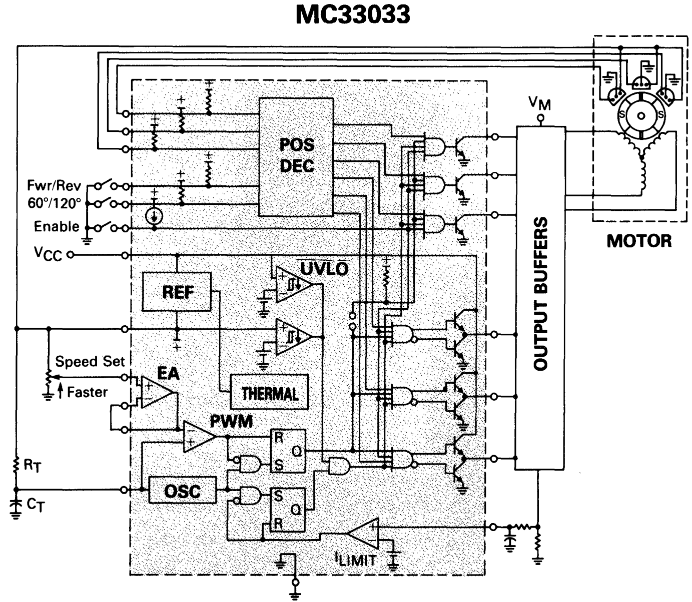


MC33033P, DW $T_A = -40°$ to $+85°C$, Case 738, 751D

The MC33033 is a lower cost second generation brushless DC motor controller which has evolved from the full featured MC33034 and MC33035 controllers. The MC33033 contains all of the active functions needed to implement a low cost open-loop motor control system. This IC has all of the key control and protection functions of the two full featured devices with the following secondary features deleted: separate drive-circuit supply and ground pins, the brake input, and the fault output signal. Like its MC33035 predecessor, the MC33033 has a control pin which allows the user to select 60°/300° or 120°/240° sensor electrical phasings.

Because of its low cost, the MC33033 can efficiently be used to control brush DC motors as well as brushless. A brush DC motor can be driven using two of the three drive output phases provided in the MC33033, while the Hall sensor input pins are selectively tied to V_{ref} or ground. Other features such as forward/reverse, output enable, speed control, current limiting, undervoltage lockout and internal thermal shutdown remain functional in this operating mode.

MC33033

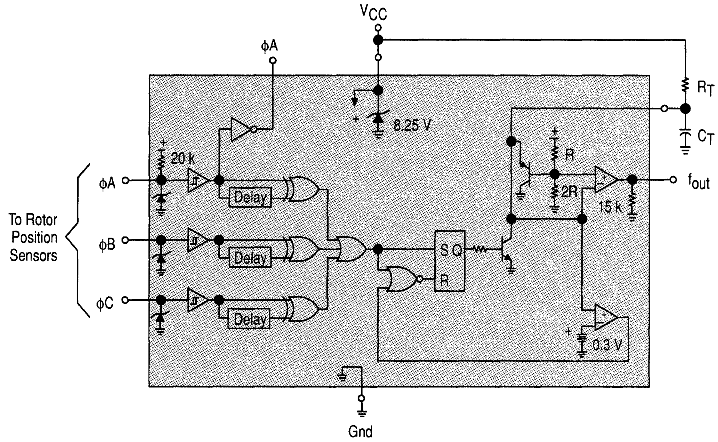


Closed-Loop Brushless Motor Adapter

MC33039P, D T_A = –40° to +85°C, Case 626, 751

The MC33039P,D is a high performance close-loop speed control adapter specifically designed for use in brushless dc motor control systems. Implementation will allow precise speed regulation without the need for a magnetic or optical tachometer. These devices contain three input buffers each with hysteresis for noise immunity, three digital edge detectors, a programmable monostable, and an internal shunt regulator. Also included is an inverter output for use in systems that require conversion of sensor phasing. Although this device is primarily intended for use with the MC33033/34/35 brushless motor controllers, it can be used cost effectively in many other closed-loop speed control applications.

MC33039

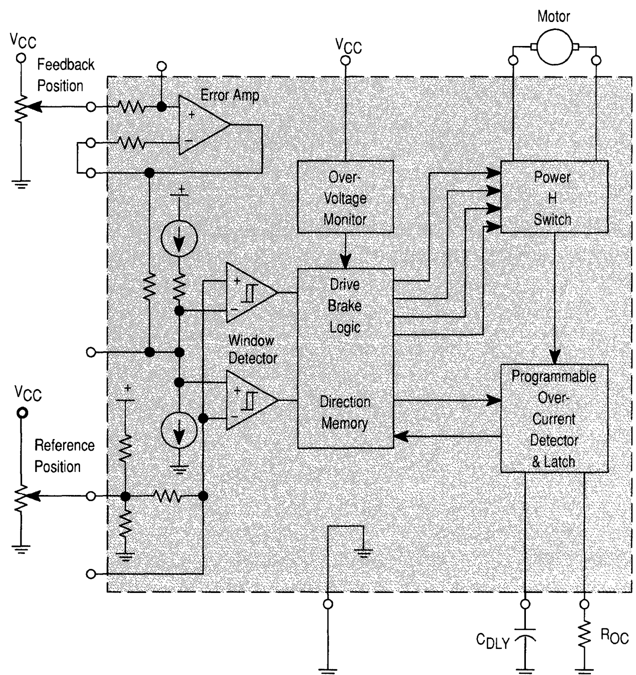


DC Servo Motor Controller/Driver

MC33030P T_A = –40° to +85°C, Case 648C

A monolithic dc servo motor controller providing all active functions necessary for a complete closed loop system. This device consists of an on-chip op amp and window comparator with wide input common mode range, drive and brake logic with direction memory, a power H switch driver capable of 1.0 A, independently programmable over current monitor and shutdown delay, and over voltage monitor. This part is ideally suited for almost any servo positioning application that requires sensing of temperature, pressure, light, magnetic flux, or any other means that can be converted to a voltage.

MC33030P

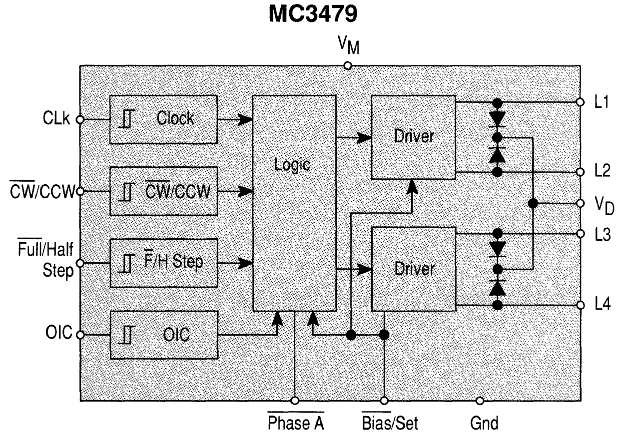


Stepper Motor Driver

MC3479P T_A = 0° to +70°C, Case 648C

This Stepper Motor Driver provides up to 500 mA of drive per coil for two phase 6.0 V to 24 V stepper motors. Control logic is provided to accept commands for clockwise, counter clockwise and half or full step operation. The device has an added Output Impedance Control (OIC) and a $\overline{\text{Phase A}}$ drive state indicator.

MC3479



Universal Motor Speed Controllers

TDA1085A T_A = 0° to +70°C, Case 648

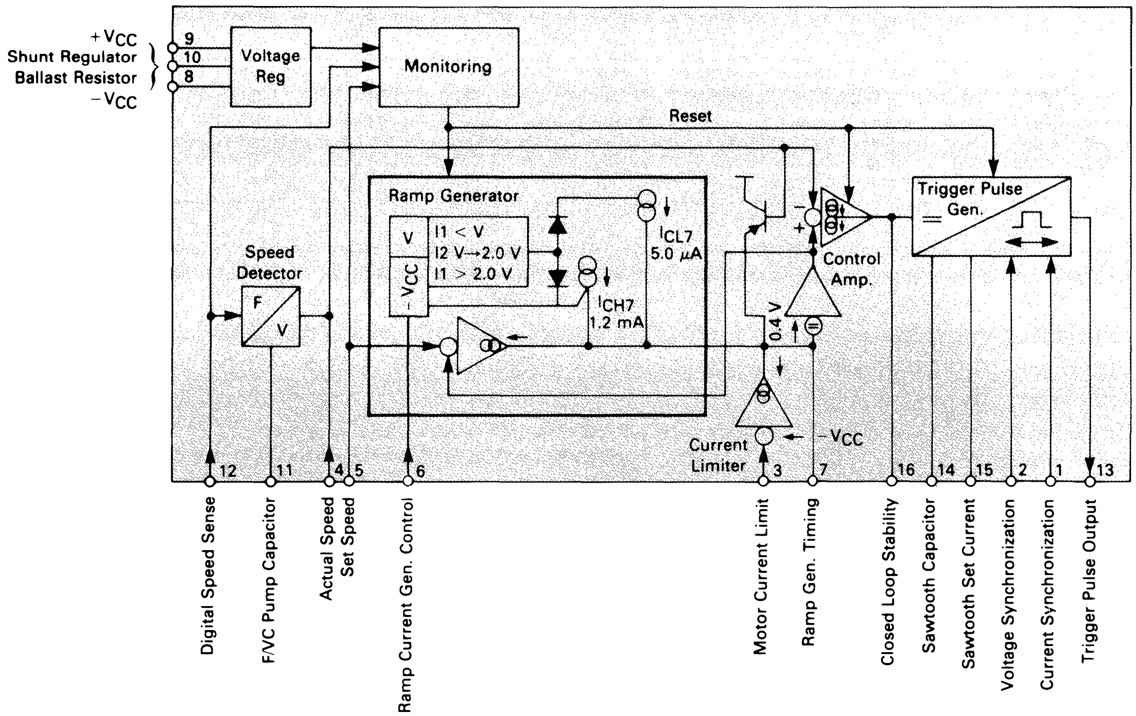
This device contains all the necessary functions for the speed control of universal (ac/dc) motors in an open or closed loop configuration. Facility for defining the initial speed/time characteristic. The circuit provides a phase angle varied trigger pulse to the motor control triac.

- Guaranteed Full Wave Triac Drive
- Soft-Start from Power-up
- On-Chip Frequency/Voltage Converter and Ramp Generator
- Current Limiting Incorporated
- Direct Drive from AC Line

TDA1085C T_A = –10° to +120°C, Case 648

Similar to TDA1085A, but designed for commercial washing machine service.

TDA1085A



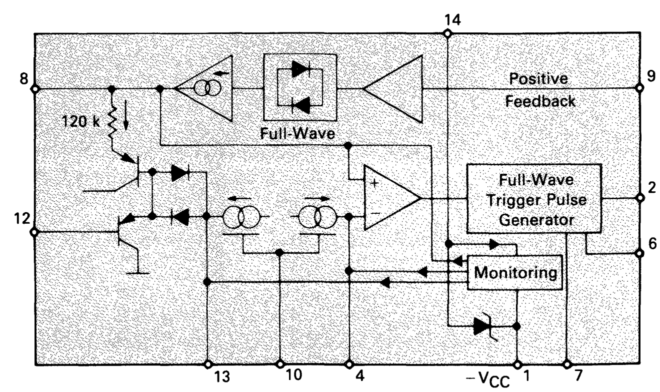
Triac Phase Angle Controller

TDA1185A T_A = 0° to +70°C, Case 646

This device generates controlled triac triggering pulses and allows tacholess speed stabilization of universal motors by an integrated positive feedback function.

- Low Cost External Components Count
- Optimum Triac Firing (2nd and 3rd Quadrants)
- Repetitive Trigger Pulses When Triac Current is Interrupted by Motor Brush Bounce
- Triac Current Sensed to Allow Inductive Loads
- Soft-Start
- Power Failure Detection and General Circuit Reset
- Low Power Consumption: 1.0 mA

TDA1185A



Voltage References

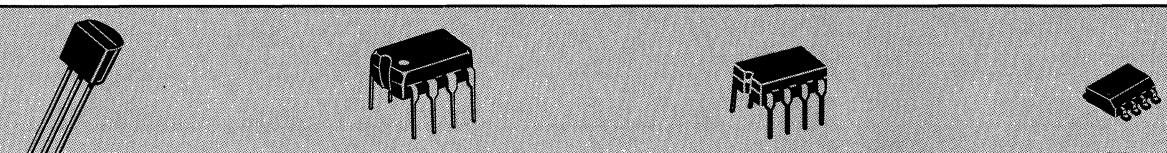
In Brief . . .

Motorola's line of precision voltage references is designed for applications requiring high initial accuracy, low temperature drift, and long term stability. Initial accuracies of ± 1.0%, and ± 2.0% mean production line adjustments can be eliminated. Temperature coefficients of 25 ppm/°C max (typically 10 ppm/°C) provide excellent stability. Uses for the references include D/A converters, A/D converters, precision power supplies, voltmeter systems, temperature monitors, and many others.

Page

Voltage References
Precision Low Voltage References

A family of precision low voltage bandgap reference devices designed for applications requiring low temperature drift.



CASE 29 PLASTIC **LP, Z SUFFIX** — CASE 626 PLASTIC **P SUFFIX** — CASE 693 CERAMIC **JG, U SUFFIX** — CASE 751 PLASTIC **D SUFFIX**

V_{out} V Typ	I_O mA Max	V_{out}/T ppm/°C Max	Device 0° to + 70°C	Device −55° to +125°C −40° to +85°C	Reg_{line} mV Max	Reg_{load} mV Max	Suffix/ Package
1.235 ± 12 mV 1.235 ± 25 mV	20	80 Typ	LM385BZ-1.2 LM385Z-1.2	LM285Z-1.2 (−40° to +85°C)	(Note 1)	1.0 (Note 2)	Z/29
2.5 ± 38 mV 2.5 ± 75 mV			LM385BZ-2.5 LM385Z-2.5	LM285Z-2.5 (−40° to +85°C)		2.0 (Note 3)	
2.5 ± 25 mV	10	25	MC1403A	MC1503A	3.0/4.5	10	U/693, D/751
		40	MC1403		(Note 4)	(Note 6)	
		55		MC1503			
5.0 ± 50 mV		25	MC1404AU5		6.0		U/693
		40	MC1404U5		(Note 5)		
		55		MC1504U5			
6.25 ± 60 mV		25	MC1404AU6				
		40	MC1404U6				
		55		MC1504U6			
10 ± 100 mV		25	MC1404AU10				
		40	MC1404U10				
		55		MC1504U10			
2.5 to 37	100	50 Typ	TL431C,AC	TL431I, AI (−40° to +85°C)	Shunt Reference Dynamic Impedance (z) ≤ 0.5 Ω		LP/29, P/626 JG/693, D/751
				TL431M			JG/693

Notes: 1. Micropower Reference Diode Dynamic Impedance (z) ≤ 1.0 Ω at I_R = 100 µA
2. 10 µA ≤ I_R ≤ 1.0 mA
3. 20 µA ≤ I_R ≤ 1.0 mA
4. 4.5 V ≤ V_{in} ≤ 15 V/15 V ≤ V_{in} ≤ 40V
5. (V_{out} + 2.5 V) ≤ V_{in} ≤ 40V
6. 0 mA ≤ I_L ≤ 10 mA

Data Conversion

In Brief . . .

Motorola's line of digital-to-analog and analog-to-digital converters includes several well established industry standards, and many are available in various linearity grades so as to suit most any application.

The A/D converters have 7 and 8-bit flash converters suitable for NTSC and PAL systems, CMOS 8 to 10-bit converters, as well as other high-speed digitizing applications.

The D/A converters have 6 and 8-bit devices, video speed (for NTSC and PAL) devices, and triple video DAC with on-board color palette for color graphics applications.

Page

Data Conversion

The line of data conversion products which Motorola offers spans a wide spectrum of speed and resolution/accuracy. Features, including bus compatibility, minimize external parts count and provide easy interface to microprocessor systems. Various technologies, such as Bipolar and CMOS, are utilized to achieve functional capability, accuracy and production repeatability. Bipolar technology generally results in higher speed, while CMOS devices offer greatly reduced power consumption.

A-D Converters

CMOS

Resolution Bits	Device	Nonlinearity Max	Conversion Time	Input Voltage Range	Supplies V	Temperature Range °C	Suffix/ Package	Comments
8	MC145040	± 1/2 LSB	10 µs	0 to V_{DD}	+5.0 ± 10%	–40 to +85 (Suffix 2 devices)	P/738 FN/775	Requires External Clock, 11-Ch MUX
	MC145041		20 µs			–40 to +125 (Suffix 1 devices)	DW/751D	Includes Internal Clock, 11-Ch MUX
	MC14442					–40 to +85	P/710 FN/776	µP Compatible 11-Ch MUX S.A.R.
	MC14549B/ MC14559B	successive approximation registers			+3.0 to +18	–55 to +125 –40 to +85	L/620 P/648	Compatible with MC1408 S.A.R. 8-bit D-A Converter
10	MC145050	± 1 LSB	21 µs	0 to V_{DD}	+5.0 ± 10%	–40 to +125	P/738 DW/751D	Requires External Clock, 11-Ch MUX
	MC145051		88 µs					Includes Internal Clock, 11-Ch MUX
	MC145053							Includes Internal Clock, 5-Ch MUX
8–10	MC14443/ MC14447	± 0.5% Full Scale	300 µs	Variable w/Supply	+5.0 to +18	–40 to +85	P/648 DW/751G	µP Compatible, Single Slope, 6-Ch MUX
3-1/2 Digit	MC14433	± 0.05% ± 1 Count	40 ms	± 2.0V ± 200 mV	+5.0 to +8.0 –2.8 to –8.0		P/709	Dual Slope

Bipolar

7	MC10321	± 1/2 LSB	40 ns	0 to 2.0 V_{pp} Max	+5.0 and –3.0 to –6.0	0 to +70	P/738 DW/751D	Video Speed, Gray Code TTL Outputs
8	MC10319	± 1 LSB					L/623 P/709 DW/751F Die Form	Video Speed Flash Converter, Internal Gray Code TTL Outputs

D-A Converters

CMOS

Resolution Bits	Device	Suffix	Accuracy @ 25°C Max	Max Settling Time (± 1/2 LSB)	Supplies V	Temperature Range °C	Package	Comments
6	MC144110	P	—	—	+5.0 to +15	0 to +85	707	Serial input, Hex DAC,
		DW					751 D	6 outputs
	MC144111	P					646	Serial input, Quad DAC,
		DW					751G	4 outputs

Bipolar

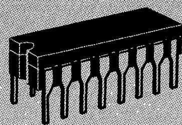
Resolution Bits	Device	Suffix	Accuracy @ 25°C Max	Max Settling Time (± 1/2 LSB)	Supplies V	Temperature Range °C	Package	Comments
8	DAC-08	Q	± 1/2 LSB	150 ns	±4.5 to ±18	–55 to +125	620	High-speed Multiplying
		AQ	± 1/4 LSB	135 ns				
		C	± 1 LSB	150 ns		0 to +70	620	
		E	± 1/2 LSB				648	
		H	± 1/4 LSB	135 ns			D/751B	
	MC1408	L6/P6	± 2 LSB	300 ns Typ	+5.0,	0 to +75	620	Multiplying
		L7/P7	± 1 LSB		–5.0 to –15		648	
		L8/P8	± 1/2 LSB					
	MC1508	L8				–55 to +125	620	
4 x 3	MC10320	L	± 1/4 LSB	3.0 ns	+5.0 or ±5.0	0 to +70	733	125 MHz Color Graphics Triple DAC
	MC10320-1							90 MHz Color
8	MC10322	P	± 1/2 LSB	5.0 ns	+5.0, –5.2	–40 to +85	649	TTL 40 MHz Min
	MC10324				–5.2			ECL 40 MHz Min

A-D/D-A Converters

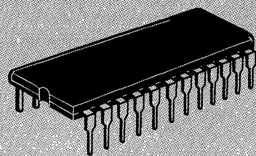
CMOS — For Telecommunications

Resolution Bits	Device	Monotonicity Bits	Conversion Time	Input Voltage Range	Supplies V	Temperature Range °C	Suffix/ Package	Comments
13	MC145402	13	62.5 μs	± 3.28 V peak	± 5.0 to 6.0	–40 to +85	L/620	Digital signal processing (e.g., echo cancelling, high speed modems, phone systems w/ conferencing)

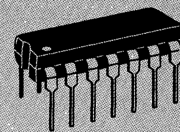
Data Conversion Package Overview



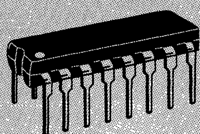
CASE 620
CERAMIC
L SUFFIX



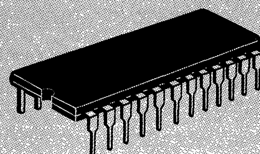
CASE 623
CERAMIC
L SUFFIX



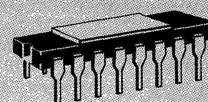
CASE 646
PLASTIC
P SUFFIX



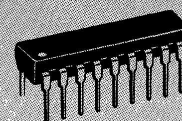
CASE 648
PLASTIC
P SUFFIX



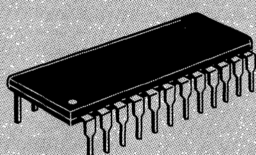
CASE 649
PLASTIC
P SUFFIX



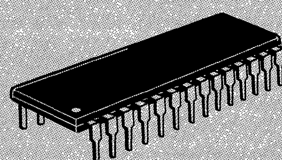
CASE 690
CERAMIC
L SUFFIX



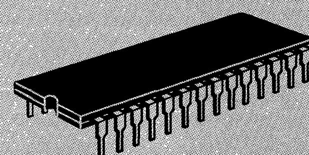
CASE 707
PLASTIC
P SUFFIX



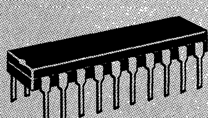
CASE 709
PLASTIC
P SUFFIX



CASE 710
PLASTIC
P SUFFIX



CASE 733
CERAMIC
L SUFFIX



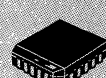
CASE 738
PLASTIC
P SUFFIX

CASE 751B
PLASTIC
D SUFFIX

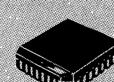
CASE 751D
PLASTIC
DW SUFFIX

CASE 751F
PLASTIC
DW SUFFIX

CASE 751G
PLASTIC
DW SUFFIX



CASE 775
PLASTIC
FN SUFFIX



CASE 776
PLASTIC
FN SUFFIX

Interface Circuits

In Brief . . .

Described in this section is Motorola's line of interface circuits, which provide the means for interfacing microprocessor or digital systems to the external world, or to other systems.

Included are devices for reading and writing to a floppy disk or tape drive system, devices which allow a microprocessor to communicate with its own array of memory and peripheral I/O circuits.

The line drivers, receivers, and transceivers permit communications between systems over cables of several thousand feet in length, and at data rates of up to several megahertz. The common EIA data transmission standards, several European standards, IEEE-488, and IBM 360/370 are addressed by these devices.

The peripheral drivers are designed to handle high current loads such as relay coils, lamps, stepper motors, and others. Input levels to these drivers can be TTL, CMOS, High Voltage MOS, or other user defined levels. The display drivers are designed for LCD, LED, incandescent and other types of displays, and provide various forms of decoding.

Interface Circuits

Magnetic Read/Write Interface and Control

Motorola's line of circuits in this category are well established industry standards for reading and writing in a floppy disk system. The write circuits are designed for both straddle erase and tunnel erase heads, and provide both the writing and erasing functions. The read circuits include all circuitry for peak detection, filtering, wave shaping, and guaranteed peak shift specifications.

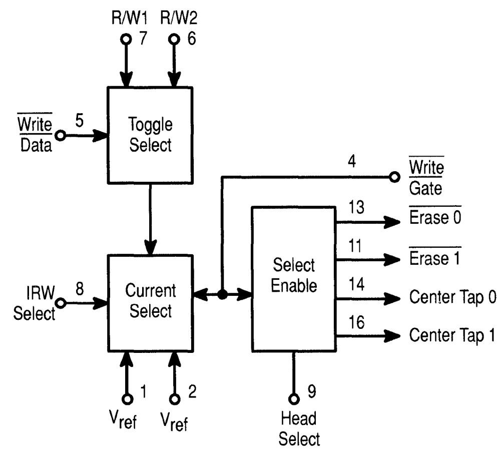
Floppy Disk Write Controllers

Straddle Erase Controller

MC3469P T_A = 0° to +70°C, Case 648

Designed to provide the entire interface between floppy disk heads and the head control and write data signals for straddle-erase heads.

Provisions are made for selecting a range of accurately controlled write currents and for head selection during both read and write operation. Additionally, provisions are included for externally adjusting degauss period and inner/outer track compensation.

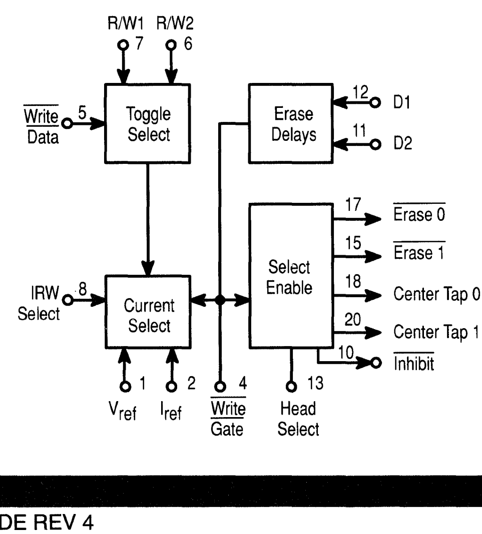


Tunnel/Straddle Erase Controller

MC3471P T_A = 0° to +70°C, Case 738

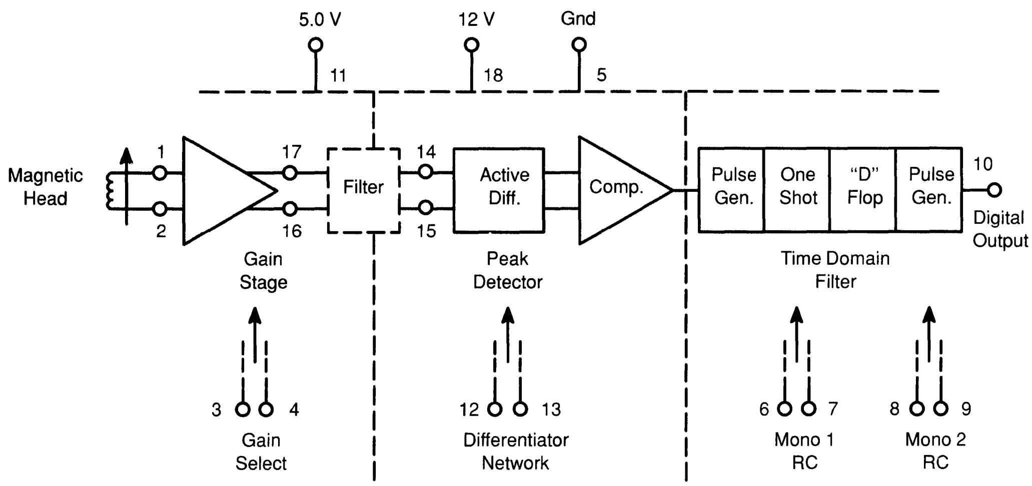
Provides the entire interface between the write data and head control signals and the heads (write and erase) for either tunnel or straddle-erase floppy disk systems.

Has provisions for external adjustment of degauss period, inner/outer track compensation, and the delay from write gate to erase turn-on and turn-off.



Floppy Disk Read Amplifier System

MC3470P,AP T_A = 0° to +70°C, Case 707



Designed as a monolithic Read Amplifier System for obtaining digital information from floppy disk storage. These devices accept differential AC signals produced by the magnetic head and provide a digital output pulse that corresponds to each peak of the input signal. A gain stage amplifies the input waveform and applies it to an external filter network, enabling the active differentiator and time domain filter to produce the desired output. These devices provide all the active circuitry to perform the floppy disk Read amplifier function, and guarantee to have a maximum peak shift of 5.0%, adjustable to zero for the MC3470P, and 2.0%, adjustable to zero for the MC3470AP.

Device	Peak Shift (f = 250 kHz, V_{ID} = 1.0 V_{PP}) % Max	Differential Input Voltage Gain (f = 200 kHz, V_{ID} = 5.0 mV [RMS]) V/V Min	V/V Max	Input Common Mode Range (5% Max THD) V Min	V Max
MC3470P	5.0	80	130	−0.1	1.5
MC3470AP	2.0	100			

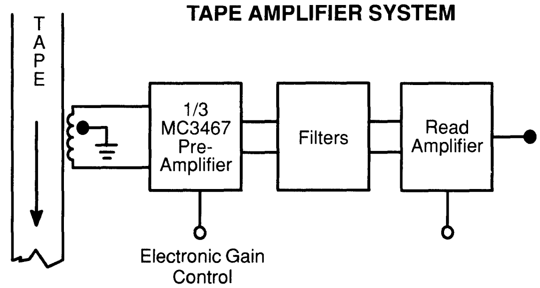
Magnetic Tape Sense Amplifier

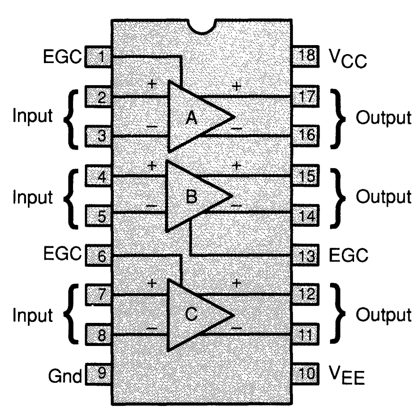
MC3467P T_A = 0° to +70°C, Case 707

The MC3467 provides three independent preamplifiers with individual electronic gain control, optimized for use in 9-track magnetic tape memory systems where low noise and low distortion are paramount objectives.

The electronic gain control allows each amplifier's gain to be set anywhere from essentially zero to a maximum of approximately 100 V/V. Minimum small-signal bandwidth is 10 MHz, and Common Mode Input Voltage range is 1.5 V minimum.

TAPE AMPLIFIER SYSTEM





Microprocessor Bus Interface

Motorola offers a spectrum of line drivers and receivers which provide interfaces to many industry standard specifications. Many of the devices add key operational features, such as hysteresis, short circuit protection, clamp diode protection, or special control functions.

Address and Control Bus Extenders

These devices are designed to extend the drive capabilities of today's standard microprocessors. All devices are fabricated with Schottky TTL technology for high speed.

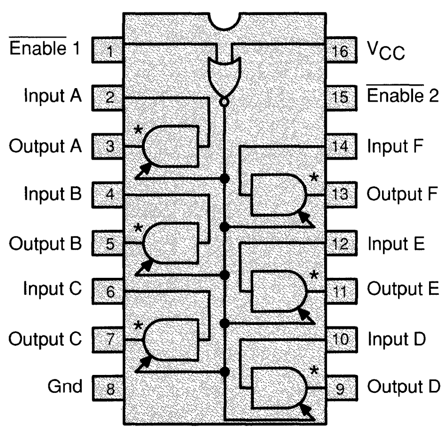
$V_{OL(max)}$ @ 48 mA	$V_{OH(min)}$ @ –5.2 mA	Propagation Delay Max (ns)	Buffers Per Package	Device	Suffix/ Package	Comments
0.5	2.4	13	6	MC8T95/ MC6885	L/620 P/648	Noninverting
		11		MC8T96/ MC6886		Inverting
		13		MC8T97/ MC6887		Noninverting
		11		MC8T98/ MC6888		Inverting

Hex 3-State Buffers/Inverters T_A = 0° to +75°C

These devices differ in that the noninverting MC8T95/ MC6885 and inverting MC8T96/MC6886 provide a two-input Enable which controls all six buffers, while the noninverting MC8T97/MC6887 and inverting MC8T98/ MC6888 provide two Enable inputs — one controlling four buffers and the other controlling the remaining two buffers.

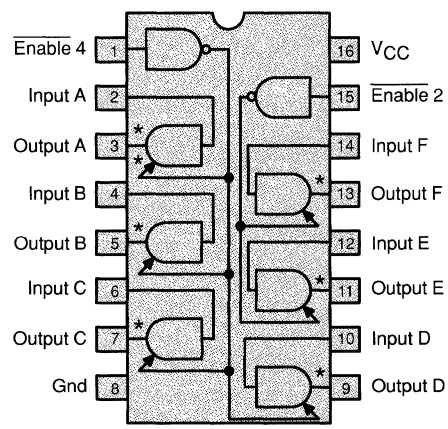
#These devices may be ordered by either of the paired numbers.

MC8T95/MC6885# — Noninverting
MC8T96/MC6886# — Inverting



*Add inverter for MC6886/MC8T96.

MC8T97/MC6887# — Noninverting
MC8T98/MC6888# — Inverting



*Add inverter for MC6888/MC8T98.

Microprocessor Data Bus Extenders

Driver Characteristics		Receiver Characteristics				
Output Current (mA)	Propagation Delay Max (ns)	Propagation Delay Max (ns)	Transceivers Per Package	Device	Suffix/ Package	Comments
48	14	14	4	MC8T26A (MC6880A)	P/648 L/620	Inverting Logic
	17	17		MC8T28 (MC6889)		Noninverting Logic

Single-Ended Bus Transceivers

For Instrumentation Bus, Meets GPIB/IEEE Standard 488

Driver Characteristics		Receiver Characteristics				
Output Current (mA)	Propagation Delay Max (ns)	Propagation Delay Max (ns)	Transceivers Per Package	Device	Suffix/ Package	Comments
48	50	50	4	MC3446A	P/648	MOS compatible, input hysteresis
	30		8	MC3447	P3/724 L/623 P/649	Input hysteresis, open collector, 3-state outputs with terminations
	17	25	4	MC3448A	P/648 D/751B L/620	Input hysteresis, open collector, 3-state outputs with terminations
100	30	30		MC3440A	P/648	Input hysteresis, enable for 3 drivers
				MC3441A		Common enable, input hysteresis

For High-Current Party-Line Bus for Industrial and Data Communications

100	15	15	4	MC26S10	P/648 D/751B L/620	Open collector, outputs, common enable

Line Receivers

General Purpose

S = Single Ended D = Differ-ential	Type* of Output	t_{prop} Delay Time Max (ns)	Party Line Opera-tion	Strobe or Enable	Power Supplies (V)	Device	Suffix/ Package	Receivers Per Package	Companion Drivers	Comments
D	TP OC	25	✓	✓	± 5	MC3450 MC3452	D/751B P/648 L/620	4	MC3453	Quad version of MC75107/108
	TP OC		✓	✓		MC75107 MC75108	P/646 L/632	2	MC75S110	Dual version of MC3450/2
S	TP	30	✓	✓	+ 5	MC3437	P/648 L/620	6		Input hysteresis

360/370 I/O Interface

S	TP	30	✓	—	+ 5	MC75125 MC75127	P/648 L/620	7	MC3481 MC3485	Schottky Circuitry
			✓	✓		MC75128 MC75129	P/738 L/732	8	MC3481 MC3485	Active high strobe Active low strobe

*OC = Open Collector, TP = Totem-pole output

EIA Standard

S = Single Ended D = Differ-ential	Type* of Output	t_{prop} Delay Time Max (ns)	Party Line Opera-tion	Strobe or Enable	Power Supplies (V)	Device	Suffix/ Package	Receivers Per Package	Companion Drivers	Comments
S	R	85	—	—	+ 5	MC1489 MC1489A	D/751A P/648 L/632	4	MC1488	EIA-232-D
S, D	TP	30	✓	✓		AM26LS32 MC3486	P/648 D/751B L/620		AM26LS31 MC3487	EIA-422/423
		35	✓	✓		SN75173 SN75175	N/648 D/751B J/620		MC75172B MC75174B	EIA-422/423/485

* (R = Resistor Pull-up, TP = Totem-pole output)

Line Drivers

General Purpose

Output Current Capability (mA)	t_{prop} Delay Time Max (ns)	S = Single Ended D = Differential	Party Line Operation	Strobe Or Enable	Power Supplies (V)	Device	Suffix/Package	Drivers Per Package	Companion Receivers	Comments
15	15	D	✓	✓	±5	MC3453	P/648 L/620	4	MC3450 MC3452	Quad version of MC75S110
			✓	✓		MC75S110	P/646 L/632	2	MC75107 MC75108	Dual version of MC3453

360/370 I/O Interface

Output Current Capability (mA)	t_{prop} Delay Time Max (ns)	S = Single Ended D = Differential	Party Line Operation	Strobe Or Enable	Power Supplies (V)	Device	Suffix/Package	Drivers Per Package	Companion Receivers	Comments
60	45	S	✓	✓	+5	MC3481	P/648 L/620	4	MC75125 MC75127	Short circuit Fault flag
			✓	✓		MC3485	P/648 L/620		MC75128 MC75129	Short circuit Fault flag

EIA Standard

Output Current Capability (mA)	t_{prop} Delay Time Max (ns)	S = Single Ended D = Differential	Party Line Operation	Strobe Or Enable	Power Supplies (V)	Device	Suffix/Package	Drivers Per Package	Companion Receivers	Comments
85	35	D	✓	✓	+5	MC75172B MC75174B	N/648 J/620	4	SN75173 SN75175	EIA-485
48	20		✓	✓		MC3487	P/648 D/751B L/620		MC3486	EIA-422 with 3-state outputs
			✓	✓		AM26LS31	PC/648 DC/620		AM26LS32	
						MC26LS31	D/751B		MC26LS32	
20		S	—	—	±12	MC3488A (μA9636A)	P1/626 D/751B U/693	2	MC3486 AM26L532	EIA-423/232-D
10	350			✓	±9 to ±12	MC1488	P/646 D/751A L/632	4	MC1489 MC1489A	EIA-232-D
60	300	S/D		422 ✓ 423 —	±5	AM26LS30	PC/648 DC/620	422-2 423-4	AM26LS32 MC3486	EIA-422 EIA-423
						MC26LS30	D/751B		MC26LS32	Switchable

Line Transceivers

Driver Prop Delay (Max ns)	Receiver Prop Delay (Max ns)	DE = Driver Enable RE = Receiver Enable	Party Line Operation	Power Supplies (V)	Device	Suffix/Package	Drivers Per Package	Receivers Per Package	EIA Standard
20	30	DE, RE	✓	+5	MC34050	L/620 D/751B P/648	2	2	EIA-422
		DE	✓		MC34051	L/620 P/648			
	20	DE, RE	✓		MC75176B	P/626	1	1	EIA-485

EIA-232-D/V.28 CMOS Driver/Receivers

Device	Suffix/ Package	Pins	Drivers	Receivers	Power Supplies (V)	Features
MC14503	P/738 DW/751D	20	3	5	± 5, ± 12	
MC145404			4	4		
MC145405			5	3		
MC145406	P/648 DW/751G	16	3			
MC145407	P/738 DW/751D	20			+ 5	Charge Pump
MC145408	P/724 DW/751E	24	5	5	± 5, ± 12	
MC145705	TBD*	20	2	3	+ 5	Charge Pump, Power Down
MC145706			3	2		
MC145707		24		3		

* TBD = To Be Determined

Peripheral Drivers

Output Current Capability (mA)	Input Capability	Propagation Delay Time Max (μs)	Output Clamp Diode	Off State Voltage Max (V)	Device	Drivers Per Package	Suffix/ Package	Logic Function
300	TTL, DTL	1.0	✓	70	MC1472	2	P1/626 U/693	NAND
500	TTL, CMOS, PMOS				ULN2801	8	A/707	Invert
	14 V to 25 V PMOS			50	ULN2802			
	TTL, CMOS				ULN2803			
	6.0 V to 15 V MOS				ULN2804			
	TTL, CMOS PMOS				MC1411,B	7	P/648	
	14 V to 25 V PMOS				MC1412,B			
	TTL, 5.0 V CMOS				MC1413,B			
	8.0 V to 18 V MOS				MC1416,B			
1500	TTL, 5.0 V CMOS				ULN2068B	4	B/648C	
			—		ULN2074B			Collector, Emitter available at pins

CMOS Display Drivers/Decoders

These CMOS devices include digit as well as matrix drivers for LEDs, LCDs, and VFDs. They find applications over a wide range of end equipment such as instruments, automotive dash boards, home computers, appliances, radios and clocks.

Display Drivers

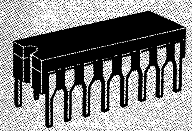
Display Type	Input Format	Drive Capability Per Package	On-Chip Latch	Display Control	Segment Drive Current	Device
LCD (Direct Drive)	Parallel BCD	7 Segments	✓	Blank	≈ 1 mA	MC14543B
				Blank, Ripple Blank		MC14544B
	Serial Binary [Compatible with the Serial Peripheral Interface (SPI) on CMOS MCUs]	33 Segments or Dots			20 µA	MC145453
Muxed LCD (1/4 Mux)		48 Segments or Dots			≈ 200 µA	MC145000
		44 Segments or Dots				MC145001
LED, Incandescent, Fluorescent*	Parallel BCD	7 Segments		Blank, Lamp Test	25 mA	MC14511B
				Blank, Ripple Blank, Lamp Test		MC14513B
				Blank	65 mA	MC14547B
Muxed LED	Serial Binary [Compatible with the Serial Peripheral Interface (SPI) on CMOS MCUs]	4 Digits + Decimals	✓	Oscillator (Scanner)	50 mA (Peak)	MC14499
		5 Characters + Decimals or 25 Lamps		Oscillator (Scanner), Low-Power Mode, Dimming	0 to 35 mA (Peak) Adjustable	MC14489
LED	Parallel Hex	7 Segments + A thru F Indicator			10 mA**	MC14495♦1
(Interfaces to Display Drivers)	Parallel BCD	7 Segments		Ripple Blank, Enable		MC14558B

*Absolute maximum working voltage = 18 V
**On-chip current-limiting resistor
♦Replace ♦ with package identifier (see product data).

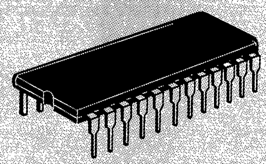
Functions

Device	Function	Package
MC14495♦1	Hexadecimal-to-7 Segment Latch/Decoder ROM/Driver	648
MC14489	Multi-Character LED Display/Lamp Driver	738, 751D
MC14499	4-Digit 7-Segment LED Display Decoder/Driver with Serial Interface	707
MC14511B	BCD-to-7-Segment Latch/Decoder/Driver	620, 648
MC14513B	BCD-to-7-Segment Latch/Decoder/Driver with Ripple Blanking	726, 707
MC14543B	BCD-to-7-Segment Latch/Decoder/Driver for Liquid Crystals	620, 648
MC14544B	BCD-to-7-Segment Latch/Decoder/Driver with Ripple Blanking	726, 707
MC14547B	High-Current BCD-to-7-Segment Decoder/Driver	620, 648
MC14558B	BCD-to-7-Segment Decoder	620, 648
MC145000	48-Segment Serial Input Multiplexed LCD Driver (Master)	709, 776
MC145001	44-Segment Serial Input Multiplexed LCD Driver (Slave)	707, 776
MC145453	33-Segment, Non-Multiplexed LCD Driver with Serial Interface	711, 777

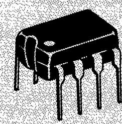
Interface Package Overview



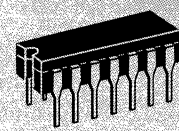
CASE 620
CERAMIC
D, DC, J, L SUFFIX



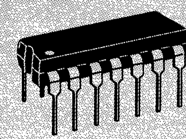
CASE 623
CERAMIC
L SUFFIX



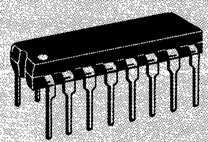
CASE 626
PLASTIC
P1 SUFFIX



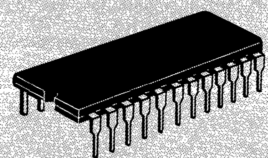
CASE 632
CERAMIC
L SUFFIX



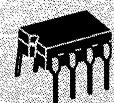
CASE 646
PLASTIC
P SUFFIX



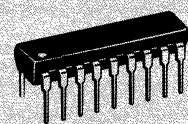
CASE 648, 648C
PLASTIC
B, N, P, PC SUFFIX



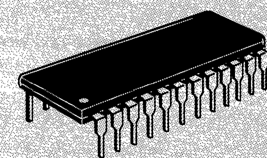
CASE 649
PLASTIC
P SUFFIX



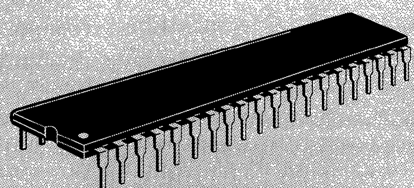
CASE 693
CERAMIC
U SUFFIX



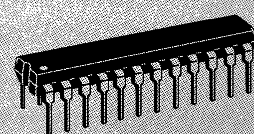
CASE 707
PLASTIC
A SUFFIX



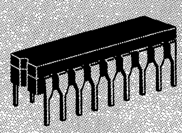
CASE 709
PLASTIC
P SUFFIX



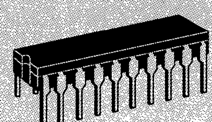
CASE 711
PLASTIC
P SUFFIX



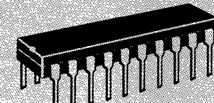
CASE 724
PLASTIC
P3 SUFFIX



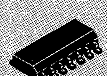
CASE 726
CERAMIC
L SUFFIX



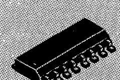
CASE 732
CERAMIC
L SUFFIX



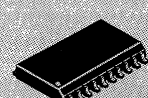
CASE 738
PLASTIC
P SUFFIX



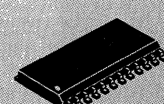
CASE 751A
PLASTIC
D SUFFIX



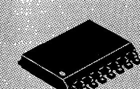
CASE 751B
PLASTIC
D SUFFIX



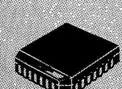
CASE 751D
PLASTIC
DW SUFFIX



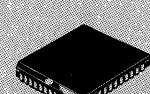
CASE 751E
PLASTIC
DW SUFFIX



CASE 751G
PLASTIC
DW SUFFIX



CASE 776
PLASTIC
FN SUFFIX



CASE 777
PLASTIC
FN SUFFIX

Communication Circuits

In Brief . . .

RF

Radio communication has greatly expanded its scope in the past several years. Once dominated by public safety radio, the 30 to 1000 MHz spectrum is now packed with personal and low cost business radio systems. The vast majority of this equipment uses FM or FSK modulation and is targeted at short range applications. From mobile phones and VHF marine radios to garage door openers and radio controlled toys, these new systems have become a part of our lifestyle. Motorola Linear has focused on this technology, adding a wide array of new products including complete receivers processed in our exclusive 3 GHz MOSAIC 1.5 process. New surface mount packages for high density assembly are available for all of these products, as is a growing family of supporting applications notes and development kits.

Telephone & Voice/Data

Traditionally, an office environment has utilized two distinctly separate wired communications systems — Telecommunications and Data communications. Each had its individual hardware components complement, and each required its own independent transmission line system: twisted wire pairs for Telecom and relatively high priced coaxial cable for Datacom. But times have changed. Today, Telecom and Datacom coexist comfortably on inexpensive twisted wire pairs and use a significant number of components in common. This has led to the development and enhancement of PBX (Private Branch Exchanges) to the point where the long heralded "office of the future," with simultaneous voice and data communications capability at each station, is no longer of the future at all. The capability is here today!

Motorola Semiconductor serves a wide range of requirements for the voice/data marketplace. We offer both CMOS and Linear technologies, each to its best advantage, to upgrade the conventional analog voice systems and establish new capabilities in digital communications. Early products, such as the solid-state single-chip crosspoint switch, the more recent monolithic Subscriber-Loop-Interface Circuit (SLIC), a single-chip Codec/Filter (Mono-circuit), the latest Universal Digital Loop Transceivers (UDLT), and single-chip telephone circuits are just a few examples of Motorola leadership in the voice/data area.

Communication Circuits

RF Communications

Wideband (FM/FSK) IFs

Device	V_{CC}	I_{CC}	Sensitivity	IF	Mute	RSSI	Max Data Rate	Notes	Package	Suffix/ Case
MC13055	3–12 V	25 mA	20 µV	40 MHz	✓	✓	2 Mb	Wideband Data IF	16 Pin DIP SO-16	P/648 D/751B

Wideband Single Conversion Receivers — VHF

Device	V_{CC}	I_{CC}	Sensitivity	RF Input	IF	Mute	RSSI	Max Data Rate	Notes	Package	Suffix/ Case
MC3356	3–9 V	25 mA	30 µV	200 MHz	10.7 MHz	✓	✓	500 kb	Includes front end mixer/L.O.	20 Pin DIP SO-20L	P/738 DW/751D
MC13156	3–7 V	3 mA	0.7 µV		21.4 MHz	—		5 Mb	Wideband Split IF	SO-20L	DW/751D

Narrowband Single Conversion Receivers — VHF

Device	V_{CC}	I_{CC}	Sensitivity	RF Input	IF	Mute	RSSI	Max Data Rate	Notes	Package	Suffix/ Case
MC3357	4–8 V	5 mA	5 µV	45 MHz	455 kHz	✓	—	—	Ceramic Quad Detector/Resonator	16 Pin DIP	P/648
MC3359	4–9 V	7 mA	2 µV						Scan output option	18 Pin DIP SO-20L	P/707 DW/751D
MC3361B	2–8 V	6 mA		60 MHz					Lowest cost receiver	16 Pin DIP SO-16	P648 D/751B
MC3367	1–5 V	1 mA	1 µV	75 MHz			—	1.2 kb	1 Cell Operation	SO-28L	DW/751F
MC3371	2–8 V	6 mA	2 µV	60 MHz			✓	—	RSSI	16 pin DIP SO-16	P/648 D/751B
MC3372									RSSI, Ceramic Quad Detector/Resonator		
MC13101	3–6 V	4 mA	0.7 µV	50 MHz					Split IF	SO-16	D/7851B

Narrowband Dual Conversion Receivers — FM/FSK — VHF

Device	V_{CC}	I_{CC}	Sensitivity	RF Input	IF1	IF2 (Limiter In)	Mute	RSSI	Data Rate	Notes	Package	Suffix/ Case
MC3362	2–7 V	3 mA	0.65 μV	180 MHz	10.7 MHz	455 kHz	—	✓	> 4.8 kb	Includes buffered VCO output	24 Pin DIP SO-24L	P/724 DW/751E
MC3363		4 mA	0.35 μV				✓			Includes RF amp/ Mute	SO-28L	DW/751F
MC3335			0.65 μV							Low cost version	SO-20L	DW/751D
MC13135	3–7 V		0.7 μV	300 MHz			—		> 50 kb	Voltage Buffered RSSI		

Transmitters — AM/FM/FSK

Device	V_{CC}	I_{CC}	P_{out}	Max RF Freq Out	Max Mod Freq	Notes	Package	Suffix/ Case
MC2831A	3–8 V	5 mA	–30 dBm	50 MHz	50 kHz	FM Transmitter. Includes low battery checker, tone oscillator	16 Pin DIP SO-16	P/648 D/751B
MC2833		10 mA	–30 dBm to +10 dBm	150 MHz		FM Transmitter. Includes two frequency multiplier/amplifier transistors		
MC13102			10 dBm			FM Transmitter with Offset Mixer	SO-16	D/751B
MC13175	3–6 V	40 mA	8.0 dBm	500 MHz	5 MHz (AM)	AM Transmitter. Single frequency PLL $f_{out} = 8 \times f_{ref}$		

Balanced Modulator/Demodulator

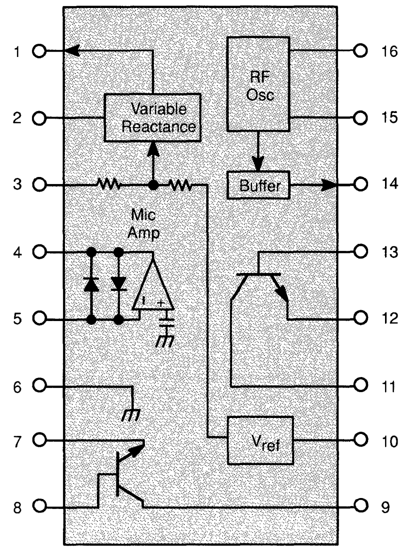
Type	V_{CC}	I_{CC}	Function	Package	Suffix/ Case
MC1596 MC1496	5-30 V	10 mA	Carrier Balance >50 dB General purpose balanced modulator/ demodulator for AM, SSB, FM Detection	14 Pin DIL, DIP, SO-14	L/632 P/646 D/751A

Low Power FM Transmitter System

MC2833 T_A, = –30° to +75°C, Case 648, 751B

- Complete VHF FM Transmitter/Exciter
- Mike Preamp with Limiting
- Tone Generator for CTSS or AFSK
- Crystal or L-C VCO Operation
- Buffer/Multiplier Output Stage
- Two Multiplier/Amplifier Stages
- Operates to 150+ MHz

MC2833

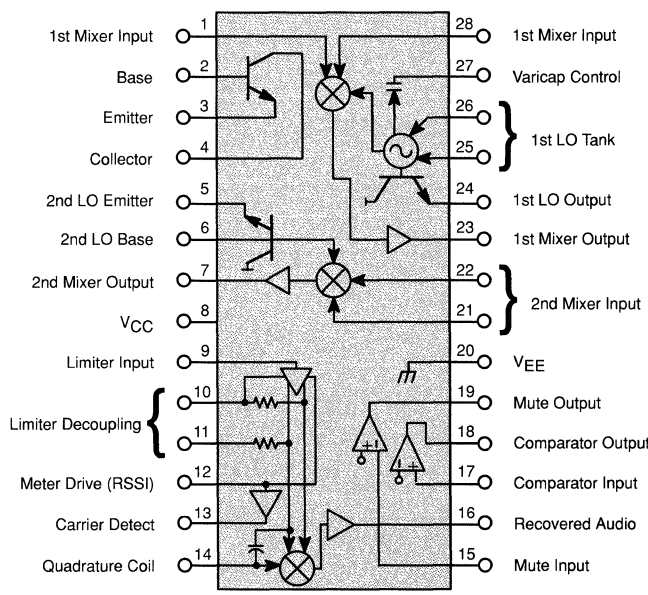


MOSAIC® 1.5 VHF Narrowband Dual-Conversion Receiver

MC3363 T_A = –40° to +85°C, Case 751F

- Operation to 180 MHz
- 2 to 8 Vdc Supply
- <0.5 µV for 20 dB Quieting Sensitivity
- Analog and Data Modulation Recovery
- >60 dB Dynamic Range RSSI
- Crystal or VCO First L.O. Operation
- On-Chip RF Amp/MC3363

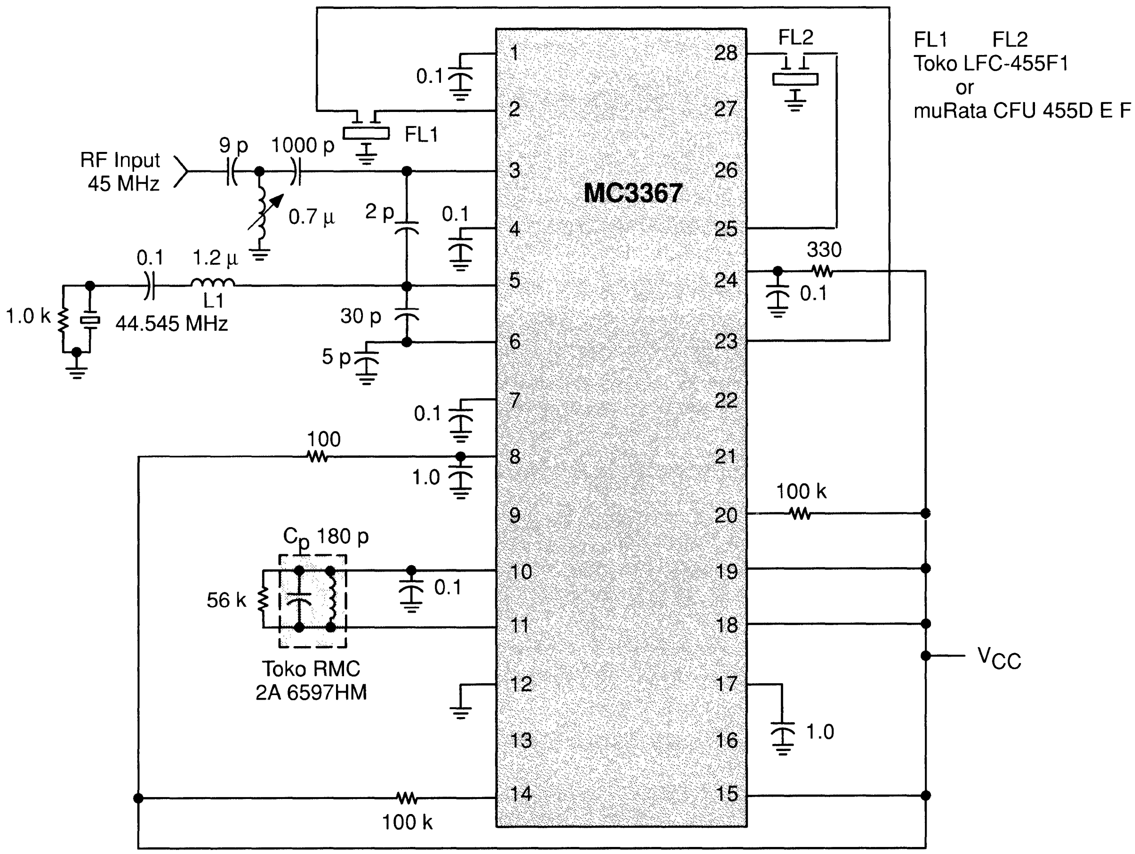
MC3363



Low Voltage FM Narrowband Receiver

MC3367 T_A = 0° to +70°C, Case 751F

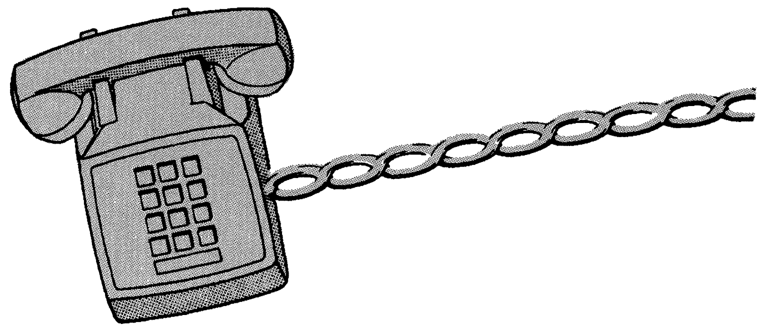
- Single Cell Operation to 0.9 V_{CC}
- Single Conversion Operation to 75 MHz
- Current Drain of 1.0 mA
- Split IF Amplifier for Single or Dual Filters
- Analog and Data Outputs
- Sensitivity of 0.7 μV Typ for 20 dB Quieting
- Low Battery Voltage Indicator



(All capacitors in μF unless otherwise stated. Resistors in ohms. Inductors in Henries.)

Telecommunications

PBX Architecture (Analog Transmission)



ANALOG PHONE

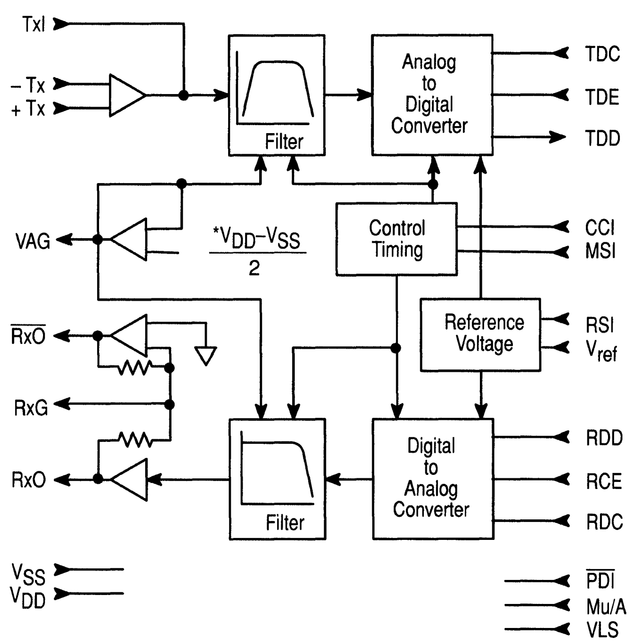
PCM Mono-Circuits Codec-Filters (CMOS LSI)

MC145500 Series Case 620, 648, 708, 726, 736, 751, 776

The Mono-circuits perform the digitizing and restoration of the analog signals. In addition to these important functions, Motorola's family of pulse-code modulation mono-circuits also provides the band-limiting filter functions — all on a single monolithic CMOS chip with extremely low power dissipation.

The Mono-circuits require no external components. They incorporate the bandpass filter required for antialiasing and 60 Hz rejection, the A/D–D/A conversion functions for either U.S. Mu-Law or European A Law companding formats, the lowpass filter required for reconstruction smoothing, an on-board precision voltage reference, and a variety of options that lend flexibility to circuit implementations. Unique features of Motorola's Mono-circuit family include wide power supply range (6 to 13 V) selectable on-board voltage reference (2.5, 3.1, or 3.8 V), and TTL or CMOS I/O interface.

Motorola supplies five versions of the PCM Mono-circuit. The MC145500, MC145503 and MC145505 are general-purpose devices in 16-pin packages designed to operate in digital telephone or line card applications. The MC145501 is the same device (in an 18-pin package) that offers the capability of selecting from three peak overload voltages (2.5, 3.15 and 3.78 V). The MC145502 is the full-feature device that presents all of the options available on the chip. This device is packaged in a 22-pin DIP and 28-pin chip carrier package.



Additional PCM Mono-Circuits:

MC145554/57/64/67 Pin compatible and functionally compatible to the 3054/57/64/67.

Also Available — Filters:

MC145414 Dual Tuneable Low-Pass Sampled Data Filter

MC145432 2600 Hz Tone Signalling Filter

Dual Tone Multiple Frequency Receiver

MC145436 Case 646, 751

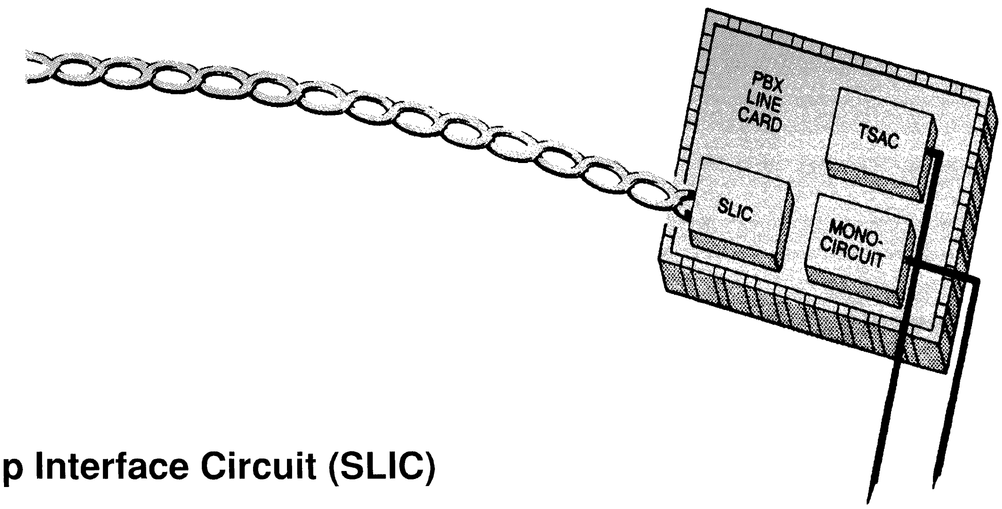
This device contains the filter and decoder for detection of a pair of tones conforming to the DTMF standard with outputs in hexadecimal. Switched capacitor filter technology is used together with digital circuitry for the timing control and output circuits. The MC145436 provides excellent power-line noise and dial tone rejection.

Crosspoint Switches

Crosspoint switches implemented with semiconductor technology take the place of the huge banks of mechanical relay matrices once utilized in Central Offices and PBXs.

Motorola's crosspoint switches have latches to control the state of any particular switch in order to route analog or digital signals. These ICs find applications in PBXs, key systems, and test equipment.

Device	Description	Suffix	Pins
MC142100	4 × 4 × 1 Analog Switch • 4.2 to 18 V Operation • Low On-State Resistance	CL, CP, DW (620, 648, 751G)	16 DIP 16 SO
MC145100	4 × 4 × 1 Analog Switch • 4.2 to 18 V Operation • Low On-State Resistance • Power On Reset	CP (648)	16 DIP

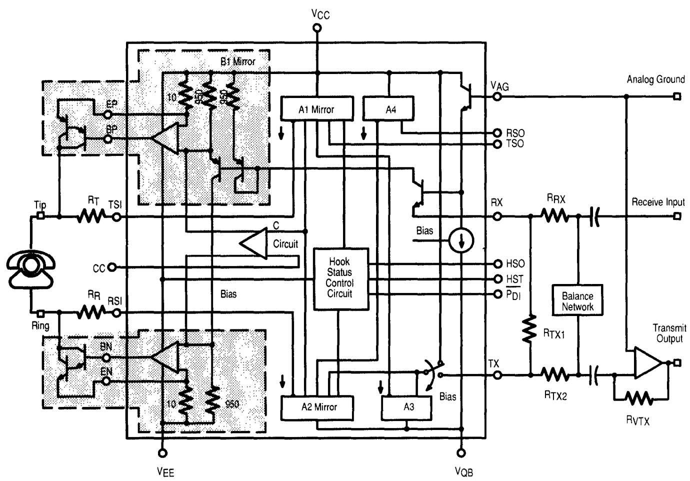


Subscriber Loop Interface Circuit (SLIC)

MC3419-1L T_A = 0° to +70°C, Case 726

The replacement of two-to-four wire conversion hybrid transformers in Central Office, PBX, and Subscriber Carrier equipment with the SLIC has resulted in major improvement in telephone equipment. The SLIC family performs this task, along with most other **BORSHT** functions required by signal transmission. These include the provision of DC power to the telephone (**B**attery); **O**vervoltage protection; **R**ing trip detection; **S**upervisory features such as hook status and dial pulsing; 2-to-4 wire conversion, suppression of longitudinal signals (**H**ybrid).

- All Key Parameters Externally Programmable
- Current Sensing Outputs Monitor Status of Both Tip and Ring Leads
- On-Hook Power Below 5.0 mW
- Digital Hook Status Output
- Power Down Input
- Ground Fault Protection
- Size and Weight Reduction Over Conventional Approaches
- The sale of this product is licensed under patent No. 4,004,109. All royalties related to this patent are included in the unit price.



MC33120 T_A = –40° to +85°C, Case 738, 751D

With a guaranteed minimum longitudinal balance of 58 dB, the MC33120 is ideally suited for central office applications, as well as PBXs, and other related equipment. Protection and sensing components on the 2 wire side can be non-precision while achieving required system performance. Most BORSHT functions are provided while maintaining low power consumption, and a cost effective design. Size and weight reduction over conventional transformer designs permit a higher density system.

- All key parameters externally programmable with resistors:
  - Transmit and receive gains
  - Transhybrid loss
  - Return loss
  - DC loop current limit and battery feed resistance
  - Longitudinal Impedance
- Single and double fault sensing and protection
- Minimum 58 dB longitudinal balance (2 wire and 4 wire) guaranteed
- Digital Hook Status and Fault outputs
- Power Down input
- Loop Start or ground start operation
- Size and weight reduction over conventional approaches
- Available in 20 pin DIP and SOIC packages

ISDN Voice/Data Circuits

Integrated Services Digital Network

ISDN is the revolutionary concept of converting the present analog telephone networks to an end-to-end global digital network. ISDN standards make possible a wide variety of services and capabilities that are revolutionizing communications in virtually every industry.

Motorola's ISDN product family includes the MC145472 U-Interface Transceiver, the MC145474/75 S/T-Interface Transceivers, MC145488 Dual Data Link Controller, and the MC68302 Integrated Multi-Protocol Processor. These are supported by a host of related devices including the MC145500 family of single-chip codec/filters, MC145436 DTMF Decoder, MC33120 Subscriber Loop Interface Circuit, MC34129 Switching Power Supply Controller, MC145601 Time Slot Interchange Circuit, MC145611 PCM Conference Circuit, and the MC145406/07 CMOS EIA 232-D Driver/Receiver family.

On the system level, Motorola offers the MC145490/91EVK ISDN Evaluation Kit and the MC145494EVK U-Interface Transceiver Evaluation Kit. The Kits include several Motorola ISDN ICs along with the software and technical information needed to design both equipment and user software.

These are but a few of the broad line of Motorola ICs suitable for applications in the global ISDN network.

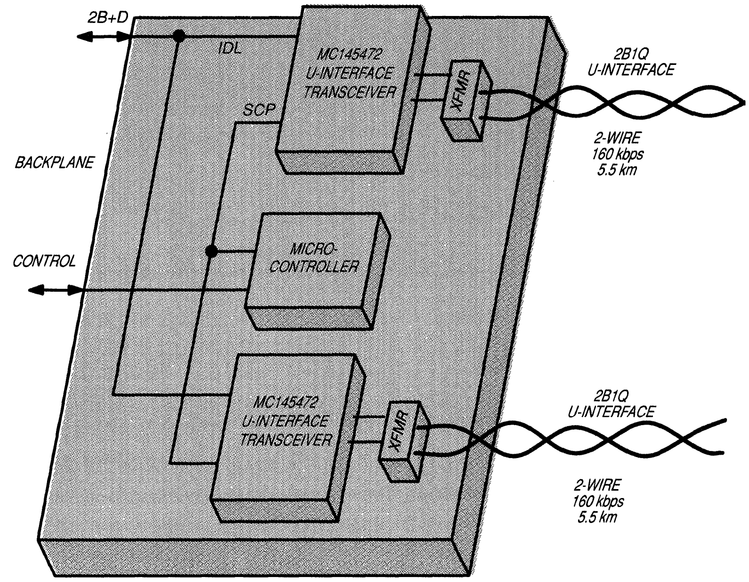
The block diagram illustrates how Motorola's key ISDN devices fit into four ISDN network applications: a digital subscriber line card, an NT1 network termination, an ISDN terminal adapter, and an ISDN terminal. Digital subscriber line cards are used in central offices, remote concentrators, channel banks, T1 multiplexers, and other switching equipment. The NT1 network termination block illustrates the simplicity of remote U to S/T-interface conversion. The ISDN terminal adapter and ISDN terminal block show how Motorola ICs are used to combine voice and data in PC compatible boards, digital telephones, and other terminal equipment. Expanded applications such as a PBX may include these and other Motorola ISDN circuits.

U-Interface Transceiver

MC145472 Case 847B

The MC145472 fully conforms to ANSI T1.601-1991, the North American standard for ISDN Basic Access on a single twisted-wire pair. The transceiver achieves a remarkable 10^{-7} bit error rate performance on all ANSI specified test loops with worst-case impairments present. The state-of-the-art 1.2 micron single-chip solution uses advanced design techniques to combine precision analog signal processing elements with three digital signal coprocessors to build an adaptively equalized echo cancelling receiver.

DIGITAL SWITCH LINE CARD



Two modes of handling U-interface maintenance functions are provided on the MC145472. In the automatic maintenance mode the U-interface transceiver handles all ANSI specified maintenance and channel procedures internally to minimize your software development effort. Automatic procedures include generating and monitoring the cyclic redundancy check, reporting and counting far end block errors (near end block errors too), handling the ACT and DEA bits, as well as monitoring and appropriately responding to embedded operations channel messages.

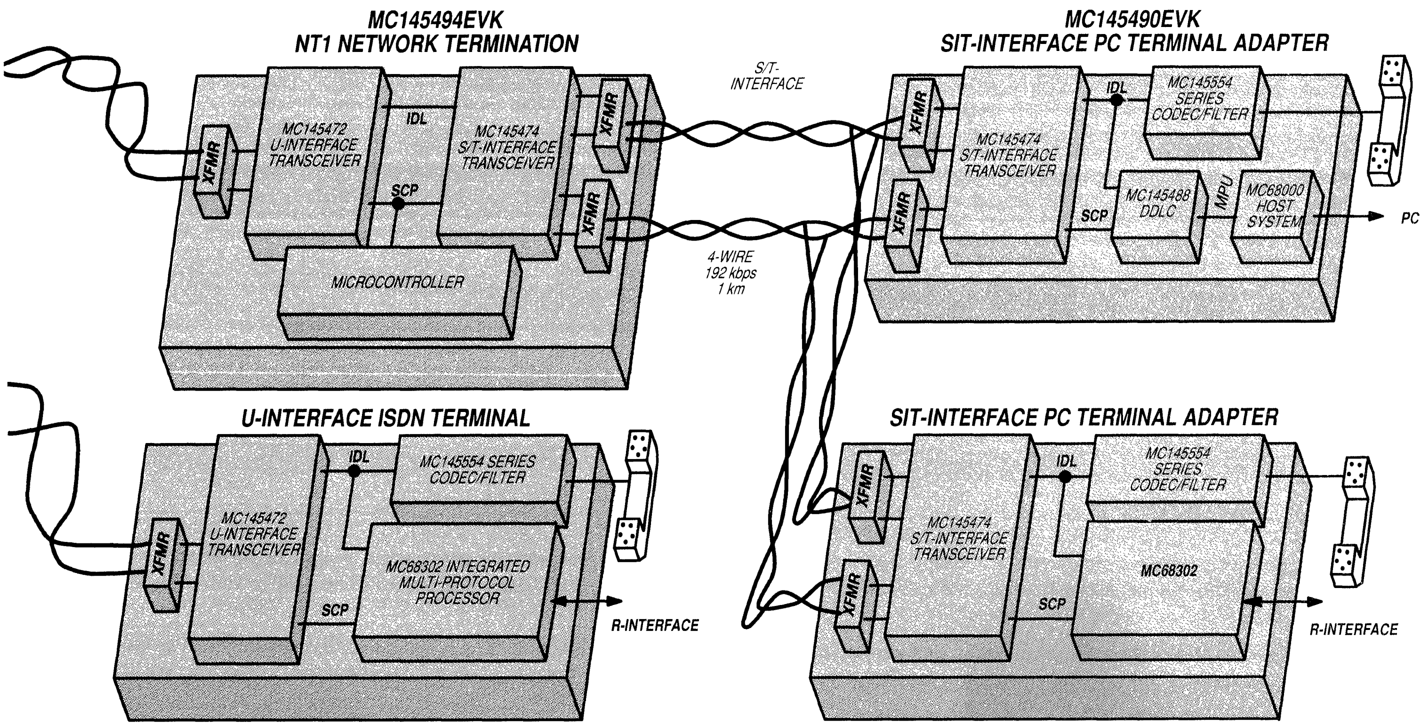
The optional manual maintenance mode lets you choose an inexpensive microcontroller, such as a member of Motorola's MC68HC05 family, to control and augment the standard maintenance channel functions. This flexible feature also allows for easy implementation of proprietary maintenance functions.

S/T-Interface Transceivers

MC145474 Case 736A
MC145475 Case 710, 751F

The MC145474/75 S/T-Interface Transceivers provide a CCITT I.430 compatible interface for use in line card, network termination, and ISDN terminal equipment applications. Manufactured with Motorola's advanced 1.5 micron CMOS mixed analog and digital process technology, the MC145474/75 is a physical layer device capable of operating in point-to-point or point-to-multipoint passive bus arrangements. In addition, the MC145475 can implement the optional NT1 Star topology.

This device features outstanding transmission performance. It reliably transmits over 2.5 kilometers in a point-to-point application with specifications of 1 kilometer. Comparable performance is achieved in all other topologies as well. Other features include pin selectable terminal or network operating modes, industry standard microprocessor serial control port, full support of the multiframing S and Q channels, a full range of loopbacks, and low power CMOS operation.



Dual Data Link Controller

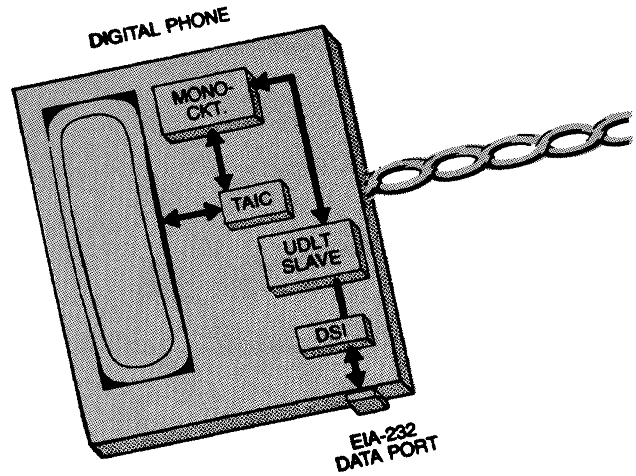
MC145488 Case 779

The MC145488 features two full-duplex serial HDLC channels with an on-chip Direct Memory Access (DMA) controller. The DMA controller minimizes the number of microprocessor interrupts from the communications channels, freeing the micorprocessor's resources for other tasks. The DMA controller can access up to 64 k bytes of memory, and transfers either 8-bit bytes or 16-bit words to or from memory. The MC145488 DDLC is compatible with Motorola's MC68000 and other micoprocessors.

In a typical ISDN terminal application, one DDLC communications channel supports the D-channel (LAPD) while the other supports the B-channel (LAPB). While the DDLC is ideally suited for ISDN applications, it can support many other HDLC protocol applications as well.

Some of the powerful extras found on the DDLC include automatic abort and retransmit of D-channel collisions in S/T-interface applications, address recognition, automatic recovery mechanisms for faulty frame correction, and several system test modes. Address recognition provides a reduction in the host micorprocessor load by filtering data frames not addressed to the host. The DDLC can compare either SAPI or TEI fields of LAPD frames. For LAPD (Q.921) applications, both A and B addresses may be checked.

Voice/Data Communication (Digital Transmission)



2-Wire Universal Digital Loop Transceiver (UDLT)

MC145422 Master Station Case 708, 736
MC145426 Slave Station Case 708, 736

The UDLT family of transceivers allows the use of existing twisted-pair telephone lines (between conventional telephones and a PBX) for the transmission of digital data. With the UDLT, every voice-only telephone station in a PBX system can be upgraded to a digital telephone station that handles the complex voice/data communications with no increase in cabling costs.

In implementing a UDLT-based system the A/D — D/A conversion function associated with each telset is relocated from the PBX directly to the teleset. The SLIC (or its equivalent circuits) is eliminated since its signaling information is transmitted digitally between two UDLTs.

The UDLT master-slave system incorporates the modulation/demodulation functions that permit data communications over a distance up to 2 kilometers. It also provides the sequence control that governs the exchange of information between master and slave. Specifically, the master resides on the PBX line card where it transmits and receives data over the wire pair to the telset. The slave is located in the telset and interfaces the mono-circuit to the wire pair. Data transfer occurs in 10-bit bursts (8 bits of data and 2 signaling bits), with the master transmitting first, and the slave responding in a synchronized half-duplex transmission format.

UDLTs utilize a 256 kilobaud modified differential phase shift keyed (MDPSK) burst modulation technique for transmission to minimize radio frequency, electro-magnetic, and crosstalk interference. Implementation through CMOS technology takes advantage of low-power operation, increased reliability, and the proven capabilities to perform complex telecommunications functions.

Functional Features

- Provides Synchronous Duplex 64 Kilobits/Second Voice/Data Channel and Two 8 Kilobits/Second Signaling Data Channels Over One 26 AWG Wire Pair Up to 2 Kilometers
- Compatible with Existing and Evolving Telephone Switch Architectures and Call Signaling Schemes
- Automatic Detection Threshold Adjustment for Optimum Performance Over Varying Signal Attenuations
- Protocol Independent
- Single 5.0 V to 8.0 V Power Supply

MC145422 Master UDLT

- 2.048 MHz Master Clock
- Pin Controlled Power-Down and Loop-Back Features
- Variable Data Clock — 64 kHz to 2.56 MHz
- Pin Controlled Insertion/Extraction of 8 Kilobits/Seconds Channel into LSB of 64 Kilobits/Second Channel for Simultaneous Routing of Voice and Data Through PCM Voice Path of Telephone Switch

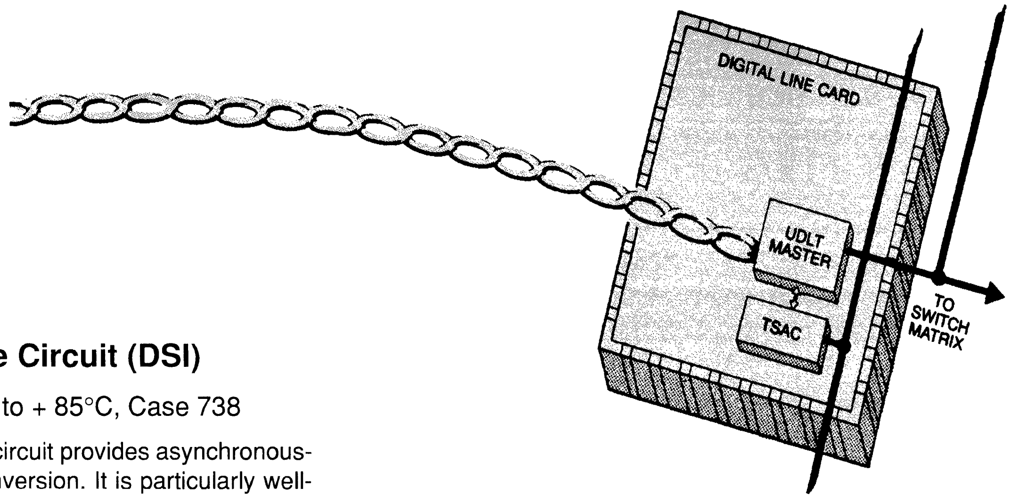
MC145426 Slave UDLT

- Compatible with MC145500 Series PCM Mono-Circuits
- Automatic Power-Up/Down Feature
- On-Chip Data Clock Recovery and Generation
- Pin Controlled 500 Hz D3 or CCITT Format PCM Tone Generator for Audible Feedback Applications

2-Wire ISDN Universal Digital Loop Transceiver II (UDLT II)

MC145421 Master Case 623, 709
MC145425 Slave Case 623, 709

Similar to the MC145422/26 UDLT, but provide 160 kbps in two 64 kbps and two 16 kbps (2B + 2D) format.



Data Set Interface Circuit (DSI)

MC145428 $T_A = -40°$ to $+ 85°C$, Case 738

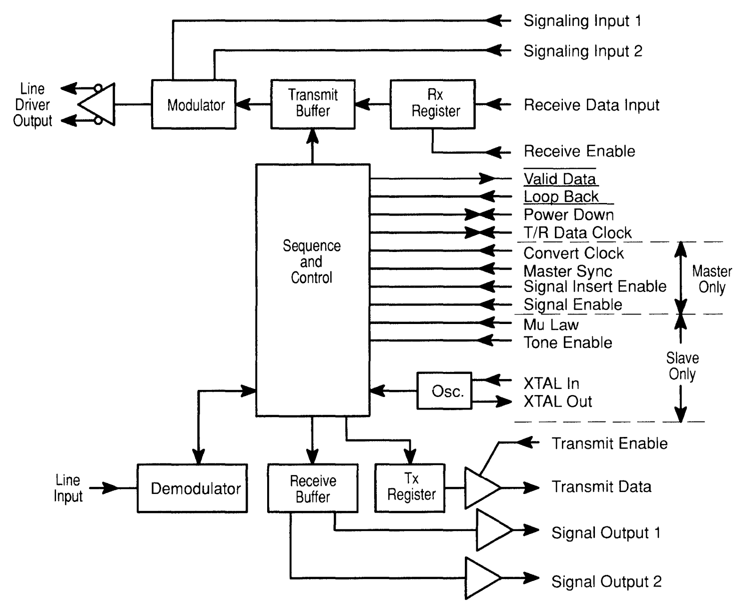
This new CMOS LSI circuit provides asynchronous-to-synchronous data conversion. It is particularly well-suited for use in conjunction with a UDLT-based integrated voice/data system. The **MC145428** DSI provides EIA-232-to-time slot data conversion that permits direct interface between existing data equipment and the UDLT without modifications. With this interactive component, digitized voice information from the PCM Monocircuit and asynchronous data from computers or terminals can be transmitted simultaneously through a synchronous switching network.

DSI circuits are also suited for data multiplexers, concentrators and deconcentrators, data rate changers, data-only switching, and PBX-based local area networks.

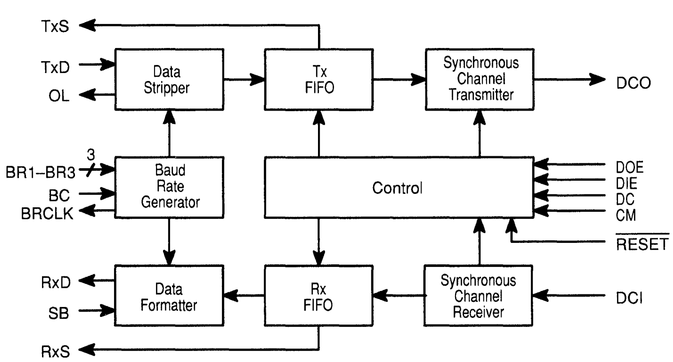
Features

- Up to 128 kbps Asynchronous Data Rate Operation
- 0 up to 2.1 Mbps Synchronous Data Rate Operation
- On-board Bit Rate Clock Generator with Pin Selectable Bit Rates of 300, 1200, 2400, 4800, 9600, 19200, and 38400 bps or an Externally Supplied 16 Times Bit Rate Clock May Be Used
- Accepts Asynchronous Data words of Eight or Nine Bits
- False Start Detection Provided
- Automatic Sync Insertion and Checking

UDLT



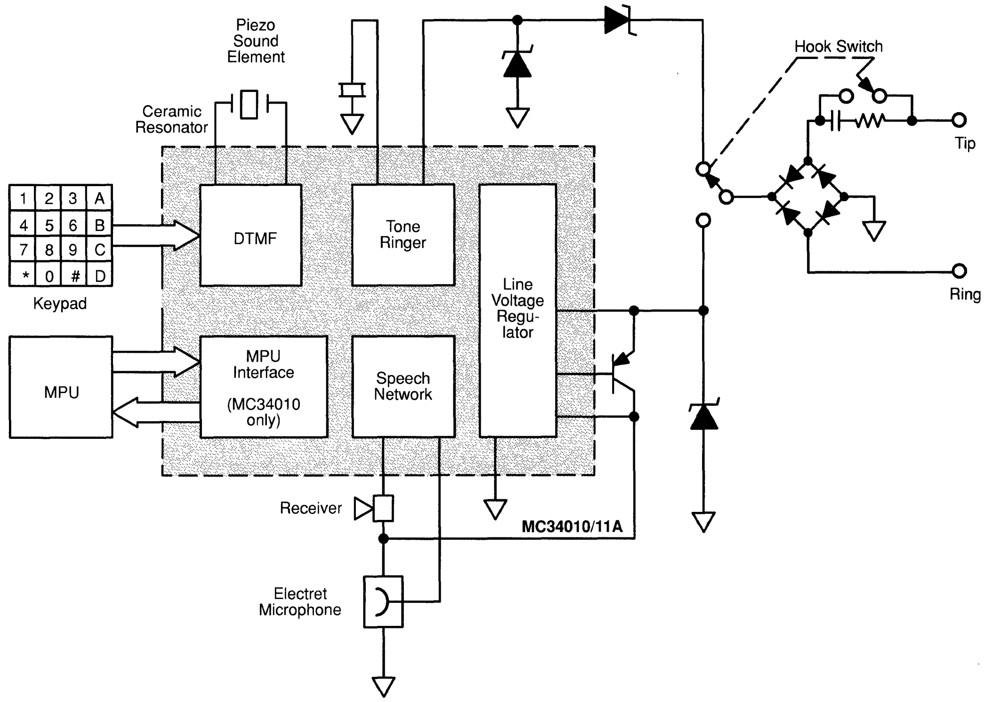
Data Set Interface Circuit



Electronic Telephone

The Complete Electronic Telephone Circuit

MC34010/11A T_A = –20° to +60°C, Case 711, 777



The conventional transformer-driven telephone handset is undergoing major innovations. The bulky transformer is disappearing. So are many of its discrete components, including the familiar telephone bell. They are being replaced with integrated circuits that perform all the major handset functions simply, reliably and inexpensively . . . functions such as 2-to-4 wire conversion, DTMF dialing, tone ringing, and a variety of related activities.

The culmination of these capabilities is the Electronic Telephone Circuit, the MC34010/11A. These ICs place all of the above mentioned functions on a single monolithic chip.

These telephone circuits utilize advanced bipolar linear (I^2L) technology and provide all the necessary elements of a modern tone-dialing telephone. The MC34010 even incorporates an MPU interface circuit for the inclusion of automatic dialing in the final system.

- Provides all basic telephone functions, including DTMF dialer, tone ringer, speech network and line voltage regulator
- DTMF generator uses low cost ceramic resonator with accurate frequency synthesis technique
- Tone ringer drives piezoelectric transducer and satisfies EIA-470 requirements
- Speech network provides 2-to-4 wire conversion with adjustable sidetone utilizing an electret transmitter
- On-chip regulator insures stable operation over wide range of loop lengths
- I^2L technology provides low 1.4 V operation and high static discharge immunity
- MC34010P provides microprocessor interface port for automatic dialing features

Also Available — a broad line of additional telephone components for customizing systems design.

Audio Control Circuit

MC145429 Telset audio interface circuit for MPU-controlled independent adjustment of ear piece, speaker and ringer volume.

Dial Circuits

MC145412/13/16 Integrated Tone/Pulse 10-number Repertory Dialer.

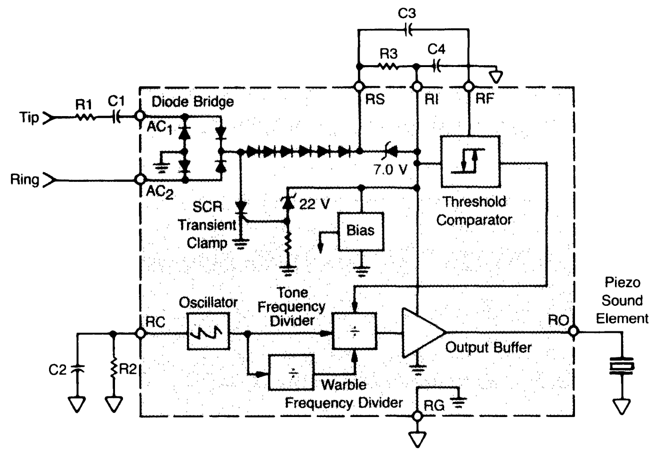
MC145512/13 Integrated Tone/Pulse 10-number Repertory Dialer.

Tone Ringers

The MC34012, MC34017, and MC34117 Tone Ringers are designed to replace the bulky bell assembly of a telephone, while providing the same function and performance under a variety of conditions. The operational requirements spelled out by the FCC and EIA-470, simply stated, are that a ringer circuit MUST function when a ringing signal is provided, and MUST NOT ring when other signals (speech, dialing, noise) are on the line. The tone ringers described below were designed to meet those requirements with a minimum of external components.

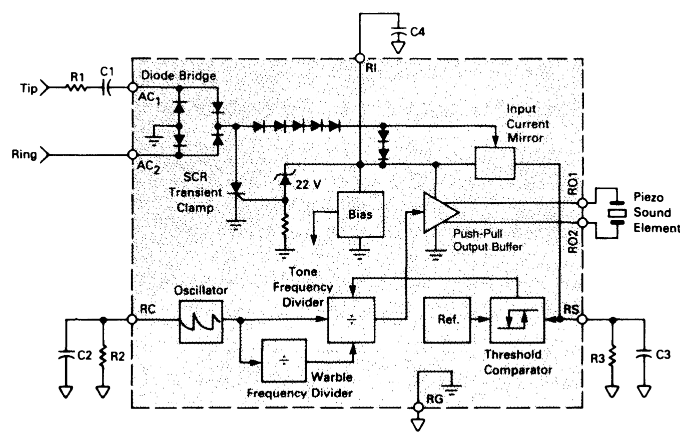
MC34012 T_A = –20° to +60°C, Case 626, 751

- Complete Telephone Bell Replacement
- On-Chip Diode Bridge and Transient Protection
- Single-Ended Output to Piezo Transducer
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial and Hook Switch Transients
- Adjustable Base Frequencies
- Output Frequency to Warble Ratio — MC34012-1:80
  MC34012-2:160
  MC34012-3:40



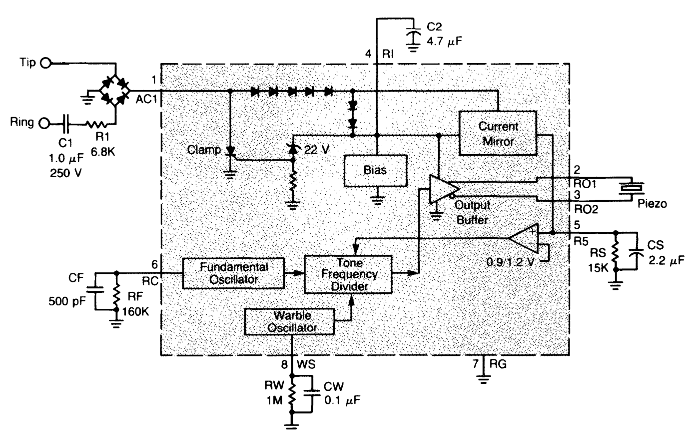
MC34017 T_A = –20° to +60°C, Case 626, 751

- Complete Telephone Bell Replacement
- On-Chip Diode Bridge and Transient Protection
- Differential Output to Piezo Transducer for Louder Sound
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial and Hook Switch Transients
- Output Frequency to Warble Ratio — MC34017-1:80
  MC34017-2:160
  MC34017-3:40



MC34117 T_A = –20° to +60°C, Case 626, 751

- Complete Telephone Bell Replacement
- External Diode Bridge
- Internal Transient Protection
- Differential Output to Piezo Transducer for Louder Sound
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial and Hook Switch Transients
- Base Frequency and Warble Frequencies are Independently Adjustable

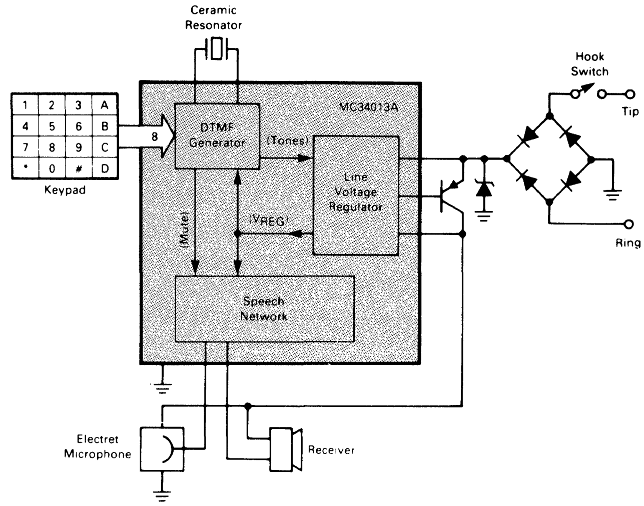


Speech Networks

Telephone Speech Network and Tone Dialer

MC34013A T_A = –20° to +60° C, Case 710, 776

- Linear/I^2L Technology Provides Low 1.4 V Operation in Both Speech and Dialing Modes
- Speech Network Provides 2–4 Wire Conversion with Adjustable Sidetone Utilizing an Electret Microphone
- DTMF Generator Uses Low-Cost Ceramic Resonator with Accurate Frequency Synthesis Technique
- On-Chip Regulator Insures Stable Operation Over Wide Range of Loop Lengths
- Dialer Mutes Speech Network with Internal Delay for Click Suppression on DTMF Key Release

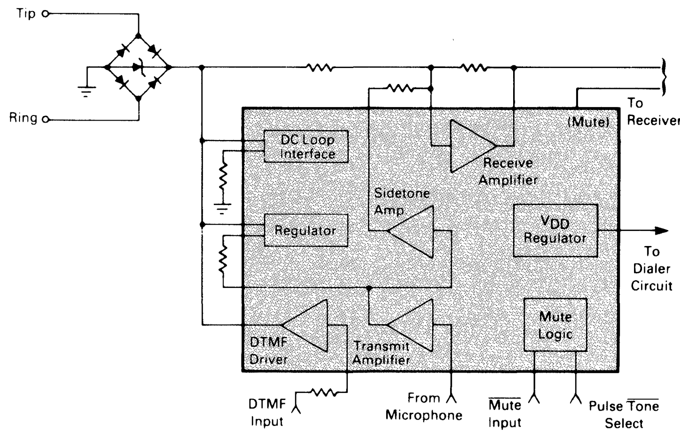


Speech Network with Dialer Interface

MC34014 T_A = –20° to +60° C, Case 707, 775

The MC34014 is a Telephone Speech Network integrated circuit which incorporates adjustable transmit, receive, and sidetone functions, line interface circuit, dialer interface, and a regulated output voltage for a dialer circuit. It includes an equalization circuit to compensate for various line lengths and the conversion from 2-to-4 wire is accomplished with supply voltages as low as 1.5 V.

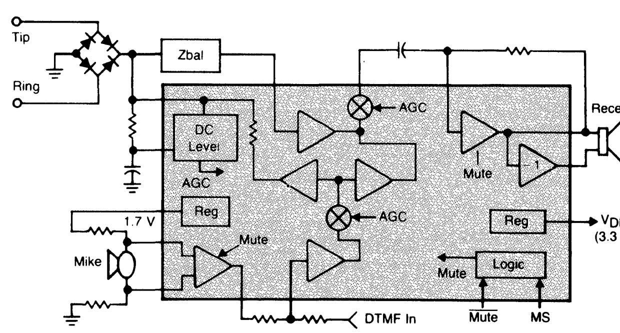
- Transmit, Receive, and Sidetone Gains Set By External Resistors
- Loop Length Equalization for Transmit, Receive, and Sidetone Functions
- Operates Down to 1.5 V (V +) in Speech Mode
- Provides Regulated Voltage for CMOS Dialer
- Speech Amplifiers Muted During Pulse and Tone Dialing
- DTMF Output Level Adjustable with a Single-Resistor
- Compatible with 2-Terminal Electret Microphones
- Compatible with Receiver Impedances of 150 Ω and Higher



Telephone Speech Network with Dialer Interface

MC34114, MC34214 T_A = –20° to +70° C, Case 707, 751D

- Operation Down to 1.2 V
- Adjustable Transmit, Receive, and Sidetone Gains by External Resistors
- Differential Microphone Amplifier Input Minimizes RFI
- Transmit, Receive, and Sidetone Equalization on both Voice and DTMF Signals
- Regulated 1.7 V Output for Biasing Microphone
- Regulated 3.3 V Output for Powering External Dailer
- Microphone and Receive Amplifiers Muted During Dialing
- Differential Receive Amplifier Output Eliminates Coupling Capacitor
- Operates with Receiver Impedances of 150 Ω and Higher



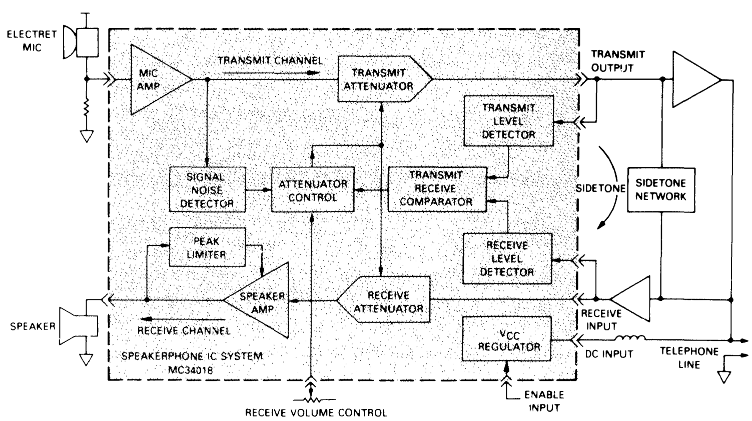
Speakerphone

Voice Switched Speakerphone Circuit

MC34018 T_A = –20° to +60°C, Case 710, 776

The MC34018 Speakerphone integrated circuit incorporates the necessary amplifiers, attenuators, and control functions to produce a high quality hands-free speakerphone system. Included are a microphone amplifier, a power audio amplifier for the speaker, transmit and receive attenuators, a monitoring system for background sound level, and an attenuation control system which responds to the relative transmit and receive levels as well as the background level. Also included are all necessary regulated voltages for both internal and external circuitry, allowing line-powered operation (no additional power supplies required). A Chip Select pin allows the chip to be powered down when not in use. A volume control function may be implemented with an external potentiometer. MC34018 applications include speakerphones for household and business uses, intercom systems, automotive telephones, and others.

- All necessary level detection and attenuation controls for a hands-free telephone in a single integrated circuit
- Background noise level monitoring with long time constant
- Wide operating dynamic range through signal compression
- On-chip supply and reference voltage regulation
- Typical 100 mW output power (into 25 Ω) with peak limiting to minimize distortion
- Chip select pin for active/standby operation
- Linear volume control function



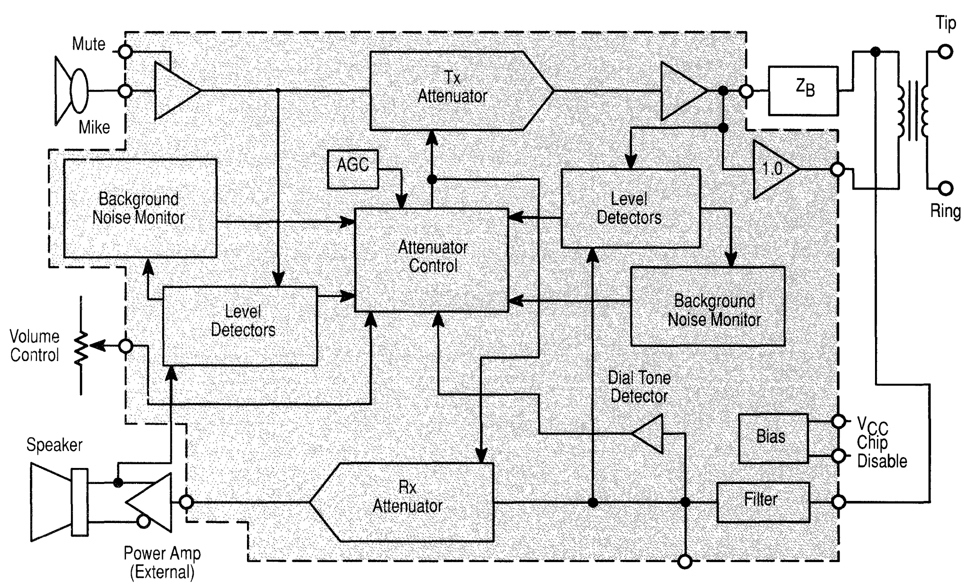
Voice Switched Speakerphone Circuit

MC34118 T_A = –20° to +60°C, Case 710, 751F

The MC34118 Voice Switched Speakerphone Circuit incorporates the necessary amplifiers, attenuators, level detectors, and control algorithm to form the heart of a high quality hands-free speakerphone system. Included are a microphone amplifier with adjustable gain and MUTE control, Transmit and Receive attenuators which operates in a complementary manner, level detectors at both input and output of both attenuators,and background noise monitors for both the transmit and receive channels. A Dial Tone Detector prevents the dial tone from being attenuated by the Receive background noise monitor circuit. Also included are two line driver amplifiers which can be used to form a hybrid network in conjunction with an external coupling transformer. A high-pass filter can be used to filter out 60 Hz noise in the receive channel, or for other filtering functions. A Chip Disable pin permits powering down the entire circuit to conserve power on long loops where loop current is at a minimum.

The MC34118 may be operated from a power supply, or it can be powered from the telephone line, requiring typically 5.0 mA. The MC34118 can be interfaced directly to Tip and Ring (through a coupling transformer) for stand-alone operation, or it can be used in conjunction with a handset speech network and/or other features of a featurephone.

- Improved attenuator gain range: 52 dB between transmit and receive
- Low voltage operation for line-powered applications (3.0 to 6.5 V)
- 4-Point signal sensing for improved sensitivity
- Background noise monitors for both transmit and receive paths
- Microphone amplifier gain set by external resistors — mute function included
- Chip disable for active/standby operation
- On board filter pinned-out for user defined function
- Dial tone detector inhibits receive idle mode during dial tone presence
- Compatible with MC34119 speaker amplifier



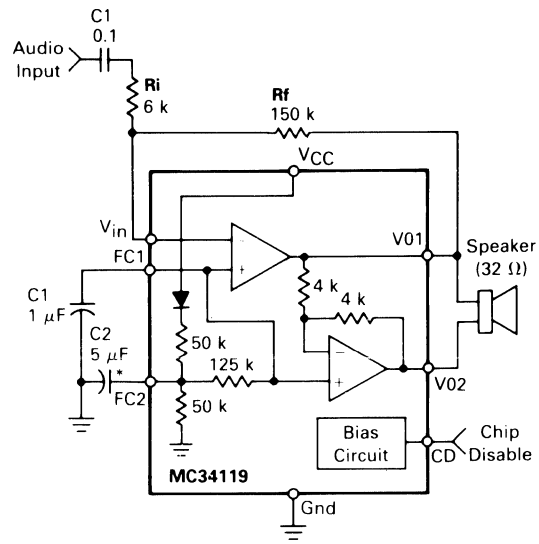
Telephone Accessory Circuits

Audio Amplifier

MC34119 T_A = 0° to +70°C, Case 626, 751

A low power audio amplifier circuit intended (primarily) for telephone applications, such as speakerphones. Provides differential speaker outputs to maximize output swing at low supply voltages (2 volt min.). Coupling capacitors to the speaker, and snubbers, are not required. Overall gain is externally adjustable from 0 to 46 dB. A Chip Disable pin permits powering-down to mute the audio signal and reduce power consumption.

- Drives a Wide Range of Speaker Loads (16 to 100 Ω)
- Output Power Exceeds 250 mW with 32 Ω Speaker
- Low Distortion (THD = 0.4% Typical)
- Wide Operating Supply Voltage (2 to 16 V) — Allows Telephone Line Powered Applications.
- Low Quiescent Supply Current (2.5 mA Typical)
- Low Power-Down Quiescent Current (60 µA Typical)



* = Optional

Differential Gain = $2 \times \frac{Rf}{Ri}$

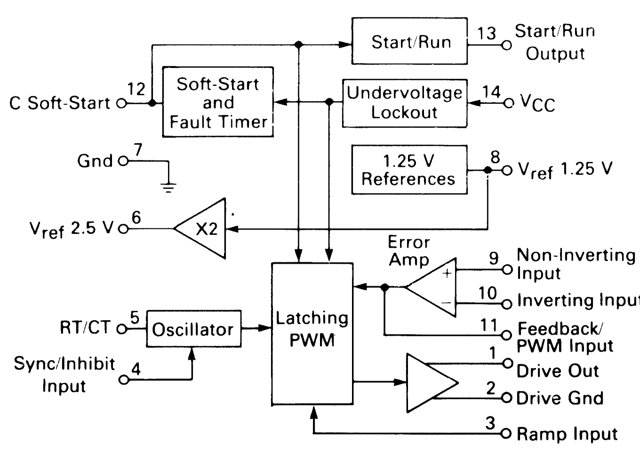
Current Mode Switching Regulator

MC34129 T_A = 0° to +70°C, Case 646, 751A

High performance current mode switching regulator for low-power digital telephones. Unique internal fault timer provides automatic restart for overload recovery. A start/run comparator is included to implement bootstrapped operation of V_{CC}.

Although primarily intended for digital telephone systems, these devices can be used cost effectively in many other applications. On-chip functions and features include:

- Current Mode Operation to 300 kHz
- Automatic Feed Forward Compensation
- Latching PWM for Cycle-By-Cycle Current Limiting
- Latched-Off or Continuous Retry after Fault Timeout
- Soft-Start with Maximum Peak Switch Current Clamp
- Internally Trimmed 2% Bandgap Reference
- Input Undervoltage Lockout



Modem/Filter

While the modulator/demodulator/filter functions required for data transmission over telephone lines are built into some of the dedicated LSI voice/data transmission circuits, many applications require the modem capabilities separately. Motorola offers a wide choice of system design alternatives by making a variety of such circuits available.

300 Baud FSK Modems

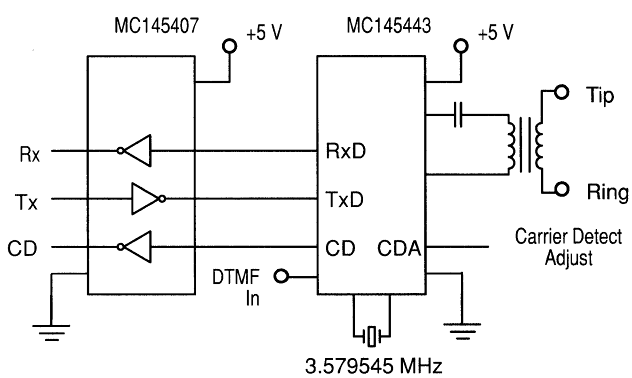
MC145442/MC145443 — Case 738, 751D

This powerful new modem combines a complete FSK modulator/demodulator and an accompanying transmit/receive filter system on a single silicon chip. Designed for bidirectional transmission over the telephone network, the modem operates at 300 baud and can be obtained for compatibility with CCITT V.21 and Bell 103 specifications.

The modem contains an on-board carrier-detect circuit that allows direct operation on a telephone line (through a simple transformer), providing simplex, half-duplex, and full-duplex data communications. A built-in power amplifier is capable of driving –9 dBm onto a 600-ohm line in the transmit mode.

CMOS processing keeps power dissipation to a very low 45 mW, with a power-down dissipation of only 1 mW . . . from a single 5 V power supply. Available in a 20-pin dual-in-line P suffix, and a wide body surface mount DW suffix.

MC145442 Modem, compatible with CCITT V.21
MC145443 Modem, compatible with Bell 102

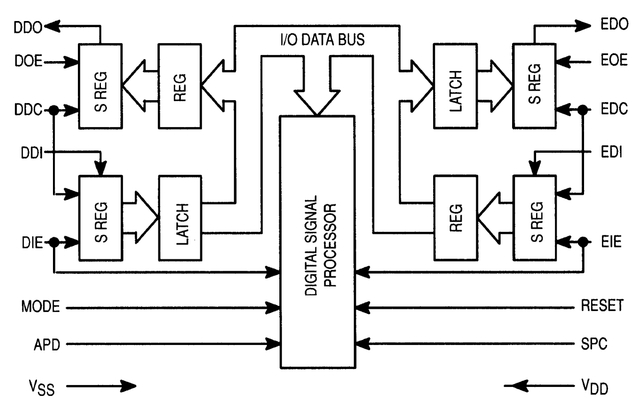


ADPCM Transcoder

MC145532 — Case 620, 751G

The MC145532 Adaptive Differential Pulse Code Modulation (ADPCM) Transcoder provides a low-cost, full-duplex, single-channel transcoder to (from) a 64 kbps PCM channel from (to) either a 16 kbps, 24 kbps, 32 kbps, or 64 kbps channel.

- Complies with CCITT Recommendation G.721 (Geneva 1986)
- Complies with the American National Standard (T1.301-1987)
- Full-Duplex, Single-Channel Operation
- μ-Law or A-Law Coding is Pin Selectable
- Synchronous or Asynchronous Operation
- Easily Interfaces with Any Member of Motorola's PCM Codec/Filter Mono-Circuit Family or Other Industry Standard Codec
- Serial PCM and ADPCM Data Transfer Rate from 64 kbps to 5.12 Mbps
- Power Down Capability for Low Cost Consumption
- The Reset State, an Option Specified in the Standards, is Automatically Initiated When the RESET Pin is Released.
- Simple Time Slot Assignment Timing for Transcoder Applications
- Single 5 V Power Supply



Bit Rate Generators

MC14411 — Case 709, 623

Internal (crystal controlled) 1.843 MHz oscillator and subsequent divider networks provide 16 different output clocks rates ranging from 75 Hz to 1.843 MHz for data communications equipment such as teleprinters, printers, CRT terminals and microprocessor systems.

MC145411 — Case 648

Similar to the MC14411, this device utilizes a 1.843 MHz or 3.6864 MHz crystal frequency input divided to provide nine different output clock rates from 150 Hz to 1.843 MHz, or 300 Hz to 3.6864 MHz, respectively.

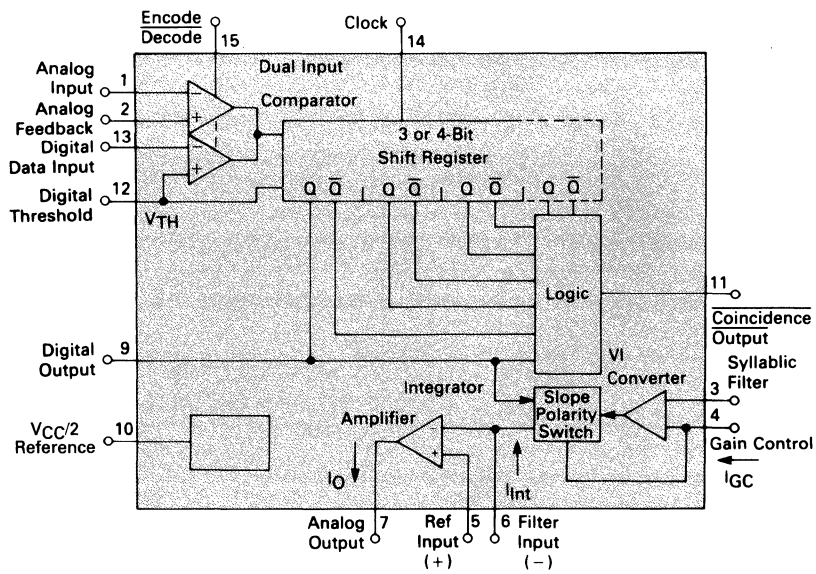
Continuously Variable Slope Delta (CVSD) Modulator/Demodulator

MC34115 T_A = 0° to +70°C, Case 648
MC3417/18 T_A = 0° to +70°C, Case 620
MC3517/18 T_A = –55° to +125°C, Case 620

Provides the A/D-D/A function of voice communications by digital transmission.

The MC3517/18 series of CVSDs is designed for military secure communications and commercial telephone applications. A single IC provides both encoding and decoding functions in a 16-pin package.

- Encode and decode functions on the same chip with a digital input for selection
- CMOS compatible digital output
- Digital input threshold selectable ($V_{CC}/2$ reference provided on chip)
- MC3417/MC3517/MC34115 have a 3-bit algorithm (general communications)
- MC3418/MC3518 have a 4-bit algorithm (commercial telephone)



Phase-Locked Loop Components

Motorola offers a choice of phase-locked loop components ranging from complete functional frequency synthesizers for dedicated applications to a wide selection of general purpose PLL circuit elements. Technologies include CMOS for lowest power consumption and bipolar for high speed operation. Typical applications include TV, CATV, radio, scanners, cordless telephones plus home and personal computers.

PLL Frequency Synthesizers

Divider Programming Format	External Prescaler Modulus	Single-Ended 3-State Phase Detector Output	Double-Ended Phase Detector Output	Number of Divider Stages ÷R	÷A	÷N	f_{max} MHz	Device Number	Suffix/ Package
Serial	Single	✓	✓	14*	—	14	20	MC145155-2	P/707, DW/751D, FN/775
		✓	✓	14	—	14	20	MC145157-2	P/648, DW/751G, FN/775
	Dual	✓✓ ♦	—	14	7	10	15	MC145149	P/738, DW/751D
		✓	✓	12*	7	10	20	MC145156-2	P/738, DW/751D, FN/775
		✓	✓	14	7	10	20	MC145158-2	P/648, DW/751G, FN/775
	Dual	Frequency Detector	Analog Detector	14	7	10	15	MC145159-1	P/738, FN/775
	None	✓✓ ♦	—	11*	—	14	60	MC145167	P/648, DW/751G
		✓✓ ♦	—	11*	—	14	60	MC145169	P/648, DW/751G
		✓	✓	15	—	16	160#	MC145170	P/648, D/751B
Parallel	Single	✓	—	11*	—	9	4	MC145106	P/707, DW/751D, FN/775
		✓	✓	14*	—	14	20	MC145151-2	P/710, FN/776
	Dual	—	✓	12*	6	10	20	MC145152-2	P/710, FN/776
	None	✓✓ ♦	—	12*	—	14	60	MC145160	P/707, DW/751D
		✓✓ ♦	—	11*	—	14	60	MC145166	P/648, DW/751G
		✓✓ ♦	—	11*	—	14	60	MC145168	P/648, DW/751G
4-Bit Bus	Single	✓	✓	12	—	14	20	MC145145-2	P/707, DW/751D
	Dual	✓	✓	12	7	10	20	MC145146-2	P/738, DW/751D

*Limited number of selectable values.
♦ Accommodates two loops per package.
#180 MHz version available. See data sheet.

Intended Applications

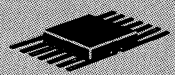
General Purpose	Cordless Phones
MC145106	MC145160
MC145145-2	MC145166
MC145146-2	MC145167
MC145149	MC145168
MC145151-2	MC145169
MC145152-2	
MC145155-2	
MC145156-2	
MC145157-2	
MC145158-2	
MC145159-1	
MC145170	

Additional Phase-Locked Loop Functions

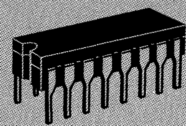
Function	Family	Devices 0 to 70°C	Suffix/Case
Oscillators			
Crystal Oscillator	MECL	MC12061	P/648, L/620
Voltage-Controller Oscillator	MECL	MC1648#	P/646, L/632, F/607
Voltage-Controlled Multivibrator	MECL	MC1658#	P/648, L/620
Dual Voltage-Controlled Multivibrator	TTL	MC4024/ MC4324*	P/648, L/632, F/607
Voltage-Controller Oscillators	TTL/LS	SN74LS724	P.626, L/693
Phase Detectors			
Digital Mixer	MECL	MC12000	P/646, L/632
Phase-Frequency Detector	MECL	MC12040	
Phase-Frequency Detector	TTL	MC4044 MC4344*	P/646, L/632, F/607
Analog Mixer, Double Balanced	MECL	MC12002#	P/646, L/632
Modulator/Demodulator	Linear	MC1496**/ MC1596*	P/646, L/632
Control Functions			
Counter-Control Logic	MECL	MC12014	P/648, L/620
Prescalers/Counters			
UHF — 2,500 MHz	MECL	MC1690#	F/650, L/620
Two-Modulus ÷ 5/ ÷ 6, 600 MHz	MECL	MC12009#	P/648, L/620
Two-Modulus ÷ 8/ ÷ 9, 600 MHz	MECL	MC12011#	
Two-Modulus ÷ 10/ ÷ 11, 600 MHz	MECL	MC12013#	
Low Power Two-Modulus ÷ 32/ ÷ 33, 225 MHz	MECL	MC12015##	P/626, D/751
Low Power Two-Modulus ÷ 40/ ÷ 41, 225 MHz	MECL	MC12016##	
Low Power Two-Modulus ÷ 64/ ÷ 65, 225 MHz	MECL	MC12017##	
Low Power Two-Modulus ÷ 128/ ÷ 129, 520 MHz	MECL	MC12018##	
Low Power Two-Modulus ÷ 20/ ÷ 21, 225 MHz	MECL	MC12019##	
Low Power Two-Modulus ÷ 64/ ÷ 65, ÷ 128/ ÷ 129 Pos. Edge 1.1 GHz	MECL	MC12022A##	
Low Power Two-Modulus ÷ 64/ ÷ 65, ÷ 128/ ÷ 129 Neg. Edge 1.1 GHz	MECL	MC12022B##	
Low Power ÷ 64 Prescaler, 225 MHz 3.2 to 5.5 V_{CC}	MECL	MC12023	
Low Power ÷ 64 Prescaler, 1.1 GHz	MECL	MC12073	
Low Power ÷ 256 Prescaler, 1.1 GHz	MECL	MC12074	
UHF ÷ 2 Prescaler, 750 MHz	MECL	MC12090	P/648, L/620, F/650
Programmable ÷ N Decade	TTL	MC4316/ MC4316*	P/648, L/620, F/650

*T_A = –55° to +125°C #T_A = –30° to +85°C
**T_A = 0° to 70°C ##T_A = –40° to +85°C
Plastic packages available for commercial temperature range only.

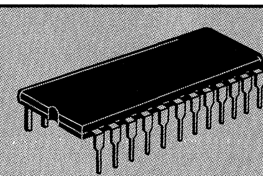
Communications Circuits Package Overview



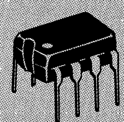
CASE 607
CERAMIC
F SUFFIX



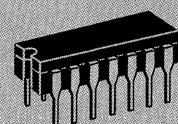
CASE 620
CERAMIC
L SUFFIX



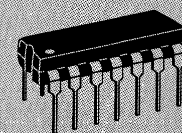
CASE 623
CERAMIC
L SUFFIX



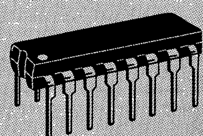
CASE 626
PLASTIC
P SUFFIX



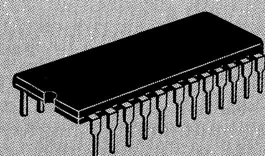
CASE 632
CERAMIC
L SUFFIX



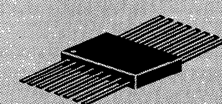
CASE 646
PLASTIC
P SUFFIX



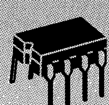
CASE 648
PLASTIC
P SUFFIX



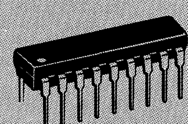
CASE 649
PLASTIC
P SUFFIX



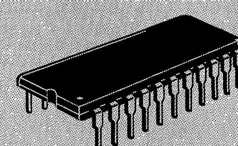
CASE 650
CERAMIC
F SUFFIX



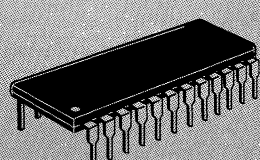
CASE 693
CERAMIC
L SUFFIX



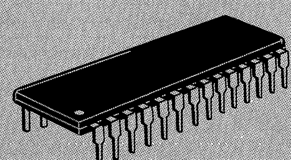
CASE 707
PLASTIC
P SUFFIX



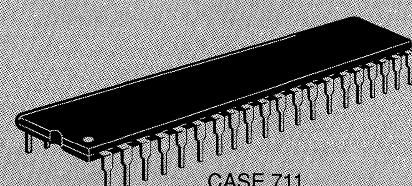
CASE 708
PLASTIC
P SUFFIX



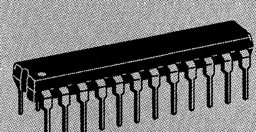
CASE 709
PLASTIC
P SUFFIX



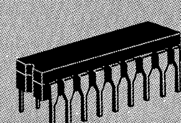
CASE 710
PLASTIC
P SUFFIX



CASE 711
CERAMIC
P SUFFIX

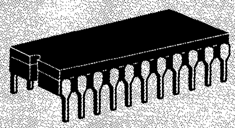


CASE 724
PLASTIC
N SUFFIX

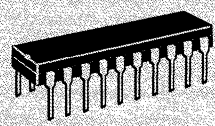


CASE 726
CERAMIC
L SUFFIX

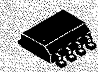
Communications Circuits Package Overview (continued)



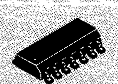
CASE 736
CERAMIC
L SUFFIX



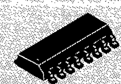
CASE 738
PLASTIC
P SUFFIX



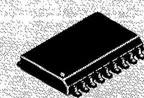
CASE 751
PLASTIC
S0-8, SOP-8
D SUFFIX



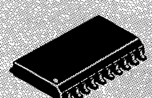
CASE 751A
PLASTIC
SO-14
D SUFFIX



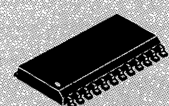
CASE 751B
PLASTIC
SO-16
D SUFFIX



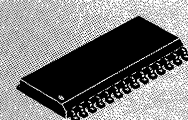
CASE 751C
PLASTIC
SO-18L
DW SUFFIX



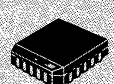
CASE 751D
PLASTIC
SO-20L
DW SUFFIX



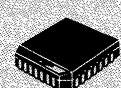
CASE 751E
PLASTIC
SO-24L
DW SUFFIX



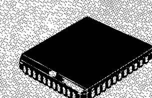
CASE 751F
PLASTIC
SO-28L
DW SUFFIX



CASE 775
PLASTIC
PLCC–20
FN SUFFIX



CASE 776
PLASTIC
PLCC-28
FN SUFFIX



CASE 777
PLASTIC
PLCC-44
FN SUFFIX

Consumer Electronic Circuits

In Brief . . .

. . . reflecting Motorola's continuing commitment to semiconductor products necessary for consumer system designs. This tabulation is arranged to simplify first-order selection of consumer integrated circuit devices that satisfy the primary functions for home entertainment products, including Television, Hi-Fi Audio and AM/FM Radio.

Consumer Electronic Circuits

Entertainment Radio Receiver Circuits

C-QUAM® AM Stereo Decoders

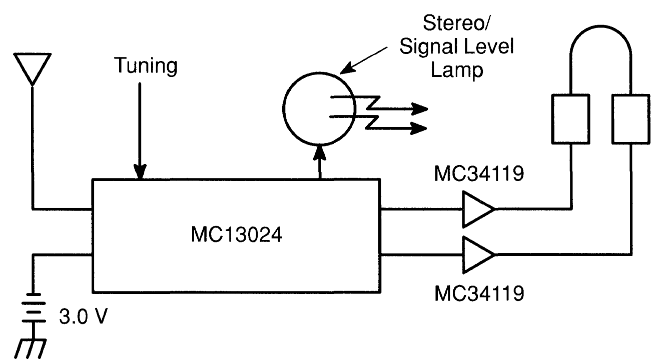
Function	Features	Suffix/ Case	Device
Basic AM Stereo Decoder	Monaural/Stereo AM Detector/Indicator, 6 to 10 V Operation	P/738	MC13020
Advanced AM Stereo Decoder	Medium Voltage 2 to 8 V, Decoder and IF Amp	DW/751F	MC13022
AM Front End	Tuning Stabilizer for MC13022	P/738	MC13023
AM Stereo Personal Radio	Complete Low Voltage AM Stereo Receiver	P/724	MC13024

Audio Amplifiers

Function	P_O Watts	V_{CC} Vdc Max	V_{in} @ rated P_O mV Typ	I_D mA Typ	R_L Ohms	Suffix/ Case	Device
Mini Watt SOIC Audio Amp	1.0 W	35	80	11	16	D/751	MC13060
Low Power Audio Amp	400 mW	16	—	2.5 mA	8–100	D/751 P/626	MC34119

Audio Attenuator

Function	V_{CC} Range Vdc	THD %	Tone Control Range dB Typ	Attenuation Range dB Typ	Suffix/ Case	Device
Electronic Attenuator	8–18	0.6 Typ	± 13	80	P/626	MC3340



C-QUAM® Portable Receiver

When AM stereo broadcasting was sanctioned by the F.C.C. in 1982, there were five different systems vying for user approval. Since then C-QUAM® has become the defacto standard in the U.S.A., with over 700 stations "on the air" as the market and broadcasters recognize its performance advantages. It is the legal standard in Canada, Australia and Brazil where A.M. is the dominant radio medium. C-QUAM is available from nearly 50 automobile radio makers and a dozen home receiver builders.

Based on the field proven C-Quam performance, Motorola has developed a low cost, high performance C-Quam AM Stereo Decoder chip, with fully compatible, no-compromise mono performance, as the basis for both broadcast and receiving equipment. Additional IC components from Motorola's inventory offer a single supply source for state-of-the-art radio receiver designs. New products cover virtually every type of receiver — home, auto, and personal portable.

Video Circuits

Modulators

Function	Features	Suffix/ Case	Device
Color TV Video Modulator	RF Oscillator and Modulator	P/626	MC1373
TV Modulator (High Quality)	RF Oscillator/Modulator, and FM Sound Oscillator/Modulator	P/646	MC1374
Video RGB to PAL/NTSC Encoder	RGB and Sync Inputs, Composite Video Out — PAL/NTSC Switch Selectable	P/738	MC1377
Video Synchronizer	Complete Color TV Video Overlay Synchronizer	P/711	MC1378

Demodulators

Color Processor	PAL/NTSC Input, RGB Output, also RGB Inputs, Plus Fast Blanking Input. Ideal for Text, Graphics, Overlays	P/711 FN/777	TDA3301B TDA3303
	PAL/NTSC Input, RGB Outputs, On-Chip Hue Control	P/724	TDA3330
Chroma 4 Multistandard Decoder	Full PAL/SECAM/NTSC Capability, Dual Composite or S-VHS Inputs, RGB Outputs, Digital Control of all On-Chip Functions	P/711	MC44000*

Filters

Enhanced Comb Filter	Fast 8-bit A/D Converter, Two 8-bit D/A Converters, Two Line-Delay Memories, Utilizes NTSC Subcarrier Frequency Clock, CMOS Technology	TBD**	MC141620

Tuning System

Remote Control Amplifier	Infrared Diode Signal Amplifier Shaper	P/626	MC3373
PLL-Tuning Circuit	TV Tuning System — Prescaler — M-Bus Control	DW/751C	MC44802
Remote Control Receiver	Infrared Preamplifier	P/626	MC44520*

Deflection

Horizontal Processor	Linear Balanced Phase Detector, Oscillator and Predriver, Adjustable DC Loop Gain, Adjustable Duty Cycle	P/626	MC1391

Sound

Sound IF Detector	Interchangeable with ULN2111A	P/646	MC1357
Sound IF, Low Pass Filter, FM Detector, DC Volume Control, Preamplifier	Complete TV Sound System; 100 μV, 3 dB Limiting Sensitivity; 4 Watts Output; V_{CC} = 24 V, R_L = 16 Ω	P/648C	TDA3190

Transistor Arrays

Function	$I_{C(max)}$ mA	V_{CEO} (V) Max	V_{CBO} (V) Max	V_{EBO} (V) Max	Suffix/ Case	Device
One Differentially Connected Pair and Three Isolated Transistors	50	15	20	5.0	P/646 D/751A	MC3346
Dual Independent Differential Amplifiers with Associated Constant Current Transistors	50	15	20	5.0	P/646	CA3054
General Purpose H/V Array	50	30	40	5.0	D/751A	CA3146

*To Be Introduced
**To Be Determined

VIDEO CIRCUITS (continued)

Television Subsystems

Function	Features	Suffix/ Case	Device
MONOMAX – 1-Chip Black and White TV Subsystem	Video IF, Detector, AGC, Video Amplifier, Horizontal Processor, Vertical Processor, and Sync For 525 Line Systems	P/710	MC13001X
	Same as Above Except For 625 Line Systems		MC13002X
Sound IF, Low Pass Filter, Detector, dc Volume Control, Preamplifier, Power Amplifier	Complete TV Sound System; 100 μV, 3 dB Limiting Sensitivity; 4 Watts Output; V_{CC} = 24 V, R_L = 16 Ω	P/648C	TDA3190

Video Amplifiers

Function	Features	Suffix/ Case	Device
1st and 2nd Video IF Amplifier	IF Gain @ 45 MHz = 50 dB typ, AGC Range = 60 dB min	P/626	MC1350
3rd IF, Video Detector, Video Buffer, and AFC Buffer	Low Level Detection, Low Harmonic Generation	P/626	MC1330A
SAW Preamp, IF Amplifier, Detector, AGC AFC	Complete Video IF or Parallel Sound IF System Complete AFT System with Simple Quadrature Detector	P/707	MC13010
Advanced Video IF	Complete Video/Audio IF System for High Performance Analog TV Receivers	DW/751F	MC44301
Video Switch	5 RGB & Video Inputs and 5 Video Outputs	P/724	MC44900*
Dual Video Amps	Gain @ 4.43 MHz = 6 dB ± 1 dB, Fixed Gain, Internally Compensated, CMOS Technology	P/626 TBD**	MC14576A
	Gain @ 5 MHz = 10 dB max, 10 MHz = 6 dB max, Adjustable Gain, Internally Compensated, CMOS Technology	P/626 TBD**	MC14577A

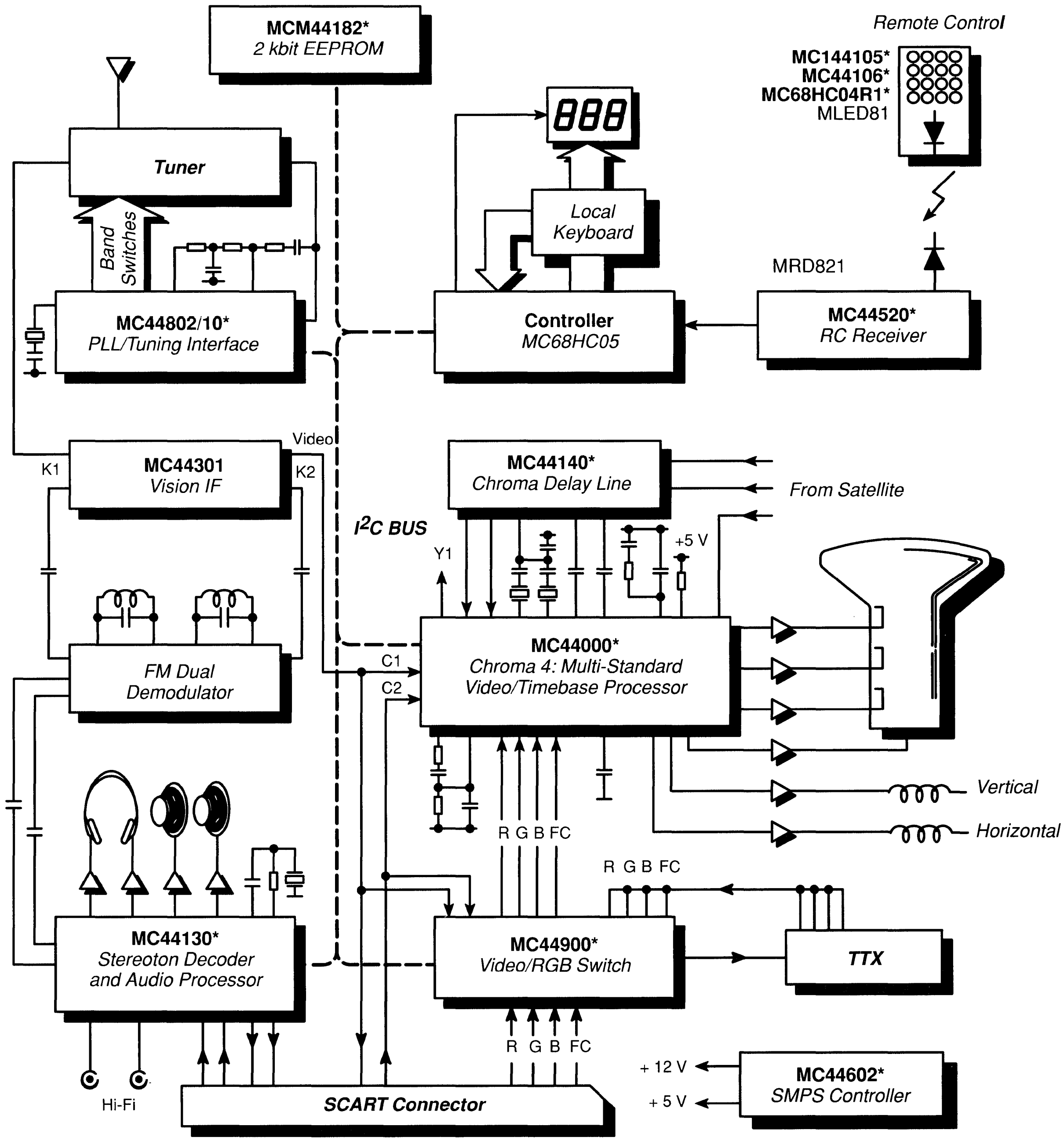
Color Graphics DACs

Resolution (Bits)	Accuracy @ 25°C (Max)	Max Settling Time (± 1/2 LSB)	Supplies (V)	Temperature Range	Comments	Suffix/ Case	Device
4 x 3	± 1/4 LSB	3.0 ns	+5.0, or ±5.0	0° to +70°C	125 MHz Color Graphics Triple DAC	L/733	MC10320
					90 MHz Color		MC10320-1

Monitor Systems

Function	Features	Suffix/ Case	Device
Multisync TTL to Analog Interface	Converts TTL Inputs from CGA or EGA to Analog RGB Outputs	P/724 DW/751E	MC1382
Multimode Monitor Processor	Auto Frequency Tracking, Vertical Output Pulse and 50 MHz Video System	P/711	MC1383
Multimode Monitor Processor with Vertical Timebase	Auto Frequency Tracking, Vertical Time Base and 50 MHz Video System	P/711	MC1384

*To Be Introduced
**To Be Determined



*To Be Introduced

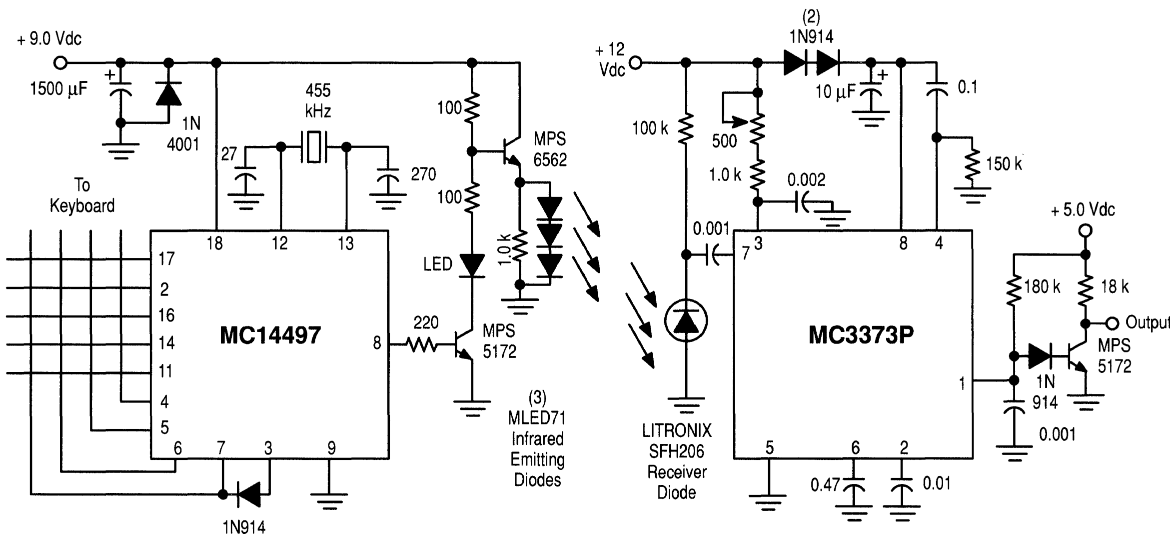
M44000 Family Block Diagram

Remote Control Circuits

MC3373P Amplifier/Detector (Bipolar), Case 626
MC14497 Transmitter (CMOS), Case 707

The MC3373 remote control receiver is specifically designed for infrared link systems where high sensitivity and good noise immunity are critical. The MC3373 incorporates a high gain detector diode preamp driving an envelope detector and data wave shaper for accurate data recovery. Provision is also made to use an external L-C tank circuit at the carrier frequency, normally 30 to 60 kHz, for extended range low noise systems. Applications include TV remote control, short range data links (up to several hundred feet), door openers and security systems. The MC14497 is an ideal companion transmitter, where a simple D.T.M.F. like key-pad control is desired. The Motorola Discrete Opto Division also has several high sensitivity detectors and emitters which match up well to the MC3373 system.

Remote Control Application
40 kHz Carrier



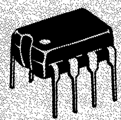
TRANSMITTER **RECEIVER**

CMOS Remote Control Functions

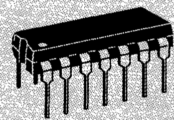
Function	Number of Address Lines	Maximum Number of Address Codes	Number of Data Bits	Operation	Device	Suffix/ Case
Addressable UART	7	128	7/8	Full Duplex	MC14469	P/711, FN/777
Transmitter	0	0	6	Simplex	MC14497	P/707
Encoder	Depends on Decoder*	Depends on Decoder*	Depends on Decoder*		MC145026	P/648, D/751B
Decoder	5	243	4		MC145027	P/648, D/751G
	9	19,683	0		MC145028	
Encoder/Decoder		512		Half Duplex	MC145030	P/738, DW/751D
	15	32,768			MC145033	DW/751F
Encoder	13 or 17	131,072	4	Simplex	MC145034	
Decoder					MC145035	

*See MC145027, MC145028

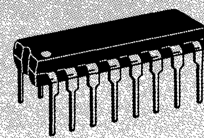
Consumer Electronic Circuits Package Overview



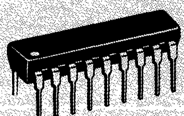
CASE 626
PLASTIC
P SUFFIX



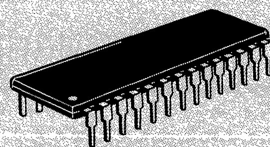
CASE 646
PLASTIC
P SUFFIX



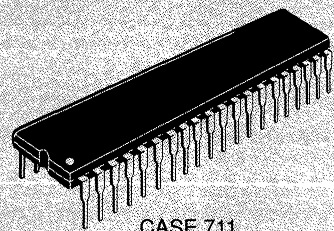
CASE 648, 648C
PLASTIC
P SUFFIX



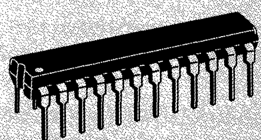
CASE 707
PLASTIC
P SUFFIX



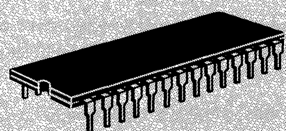
CASE 710
PLASTIC
P SUFFIX



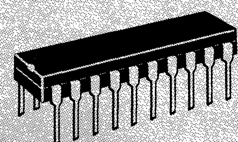
CASE 711
PLASTIC
P SUFFIX



CASE 724
PLASTIC
P SUFFIX



CASE 733
CERAMIC
L SUFFIX

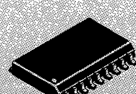


CASE 738
PLASTIC
P SUFFIX

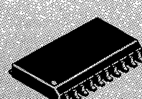
CASE 751
PLASTIC
D SUFFIX

CASE 751A
PLASTIC
D SUFFIX

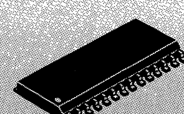
CASE 751B
PLASTIC
D SUFFIX



CASE 751C
PLASTIC
DW SUFFIX

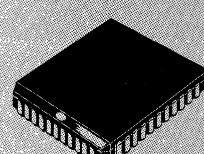


CASE 751D
PLASTIC
DW SUFFIX



CASE 751F
PLASTIC
DW SUFFIX

CASE 751G
PLASTIC
DW SUFFIX



CASE 777
PLASTIC
FN SUFFIX

Winner 1988 Malcolm Baldrige National Quality Award

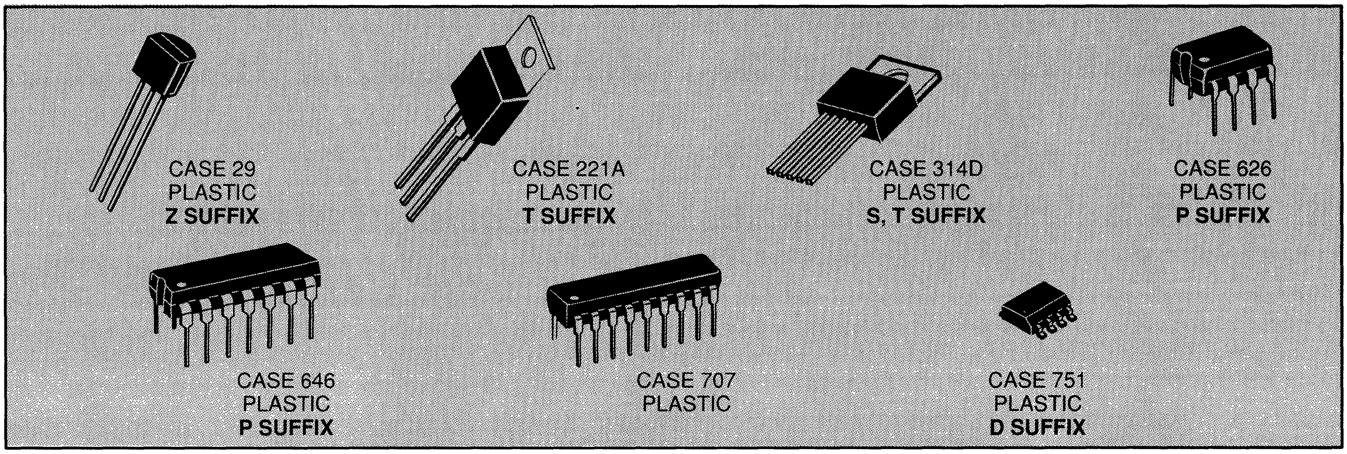
Automotive Electronic Circuits

In Brief . . .

Motorola Linear has established itself as the leader in custom bipolar integrated circuits in the American and European automotive markets. These products are key elements in the rapidly growing engine control and body electronics portions of modern automobiles. Today, based on this new technology, Motorola offers a wide array of standard products to serve the broad base of manufacturers who support this industry. These products range from rugged high current "smart" fuel injector drivers which control and protect the fuel management system, through the rigors of the underhood environment, to the latest in BiMOS switches. Several devices are targeted to support microprocessor housekeeping and data line protection. A wide range of packaging is available, from die and SOICs for high density layouts, to low thermal resistance multi-pin, single-in-line types for high power control ICs.

Page

Automotive Electronic Circuits



Voltage Regulators

Function	Features	Suffix/ Case	Device
Automotive Voltage Regulator	Designed for use with NPN Darlington, Overvoltage Protection; "Open Sense" Shut Down; Selectable Temperature Coefficient for Use in a Floating Field Alternator Charging System	P/646	MC3325
Low Dropout Voltage Regulator	Positive fixed and adjustable output voltage regulators which maintain regulation with very low input to output voltage differential.	Z/29, T/221A, T/314D	LM2931,C
Low Dropout Dual Regulator	Positive low voltage differential regulator which features dual 5 V outputs, with currents in excess of 750 mA and 10 mA standby, and a low quiescent current of 3 mA or less.	T/314D	LM2935

Electronic Ignition

Electronic Ignition Circuit	Designed for Use in High Energy Variable Dwell Electronic Ignition Systems with Variable Reluctance Sensors. Dwell and Spark Energy are Externally Adjustable	P/626, D/751	MC3334
Flip-Chip Electronic Ignition Circuit	Same as MC3334 — Mirror Image Die for Inverted "Bumped" Mounting to Substrate	—	MCCF3334

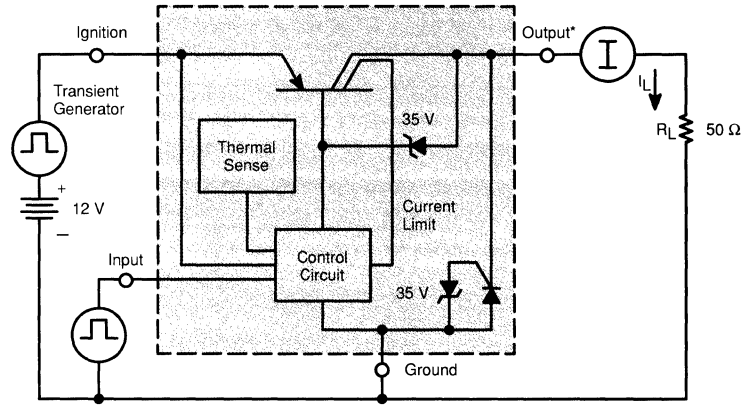
Special Functions

Injector Driver	Power Driver for Automotive Fuel Injection Systems, Reduced Hold Current MC3484S2-2 — 2 Amps, MC3484S4-2 — 4 Amps	S/314D	MC3484
High Side Driver Switch	Drives loads from positive side of power supply and protects against high-voltage transients.	T/314D	MC3399T
Automotive Direction Indicator	Detects defective lamps and protects against overvoltage and short circuit hazards.	P/626	UAA1041
Peripheral Clamping Array	Protects up to six MPU I/O lines against voltage transients.	D/751	TCF6000

Automotive High-Side Driver Switch

MC3399T T_J = –40° to +150°C, Case 314D

The MC3399T is a High-Side Driver Switch that is designed to drive loads from the positive side of the power supply. The output is controlled by a TTL compatible Enable pin. In the ON state, the device exhibits very low saturation voltages for load currents in excess of 750 mA. The device also protects the load from positive or negative going high voltage transients by becoming an open circuit and isolating the transient for its duration from the load.



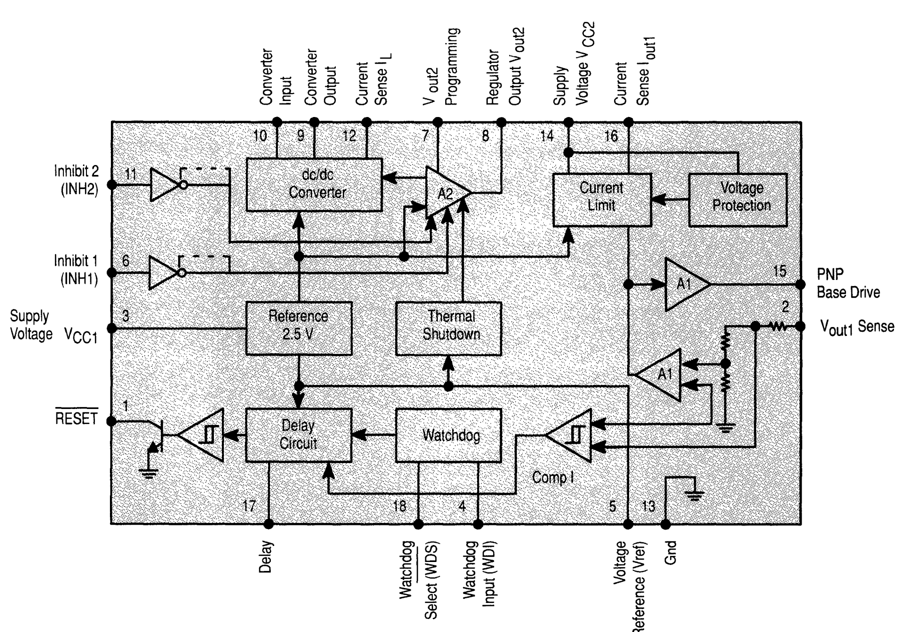
NOTE:
*Depending on Load Current and Transient Duration, an Output Capacitor (C_O) of sufficient value may be used to hold up Output Voltage during the Transient, and absorb Turn-off Delay Voltage Overshoot.

Universal Microprocessor Power Supply

TCA5600 T_A = 0° to +125°C, Case 707
TCF5600 T_A = –40° to +75°C, Case 707

These devices are versatile power supply control circuits for microprocessor based systems and mainly intended for automotive applications and battery powered instruments. To cover a wide range of applications, they offer high circuit flexibility with a minimum of external components.

Functions included in these ICs are a temperature compensated voltage reference, on-chip DC/DC converter, programmable and remote controlled voltage regulator, fixed 5.0 V supply voltage regulator with external PNP power device, undervoltage detection circuit, power-on RESET delay and watchdog feature for orderly microprocessor operations.

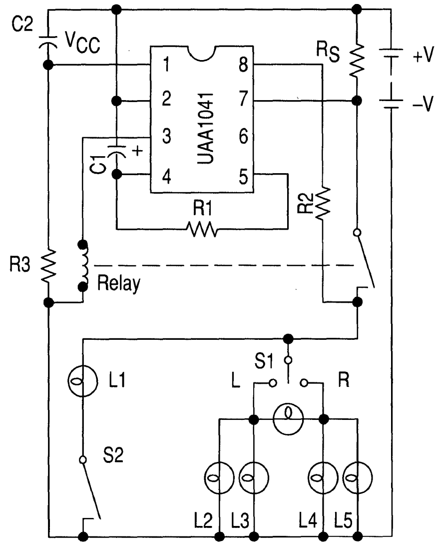


Automotive Direction Indicator

UAA1041,D T_A = –40° to +100°C, Case 626, 751

This device is designed for use in conjunction with a relay in automotive applications. It is also applicable for other warning lamps like "handbrake on" etc.

- Defective Lamp Detection
- Overvoltage Protection
- Short Circuit Detection and Relay Shutdown to Prevent Risk of Fire
- Reverse Battery Connection Protection
- Integrated Suppression Clamp Diode



L1: 1.2 W warning light-handbrake ON
R1 = 75 k
R2 = 3.3 k
R3 = 220 Ω

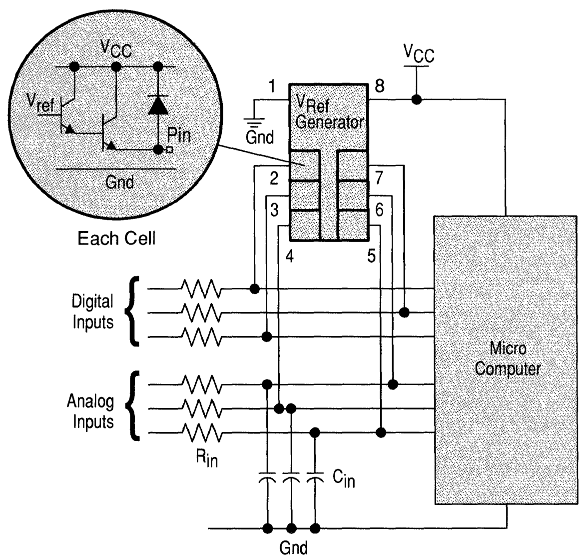
L2, L3, L4, L5: 21 W, turn signals
R_S = 30 mΩ
C1 = 5.6 μF
C2 = 0.047 μF

Peripheral Clamping Array

TCF6000D T_A = –40° to +85°C, Case 751

This device is designed to protect input/output lines of microprocessor systems against voltage transients.

- Optimized for HMOS System
- Minimal Component Count
- Low Board Space Requirement
- No. P.C.B. Track Crossovers Required
- Other Applications Include Industrial, Telecommunications and Consumer Goods



Other Linear Circuits

In Brief . . .

A variety of other analog circuits are provided for special applications with both bipolar and CMOS technologies. These circuits range from the industry standard analog timing circuits and multipliers to specialized CMOS smoke detectors and encoder/decoder functions. Other circuits include a transmitter receiver pair and a single chip receiver/transmitter. These products provide key functions in a wide range of applications, including data transmission, commercial smoke detectors, and various industrial controls.

Other Linear Circuits

Timing Circuits

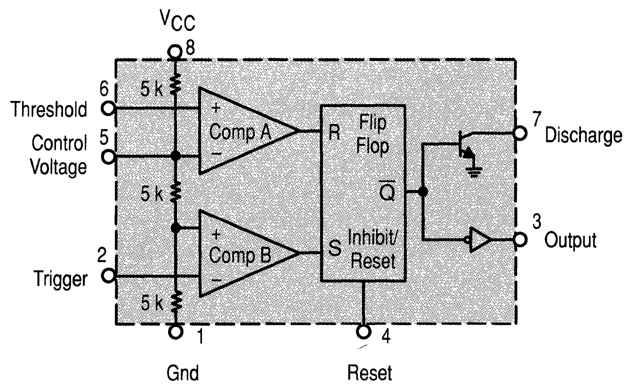
These highly stable timers are capable of producing accurate time delays or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The output structure can source or sink up to 200 mA or drive TTL circuits. Timing intervals from microseconds through hours can be obtained.

Singles

MC1455P1,U T_A = 0° to +70°C, Case 626, 693
MC1455BP1 T_A = –40° to +85°C, Case 626

Dual

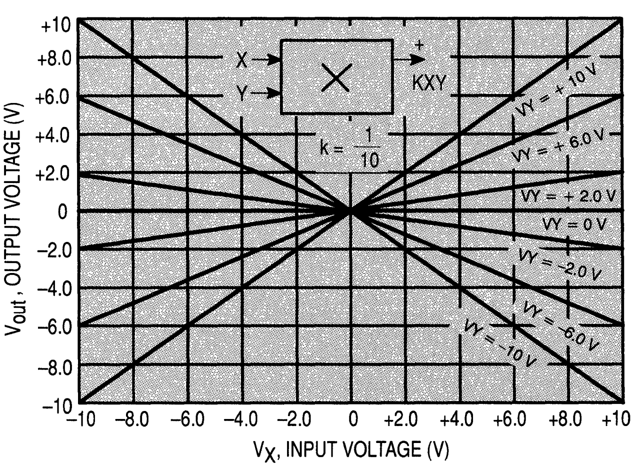
MC3456L,P T_A = 0° to +70°C, Case 632, 646



Multipliers

Linear Four-Quadrant Multipliers

Multipliers are designed for use where the output voltage is a linear product of two input voltages. Typical applications include: multiply, divide, square, root-mean-square, phase detector, frequency doubler, balanced modulator/demodulator, electronic gain control.



MC1594L T_A = –55° to +125°C, Case 620
MC1494L T_A = 0° to +70°C, Case 620

The MC1594/MC1494 is a Variable Transconductance Multiplier with internal level-shift circuitry and voltage regulator. Scale factor, input offsets and output offset are completely adjustable with the use of four external potentiometers. Two complementary regulated voltages are provided to simplify offset adjustment and improve power-supply rejection.

MC1595L T_A = –55° to +125° C, Case 632
MC1495L T_A = 0° to +70° C, Case 632

These devices are designed for uses where the output is a linear product of two input voltages. Maximum versatility is assured by allowing the user to select the level shift method. Typical applications include: multiply, divide*, square root*, mean square*, phase detector, frequency doubler, balanced modulator/demodulator, electronic gain control.

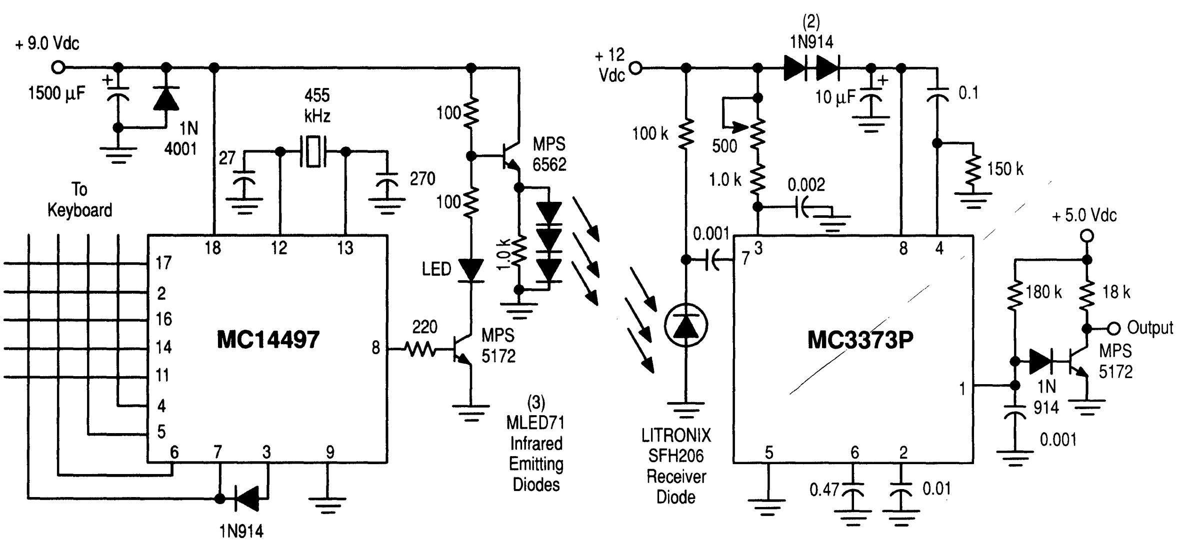
*When used with an operational amplifier.

Remote Control Circuits

MC3373P Amplifier/Detector (Bipolar), Case 626
MC14497 Transmitter (CMOS), Case 707

The MC3373 remote control receiver is specifically designed for infrared link systems where high sensitivity and good noise immunity are critical. The MC3373 incorporates a high gain detector diode preamp driving an envelope detector and data wave shaper for accurate data recovery. Provision is also made to use an external L-C tank circuit at the carrier frequency, normally 30 to 60 kHz, for extended range low noise systems. Applications include TV remote control, short range data links (up to several hundred feet), door openers and security systems. The MC14497 is an ideal companion transmitter, where a simple D.T.M.F. like key-pad control is desired. The Motorola Discrete Opto Division also has several high sensitivity detectors and emitters which match up well to the MC3373 system.

Remote Control Application
40 kHz Carrier



TRANSMITTER **RECEIVER**

CMOS Remote Control Functions

Function	Number of Address Lines	Maximum Number of Address Codes	Number of Data Bits	Operation	Device	Suffix/ Case
Addressable UART	7	128	7/8	Full Duplex	MC14469	P/711, FN/777
Transmitter	0	0	6	Simplex	MC14497	P/707
Encoder	Depends on Decoder*	Depends on Decoder*	Depends on Decoder*		MC145026	P/648, D/751B
Decoder	5	243	4		MC145027	P/648, D/751G
	9	19,683	0		MC145028	
Encoder/Decoder		512		Half Duplex	MC145030	P/738, DW/751D
	15	32,768			MC145033	DW/751F
Encoder	13 or 17	131,072	4	Simplex	MC145034	
Decoder					MC145035	

*See MC145027, MC145028

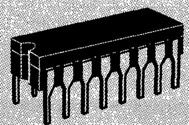
Smoke Detectors (CMOS)

These smoke detector ICs require a minimum number of external components. When smoke is sensed, or a low battery voltage is detected, an alarm is sounded via an external piezoelectric transducer. All devices are designed to comply with UL specifications.

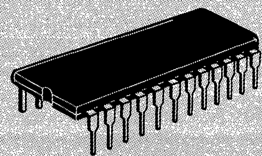
Function	Recommended Power Source	Unique Feature	Low Battery Detector	Piezoelectric Horn Driver	Complies with UL217 and UL268	Device Number	Suffix/ Case
Ionization-Type Smoke Detector	Battery	High Input Impedance FET Comparator	✓	✓	✓	MC14467-1	P1/626
	Line		—	—	✓	MC14578	P/648
Ionization-Type Smoke Detector with Interconnect	Battery		✓	✓	✓	MC14468	
	Line		—	✓	✓	MC14470	
Photoelectric-Type Smoke Detector with Interconnect	Battery	Photo Amplifier	✓	✓	✓	MC145010	P/648 DW/751G
	Line		*	✓	✓	MC145011	

*Low-supply detector

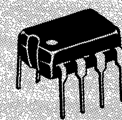
Other Linear Circuits Package Overview



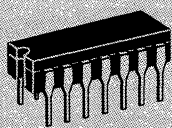
CASE 620
CERAMIC
L SUFFIX



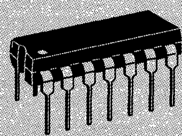
CASE 623
CERAMIC
L SUFFIX



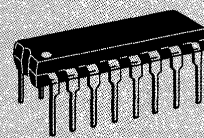
CASE 626
PLASTIC
P1 SUFFIX



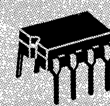
CASE 632
CERAMIC
L SUFFIX



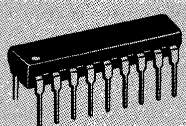
CASE 646
PLASTIC
P SUFFIX



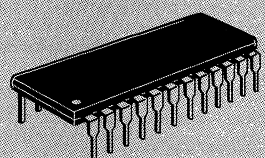
CASE 648
PLASTIC
P SUFFIX



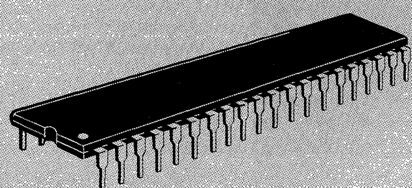
CASE 693
CERAMIC
U SUFFIX



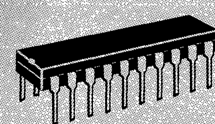
CASE 707
PLASTIC
P SUFFIX



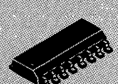
CASE 709
PLASTIC
P SUFFIX



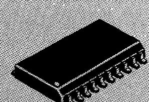
CASE 711
PLASTIC
P SUFFIX



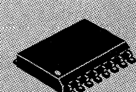
CASE 738
PLASTIC
P SUFFIX



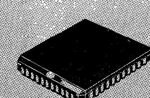
CASE 751B
PLASTIC
D SUFFIX



CASE 751D
PLASTIC
DW SUFFIX



CASE 751G
PLASTIC
DW SUFFIX



CASE 777
PLASTIC (PLCC)
FN SUFFIX

Surface Mount Technology

In Brief . . .

Surface Mount Technology is now being utilized to offer answers to many problems that have been created in the use of Insertion Technology.

Limitations have been reached with insertion packages and PC board technology. Surface Mount Technology offers the opportunity to continue to advance state-of-the-art designs that cannot be accomplished with Insertion Technology.

Surface Mount packages allow more optimum device performance with the smaller Surface Mount configuration. Internal lead lengths, parasitic capacitance and inductance that placed limitations on chip performance, has been reduced.

The lower profile of Surface Mount packages allows more boards to be utilized in a given amount of space. They are stacked closer together and utilize less total volume than insertion populated PC boards.

Printed circuit costs are lowered with the reduction of the number of board layers required. The elimination or reduction of the number of plated-through-holes in the board, contribute significantly to lower PC board prices.

Surface Mount assembly does not require the preparation of components that are common on insertion technology lines. Surface Mount components are set directly to the assembly line, eliminating an intermediate step.

Automatic placement equipment is available that can place Surface Mount components at the rate of a few thousand per hour to hundreds of thousands of components per hour.

Surface Mount Technology is cost effective, allowing the manufacturer the opportunity to produce smaller units and offer increased functions with the same size product.

Page

Surface Mount Technology

Linear and Interface

Bipolar

All the major bipolar analog families are now represented in surface mount packaging. Standard SOIC and PLCC packages are augmented by SOP-8 and DPAK for Linear regulators. In addition, tape and reel shipping to the updated EIA-481A is now on line for the industry's largest array of operational amplifiers, regulators, interface, data conversion, consumer, telecom and automotive Linear ICs.

Device	Function	Package
CA3146D	Transistor Array	SO-14
DAC-08CD, ED	High-Speed 8-Bit Multiplying D-to-A Converter	SO-16
LF351D	Single BIFET Operational Amplifier	SO-8
LF353D	Dual BIFET Operational Amplifiers	SO-8
LF411CD	Single/Dual JFET Operational Amplifier	SO-8
LF412CD	Dual BIFET High Power Operational Amplifiers	SO-8
LF441CD	Single BIFET Low Power Operational Amplifier	SO-8
LF442CD	Dual BIFET Low Power Operational Amplifiers	SO-8
LF444CD	Quad BIFET Low Power Operational Amplifiers	SO-14
LM201AD	General Purpose Adjustable Operational Amplifier	SO-8
LM211D	High Performance Voltage Comparator	SO-8
LM224D	Quad Low Power Operational Amplifiers	SO-14
LM239D,AD	Quad Single Supply Comparators	SO-14
LM258D	Dual Low Power Operational Amplifiers	SO-8
LM285D-1.2	Micropower Voltage Reference Diode	SO-8
LM285D-2.5	Micropower Voltage Reference Diode	SO-8
LM293D	Dual Comparators	SO-8
LM301AD	General Purpose Adjustable Operational Amplifier	SO-8
LM308AD	Precision Operational Amplifier	SO-8
LM311D	High Performance Voltage Comparator	SO-8
LM317LD	Positive Adjustable 100 mA Voltage Regulator	SOP-8
LM317MDT	Positive Adjustable 500 mA Voltage Regulator	DPAK
LM324D,AD	Quad Low Power Operational Amplifiers	SO-14
LM339D,AD	Quad Single Supply Comparators	SO-14
LM348D	Quad MC1741 Operational Amplifiers	SO-14
LM358D	Dual Low Power Operational Amplifiers	SO-8
LM385D-1.2	Micropower Voltage Reference Diode	SO-8
LM385D-2.5	Micropower Voltage Reference Diode	SO-8
LM393D	Dual Comparators	SO-8
LM833D	Dual Audio Amplifiers	SO-8
LM2901D	Quad Single Supply Comparators	SO-14
LM2902D	Quad Low Power Operational Amplifiers	SO-14
LM2903D	Dual Comparators	SO-8
LM2904D	Dual Low Power Operational Amplifiers	SO-8
LM2931AD-5.0,D-5.0	Low Dropout Voltage Regulator	SOP-8
LM2931CD	Adjustable Low Dropout Voltage Regulator	SOP-8
LM3900D	Quad Single Supply Operational Amplifiers	SO-14
MC1350D	IF Amplifier	SO-8
MC1357D	FM IC with Quadrature Detector	SO-14
MC1377DW	Color Television RGB to PAL/NTSC Encoder	SO-20L
MC1378FN	Video Overlay Synchronizer	PLCC-44
MC1381FB*	Multimode Monitor Processor	QFP-44
MC1382DW	Multimode Monitor TTL To Analog Video	SO-24L
MC1403D	Precision Low Voltage Reference	SO-8

*To Be Introduced.

Device	Function	Package
MC1413D	Peripheral Driver Array	SO-16
MC1436D,CD	High Voltage Operational Amplifier	SO-8
MC1455D	Timing Circuit	SO-8
MC1458D,CD	Dual Operational Amplifiers	SO-8
MC1488D	Quad EIA-232C Drivers	SO-14
MC1489D	Quad EIA-232C Receivers	SO-14
MC1495D	Four-Quadrant Multiplier	SO-14
MC1496D	Balanced Modulator/Demodulator	SO-14
MC1723CD	Adjustable Positive Or Negative Voltage Regulator	SO-14
MC1741CD	General Purpose Operational Amplifier	SO-8
MC1747CD	Dual MC1741 Operational Amplifiers	SO-14
MC1776CD	Programmable Operational Amplifier	SO-8
MC26LS31D	Quad EIA-422/23 Drivers	SO-16
MC26LS32D	Quad EIA-422 Receivers	SO-16
MC26S10D	Quad Bus Transceiver	SO-16
MC2831AD	FM Transmitter	SO-16
MC3303D	Quad Differential-Input Operational Amplifier	SO-14
MC3335DW	Basic Dual Conversion Receiver	SO-20L
MC3346D	General Purpose Transistor Array	SO-14
MC3356DW	FSK Receiver	SO-20L
MC3359DW	Low Power Narrowband FM IF Amplifier	SO-20L
MC3361AD	Low Voltage Narrowband FM IF Amplifier	SO-16
MC3362DW	Dual Conversion Receivers	SO-28L
MC3363DW	Dual Conversion Receivers	SO-28L
MC3367DW	Low Voltage VHF Receiver	SO-28L
MC3371D	Low Voltage FM Receiver with RSSI, LC Quadrature Detector	SO-16
MC3372D	Low Voltage FM Receiver with RSSI, Ceramic Quadrature Detector	SO-16
MC3401D	Quad Operational Amplifiers	SO-14
MC3403D	Quad Differential-Input Operational Amplifier	SO-14
MC3423D	Overvoltage Sensing Circuit	SO-8
MC3448AD	Quad GPIB Transceivers	SO-16
MC3450D	Quad Line Receivers	SO-16
MC3452D	Quad Line Receivers	SO-16
MC3456D	Dual Timing Circuit	SO-14
MC3458D	Dual Low Power Operational Amplifiers	SO-8
MC3486D	Quad EIA-422/23 Receivers	SO-16
MC3487D	Quad EIA-422 Drivers	SO-16
MC4558CD	Dual High Frequency Operational Amplifiers	SO-8
MC4741CD	Quad MC1741 Operational Amplifiers	SO-14
MC78L05ACD	Positive Voltage Regulator, 5 V, 100 mA	SOP-8
MC78L08ACD	Positive Voltage Regulator, 8 V, 100 mA	SOP-8
MC78L12ACD	Positive Voltage Regulator, 12 V, 100 mA	SOP-8
MC78L15ACD	Positive Voltage Regulator, 15 V, 100 mA	SOP-8
MC78M05CDT	Positive Voltage Regulator, 5 V, 500 mA	DPAK
MC78M08CDT	Positive Voltage Regulator, 8 V, 500 mA	DPAK
MC78M12CDT	Positive Votlage Regulator, 12 V, 500 mA	DPAK
MC78M15CDT	Positive Voltage Regulator, 15 V, 500 mA	DPAK
MC79L05ACD	3-Terminal Negative Fixed Voltage Regulator, –5 V, 100 mA	SOP-8
MC79L12ACD	3-Terminal Negative Fixed Voltage Regulator, –12 V, 100 mA	SOP-8
MC79L15ACD	3-Terminal Negative Fixed Voltage Regulator, –15 V, 100 mA	SOP-8
MC79M05CDT	3-Terminal Negative Fixed Voltage Regulator, –5 V, 500 mA	DPAK
MC79M12CDT	3-Terminal Negative Fixed Voltage Regulator, –12 V, 500 mA	DPAK
MC79M15CDT	3-Terminal Negative Fixed Voltage Regulator, –15 V, 500 mA	DPAK
MC10319DW	8-Bit A/D Flash Converter	SO-24L

(continued)

Linear and Interface (continued)

Device	Function	Package
MC10321DW	7-Bit A/D Flash Converter	SO-20L
MC13022DW*	Medium Voltage AM Stereo C-QUAM® Decoder	SO-28L
MC13023D*	AM Front End/Tuning Stabilizer	SO-16
MC13024DW	Low Voltage C-QUAM® Receiver	SO-24L
MC13055D	VHF LAN Receiver — FSK	SO-16
MC13060D	1 Watt Audio Amplifier	SOP-8
MC33033DW	Brushless DC Motor Controller	SO-20L
MC33034DW120,DW60	Brushless DC Motor Controller	SO-24L
MC33035DW	Brushless DC Motor Controller	SO-24L
MC33039D	Closed Loop Brushless Motor Adaptor (5 V ± 5% Supply)	SO-8
MC33064D-5	Undervoltage Sensing Circuit	SO-8
MC33065DW	Dual Current Mode PWM Controller	SO-16L
MC33071D,AD	Single, High Speed Single Supply Operational Amplifiers	SO-8
MC33072D,AD	Dual, High Speed Single Supply Operational Amplifiers	SO-8
MC33074D,AD	Quad, High Speed Single Supply Operational Amplifiers	SO-14
MC33077D	Dual, Low Noise High Frequency Operational Amplifiers	SO-8
MC33078D	Dual Audio, Low Noise Operational Amplifiers	SO-8
MC33079D	Low Power, Single Supply Operational Amplifier	SO-14
MC33110D	Low Voltage Compander	SO-14
MC33120DW*	SLIC II	SO-20L
MC33164D-3	Micropower Undervoltage Sensing Circuit (3 V ± 5% Supply)	SO-8
MC33164D-5	Micropower Undervoltage Sensing Circuit (5 V ± 10% Supply)	SO-8
MC33171D	Single, Low Power, Single Supply Operational Amplifier	SO-8
MC33172D	Dual, Low Power, Single Suuply Operational Amplifiers	SO-8
MC33174D	Quad, Low Power, Single Supply Operational Amplifiers	SO-14
MC33178D	Dual Precision Operational Amplifiers	SO-8
MC33179D	Quad Precision Operational Amplifiers	SO-14
MC33272D	Dual Precision Bipolar Operational Amplifiers	SO-8
MC33274D	Quad Precision Bipolar Operational Amplifiers	SO-14
MC33282D	Dual Precision Low Input JFET Operational Amplifiers (Trim-in-the-Package)	SO-8
MC33284D	Quad Precision JFET Operational Amplifiers (Trim-in-the-Package)	SO-14
MC34001D,BD	Single JFET Input Operational Amplifier	SO-8
MC34002D,BD	Dual JFET Input Operational Amplifiers	SO-8
MC34011AFN	Electronic Telephone Circuit	PLCC-44
MC34012-1D	Telephone Tone Ringer	SO-8
MC34012-2D	Telephone Tone Ringer	SO-8
MC34012-3D	Telephone Tone Ringer	SO-8
MC34013AFN	Speech Network and Tone Dialer	PLCC-28
MC34014FN,DW	Telephone Speech Network with Dialer Interface	PLCC-20, SO-20L
MC34017-1D	Telephone Tone Dialer	SO-8
MC34017-2D	Telephone Tone Dialer	SO-8
MC34017-3D	Telephone Tone Dialer	SO-8
MC34018DW	Voice Switched Speakerphone Circuit	SO-28L
MC34050D	EIA-422/23 Transceivers	SO-16
MC34051D	EIA-422/23 Transceivers	SO-16
MC34060AD	Switchmode Pulse Width Modulation Control Circuit	SO-14
MC34063AD	Precision DC-to-DC Converter Control Circuit	SO-8
MC34064D-5	Undervoltage Sensing Circuit (5 V ± 5% Supply)	SO-8
MC34065DW	Dual Current Mode PWM Controller	SO-16L
MC34071D,AD	Single, High Speed, Single Supply Operational Amplifier	SO-8
MC34072D,AD	Dual, High Speed, Single Supply Operational Amplifiers	SO-8
MC34074D,AD	Quad, High Performance, Single Supply Operational Amplifiers	SO-14
MC34080D	High Speed Decompensated ($A_{VCL} \geq 2$) JFET Input Operational Amplifier	SO-8
MC34081D	High Speed JFET Input Operational Amplifier	SO-8

*To Be Introduced.

Device	Function	Package
MC34084DW,ADW	Quad High Speed, JFET Operational Amplifier	SO-16L
MC34085DW,ADW	Quad High Speed, JFET Operational Amplifier	SO-16L
MC34114DW	Speech Network II	SO-18L
MC34118DW	Speakerphone II	SO-28L
MC34119D	Telephone Speaker Amplifier	SO-8
MC34129D	Power Supply Controller	SO-14
MC34164D-3	Micropower Undervoltage Sensing Circuit (3 V ± 5% Supply)	SO-8
MC34164D-5	Micropower Undervoltage Sensing Circuit (5 V ± 10% Supply)	SO-8
MC34181D	Single, Low Power, High Speed JFET Operational Amplifier	SO-8
MC34182D	Dual, Low Power, High Speed JFET Operational Amplifiers	SO-8
MC34184D	Quad, Low Power, High Speed JFET Operational Amplifiers	SO-14
MC44301DW	High Performance Video IF	SO-24L
MC44802DW	PLL Tuning Circuit w/1.3 GHz Prescaler	SO-20L
NE556D	Dual Timing Circuit	SO-14
TL064CD	Quad BIFET Low Power Operational Amplifiers	SO-14
TL071CD,ACD	Single, Low Noise JFET Input Operational Amplifier	SO-8
TL072CD,ACD	Dual, Low Noise JFET Input Operational Amplifiers	SO-8
TL081CD,ACD	Single, JFET Input Operational Amplifier	SO-8
TL082CD,ACD	Dual, JFET Input Operational Amplifiers	SO-8
TL431ACD,AID,CD,ID	Programmable Precision Reference	SOP-8
UAA1041D	Automotive Direction Indicator	SO-8
UC2842AD	Off-Line Current Mode PWM Controller	SO-14
UC2843AD	Current Mode PWM Controller	SO-14
UC2844D	Off-Line Current Mode PWM Controller (DC ≤ 50%)	SO-14
UC2845D	Current Mode PWM Controller (DC ≤ 50%)	SO-14
UC3842AD	Off-Line Current Mode PWM Controller	SO-14
UC3843AD	Current Mode PWM Controller	SO-14
UC3844D	Off-Line Current Mode PWM Controller (DC ≤ 50%)	SO-14
UC3845D	Current Mode PWM Controller (DC ≤ 50%)	SO-14

MOS Digital-Analog

A/D and D/A Converters

Device	Function	Package
MC14433DW	3-1/2 Digit A/D Converter	SO-24L
MC14442FN	11-Channel 8-Bit A/D Converter with Parallel Interface	PLCC-28
MC14443DW	6-Channel A/D Converter Subsystem	SO-16L
MC14447DW	6-Channel A/D Converter Subsystem	SO-16L
MC144110DW	Hex D/A Converter with Serial Interface	SO-20L
MC144111DW	Quad D/A Converter with Serial Interface	SO-16L
MC145040FN1**	11-Channel, 8-Bit A/D Converter with Serial Interface	PLCC-20
MC145040FN2**	11-Channel, 8-Bit A/D Converter with Serial Interface	PLCC-20
MC145041FN1**	11-Channel, 8-Bit A/D Converter with Serial Interface	PLCC-20
MC145041FN2**	11-Channel, 8-Bit A/D Converter with Serial Interface	PLCC-20

Decoders/Display Drivers

Device	Function	Package
MC14489DW	Multi-Character LED Display/Lamp Driver	SO-20L
MC14495DW1	Hex-to-7 Segment Latch/Decoder ROM/Driver	SO-16L
MC14499DW	7-Segment LED Display Decoder/Driver with Serial Interface	SO-20L
MC145000FN	48-Segment Multiplexed LCD Driver (Master)	PLCC-28
MC145001FN	44-Segment Multiplexed LCD Driver (Slave)	PLCC-28
MC145453FN	33-Segment LCD Driver with Serial Interface	PLCC-44

** The digit 1 or 2 after the package designator is not a part of the package definition, but describes electrical capability of the device.

MOS Digital-Analog (continued)

Operational Amplifiers/Comparators

Device	Function	Package
MC14573D	Quad Programmable Operational Amplifier	SO-16
MC14574D	Quad Programmable Comparator	SO-16
MC14575D	Dual Programmable Operational Amplifier and Dual Comparator	SO-16
MC14578D	Micro-Power Comparator Plus Voltage Follower	SO-16

Phase-Locked Loop Frequency Synthesizers

Device	Function	Package
MC145106FN	PLL Frequency Synthesizer	PLCC-20
MC145145DW1	4-Bit Data Bus Input PLL Frequency Synthesizer	SO-20L
MC145146DW1	4-Bit Data Bus Input PLL Frequency Synthesizer	SO-20L
MC145151FN2	Parallel Input PLL Frequency Synthesizer	PLCC-28
MC145152FN2	Parallel Input PLL Frequency Synthesizer	PLCC-28
MC145155FN2	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145155DW2	Serial Input PLL Frequency Synthesizer	SO-20L
MC145156FN2	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145156DW2	Serial Input PLL Frequency Synthesizer	SO-20L
MC145157FN2	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145157DW2	Serial Input PLL Frequency Synthesizer	SO-16L
MC145158FN2	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145158DW2	Serial Input PLL Frequency Synthesizer	SO-16L
MC145159FN#	Serial Input PLL Frequency Synthesizer with Analog Phase Detector	PLCC-20
MC145160DW	Dual PLL for Cordless Telephones	SO-20L
MC145166DW	Dual PLL for Cordless Telephones	SO-16L
MC145167DW	Dual PLL for Cordless Telephones	SO-16L

** The digit 1 or 2 after the package designator is not a part of the package definition, but describes electrical capability of the device.
# Electrical variations may require a numerical suffix after the package suffix. Contact your Motorola representative for details.

Remote Control Functions

Device	Function	Package
MC14469FN	Addressable Asynchronous Receiver/Transmitter	PLCC-44
MC14497	PCM Remote Control Transmitter	*
MC145026D	Remote Control Encoder	SO-16
MC145027DW	Remote Control Decoder	SO-16L
MC145028DW	Remote Control Decoder	SO-16L
MC145030DW	Remote Control Encoder/Decoder	SO-20

Smoke Detectors

Device	Function	Package
MC14467	Low-Cost Smoke Detector	*
MC14468	Interconnectable Smoke Detector	*
MC145010DW	Photoelectric Smoke Detector with I/O	SO-16L

Telecommunications Devices

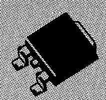
Device	Function	Package
MC14410DW	2-of-8 Tone Encoder	SO-16L
MC14411DW	Bit Rate Generator	SO-24L
MC142100DW	Crosspoint Switch with Control Memory (4 × 4 × 1)	SO-16L
MC142103	Transcoder HDB31 AMI to NRZ	*
MC143403D	Quad Line Driver (Op Amp)	SO-14
MC145406DW	EIA-232/V.28 CMOS Driver/Receiver	SO-16L
MC145407DW	EIA-232/V.28 CMOS Driver/Receiver, 5 Volts Only	SO-20L
MC145412	Pulse/Tone Repertory Dialer (Nine 18-Digit Memory)	*
MC145421DW	UDLT II Master	SO-24L
MC145425DW	UDLT II Slave	SO-24L
MC145436	DTMF Decoder	*
MC145439	Transcoder B8ZS, B6ZS, HDB3 to NRZ	*
MC145443DW	300-Baud Bell 103 Single-Chip Modem	SO-20L
MC145475DW	ISDN S/T Transceiver	SO-28L
MC145488	Dual Data Link Controller	*
MC145502	PCM Codec/Filter	*
MC145503DW	PCM Codec/Filter	SO-16L
MC145505DW	PCM Codec/Filter	SO-16L
MC145554DW	PCM Codec/Filter (TP3054 Compatible)	SO-16L
MC145557DW	PCM Codec/Filter (TP3057 Compatible)	SO-16L
MC145564DW	PCM Codec/Filter (TP3064 Compatible)	SO-20L
MC145567DW	PCM Codec/Filter (TP3067 Compatible)	SO-20L

Real-Time Clock

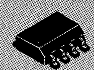
Device	Function	Package
MC68HC68T1DW	Real-Time Clock Plus RAM with Serial Interface	SO-16L

* Introduction of this device in surface mount packages is dependent on market demand.

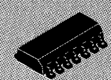
Surface Mount Technology Package Overview



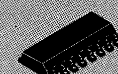
CASE 396A
PLASTIC
DPAK
DT SUFFIX



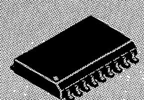
CASE 751
PLASTIC
SO-8, SOP-8
D SUFFIX



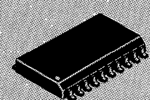
CASE 751A
PLASTIC
SO-14
D SUFFIX



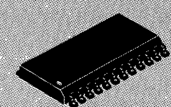
CASE 751B
PLASTIC
SO-16
D SUFFIX



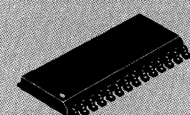
CASE 751C
PLASTIC
SO-18L
DW SUFFIX



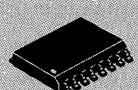
CASE 751D
PLASTIC
SO-20L
DW SUFFIX



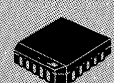
CASE 751E
PLASTIC
SO-24L
DW SUFFIX



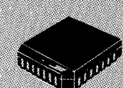
CASE 751F
PLASTIC
SO-28L
DW SUFFIX



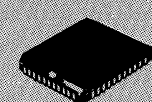
CASE 751G
PLASTIC
SO-16L
DW SUFFIX



CASE 775
PLASTIC
PLCC-20
FN SUFFIX



CASE 776
PLASTIC
PLCC-28
FN SUFFIX



CASE 777
PLASTIC
PLCC-44
FN SUFFIX

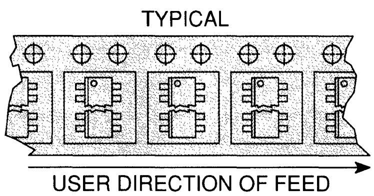
Tape and Reel

Standard Bipolar Logic, Bipolar Analog and MOS Integrated Circuits

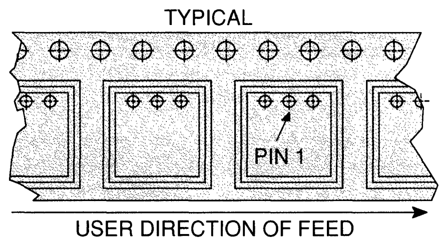
Motorola has now added the convenience of Tape and Reel packaging for our growing family of standard Integrated Circuit products. Three reel sizes are available, for all but the largest types, to support the requirements of both first and second generation pick-and-place equipment. The packaging fully conforms to the latest EIA-481A specification. The antistatic embossed tape provides a secure cavity, sealed with a peel-back cover tape.

Mechanical Polarization

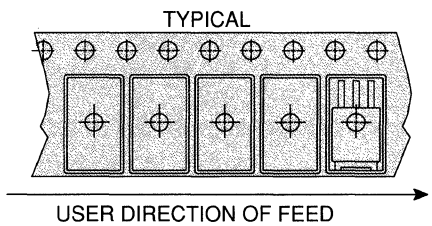
SOIC DEVICES



PLCC DEVICES



DPAK DEVICES



Package	Tape Width (mm)	Device[1] per Reel	Reel Size (inch)	Device Suffix
SO-8, SOP-8	12	2,500	13	R2
SO-14	16	2,500	13	R2
SO-16	16	2,500	13	R2
SO-16L WIDE	16	1,000	13	R2
SO-20L WIDE	24	1,000	13	R2
SO-24L WIDE	24	1,000	13	R2
SO-28L WIDE	24	1,000	13	R2
PLCC-20	16	1,000	13	R2
PLCC-28	24	500	13	R2
PLCC-44	32	500	13	R2
PLCC-52	32	500	13	R2
PLCC-68	44	250	13	R2
PLCC-84	44	250	13	R2
TO-226AA (TO-92)[2]	18	2000	13	RA, RB RE, RM, or RP (Ammo Pack) only
DPAK	16	2500	13	RK

Notes: 1. Minimum order quantity is 1 reel. Distributors/OEM customers may break lots or reels at their option, however broken reels may not be returned.
2. Integrated Circuits in TO-226AA packages are available in Styles A, B and E only, with optional "Ammo Pack" (Suffix RM or RP). For ordering information please contact your local Motorola Semiconductor Sales Office.

Discrete Products

In Brief . . .

With the advent of integrated circuits, many leading semiconductor manufacturers have de-emphasized or eliminated discrete components from their product portfolio. Not so Motorola.

Here, continuing major investments in research and development for discrete product categories underscore a commitment to remain the world leader in both scope and breadth of these product lines.

But things are changing significantly and the changes are not limited simply to the expansion of product lines through enhancement of specification limits.

The power transistor category which had been dominated by bipolar technology is now getting major competition from expanding MOS products. Already the voltage and current range of bipolar power is challenged by Motorola TMOS products. With the design advantages attributed to MOS characteristics in numerous applications, an important new design alternative has become available.

Size reduction continues to be an important factor in system design – a consideration that has propelled surface-mount packaging into the limelight of semiconductor device change. And new ideas, such as combining mounting hardware with semiconductor packaging (as in Motorola Fiber Optics components) are beginning to emerge.

But more important is the changing nature of the entire concept of discrete componentry. With integrated circuit technology heading toward ever larger and more complex chips, discrete product designers are rapidly filling the gap for small-scale integration – but in categories that add new design freedoms. One such category is SMARTDISCRETE products which offer devices with on-chip protective circuitry. Another is in RF technology where discrete product engineers are generating hybrid modules for CATV and general amplifier applications.

Thus, the field of "discrete products" is changing, both in definition and in perspective, toward a "multi-function" capability, and Motorola will continue to be the one-stop shopping center for all your combined IC/discrete semiconductor requirements.

Power Transistor Products

In Brief . . .

Motorola's power transistor products include not only the wide range of specifications associated with bipolar and field-effect (TMOS) transistors' which are the two primary discrete transistor categories, but enhance these capabilities with multiple-device structures to meet even greater gain, voltage, current and power requirements. In addition, the emerging field of SMARTDISCRETE™ products offer the advantages of a power MOS device with on-chip protective circuitry. The Motorola power products line offers the following choices and options:

Discrete Power Transistors

- Bipolar and TMOS
- Metal and Plastic Packaging
- Unpackaged "Chips" for Hybrid Assemblies
- Virtually Unlimited Choice of Specifications

Power Modules

- Single and Multiple Darlington and Tri-Stage Structures, with rating to 300 A and 1200 V.

SMARTDISCRETE™ Products

- Automotive, Industrial, and other general purpose applications

Page

TMOS Power MOSFET Numbering System

Wherever possible, Motorola has tried to use the following numbering systems for TMOS power MOSFET products.

MTP10N10M

- MOTOROLA — M
- TMOS (T FOR TMOS, G FOR IGBT) — T
- PACKAGE TYPE — P
  - P FOR PLASTIC TO-220
  - H FOR TO-218
  - M FOR METAL TO-204 (TO-3)
  - D FOR DPAK
  - A FOR TO-220 ISOLATED
  - G FOR TO-218 ISOLATED
  - W FOR TO-247
  - B FOR D²PAK
- CURRENT — 10
- CHANNEL POLARITY, N OR P — N
- VOLTAGE RATING DIVIDED BY 10 — 10
- OPTIONAL SUFFIX: — M
  - M FOR SENSEFET
  - L FOR LOGIC LEVEL
  - E FOR ENERGY

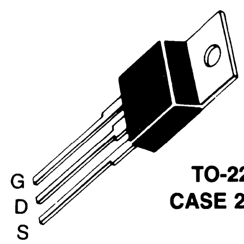
Selection by Package

The product listed in Tables 1 through 22 have been compiled on an IBM and Macintosh or compatible personal computer disk for quick selection of product. This versatile disk may be obtained by contacting a Motorola sale office in your area or by contacting a Motorola Literature Distribution Center listed on the back cover. Order the disk by requesting DK101/D for IBM disk and DK201/D for Macintosh disk.

Tables 1 through 21 are shown by package type. Within the tables the devices are arranged by breakdown voltage and on-resistance as the primary selection criteria.

TMOS Power MOSFETs

Plastic Packages — TO-220AB



TO-220AB
CASE 221A-06

Table 1 — P-Channel

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
500	6	1	MTP2P50	2	75
450			MTP2P45		
200	1	3.0	MTP6P20E	6	
	0.6	4	MTP8P20	8	
100	0.4	4	MTP8P10	8	60
	0.3	6	MTP12P10	12	88
60	0.6	3.5	MTP7P06	7	75
	0.3	6	MTP2955	12	
	0.12	11.5	MTP23P06	23	125

* T_C = 25°C

Table 2 — N-Channel

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
1000	4	1.5	MTP3N100E	3	75
800	3	2	MTP4N80E	4	
600	3.8	1	MTP2N60E	2	50
	2.2	1.5	MTP3N60E	3	75
	1.2	3	MTP6N60E	6	125
500	3	1.5	IRF820	2.5	40
			MTP3N50E	3	50
	1.5		IRF830	4.5	75
		2	MTP4N50E	4	
	0.85	4	IRF840	8	125
	0.8		MTP8N50E		
400	1.8	1.5	IRF720	3	40
		2	MTP4N40E	4	50
	1	3	IRF730	4.5	75
		2.5	MTP5N40E	5	
	0.55	5	IRF740	10	125
			MTP10N40E		

Table 2 — N-Channel — continued

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
250	0.45	5	MTP10N25	10	100
200	1.5	1.3	IRF610	2.5	20
	1		MTP5N20	5	75
	0.8		IRF620		40
	0.7	3.5	MTP7N20	7	75
	0.4	3	IRF630	9	
		4	MTP8N20	8	
	0.35	6	MTP12N20	12	100
	0.18	10	IRF640	18	125
	0.14		MTP20N20E	20	
150	0.3	5	MTP10N15	10	75
	0.25	7.5	MTP15N15	15	100
100	0.6	2	IRF510	4	20
	0.27	5	IRF520	9	40
	0.25		MTP10N10E	10	75
	0.16	7	IRF530	14	
		6	MTP12N10E	12	
	0.077	14	IRF540	28	125
	0.055	16.5	MTP33N10E	33	

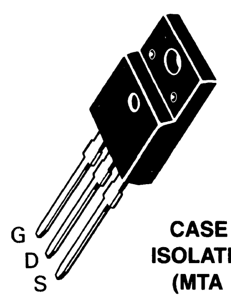
BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
60	0.15	6	MTP3055E	30	40
	0.12	7.5	MTP15N06E	15	75
	0.085	10	MTP20N06	20	
	0.04	18	MTP36N06E	36	
	0.025	25	MTP50N06E	50	125
50	0.12	6	BUZ71A	12	40
			MTP12N05E		
			IRFZ22	14	
	0.1		BUZ71	12	
		7.5	MTP15N05E	15	
			IRFZ20		
	0.07	12.5	IRFZ32	25	100
	0.06	15	BUZ11A		75
	0.04		BUZ11	30	
	0.028	25	MTP50N05E	50	125
		29	IRFZ40	50	

* T_C = 25°C

Table 3 — N- and P-Channel — Isolated TO-220

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
600	2.2	1.5	MTA2N60E	2	40
	1.2	3	MTA4N60E	4	50
500	1.5	2	MTA4N50E	4	40
	0.8	4	MTA5N50E	5	50
400	0.55	5	MTA6N40E	6	50
100	0.25	5	MTA8N10E	8	35
	0.16	11	MTA11N10EL	11	40
	0.077	11.5	MTA21N10EL	21	50
60	0.3	6	MTA2955**	8	40
	0.15		MTA3055E	9	30
	0.085	7.5	MTA15N06	15	50
	0.025	25	MTA30N06E	30	

* T_C = 25°C
** Indicates P-Channel



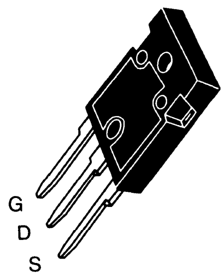
CASE 221D-02
ISOLATED TO-220
(MTA PREFIX)

TMOS

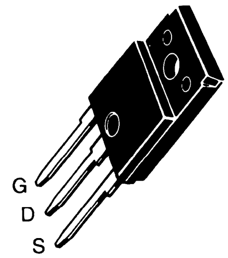
TMOS Power MOSFETs

Plastic Packages — TO-247

— TO-218AC



TO-247
CASE 340F-02
(MTW PREFIX)



CASE 340B-03
ISOLATED TO-218
(MTG PREFIX)

Table 4 — TO-247

BV_{DSS} (Volts) Min	$R_{DS(on)}$ @ (Ohms) Max	I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
1000	2	3.0	MTW6N100E	6	180
	1.2	5	MTW10N100E	10	250
800	1.2	3.5	MTW7N80E	7	180
500	0.8	4	MTW8N50E	8	150
	0.4	7	MTW14N50E	14	180
	0.27	10	MTW20N50E	20	250
400	0.55	5	MTW10N40E	10	150
	0.3	8	MTW16N40E	16	180
	0.2	12	MTW24N40E	24	250
250	0.14	11.5	MTW23N25E	23	180
	0.1	16	MTW32N25E	32	250
200	0.14	11	MTW22N20E	22	150
	0.085	16	MTW32N20E	32	180
100	0.055	16.5	MTW33N10E	33	160
	0.04	22.5	MTW45N10E	45	180
60	0.025	25	MTW50N06E	50	180
50	0.014	27	MTW54N05E	54	210

* T_C = 25°C

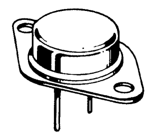
Table 5 — N- and P-Channel Isolated TO-218

BV_{DSS} (Volts) Min	$R_{DS(on)}$ @ (Ohms) Max	I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
1000	2	3	MTG4N100E	4	70
500	0.4	7	MTG9N50E	9	
200	0.08	15	MTG20N20	20	
100	0.15	10	MTG15P10**	15	

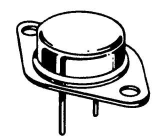
* T_C = 25°C
** Indicates P-Channel

TMOS Power MOSFETs

Metal Packages — TO-204AA/AE



TO-204AA
CASE 1-07



TO-204AE
CASE 197A-02

Table 6 — P-Channel

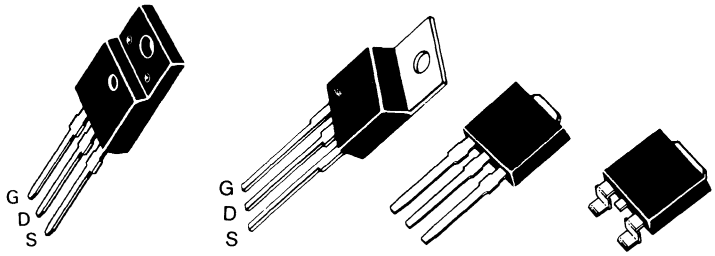
BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
100	0.3	6	MTM12P10	12	75
	0.15	10	MTM20P10	20	125

* T_C = 25°C

Table 7 — N-Channel

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
1000	2	3	MTM6N100E	6	150
800	1.4		MTM6N80E		
500	0.85	4	IRF440	8	125
	0.8	3.5	MTM7N50	7	150
	0.4		IRF450	13	
		6.5	MTM13N50E	15	
400	0.3	8	IRF350	15	150
		7.5	MTM15N40E		
200	0.18	10	IRF240	18	125
	0.16	7.5	MTM15N20	15	150
	0.085	16	IRF250	30	
	0.08	20	MTM40N20	40	250
100	0.085	15	IRF140	27	100
	0.075	12.5	MTM25N10E	25	150
	0.055	20	IRF150	40	
	0.04	27.5	MTM55N10	55	250

* T_C = 25°C



CASE 221D-02
ISOLATED TO-220
(MTA PREFIX)

TO-220AB
CASE 221A-06
(MTP PREFIX)

TO-251***
CASE 369-05
(MTD PREFIX)

TO-252
CASE 369A-07
(MTD PREFIX)

TMOS Power MOSFETs

Logic Level Power MOSFETs

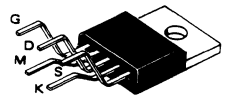
Logic level MOSFETs are fully enhanced with 5 volts applied to the gate.

Table 8 — N-Channel Logic Level Power MOSFETs (TO-204AA and TO-220AB)

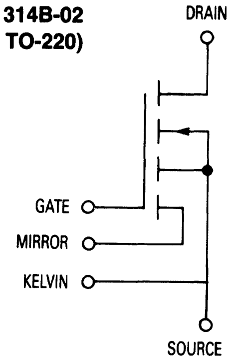
BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max @	I_D (Amps)	Device	$I_{D(Cont)}$ (Amps)	P_D* (Watts) Max
100	0.16	6	MTP12N10EL	12	75
			MTA11N10EL	11	40
	0.077	9	MTP25N10EL	25	125
			MTA18N10EL	18	50
80	0.135	7.5	MTP15N08EL	15	75
60	0.18	6	MTD3055EL	12	175**
			MTP3055EL		40
	0.12	7.5	MTP15N06EL	15	
	0.05	15	MTP30N06EL	30	75
	0.028	25	MTP50N06EL	50	150

* T_C = 25°C
** Power rating when mounted on a board with the minimum pad size recommended.
*** Add -1 Suffix to part number to order insertion mountable package.

TMOS SENSEFETs



CASE 314B-02
(5 PIN TO-220)



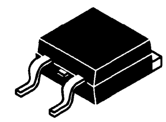
SENSEFETs are conventional power MOSFETs with an option provided to sense the drain current by measuring a small proportion of the total drain current. These devices are ideal for current mode switching regulators and motor controls.

Table 9 — Case 314B-02

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
60	0.04	20	MTP40N06M	40	125
80	0.065	15	MTP30N08M	30	
100	0.25	5	MTP10N10M	10	75

* T_C = 25°C

D²PAK



CASE 418B-01

Table 11 — Case 418B-01

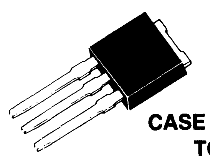
BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
500	0.8	4	MTB8N50E	8	4**
400	0.55	5	MTB10N40E	10	4**
200	0.18	10	MTB20N20E	20	4**
100	0.055	12.5	MTB33N10E	33	4**
60	0.12	11.5	MTB23P06***	23	4**
		7.5	MTB15N06E	15	4**
	0.05	15	MTB30N06EL	30	4**
	0.04	18	MTP36N06E	36	4**
	0.028	25	MTB50N06EL	50	4**
	0.025		MTB50N06E		4**

* T_C = 25°C
** Power rating when mounted on a board with the minimum pad size recommended.
*** Indicates P-Channel

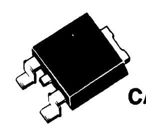
DPAK

Table 10 — Case 369A-07 Surface Mount Case 369-05 Insertion Mountable

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
500	6	0.5	MTD1N50	1	1.75**
	4	1	MTD2N50	2	
450	6	0.5	MTD1N45	1	2**
400	5		MTD1N40		1.75**
200	1.5	1	MTD2N20	2	
	0.7	2	MTD4N20	4	
150	0.3	3	MTD6N15	6	
100	0.5	2.5	MTD5N10	5	2**
	0.25	4.5	MTD9N10E	9	1.75**
		3	MTD6N10	6	
80	0.26	2.5	MTD5N08L	5	



CASE 369-05****
TO-251



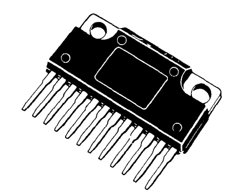
CASE 369A-07*****
TO-252

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
60	0.6	2	MTD4P06***	4	1.75**
	0.4	2.5	MTD5N06	5	
	0.3	6	MTD2955***	12	
	0.18		MTD3055EL		
	0.15	4	MTD3055E	8	
50	0.4	2.5	MTD5N05	5	
	0.1	5	MTD10N05E	10	

* T_C = 25°C
** Power rating when mounted on a board with the minimum pad size recommended.
*** Indicates P-Channel
**** Add -1 Suffix to part number to order insertion mountable package.
***** Available in tape and reel – add T4 Suffix to part number.

TMOS Power MOSFETs

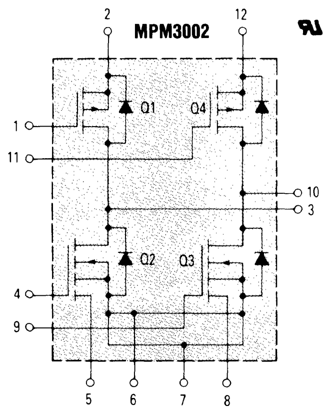
Multiple Chip Products



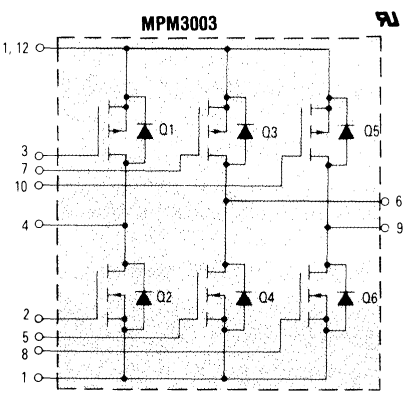
CASE 806-04

The ICePAK leadframe versatility can be used to construct many different custom or semi-custom circuits — 2 pad (H-bridge), 3 pad (3-phase or tri-die), and 4 pad (quad die). Contact your local Motorola sales office for your copy of the ICePak Design Guide.

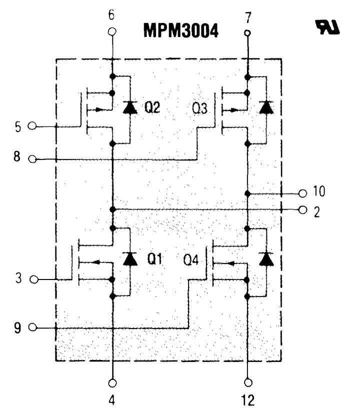
Table 12 — Multiple Chip Products in the Isolated ICePAK



H-Bridge with Current Sensing
100 Volts and 8 Amperes
P-Channel MOSFETs — $R_{DS(on)}$ = 0.4 Ohms Max
N-Channel SENSEFETs — $R_{DS(on)}$ = 0.15 Ohms Max



Three-Phase Bridge with Complementary Outputs
60 Volts and 10 Amperes
P-Channel — $R_{DS(on)}$ = 0.28 Ohms Max
N-Channel — $R_{DS(on)}$ = 0.15 Ohms Max



H-Bridge
60 Volts and 10 Amperes
P-Channel MOSFETs — $R_{DS(on)}$ = 0.28 Ohms Max
N-Channel MOSFETs — $R_{DS(on)}$ = 0.15 Ohms Max

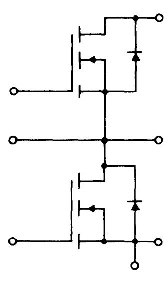
Table 13 — TMOS Power MOSFET Modules

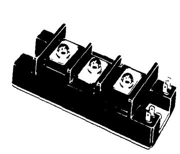
Max I_D (cont) Amps	Max V_{DSS} Volts	Device Type	Module Type	Max $V_{DS(on)}$ Volts	Conditions I_D Amps	Conditions V_{GS} Volts	Max. Resistive Switching t_{on} μs	t_{off} μs	t_f μs	Conditions I_D(A)	Conditions V_G	P_D T_C = 25°C Watts	Case No.	Circuit Config.
15	450	MT15FR45	Six-pack	6	15×6	10	0.6	2	0.5	15	10	125×6	809-02	Y
50	450	MT50BY45	Dual	7	50	10	0.8	1.3	0.2	50	10	400×2	816-02	R

UL RECOGNIZED

Table 14 — TMOS Power MOSFET Module Circuit Configurations and Packages

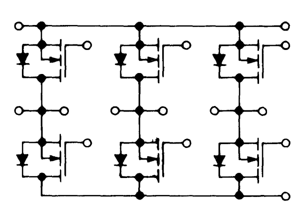
R

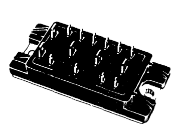




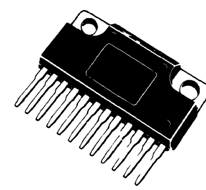
CASE 816-02

Y





CASE 809-02



CASE 806*

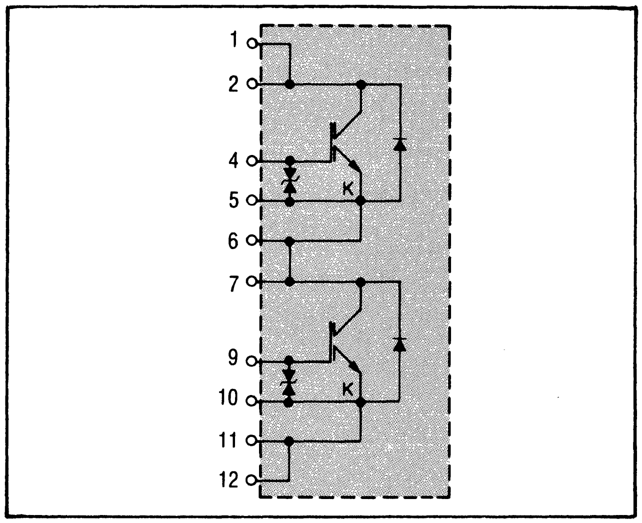
Multiple Chip Products (continued)

This advanced high voltage Insulate Gate Bipolar Transistor (IGBT) Half Bridge with Free Wheeling Diodes in the ICePAK™ is designed for high voltage, high speed switching applications in bridge configurations such as servo drives, PWM motor controls and other application where a robust device with low on losses, fast switching times and ease of drive are important considerations.

Table 15 — Multiple Chip Products in the Isolated ICePAK Insulated Gate Bipolar Power Transistor Half-Bridge with Free Wheeling Diodes

Max I_C (cont) Amps	Device Type	$V_{(BR)CES}$ Volts	$V_{CE(on)}$ Volts
15	MPM6002	600	3.5

MPM6002



*For Case 806 Pins 3 and 8 are removed. See schematic for details.

Features:

- Free Wheeling Diodes Included within Package
- High Input Impedance Similar to a MOSFET
- Low Saturation Voltage — 3.5 V Maximum at 7.5 A
- Fast Switching Times — fall time of 200 nsec Typ.
- User Friendly Isolated ICePAK™ Package for Ease of Mounting
- Low Stored Charge for Efficient Switching
- Excellent Short Circuit Capability, 10 μsec minimum
- Gate-Emitter Protected with Back-to-Back Zener Diodes
- Kelvin Contacts to Simplify Gate Driving

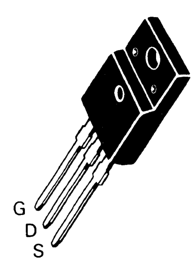
TMOS™

SMARTDISCRETE

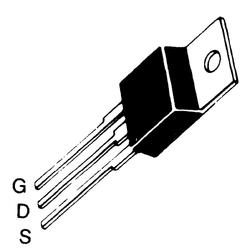
Table 16 — Case 221D-02 Case 221A-06

BV_{DSS} (Volts) Min	$R_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (cont) Amps	P_D* (Watts) Max
80	0.75	1	MLP1N08L	current limited	30
			MLA1N08L		25
60			MLP1N06CL	current limited voltage clamped	40
			MLA1N06CL		30

* T_C = 25°C

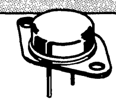
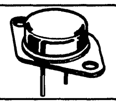
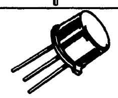
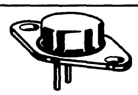
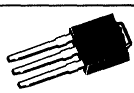
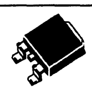
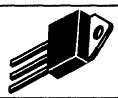
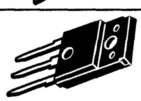
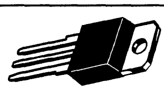
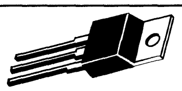
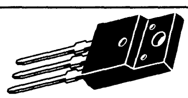
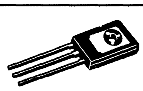
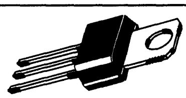
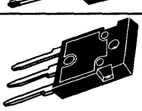
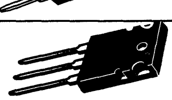


CASE 221D-02
ISOLATED TO-220
(MLA PREFIX)



TO-220AB
CASE 221A-06
(MLP PREFIX)

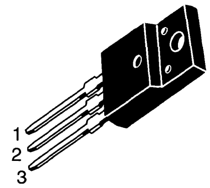
Selection By Package

Package		I_C Range (Amps)	V_{CE} Range (Volts)	P_D (Watts)	Page #
	TO-204AA (TO-3) Case 1-07	2.5–30	40–1500	36–250	5-25
	TO-204AE Case 197A-03	40–60	60–500	250–300	5-25
	TO-205AD (TO-39) Case 79-04	0.5–5.0	40–400	5.0–10	5-32
	TO-213AA (TO-66) Case 80-02	1.0–10	40–325	20–90	5-31
	DPAK Case 369-05	0.5–10	40–400	12.5–20	5-24
	DPAK Case 369A-07	0.5–10	40–400	12.5–20	5-24
	TO-218AC Case 340-02	5.0–25	40–1500	80–150	5-19, 21
	ISOLATED TO-218 TYPE Case 340B-03	8–15	400–700	50	5-15
	TO-218 TYPE Case 340D-01	6.0–25	60–850	100–150	5-19, 20
	TO-220AB Case 221A-06	0.5–15	30–1800	15–125	5-15
	ISOLATED TO-220 TYPE Case 221D-02	5–12	80–550	40–45	5-14
	TO-225AA (TO-126 TYPE) Case 77-07	0.3–5.0	25–400	12.5–40	5-22
	Case 152-02	0.5–2.0	30–300	10	5-25
	Case 340F-02	10–15	100–1500	100–200	5-21
	TO-3PBL Case 340G-01	15–25	60–1000	150–200	5-21

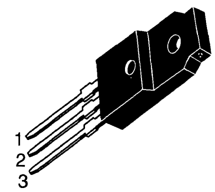
Bipolar Power Transistors

TABLE 1 – PLASTIC (Isolated TO-220 Type)

STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER



STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER



CASE 221D-02

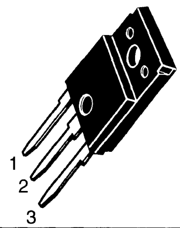
CASE 221H-01 (for 25C3298B & 25A1306B only)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
1	250	MJF47		30/150	0.3	2 typ	0.17 typ	0.3	10	28
1.5	200	2SC3298B†† ★	2SA1306B†† ★	70/240	0.1				100 typ	20
2	450	BUL44F ★		14/36	0.4	2.75**	0.2**	1	12 typ	20
		MJF18002 ★		14/36	0.2	3**	0.17**	1	12 typ	20
3	100	MJF31C ★	MJF32C ★	10 min	1	0.6	0.3	1	3	28
5	100	MJF122##	MJF127##	2000 min	3	1.5 typ	1.5 typ	3	4#	28
	400	BUL45F ★		16/40	1	1.7**	0.12**	1	12 typ	25
	450	BUT11AF		10 min	0.005	4	0.8	2.5		40
		MJF16002		5 min	5	3	0.3	3		40
		MJF18004 ★		14/36	1	3**	0.3**	2.5	12 typ	25
6	550*	MJF16204		5 min	6	1.5**	0.15**	1	10	45
8	80		MJF6107	30/90	2	0.5 typ	0.13 typ	2	4	35
	150	MJF15030	MJF15031	40 min	3	1 typ	0.15 typ	3	30	35
	400	MJF13007		5/30	5	3	0.7	5	4	40
		BUL146F ★		14/36	1.5	4**	0.17**	3	12 typ	40
	450	MJF18006 ★		14/36	1.5	1.5 typ**	0.1 typ**	3	12 typ	40
10	60	MJF3055	MJF2955	20/100	4				2	40
	80	MJF44H11	MJF45H11	40/100	4	0.5 typ	0.14 typ	5	40	35
	100	MJF6388##	MJF6668##	3k/20k	3	1.5 typ	1.5 typ		20#	40
	400	BUL147F ★		14/36	2	4**	0.17**	4	12 typ	45
	450	MJF18008 ★		16/36	2	3 typ**	0.12 typ**	4	12 typ	45
12	400	MJF13009		6/30	8	3	0.7	8	8	40

$|h_{fe}|$ @ 1 MHz
Darlington
* $V_{(BR)CEV}$
** Switching tests performed w/special application simulator circuit. See data sheet for details.
†† Supplied in Case 221H-01
★ New Product

TABLE 2 – PLASTIC (Isolated TO-218 Type)

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER



CASE 340B-03

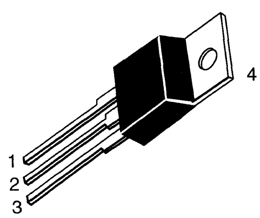
I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
8	500	MJF16006A		5 min	8	2.5	0.25	5		50
	700	BU1008AF BU1008ADF†		3 min 3 min	4.5 4.5	8** 8**	0.5** 0.5**	4.5 4.5	7 typ 7 typ	50 50
10	400	MJF10012##		100/12k	6	15	15	6		50
	650	MJF16212★		4/10	10				2.75 typ	50
	800	MJF16018★		4 min	5	4.5 typ	0.2 typ	5		50
12	500*	MJF16206★		5/13	10	2.25	0.25	6.5	3 typ	50
15	500	MJF16010A MJF16210★		5 min 5/13	15 15	3	0.4 0.24**	10 8.5	 2.5 typ	50 50
20	100	MJF6284##	MJF6287##	750/18k	10	1.0	2.0	10	4#	50

† "D" designator indicates internal Collector-emitter diode
# $|h_{fe}|$ @ 1 MHz, ## Darlington
* V_{CES} = 1200 volts

** Switching tests performed w/special application simulator circuit. See data sheet for details.
★ New Product

TABLE 3 – PLASTIC TO-220

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR



CASE 221A-06 (TO-220AB)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
0.5	350	MJE2360T MJE2361T		15 min 40 min	0.1 0.1				10 typ 10 typ	30 30
1	80	TIP29B	TIP30B	15/75	1	0.6 typ	0.3 typ	1	3	30
	100	TIP29C	TIP30C	15/75	1	0.6 typ	0.3 typ	1	3	30
	250	TIP47		30/150	0.3	2 typ	0.18 typ	0.3	10	40
	300	TIP48	MJE5730	30/150	0.3	2 typ	0.18 typ	0.3	10	40
	350	TIP49	MJE5731	30/150	0.3	2 typ	0.18 typ	0.3	10	40
	400	TIP50	MJE5731A*	30/150	0.3	2 typ	0.18 typ	0.3	10	40
2	60	BD239A TIP110##	BD240A TIP115##	15 min 500 min	1 2	 1.7 typ	 1.3 typ	 2	3 25#	30 50
	80	BD239B TIP111##	BD240B TIP116##	15 min 500 min	1 2	 1.7 typ	 1.3 typ	 2	3 25#	30 50
	100	BD239C TIP112## C	BD240C TIP117## C	25 min 500 min	1 2	 1.7 typ	 1.3 typ	 2	3 25#	30 50

$|h_{fe}|$ @ 1 MHz, ## Darlington
* V_{CEO} = 375 V

C Available as preferred chip
Device Numbers in **Bold** type are preferred.

(continued)

TABLE 3 – PLASTIC TO-220 (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
2	400	**BUL44★**		14/36	0.4	2**	0.2**	1	12 typ	40
	450	**BUX85**		30	0.1	3.5	1.4	1	4	50
		MJE18002★		14/36	0.2	3**	0.17**	1	12 typ	40
	900	**MJE1320**		3 min	1	4 typ	0.8 typ	1		80
2.5	700	**MJE8500**		7.5 min	0.5	4	2	1		65
	750	**MJE12007** [C]		1.1 min	2		1	2	4 typ	65
	800	**MJE8501**		7.5 min	0.5	4	2	1		65
3	60	BD241A	BD242A	25 min	1				3	40
		TIP31A	TIP32A	25 min	1	0.6 typ	0.3 typ	1	3	40
	80	**BD241B**	**BD242B**	25 min	1				3	40
		TIP31B	**TIP32B**	25 min	1	0.6 typ	0.3 typ	1	3	40
	100	**BD241C**	**BD242C**	25 min	1				3	40
		TIP31C [C]	**TIP32C** [C]	25 min	1	0.6 typ	0.3 typ	1	3	40
4	60	**BD535**	**BD536**	25 min	2	0.5 Typ	0.05 Typ		3	50
		MJE800T##	**MJE700T##**	750 min	1.5				1#	40
	80	**D44C12★**	**D45C12★**	40/120	0.2			1	40 typ	30
	300	MJE13004		6/30	3	3	0.7	3	4	60
	400	**MJE13005**		6/30	3	3	0.7	3	4	60
5	60	TIP120##	TIP125##	1k min	3	1.5 typ	1.5 typ	3	4#	65
	80	**TIP121##**	**TIP126##**	1k min	3	1.5 typ	1.5 typ	3	4#	65
	100	**TIP122##** [C]	**TIP127##** [C]	1k min	3	1.5 typ	1.5 typ	4	4#	75
	250	**2N6497**		10/75	2.5	1.8	0.8	2.5	5	80
	300	**2N6498**		10/75	2.5	1.8	0.8	2.5	5	80
	400	**BUL45★**		16/40	1	1.7**	0.12**	1	12 typ	100
	450	**MJE16002**		5 min	5	3	0.3	3		80
		MJE16004		7 min	5	2.7	0.35	3		80
		MJE18004		10 min	2	3	0.5	2.5	12	100
	700	**MJE8502**		7.5 min	1	4	2	2.5		80
	800	**MJE8503**		7.5 min	1	4	2	2.5		80
6	60	BD243A	BD244A	15 min	3				3	65
		TIP41A	TIP42A	15/75	3	0.4 typ	0.15 typ	3	3	65
	80	**BD243B**	**BD244B**	15 min	3				3	65
		TIP41B	**TIP42B**	15/75	3	0.4 typ	0.15 typ	3	3	65
	100	**BD243C**	**BD244C**	15 min	3				3	65
		TIP41C	**TIP42C**	15/75	3	0.4 typ	0.15 typ	3	3	65
	400	**BUV46**		5 min	3.5	3	0.8	2.5	12	85
	550*	**MJE16204**		5 min	6	1.5**	0.15**	1	10	80

$|h_{fe}|$ @ 1 MHz, ## Darlington

* $V_{(BR)CEV}$

** Switching tests performed w/special application simulator circuit. See data sheet for details.

★ New Product

[C] Available as preferred chip

Device Numbers in **Bold** type are preferred

(continued)

TABLE 3 – PLASTIC TO-220 (continued)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	t_f µs Max	@ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
7	30	2N6288	2N6111	30/150	3	0.4 typ	0.15 typ	3	4	40
	50		2N6109	30/150	2.5	0.4 typ	0.15 typ	3	4	40
	60	BD797	BD798	25 min	3				3	65
	70	**2N6292**	**2N6107**	30/150	2	0.4 typ	0.15 typ	3	4	40
	80	**BD799**	**BD800**	15 min	3				3	65
	100	**BD801**	**BD802**	15 min	3				3	65
	150	**BU407,D**		30 min	1.5		0.75	5	10	60
	200	**BU406,D**		30 min	1.5		0.75	5	10	60
	375	**BU522##**		250 min	2.5				7.5	75
	425	**BU522A##**		250 min	2.5				7.5	75
	450	**BU522B##**		250 min	2.5				7.5	75
8	60	2N6043##	2N6040##	1k/10k	4	1.5 typ	1.5 typ	3	4#	75
		BDX53A##	BDX54A##	750 min	3				4#	60
		BD897##	BD898##	750 min	3				1#	70
		BD897A##	BD898A##	750 min	4				1#	70
		TIP100##	TIP105##	1k/20k	3	1.5 typ	1.5 typ	3	4#	80
	80	**2N6044##**	**2N6041##**	1k/10k	4	1.5 typ	1.5 typ	3	4#	75
		BDX53B##	**BDX54B##**	750 min	3				4#	60
		BD899##	**BD900##**	750 min	3				1#	70
		BD899A##	**BD900A##**	750 min	4				1#	70
		TIP101##	**TIP106##**	1k/20k	3	1.5 typ	1.5 typ	3	4#	80
	100	**2N6045##**	**2N6042##**	1k/10k	3	1.5 typ	1.5 typ	3	4#	75
		BDX53C##	**BDX54C##**	750 min	3					
		BD901##	**BD902##**	750 min	3				1#	70
		TIP102##	**TIP107##**	1k/20k	3	1.5 typ	1.5 typ	3	4#	80
	120	**BDX53D##**	**BDX54D##**	750 min	3				4#	60
		MJE15028	**MJE15029**	20 min	4				30	50
	150	**MJE15030** C	**MJE15031** C	20 min	4				30	50
		BU807##		100 min	5	0.55 typ	0.2 typ	5		60
	200	**BU806##**		100 min	5	0.55 typ	0.2 typ	5		60

$|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

C Available as preferred chip

Device Numbers in **Bold** type are preferred

TABLE 3 – PLASTIC TO-220 (continued)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	t_f µs Max	@ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
8	300	MJE13006		5/30	5	3	0.7	5	4	80
		MJE5740##		200 min	4	8 typ	2 typ	6	4	80
			MJE5850	15 min	2	2	0.5	4		80
	350	**MJE5741##**		200 min	4	8 typ	2 typ	6		80
			MJE5851	15 min	2	2	0.5	4		80
	400	**BUL146**		14/36	2	4**	0.17**	4	12 typ	100
		MJE5742##		200 min	4	8 typ	2 typ	6		80
		MJE13007 [C]		5/30	5	3	0.7	5		80
			MJE5852 [C]	15 min	2	2	0.5	4		80
		MJE16106 ★		6/22	8	2 typ	0.1 typ	5		100
	450	**BUT56A**		10 min	2	3	0.5	2	12	100
		MJE18006 ★		14/36	1.5	1.5 typ**	0.1 typ**	3	12 typ	100
	550	**BUT47C**		8 min	2	4		4	12	100
10	**20**	**MJE5420Z##(1)** ★		6k min	6					100
	60	**BDX33A##**	**BDX34A##**	750 min	4				3	70
		BD807	**BD808**	15 min	4				1.5	90
		D44H8	**D45H8**	40 min	4					50
		MJE3055T	**MJE2955T**	20/70	4					75
		2N6387##	**2N6667##**	1k/20k	5				20#	65
	80	**BDX33B##**	**BDX34B##**	750 min	3				3	70
		BD809	**BD810**	15 min	4				1.5	90
		D44E3##		1000 min	5	2 typ	0.5 typ	10		50
		2N6388##	**2N6668##**	1k/20k	5				20#	65
		D44H10	**D45H10**	20 min	4	0.5 typ	0.14 typ	5	50 typ	50
		D44H11 [C]	**D45H11** [C]	40 min	4	0.5 typ	0.14 typ	5	50 typ	50
	100	**BDX33C##**	**BDX34C##**	750 min	3				3	70
	400	**BUL147**		14/36	2	4**	0.17**	4	12 typ	125
	450	**MJE18008** ★		16/36	2	3 typ**	0.1 typ**	4	12 typ	125
12	300	MJE13008		6/30	8	3	0.7	8	4	100
	400	**MJE13009**		6/30	8	3	0.7	8	4	100
15	**60**	**2N6487**	**2N6490**	20/150	5	0.6 typ	0.3 typ	5	5	75
		BDW40##	**BDW45##**	1k min	5	1 typ	1.5 typ	5	4	85
	80	**2N6488**	**2N6491**	20/150	5	0.6 typ	0.3 typ	5	5	75
		BDW41##	**BDW46##**	1k min	5	1 typ	1.5 typ	5	4	85
		D44VH10	**D45VH10**	20 min	4	0.5	0.09	8	50 typ	83
	100	**BDW42##**	**BDW47##**	1k min	5	1 typ	1.5 typ	5	4	85

** Switching tests performed w/special application simulator circuit. See data sheet for details.

$|h_{fe}|$ @ 1 MHz, ## Darlington

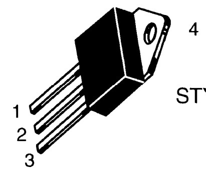
★ New Product

(1) Self protected Darlington

[C] Available as preferred chip

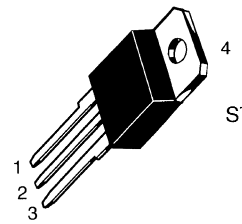
Device Numbers in **Bold** type are preferred

TABLE 4 – PLASTIC TO-218 (During the second half of 1991, devices listed below will change from Case 340-02 to Case 340D-01)



STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 340-02 (TO-218AC)



STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

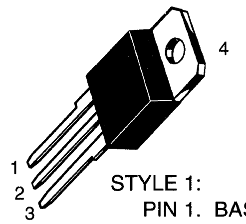
CASE 340D-01 (TO-218 Type)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
5	450	**MJH16002**		5 min	5	3	0.3	3		100
		MJH16004		7 min	5	2.7	0.35	3		100
	500	**MJH16002A**		5 min	5	3	0.3	3		100
	1500*	**MJH12004**		2.5 min	4.5		1	4.5	4	100
8	400	**MJH16106**		6/22	8	2 typ	0.1 typ	5		125
	450	**MJH16006**		5 min	8	2.5	0.25	5		125
		MJH16008		7 min	8	2.2	0.25	5		125
	500	**MJH16006A**		5 min	8	2.5	0.25	5		125
	750	**MJH12005**					0.4 typ	5	4	100
10	60	TIP140##	TIP145##	500 min	10	2.5 typ	2.5 typ	5	4#	125
	80	**TIP33B**	**TIP34B**	20 min	3				3	80
		TIP141##	**TIP146##**	500 min	10	2.5 typ	2.5 typ	5	4#	125
	100	TIP33C	TIP34C	20 min	3				3	80
		TIP142##	TIP147##	500 min	10	2.5 typ	2.5 typ	5	4#	125
	400	**MJH10012##**		100/2k	6	15	15	6		118
15	60	**TIP3055**	**TIP2955**	5 min	10				2.5	80
	150	**MJH11018##**	**MJH11017##**	400/15k	10				3#	150
	200	**MJH11020##**	**MJH11019##**	400/15k	10				3#	150
	250	**MJH11022##**	**MJH11021##**	400/15k	10				3#	150
16	140	**MJE4342**	**MJE4352**	15 min	8	1.2 typ	1.2 typ	8	1	125
	160	**MJE4343**	**MJE4353**	15 min	8	1.2 typ	1.2 typ	8	1	125
20	60	MJH6282##	MJH6285##	750/18k	10				4#	125
	80	**MJH6283##**	**MJH6286##**	750/18k	10				4#	125
	100	**MJH6284##**	**MJH6287##**	750/18k	10				4#	125
25	60	TIP35A	TIP36A	10/75	15	0.6 typ	0.3 typ	10	3	125
	80	**TIP35B**	**TIP36B**	10/75	15	0.6 typ	0.3 typ	10	3	125
	100	**TIP35C**	**TIP36C**	10/75	15	0.6 typ	0.3 typ	10	3	125

$|h_{fe}|$ @ 1 MHz, ## Darlington
* $V_{(BR)CEX}$ or $V_{(BR)CES}$
** Tested in Applications simulator: see Data Sheet

★ New Product
Device Numbers in **Bold** type are preferred

TABLE 5 – PLASTIC TO-218 TYPE



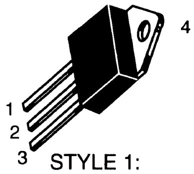
STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 340D-01 (TO-218 Type, SOT-93)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
6	375	**BU426**		30 typ	0.6	2 typ	0.5 typ	2.5	6 typ	113
	400	**BU426A**		30 typ	0.6	2 typ	0.5 typ	2.5	6 typ	113
8	500	**BUT50P##**		30 min	2	0.75 typ	0.1 typ	5		100
9	400	**BUV47**		7 min	5	2	0.4	6		128
	450	**BUV47A**		7 min	6	2	0.4	6		128
10	100	**BDV65B##**	**BDV646##**	1k min	5					125
	250	**BU323AP##**		150 min	6	15	15	6		125
15	400	**BUV48**		8 min	10	2	0.4	10		150
	450	**BUV48A**		8 min	8	2	0.4	10		150
	500	**BUT51P##**		40 min	5	1.1	0.16	10		125
20	100	**MJH6284##**	**MJH6287##**	750/18k	10				4#	125
25	60	BD249A	BD250A	10 min	15				3	125
	80	**BD249B**	**BD250B**	10 min	15				3	125
	100	**BD249C**	**BD250C**	10 min	15				3	125

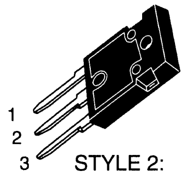
$|h_{fe}|$ @ 1 MHz, ## Darlington
Device Numbers in **Bold** type are preferred

TABLE 6 – PLASTIC TO-218/TO-247 (During the second half of 1991, devices listed below will change from Case 340-02 to Case 340F-02 and the part number prefix will become MJW_____.)



STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 340-02 (TO-218AC)



STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

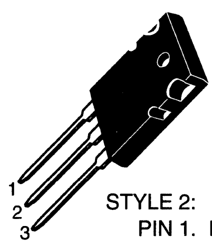
CASE 340F-02

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
10	650	**MJH16212★**		4/10	10					150
	800	**MJH16018★**		4 min	5	4.5 typ	0.2 typ	5	3 typ	150
12	1200*	**MJH16206★**		5/13	10	2.25	0.25	6.5	3 typ	150
15	200	**MJH6678★**		8 min	15	2.5	0.5	15		125
	400	**MJH16110**		6/20	10	0.8 typ	0.1 typ	10		135
	450	**MJH16010**		5 min	15	1.2	0.2	10		150
		MJH16012		7 min	15	0.9	0.15	10		150
	500	**MJH16010A**		5 min	15	3	0.4	10		150
		MJH16210★		5/13	15		0.24**	8.5**	2.5 typ	150
30	450	**MJW18020★**		8 min	20					180

$|h_{fe}|$ @ 1 MHz
* $V_{(BR)CEX}$ or $V_{(BR)CES}$
** Tested in Applications simulator: see Data Sheet

★ New Product
Device Numbers in **Bold** type are preferred

TABLE 7 – PLASTIC TO-3PBL



STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

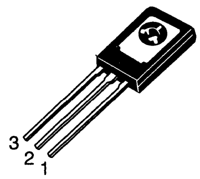
CASE 340G-01 (TO-3PBL)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
15	200	**2SC3281★**	**2SA1302 ★**	55/160	1				30 typ	150

★ New Product
Device Numbers in **Bold** type are preferred

TABLE 8 – PLASTIC TO-225 Type (Formerly TO-126 Type)

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. BASE



STYLE 3:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

CASE 77-07 (TO-225AA)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
0.3	350	**MJE3439**		40/160	0.02				15	15
0.5	150	**MJE341**		25/200	0.05				15	20.8
	200	**MJE344**		30/300	0.05				15	20.8
	250	2N5655		30/250	0.1	3.5 typ	0.24 typ	0.1	10	20
		BD157		30/240	0.05					20
	300	**BD158**		30/240	0.05					20
		BD232		20 min	0.15					20
		MJE340 [C]	**MJE350** [C]	30/240	0.05					20.8
		2N5656		30/250	0.1	3.5 typ	0.24 typ	0.1	10	20
	350	**2N5657**		30/250	0.1	3.5 typ	0.24 typ	0.1	10	20
		BD159		30/240	0.05					20
1	40	**2N4921**	**2N4918**	20/100	0.5	0.6 typ	0.3 typ	0.5	3	30
	60	**2N4922**	**2N4919**	20/100	0.5	0.6 typ	0.3 typ	0.5	3	30
	80	**2N4923**	**2N4920**	20/100	0.5	0.6 typ	0.3 typ	0.5	3	30
1.5	45	**BD165**	**BD166**	15 min	0.5				6	20
		BD135	**BD136**	40/250	0.15					12.5
	60	**BD167**		15 min	0.5				6	20
		BD137	**BD138**	40/250	0.15					12.5
	80	**BD169**	**BD170**	15 min	0.5				6	20
		BD139	**BD140**	40/250	0.15					12.5
		BD139.10	**BD140.10**	63/160	0.15					12.5
	300	**MJE13002**●		5/25	1	4	0.7	1	5	40
	400	**MJE13003**● [C]		5/25	1	4	0.7	1	5	40
2	60	**BD235**	**BD236**	25 min	1				3	25
	80	**BD237**		25 min	1				3	25
	100	**MJE270##**●	**MJE271##**●	1.5k min	0.12				6	15
3	60	**MJE181**	**MJE171**	50/250	0.1	0.6 typ	0.12 typ	0.1	50	12.5
	80	**BD179**	**BD180**	40/250	0.15				3	30
		MJE182 [C]	**MJE172** [C]	50/250	0.1	0.6 typ	0.12 typ	0.1	50	12.5
	200	**BUY49P**		30 min	0.5				25	20

●Case 77 (Style 3), # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

[C] Available as preferred chip
Device Numbers in **Bold** type are preferred

TABLE 8 – PLASTIC TO-225 Type (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	t_f µs Max	@ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
4	40	**MJE521**	**MJE371**	40 min	1					40
	45	**BD437**	**BD438**	40 min	2				3	36
			BD776##	750 min	2				20	15
	60	**BD189**		15 min	2				20	40
			BD440	25 min	2				3	36
		BD677##	**BD678##**	750 min	1.5					40
		BD677A##	**BD678A##**	750 min	2					40
		BD787	**BD788**	20 min	2				50	15
		BD777##	**BD778##**	750 min	2				20	15
		2N5191	**2N5194**	25/100	1.5	0.4 typ	0.4 typ	1.5	2	40
		MJE800##	**MJE700##**	750 min	1.5				1#	40
		2N6038##	**2N6035##**	750/18k	2	1.7 typ	1.2 typ	2	25	40
	80	**2N5192**	**2N5195**	25/100	1.5	0.4 typ	0.4 typ	1.5	2	40
		BD441	**BD442**	15 min	2				3	36
		BD679##	**BD680##**	750 min	1.5					40
		BD679A##	**BD680A##**	750 min	2					40
		BD789	**BD790**	10 min	2				40	15
		BD779##	**BD780##**	750 min	2				20	15
		MJE240	**MJE250**	40/200	0.2	0.15 typ	0.07 typ	2	40	15
		MJE241	**MJE251**	40/120	0.2	0.15 typ	0.07 typ	2	40	15
		MJE802##	**MJE702##**	750 min	1.5				1#	40
		MJE803##	MJE703##	750 min	2				1#	40
		2N6039## [C]	**2N6036##** [C]	750/18k	2	1.7 typ	1.2 typ	2	25	40
	100	**BD681##**	**BD682##**	750 min	1.5					40
		BD791	**BD792**	10 min	2				40	15
		MJE243	**MJE253**	40/120	0.2	0.15 typ	0.07 typ	2	40	15
5	25	**MJE200** [C]	**MJE210** [C]	45/180	2	0.13 typ	0.035 typ	2	65	15

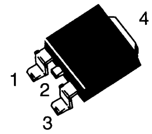
$|h_{fe}|$ @ 1 MHz, ## Darlington

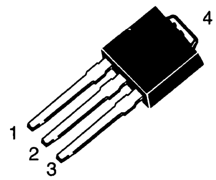
[C] Available as preferred chip

Device Numers in **Bold** type are preferred

TABLE 9 – DPAK — SURFACE MOUNT POWER PACKAGE

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR





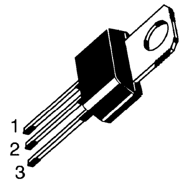
CASE 369A-07** **CASE 369-05***

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Typ	t_f µs Typ	@ I_C Amp		
0.5	300	MJD340	MJD350	30/240	0.05					15
1	250	MJD47		30/150	0.3	2	0.2	0.3	10	15
	350		MJD5731★	30/175	0.3	1.5	0.2	0.3	10	15
	400	MJD50		30/150	0.3	2	0.2	0.3	10	20
1.5	400	MJD13003		5/25	1	4 max	0.7 max	1	4	15
2	100	MJD112##	MJD117##	1000 min	2	1.7	1.3	2	25#	20
3	40	MJD31	MJD32	10 min	1	0.6	0.3	1	3	15
	100	MJD31C	MJD32C	10 min	1	0.6	0.3	1	3	15
4	45	MJD148		30 min	4				3	20
	80	MJD6039##	MJD6036##	1k/12k	2	1.7	1.2	2	25	20
	100	MJD243	MJD253	40/180	0.2	0.16	0.04	1	40	12.5
5	25	MJD200	MJD210	45/180	2	0.15	0.04	2	65	12.5
6	100	MJD41C	MJD42C	15/75	3	0.4	0.15	3	3	20
8	80	MJD44H11	MJD45H11	40 min	4	0.5	0.14	5	50 typ	20
	100	MJD122##	MJD127##	1k/12k	4	1.5	2	4	4#	20
10	60	MJD3055	MJD2955	20/100	4	1.5	1.5	3	2	20
	80	MJD44E3##		1k min	5	2	0.5	10		20

Darlington
* Case 369-05 may be ordered by adding -1 suffix to part number.
** Case 369A-07 may be ordered tape and reeled by adding a "T4" suffix; 2500 units/reel.
★ New Product
Device Numbers in **Bold** type are preferred

TABLE 10 – PLASTIC CASE 152

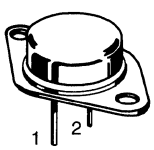
STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
(COLLECTOR CONNECTED TO TAB)

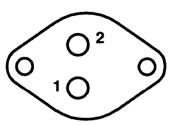


I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
0.5	300	MPSU10	MPSU60	30 min	0.03				45	10
0.8	40	MPSU02	MPSU52	30 min	0.5				100	10
1	120	MPSU03		40 min	0.01				35	10
	180	MPSU04		40 min	0.01				35	10
2	30	MPSU01	MPSU51	50 min	1				50	10
	40	MPSU01A	MPSU51A	50 min	1				50	10
		MPSU45##	MPSU95##	4k min	1					10
	60	MPSU05	MPSU55	60 min	0.25				50	10
	80	MPSU06	MPSU56	60 min	0.25				50	10
	100	MPSU07	MPSU57	30 min	0.25				50	10

Darlington

TABLE 11 – METAL TO-204 (Formerly TO-3), TO-204AE





STYLE 1:
PIN 1. BASE
2. EMITTER
CASE 3. COLLECTOR

CASE 1-07 — 40 mil pins (TO-204AA)
CASE 197A-03 — 60 mil pins (TO-204AE) **(Used for high current types at end of table. See types w/dots.)**

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
4	200	MJ15018	MJ15019	30 min	1.0				20	150
	250	**MJ15020**	**MJ15021**	30 min	1.0				20	150
5	**450**	**MJ16002**		5 min	5	3	0.3	3		125
	500	**MJ16002A**		5 min	5	3	0.3	3		125
	700	MJ8502		7.5 min	1	4	2	2.5		150

Device Numbers in **Bold** type are preferred

TABLE 11 – METAL TO-204, TO-204AE (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
5	**800**	**MJ8503**		7.5 min	1	4	2	2.5		150
	700*	**BU208A**		2.5 min	4.5	8 typ	0.4 typ	4.5	4 typ	90
	750*	**MJ12004**		2.5 min	4.5		1	4.5	4	100
6	**100**	**2N5758**		25/100	3	0.7 typ	0.5 typ	3	1	150
8	60	MJ1000##	MJ900##	1k min	3					90
		2N6055##	2N6053##	750/18k	4	1.5 typ	1.5 typ	4	4#	100
	80	**MJ1001##**	**MJ901##**	1k min	3					90
		2N6056##	**2N6054##**	750/18k	4	1.5 typ	1.5 typ	4	4#	100
	380	**MJ6308** ★		5/20	8	2.3**	0.12**	5		125
	400		**MJ6503**	15 min	2	2	0.5	4		125
	450	**MJ16006**		5 min	8	2.5	0.25	5		150
		MJ16008		7 min	8	2.2	0.25	5		150
	500	MJ16006A		5 min	8	3	0.4	5		150
	750*	**MJ12005**		5 min	5		1	5		100
10	40	2N6383##	2N6648##	1k/20k	5				20#	100
	60	2N3715	2N3791	30 min	3	0.3 typ	0.4 typ	5	4	150
		2N5877	2N5875	20/100	4	1	0.8	4	4	150
		MJ3000##	MJ2500##	1k min	5					150
	80	**2N3716** [C]	**2N3792** [C]	30 min	3	0.3 typ	0.4 typ	5	4	150
		2N5878	**2N5876**	20/100	4	1	0.8	4	4	150
		MJ3001##	**MJ2501##**	1k min	5					150
	140	**2N3442**		20/70	4					117

$|h_{fe}|$ @ MHz, ## Darlington

(continued)

** Inductive Switching

† D Suffix on this device signifies internal C-E Diode

★ New Product

[C] Available as preferred chip

* V_{CES} = 1500 V

Device Numbers in **Bold** type are preferred

TABLE 11 – METAL TO-204, TO-204AE (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s µs Max	t_f µs Max	@ I_C Amp		
10	**200**	**MJ410**		30/90	1				2.5	100
	250	**MJ15011**	**MJ15012**	20/100	2					200
	300	**MJ3041##**		250 min	2.5					175
	325	**MJ413**		20/80	0.5				2.5	125
		MJ423		30/90	1				2.5	125
	350	MJ13014		8/20	5	2	0.5	5		150
		MJ10006##		30/300	5	1.5	0.5	5	10#	150
	400	**BU323A##**		150 min	6	7.5 typ	5.2 typ	6		175
		MJ10007##		30/300	5	1.5	0.5	5	10#	150
		MJ10012##		100/2k	6	15	15	6		175
		MJ13015		8/20	5	2	0.5	5		150
	600	**MJ10014##**		10/250	10	2.5	0.8	10		175
	800	**MJ8505**		7.5 min	1.5	4	2	5		175
		MJ16018		4 min	5	4.5 typ	0.2 typ	5		150
12	60	2N6057##	2N6050##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	80	2N6058##	2N6051##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	100	**2N6059##** [C]	**2N6052##** [C]	750/18k	6	1.6 typ	1.5 typ	6	4#	150
15	**60**	**2N3055** [C]	**MJ2955** [C]	20/70	4	0.7 typ	0.3 typ	4	2.5	115
		2N3055A	**MJ2955A**	20/70	4				0.8	115
		2N6576##		2k/20k	4	2	7	10	10-200#	120
		2N5881	2N5879	20/100	6	1	0.8	6	4	160
	80	**2N5882** [C]	**2N5880** [C]	20/100	6	1	0.8	6	4	160
	90	**2N6577##**		2k/20k	4	2	7	10	10-200#	120
	120	**MJ15015** [C]	**MJ15016**	20/70	4	0.7 typ	0.3 typ	4	1	180
		2N6578##		2k/20k	4	2	7	10	10-200#	120
	140	**MJ15001**	**MJ15002**	25/150	4				2	200
	150	MJ11018##	MJ11017##	100 min	15				3#	175
	200	**BUX41**		8 min	8	1.5	0.4	8	8	120
		MJ11020##		100 min	15				3#	175
	250	**MJ11022##** [C]	**MJ11019##** [C]	100 min	15				3#	175
	300	2N6546	**MJ11021##**	6/30	10	4	0.7	10	6 to 24	175
	350	**2N6251**		6/50	10	3.5	1	10	2.5	175

$|h_{fe}|$ @ MHz, ## Darlington

(continued)

[C] Available as preferred chip.

Device Numbers in **Bold** type are preferred

TABLE 11 – METAL TO-204, TO-204AE (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
15	400	**BUX48**		8 min	10	2	0.4	10		175
		2N6547		6/30	10	4	0.7	10	6 to 24	175
		MJ16110		6/20	15	0.8 typ	0.1 typ	10		175
	450	**BUX48A**		8 min	8	2	0.4	10		175
		MJ16010		5 min	15	1.2 typ	0.2 typ	10		175
		MJ16012		7 min	15	0.9 typ	0.15 typ	10		175
		2N6836		10/30	10	3	0.35	10	10	175
	500	**MJ16010A**		5 min	15	3	0.4	10		175
16	120	2N5630	2N6030	20/80	8	1.2 typ	1.2 typ	8	1	200
	140	**2N3773** $\boxed{C}$	**2N6609**	15/60	8	1.1 typ	1.5 typ	8	4	150
		2N5631	**2N6031** $\boxed{C}$	15/60	8	1.2 typ	1.2 typ	8	1	200
	200	MJ15022	MJ15023	15/60	8				5	250
	250	**MJ15024**	**MJ15025**	15/60	8				5	250
18	160	**BUX41N**		8 min	12	1.2	0.25	12	8	120
20	60	**2N3772**		15/60	10				2	150
		2N6282##	2N6285##	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	75	2N5039		20/100	10	1.5	0.5	10	60	140
	80	**2N5303**	**2N5745**	15/60	10	2	1	10	2	200
		2N6283##	**2N6286##**	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	90	**2N5038** $\boxed{C}$		20/100	12	1.5	0.5	12	60	140
	100	**2N6284##** $\boxed{C}$	**2N6287##** $\boxed{C}$	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	125	**BUX40**		8 min	15	1	0.25	15	8	120
	140	**MJ15003** $\boxed{C}$	**MJ15004** $\boxed{C}$	25/150	5				2	250
	160	**BUX11**		10 min	15	1.2	0.25	15	8	150
	200	**BUV11**		10 min	12	1.8	0.4	12	8	150
	350	**MJ10000##**		40/400	10	3	1.8	10	10#	175
		MJ10004##		40/400	10	1.5	0.5	10	10#	175

$|h_{fe}|$ @ MHz, ## Darlington

(continued)

$\boxed{C}$ Available as preferred chip

Device Numbers in **Bold** type are preferred

TABLE 11 – METAL TO–204, TO–204AE (continued)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
20	**400**	**MJ10001##**		40/400	10	3	1.8	10	10#	175
		MJ10005##		40/400	10	1.5	0.5	10	10#	175
		MJ13333		10/60	5	4	0.7	10		175
	450	**MJ10008##**		30/300	10	2	0.6	10	8#	175
		MJ16014		5 min	20	2.7	0.35	20		250
		MJ16016		7 min	20	2.2	0.25	20		250
		2N6837		10/30	15	2.5	0.25	15		250
	500	**MJ10009##**		30/300	10	2	0.6	10	8#	175
		MJ13335		10/60	5	4	0.7	10		175
	750	**MJ10024##**		50/600	20	5	1.8	10		250
	850	**MJ10025##**		50/600	20	5	1.8	10		250
25	60	2N5885	2N5883	20/100	10	1	0.8	10	4	200
	80	**2N5886** [C]	**2N5884** [C]	20/100	10	1	0.8	10	4	200
			2N6436	30/120	10	1	0.25	10	40	200
	100	**2N6338**	**2N6437**	30/120	10	1	0.25	10	40	200
	120	**2N6339** [C]	**2N6438** [C]	30/120	10	1	0.25	10	40	200
	125	**BUV10**		10 min	20	1.2	0.25	20	8	150
	140	2N6340		30/120	10	1	0.25	10	40	200
	150	**2N6341**		30/120	10	1	0.25	10	40	200
28	**400**	**BUT13##**		20 min	20	2.6	0.8	18		175
30	**40**	**2N3771**		15/60	15				2	150
		2N5301	2N4398	15/60	15	2	1	10	2	200
	60	**2N5302**	**2N4399**	15/60	15	2	1	10	2	200
		MJ11012##	MJ11011##	1k min	20				4#	200
	90	**BUX39**		8 min	20	1	0.25	20	8	120
		MJ11014##	**MJ11013##**	1k min	20				4#	200
	100	**2N6328**		6/30	30				3	200
		MJ802	**MJ4502**	25/100	7.5				2	200
	120	**MJ11016##** [C]	**MJ11015##** [C]	1k min	20				4#	200
	325	**BUV23•**		8 min	16	1.8	0.4	16	8	250
	400	**BUS98•**		8 min	20	2.3	0.4	20		250
		BUX98•				3	0.8	20		250
	450	**BUS98A •**		8 min	16	2.3	0.4	16		250
		BUX98A •				3	0.8	16		250
		MJ16020•		5 min	30	1.8	0.2	20		250
		MJ16022•		7 min	30	1.5	0.15	20		250

$|h_{fe}|$ @ MHz, ## Darlington

(continued)

• Case 197A-03 (TO-204AE)

[C] Available as preferred chip

Device Nmbers in **Bold** type are preferred

TABLE 11 – METAL TO-204, TO-204AE (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
40	200	**BUV21•**		10 min	25	1.8	0.4	25	8	150
	250	**BUS52•**		15 min	40					350
		BUV22•		10 min	20	1.1	0.35	20	8	250
	350	**MJ10022•##**		50/600	10	2.5	0.9	20		250
	400	**MJ10023•##**		50/600	10	2.5	0.9	20		250
	700	**BUT35•##**		15 min	24	4	1.2	24		250
50	60	**2N5685•**	**2N5683•**	15/60	25	0.5 typ	0.3 typ	25	2	300
		MJ11028•##	MJ11029•##	400 min	50					300
	80	**2N5686•** $\boxed{C}$	**2N5684•** $\boxed{C}$	15/60	25	0.5 typ	0.3 typ	25	2	300
			2N6377•	30/120	20	0.8	0.25	20	30	250
	90	**MJ11030•##**	**MJ11031•##**	400 min	50					300
	100	**2N6274•**	**2N6378•**	30/120	20	0.8	0.25	20	30	250
	120	**2N6275•**	**2N6379•**	30/120	20	0.8	0.25	20	30	250
		MJ11032•##	**MJ11033•##**	400 min	50					300
	125	**BUV20•**		10 min	50	1.2	0.25	50	8	250
		BUV60•		10 min	80	1.1	0.25	80		250
	150	**2N6277•**		30/120	20	0.8	0.25	20	30	250
	200	**BUS51•**		15 min	50					350
	400	**MJ10015•##**		10 min	40	2.5	1	20		250
	500	**BUT34•##**		15 min	32	3	1.5	32		250
		MJ10016•##		10 min	40	2.5	1	20		250
56	400	**BUT33•##**		20 min	36	3.3	1.6	36		250
60	60	MJ14000•	MJ14001•	15/100	50					300
	80	**MJ14002•**	**MJ14003•**	15/100	50					300
	200	**MJ10020•##**		75 min	15	3.5	0.5	30		250
	250	**MJ10021•##** $\boxed{C}$		75 min	15	3.5	0.5	30		250
70	125	**BUS50•**		15 min	50					350
80	100	**BUV18A•**		10 min	80	1.1	0.25	80		250

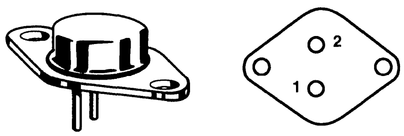
$|h_{fe}|$ @ MHz, ## Darlington

• Case 197A-03 (TO-204AE)

$\boxed{C}$ Available as preferred chip

Device Numbers in **Bold** type are preferred

TABLE 12 – METAL TO-213 (Formerly TO-66)



STYLE 1:
PIN 1. BASE
2. EMITTER
CASE 3. COLLECTOR

CASE 80-02 (TO-213AA)

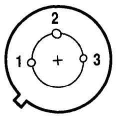
I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
1	**80**	**2N4912**		20/100	0.5	0.6 typ	0.3 typ	0.5	3	25
	225	2N3738		40/200	0.1	3 typ	0.3 typ	0.1	10	20
	300	**2N3739**		40/200	0.1	3 typ	0.3 typ	0.1	10	20
2	225		2N6211	10/100	1	2.5	0.6	1	20	35
	250	**2N3584**	**2N6421**	25/100	1	4	3	1	10	35
	300		**2N6212**	10/100	1	2.5	0.6	1	20	35
		2N3585		25/100	1	4	3	1	10	35
		2N4240		30/150	0.75	6	3	0.75	15	35
	350		**2N6213**	10/100	1	2.5	0.6	1	20	35
3	**140**	**2N3441**		25/100	0.5				0.2	25
4	**60**		2N3740	30/100	0.25	1.3 typ	0.27 typ	0.25	4	25
		2N3054,A		25/100	0.5	1 typ	0.3 typ	0.5	3	75
		2N3766		40/160	0.5	0.9 typ	0.09 typ	0.5	10	20
		2N6294##	2N6296##	750/18k	2	0.9 typ	0.7 typ	2	4#	50
	80		**2N3741**	30/100	0.25	1.3 typ	0.27 typ	0.25	4	25
		2N3767		40/160	0.5	0.9 typ	0.09 typ	0.5	10	20
		2N6295## C	2N6297## C	750/18k	2	0.9 typ	0.7 typ	2	4	50
5	**80**	**2N4233A**		25/100	1.5	0.5 typ	0.2 typ	1.5	4	75
	325	**2N6235**		25/125	1	3.5	0.5	1	20	50
7	60		2N6317	20/100	2.5	1	0.8	2.5	4	90
	80	**2N5428**		60/240	2	2	0.2	2	30	40
	100		**2N6318**	20/100	2.5	1	0.8	2.5	4	90
		2N5430		60/240	2	2	0.2	2	30	40
8	60	2N6300##	2N6298##	750/18k	4	1.5 typ	1.5 typ	4	4#	75
	80	**2N6301## C**	**2N6299## C**	750/18k	4	1.5 typ	1.5 typ	4	4#	75

$|h_{fe}|$ @ MHz, ## Darlington

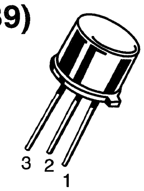
C Available as preferred chip

Device Numbers in **Bold** type are preferred

TABLE 13 – METAL TO-205 (Formerly TO-39)



STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
(Pin 3 connected to case)



CASE 79-04 (TO-205AD)

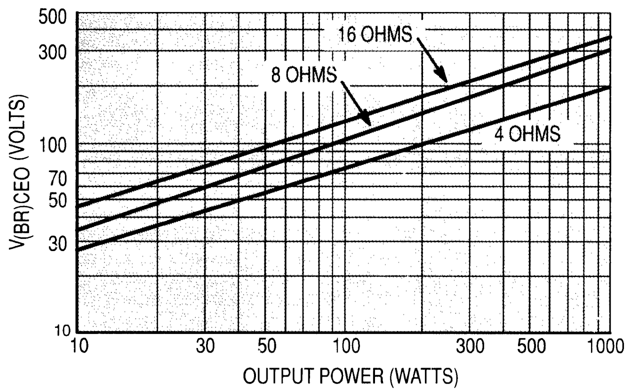
I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	t_f µs Max	@ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
0.5	**300**		**MJ4646**	20 min	0.5	0.72*		0.05	40	5
	400		**MJ4647**	20 min	0.5	0.72*		0.05	30	5
3	**40**		**2N3719**	25/180	1	0.4*		1	60	6
			2N3867	40/200	1.5	0.4*		1.5	60	6
	60		**2N3720**	25/180	1	0.4*		1	60	6
			2N3868	30/150	1.5	0.4*		1.5	60	6
	80		**2N6303**	30/150	1.5	0.4*		1.5	60	6
5	**80**	**2N5336**	**2N6190**	30/120	2	2	0.2	2	30	6
		2N5337	**2N6191**	60/240	2	2	0.2	2	30	6
	100	**2N5338**		30/120	2	2	0.2	2	30	10
		2N5339	**2N6193**	60/240	2	2	0.2	2	30	6

*t_{off}

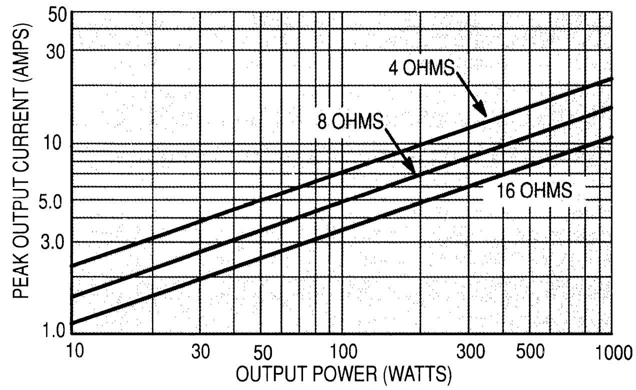
Audio

GENERAL DESIGN CURVES FOR POWER AUDIO OUTPUT STAGES

$V_{(BR)CEO}$ Required on Output and Driver Transistors versus Output Power for 4, 8 and 18 Ohm Load



Output Transistor Peak Collector Current versus Output Power for 4, 8 and 16 Ohm Loads



Another important parameter that must be considered before selecting the output transistors is the safe-operating area these devices must withstand. For a complete discussion on these see Application Notes AN484A and AN485.

TABLE 14 – RECOMMENDED POWER TRANSISTORS FOR AUDIO/SERVO LOADS

RMS Power Output	NPN	PNP	Case	P_D Watts @ 25°C	V_{CEO}	h_{FE} @ Min/Max	I_C Amps	f_T MHz Typ	ISB Volts/Amps
To 25W	MJE15030	MJE15031	TO-220	50	150	20 min	4	70	14/3.6
25 to 50W	2N3055A	MJ2955A	TO-204	120	120	20/70	4	3	60/2
	MJ15001	MJ15002	TO-204	200	140	25/150	4	3	40/5
50 to 100W	MJ15015	MJ15016	TO-204	180	120	20/70	4	3	60/3
	MJ15003	MJ15004	TO-204	250	140	25/150	5	3	100/1
	MJ15020	MJ15021	TO-204	150	250	30 min	1	20	50/3
Over 100W	MJ15024	MJ15025	TO-204	250	250	15/60	8	8	80/2.2
	2SC3298B	2SA1306B	221H-01	20	200	70/240	0.1	100	55/0.2
	2SC3281	2SA1302	340G-01	150	200	35 min	8	30	70/2

The Power Transistors shown are provided for reference only and show device capability. The final choice of the Power Transistors used is left to the circuit designer and depends upon the particular safe-operating area required and the mounting and heat sinking configuration used.

CRT Deflection

A new family of SCANSWITCH bipolar power transistors, containing state-of-the-art application specific die, and a series of damper diodes have been designed for high and very high resolution horizontal deflection circuits. The horizontal output transistors minimize fall time, storage time and dynamic desaturation; turn-off energy is specified for optimum design considerations. The power rectifiers, designed for use as damper diodes in horizontal deflection circuits, are enhanced for turn-on overshoot voltage and forward recovery time. Overall circuit performance is optimized when these damper diodes are paired with their specific horizontal output transistors.

DYNAMIC DESATURATION

A large amount of power dissipation in horizontal deflection output circuitry occurs during the transistor's turn-off. Most of this dissipation happens as the collector-emitter voltage rises during storage time. Since there is a tendency for the voltage waveform to be soft and rounded as opposed to abrupt and square. The parameter used to describe this behavior is dynamic desaturation and is shown in Figure A as the area below the dashed line. The SCANSWITCH series of transistors has been designed to minimize dynamic desaturation and simultaneously avoid collector current tailing.

OPTIMIZED BASE DRIVE

The base drive can be optimized to take full advantage of the advanced device design of the SCANSWITCH series of transistors. The five conditions necessary for optimization are:

1) Provide adequate drive just prior to turn-off to minimize dynamic desaturation.
2) Avoid overdrive during any portion of the turn-on time to avoid collector current tailing.
3) Provide reverse base current that is independent of forward base current so full transistor performance can be realized.
4) Provide for a controlled rate of transition from forward to reverse drive to avoid tailing.
5) Avalanche the base-emitter junction during fall time.

Typical techniques for driving horizontal outputs use a base drive waveform which results in overdrive at turn-on and underdrive just prior to turn-off. An optimized base drive is one with the same forced gain throughout the turn-on period. A comparison of the two drives is shown in Figure B.

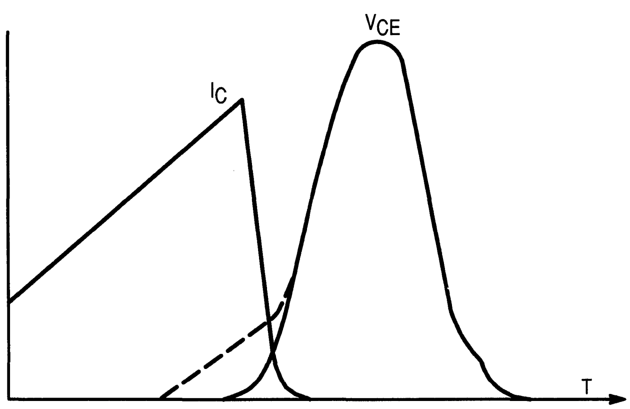


Figure A. Dynamic Desaturation

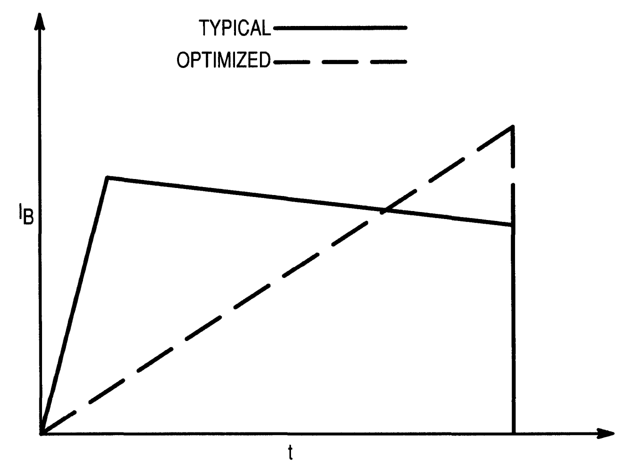
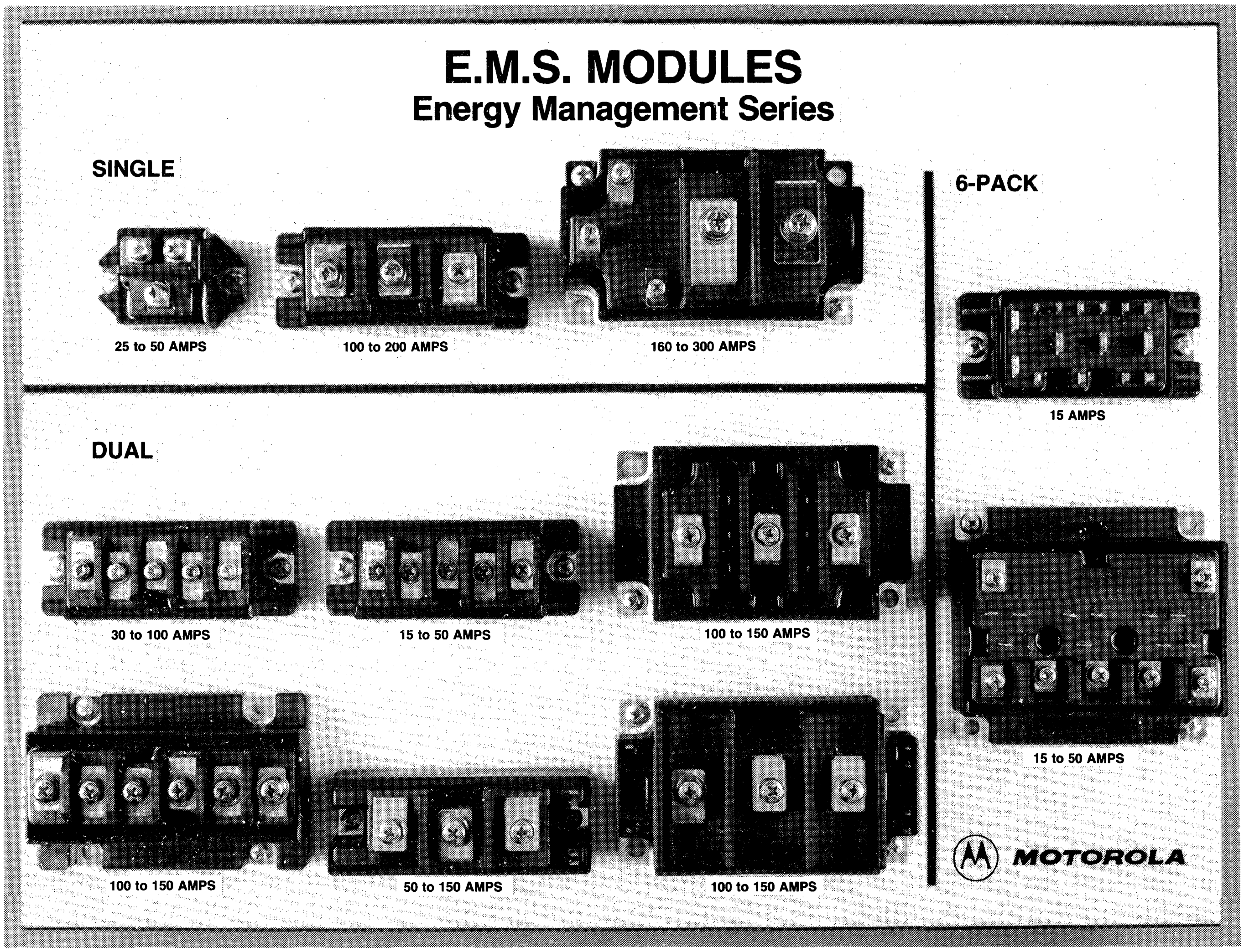


Figure B. Base Drive Comparison

TABLE 15 – HORIZONTAL CRT DEFLECTION TRANSISTOR SELECTOR GUIDE

	Monitor Description	Horizontal Scan Freq.	CRT Size	Pixel Size	Transistor	Diode
MONOCHROME	Low Resolution to Mid Resolution	15–50 kHz	12–15 in.	>1024 x 768	MJE/MJF16204 *MJE/MJF16205 MJ12004	MUR860E MUR880E
MONOCHROME	High Resolution	50–100 kHz	15–19 in.	>2000 x 1600	MJF/MJH16206 MJF/MJH16210 MJF/MJH16212	MR/MUR10100E MR/MUR10120E MR/MUR10150E
MONOCHROME	Ultra-High Resolution	>100 kHz	19–24 in.	>2000 x 2000	*MJF16214 *MJF16216 *MJF16218	MR/MUR10100E MR/MUR10120E MR/MUR10150E
COLOR	Low Resolution	15–22 kHz	12–15 in.	>320 x 200	BU1508AF *BU1508ADF	MUR05150E
COLOR	Mid Resolution	22–50 kHz	12–15 in.	>1024 x 768	BU1508AF *BU1508ADF	MUR05150E
COLOR	High Resolution	50–90 kHz	17–27 in.	>1280 x 1024	MJF/MJH16206 MJF/MJH16210 MJF/MJH16212	MR/MUR10100E MR/MUR10120E MR/MUR10150E
COLOR	Ultra-High Resolution	>90 kHz	17–27 in.	1600 x 1280	MJF/MJH16210(2) *MJF/MJW16218	MUR8100E(2) MR/MUR10150E

* Introduction Pending



Energy Management Series

Motorola has taken the familiar Darlington (high voltage) and Tri-Stage (still higher voltage) transistor structures and encased them in modules with a variety of conveniently accessible terminal arrangements to provide power switching capabilities ranging as high as 300 amps, 1200 volts and 1600 watts. What's more, the available selection includes singles, duals and "six-pack" structures, with 4-pack configurations available on special order.

The modules provide functional selectivity for line-operated PWM, six-step motor control systems and other industrial applications requiring high power switching capabilities. They incorporate electrical isolation between the terminals and the heat-sink mounting surface, and are capable of meeting U.L., CSA, and VDE requirements in most applications. Most devices are U.L. recognized.

Transistor structures include bipolar devices for highest power, Isolated Gate Bipolar Transistors (IGBT's) devices for increased switching speed, and Power MOSFET transistors for highest speed with more limited voltage/current capabilities.

E.M.S. Modules — continued

BIPOLAR DARLINGTON TRANSISTOR

Module Type	Max I_C(cont) Amps	V_{CEX} (sus) Volts	$V_{CEO(sus)}$ Volts	Motorola Type		h_{FE} Min	V_{CE} = 5V I_C Amps	Max. Resistive Switching t_{on} μs	t_{stg} μs	t_f μs	@ I_C(A)	P_D T_C = 25°C Watts	Case No.	Circuit Config.
Single	50	600	450	MJ50AB45	UR	100	50	1	12	2	50	300	C.F.	B
Single	50	1000	880	MJ50AC100	UR	100	50	2	20	5	50	350	373-01	K
Single	100	600	450	MJ100AA45		100	100	1	12	2	100	600	807A-03	A
Single	200	600	550	MJ200AA55	UR	80	200	2	12	4	200	800	807A-03	A
Single	200	600	550	MJ200AF55	UR	80	200	2	12	4	200	800	414-01	F
Single	200	1000	880	MJ200AV100	UR	100	200	2	15	5	200	1400	812-02	V
Single	200	1200	900	MJ200AV120	UR	100	200	2	13	4	200	1400	812-02	V
Single	300	600	550	MJ300A2F55	UR	80	300	2	12	5	300	1400	812-02	2F
Single	300	1000	880	MJ300AV100	UR	100	300	2	15	5	300	1600	812-02	V
Single	300	1200	900	MJ300AV120	UR	100	300	4	12	5	300	1600	812-02	V
Single	400	600	550	MJ400A2F55	UR	80	400	4	12	4	400	1600	812-02	2F
Dual	25	1000	880	MJ25BX100A		100	25	2	15	5	25	300 X 2	C.F.	X
Dual	40	1400	1000	MJ40BX140		100	40	2	17	3	40	400 X 2	816-02	X
Dual	50	600	450	MJ50B2D45	UR	100	50	1	12	2	50	300 X 2	813-02	2D
Dual	50	1000	880	MJ50BX100	UR	100	50	2	15	5	50	350 X 2	813-02	X
Dual	50	1000	880	MJ50BX100A		100	50	2	15	5	50	350 X 2	C.F.	X
Dual	50	1200	900	MJ50BX120	UR	100	50	2	13	4	50	350 X 2	813-02	X
Dual	75	600	450	MJ75BD45		80	75	2	12	2	75	350 X 2	807-03	D
Dual	75	600	500	MJ75B2D50	UR	80	75	2	12	4	75	350 X 2	813-02	2D
Dual	75	1000	880	MJ75BX100	UR	100	75	2	15	5	75	400 X 2	816-02	X
Dual	75	1200	900	MJ75BX120	UR	100	75	3	12	5	75	400 x 2	816-02	X
Dual	80	1400	1000	MJ80BX140		100	80	2	17	3	80	800 x 2	814-02	X
Dual	100	600	450	MJ100BD45		100	100	2	12	2	100	400 x 2	807-03	D
Dual	100	600	450	MJ100B3D45	UR	100	100	2	12	2	100	400 x 2	814A-02	3D
Dual	100	600	550	MJ100BE55	UR	80	100	2	12	4	100	400 x 2	819-02	E
Dual	100	1000	880	MJ100BX100	UR	100	100	2	15	5	100	700 x 2	814-02	X
Dual	100	1200	900	MJ100BX120	UR	100	100	2	13	4	100	700 x 2	814-02	X
Dual	150	600	550	MJ150BE55		80	150	2	12	5	150	700 x 2	819-02	E
Dual	150	600	550	MJ150B3D55	UR	80	150	3	12	5	150	700 x 2	814A-02	3D
Dual	150	1000	880	MJ150BK100	UR	100	150	2	15	5	150	800 x 2	808-01	K
Dual	150	1000	880	MJ150BX100	UR	100	150	2	15	5	150	800 x 2	814-02	X
Dual	150	1200	900	MJ150BX120A		130	150	3	12	5	150	800 x 2	814-02	X
6-Pack	15	600	450	MJ15FG45	UR	100	15	1	12	2	15	100 x 6	809-02	G
6-Pack	15	1100	900	MJ15FL110	UR	100	15	2	11	6	15	150 x 6	C.F.	L
6-Pack	20	600	450	MJ20FG45	UR	100	20	1	12	2	20	125 x 6	809-02	G
6-Pack	25	1100	900	MJ25FL110	UR	100	25	2	14	6	25	300 x 6	C.F.	L
6-Pack	30	600	450	MJ30FG45	UR	100	30	1	12	2	30	250 x 6	C.F.	G
6-Pack	50	600	450	MJ50FG45	UR	100	50	1	12	2	50	300 x 6	C.F.	G
6-Pack	50	600	450	MJ50FG45B	UR	100	50	1	12	2	50	300 x 6	C.F.	G
6-Pack	75	600	450	MJ75FG45		80	75	2	12	3	75	350 x 6	C.F.	G

POWER MOSFET

Module Type	Max I_D (cont) Amps	Max V_{DSS} Volts	Motorola Type	Max $R_{DS(on)}$ Ohms	Conditions I_D Amps	V_{GS} Volts	C_{iss} pf	Max. Resistive Switching t_r μs	t_{on} μs	t_s μs	t_f μs	Conditions I_D(A)	V_{GS}(V)	P_D T_C = 25°C Watts	Case No.	Circuit Config.
Single	90	200	MT90B3Y20A(1) UR	0.13	90	10	—	—	—	—	—	—	—	415 x 2	TO-240	3Y
Dual	50	450	MT50B2Y45	0.14	50	10	13000	0.7	0.8	0.2	1.3	50	10	400 x 2	C.F.	2Y
Dual	50	450	MT50BY45	0.14	50	10	13000	0.7	0.8	0.2	1.3	50	10	400 x 2	816-02	Y
Dual	50	500	MT50B2Y50	0.13	50	10	9600	0.8	1	0.25	0.7	50	10	400 x 2	C.F.	2Y
Dual	50	500	MT50BY50	0.13	50	10	9600	0.8	1	0.25	0.7	50	10	400 x 2	816-02	Y
6-Pack	8	450	MT8FR45	0.75	8	10	3100	0.4	0.5	0.25	1	8	10	100 x 6	809-02	R
6-Pack	15	450	MT15FR45 UR	0.40	15	10	4500	0.5	0.6	0.5	2	15	10	125 x 6	809-02	R
6-PakSIP	15	250	MPM6702	0.25	15	10	2000	0.6	0.8	0.2	0.8	15	10	70 x 6	C.F.	R

▢ Introduction Pending

UR :UL Recognized

(1) Note: The MT90B3Y20A is available from Motorola Automotive and Industrial Electronics Group, 4000 Commercial Avenue, Northbrook, IL 60062, Phone (708) 480-8111.

E.M.S. Modules — continued

ISOLATED GATE BIPOLAR TRANSISTORS (IGBT)

Module Type	Max I_C (cont) Amps	Max V_{CES} Volts	Motorola Type	UL	Max V_{CE} Volts	Conditions I_C Amps	Conditions V_G Volts	C_{ies} pf	Max. Resistive Switching t_r µs	t_{on} µs	t_f µs	t_{off} µs	Conditions I_C(A)	Conditions V_{GS}(V)	P_D T_C = 25°C Watts	Case No.	Circuit Config.
Single	25	1000	MG25AU100		5	25	15	3000	1	1	1	2	25	15	150	373-01	U
Single	50	500	MG50AU50		5	50	15	3000	1	1	1	1.5	50	15	150	C.F.	U
Single	50	1000	MG50AU100		5	50	15	7200	1	1	1	1.5	50	15	300	373-01	U
Single	100	500	MG100AU50		5	100	15	7200	1.5	1.5	1	1.5	100	15	300	C.F.	U
Single	200	1000	MG200A2U100	UL	5	200	15	30000	1.5	2	1	2	200	15	1200	C.F.	2U
Single	300	1000	MG300A2U100	UL	5	300	15	38000	1.5	2	1	2	300	15	1400	C.F.	2U
Single	300	1200	MG300A2U120	UL	4	300	15	42000	0.6	0.8	0.5	1.5	300	15	1400	C.F.	2U
Dual	15	1000	MG15BZ100		5	15	15	2000	1	1	1	2	15	15	125 x 2	813-02	Z
Dual	25	500	MG25BZ50	UL	5	25	15	1500	1	1	1	1.5	25	15	125 x 2	813-02	Z
Dual	25	1000	MG25BZ100	UL	5	25	15	3000	1	1	1	2	25	15	200 x 2	813-02	Z
Dual	50	500	MG50BZ50	UL	5	50	15	3000	1	1	1	1.5	50	15	300 x 2	813-02	Z
Dual	50	600	MG50BZ60	UL	4	50	15	3500	0.6	0.8	0.4	1	50	15	250 x 2	813-02	Z
Dual	50	600	MG50BZ60AL	UL	2.7	50	15	3500	0.6	0.8	1	1.6	50	15	250 x 2	C.F.	Z
Dual	50	1000	MG50BZ100	UL	5	50	15	7200	1	1	1	1.5	50	15	300 x 2	813-02	Z
Dual	75	500	MG75BZ50		5	75	15	5600	1.5	1.5	1	1.5	75	15	350 x 2	813-02	Z
Dual	75	600	MG75BZ60	UL	4	75	15	6000	0.6	0.8	0.4	1	75	15	350 x 2	813-02	Z
Dual	75	1000	MG75BZ100		5	75	15	9500	1	1	1	2	75	15	400 x 2	816-02	Z
Dual	75	1200	MG75BZ120		4	75	15	10500	0.6	0.8	0.5	1.5	75	15	400 x 2	816-02	Z
Dual	100	500	MG100BZ50	UL	5	100	15	7200	1.5	1.5	1	1.5	100	15	400 x 2	813-02	Z
Dual	100	600	MG100BZ60	UL	4	100	15	8200	0.6	0.8	0.4	1	100	15	400 x 2	813-02	Z
Dual	100	600	MG100BZ60AL	UL	2.7	100	15	6500	0.6	0.8	1	1.6	100	15	400 x 2	C.F.	Z
Dual	100	1000	MG100BZ100	UL	5	100	15	15000	1	1	2	1	100	15	600 x 2	814B-01	Z
Dual	100	1200	MG100BZ120	UL	4	100	15	15600	0.6	0.8	0.5	1.5	100	15	600 x 2	C.F.	Z
Dual	150	500	MG150BZ50		5	150	15	11000	1.5	1.5	1	1.5	150	15	700 x 2	C.F.	Z
Dual	150	600	MG150BZ60		4	150	15	12000	0.6	0.8	0.4	1	150	15	700 x 2	C.F.	Z
Dual	150	1000	MG150BZ100	UL	5	150	15	19000	1.5	2	1	2	150	15	800 x 2	C.F.	Z
Dual	150	1200	MG150BZ120	UL	4	150	15	21000	0.6	0.8	0.5	1.5	150	15	800 x 2	C.F.	Z
Dual	150	1200	MG150BZ120L		2.7	150	15	21000	0.6	0.8	1	1.8	150	15	800 x 2	C.F.	Z
Dual	200	500	MG200BZ50		5	200	15	15000	1.5	1.5	1	1.5	200	15	800 x 2	C.F.	Z
Dual	200	600	MG200BZ60		4	200	15	16000	0.6	0.8	0.4	1	200	15	800 x 2	C.F.	Z
6-Pack	8	1000	MG8F2R100		5	8	15	800	0.8	1	1	1.4	8	15	80 x 6	C.F.	2R
6-Pack	15	1000	MG15F2R100		5	15	15	2000	1	1	1	2	15	15	125 x 6	C.F.	2R

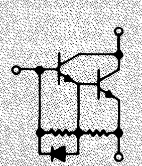
☐ Introduction Pending

UL :UL Recognized

E.M.S. Circuits

Bipolar Transistors

B



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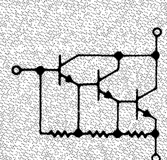

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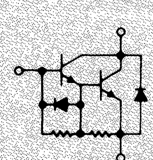

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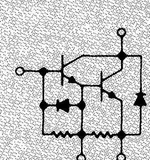

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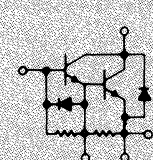

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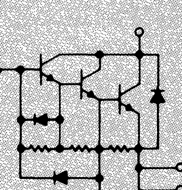
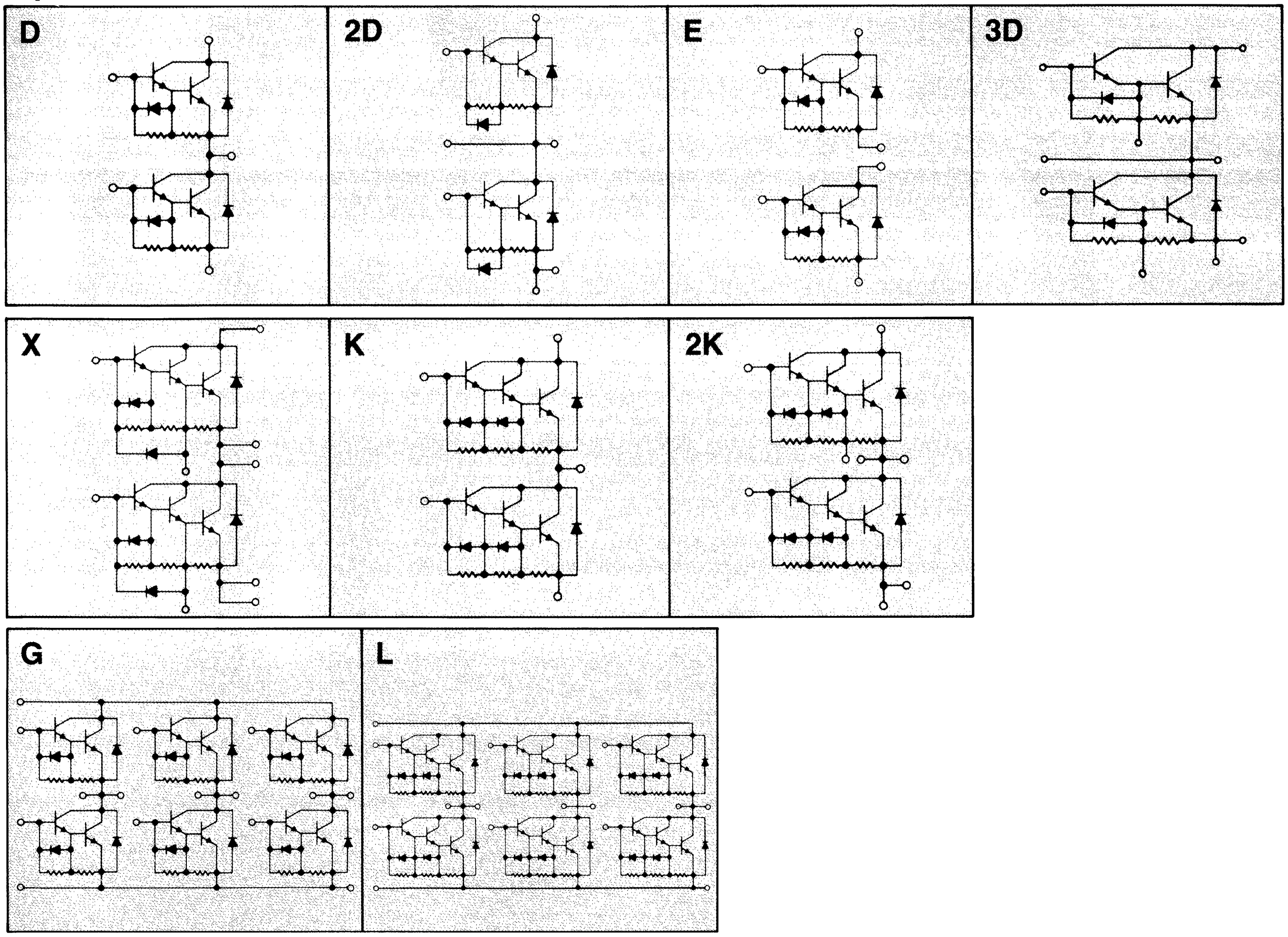
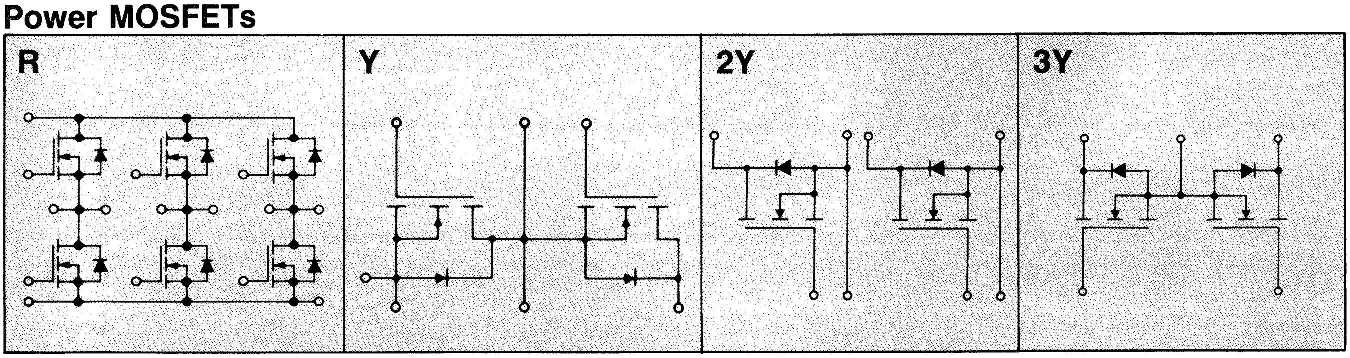


E.M.S. Circuits — continued

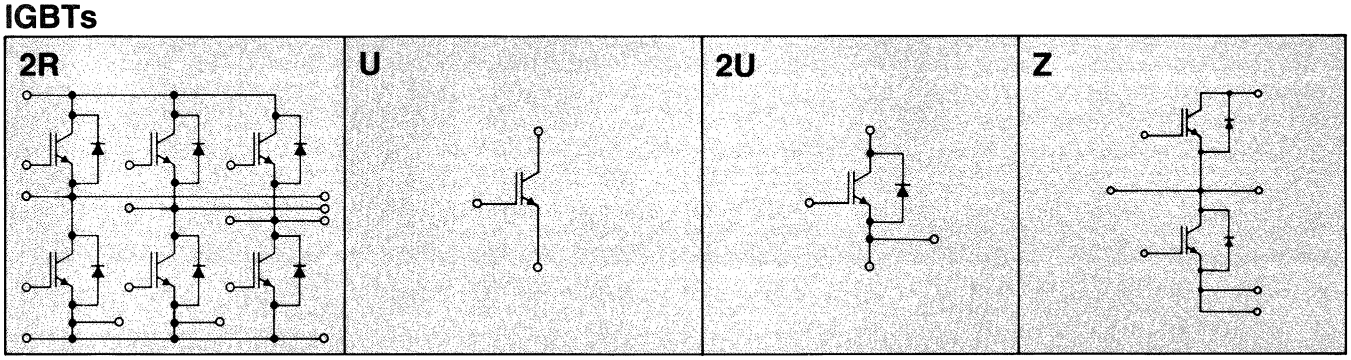
Bipolar Transistors — continued



Power MOSFETs



IGBTs



Thyristors and Triggers

In Brief . . .

Motorola's broad line of Thyristors include. . . .

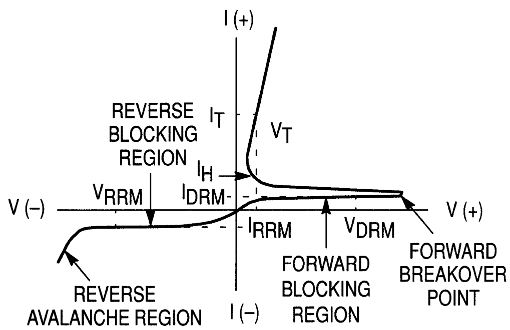
- A full line of TRIACs and SCRs covering a forward current range from 0.5 to 55 amperes and blocking voltages from 15 to 800 volts.
- Two basic package categories – plastic for lowest cost – including fully insulated plastic Case 221C-02 (TO-220 Isolated); metal for hermetically-sealed requirements in high-reliability projects.
- An extensive line of trigger devices that includes PUTs, SBS – even optically-coupled TRIAC drivers from Motorola's optoelectronic product line.

Then there are the special applications devices – for Ignition circuits, Crowbar applications; even isolated packaged devices for appliances and surface mount packages for surface mounting in space-saving requirements.

Finally, there is the continued Motorola investment in discrete-product R & D, producing new capabilities such as transient SIDACs for use in circuits sensitive to high voltage transients.

SCRs

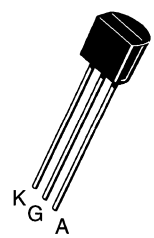
Silicon Controlled Rectifiers



Thyristors — SCR's

Metal/Plastic Packages

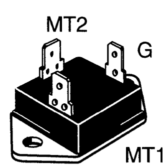
0.5 to 55 Amperes RMS
25–1000 Volts

On-State (RMS) Current		V_{DRM} V_{RRM} (Volts)
0.8 AMP	**1.5 AMPS**	
T_C = 58°C	T_C = 50°C	
		
Sensitive Gate		
Case 29-04 TO-226AA (TO-92) Style 10		
MCR102 2N5060 BRX44/BRY55-30*		25
MCR103 2N5061 BRX45/BRY55-609*	MCR22-2	50
MCR100-3 2N5062 BRX46/BRY55-100*	MCR22-3	100
MCR100-4 2N5064 BRX47/BRY55-200*	MCR22-4	200
MCR100-6 BRX49/BRY55-400*	MCR22-6	400
BRY55-500*		500
MCR100-8 BRY55-600*	MCR22-8	600
Maximum Electrical Characteristics		
10	15 150(1)	I_{TSM} (Amps) 60 Hz
0.2		I_{GT} (mA)
0.8		V_{GT} (V)
–65 to +110	–40 to +125	T_J Operating Range (°C)

(1) Exponential decay 2 µs wide at 5 time constants, f = 12 Hz.
* European Part Numbers. Package is Case 29 with Leadform 18. Case style is 3.

ATTENTION:
PACKAGE INNOVATION

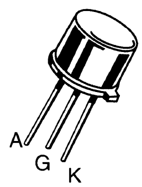
Isolated TRIAC Mold Type

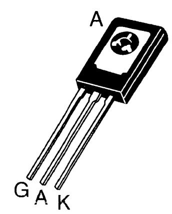


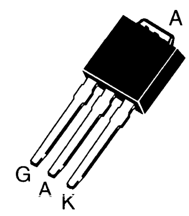
CASE 383-01

Features a TO-3 isolated mounting with a high isolation voltage of 2.5 kVrms min. This package also offers quick disconnect lead attachments, is plastic encapsulated to provide economical cost and is UL recognized. See pages 2-22 and 2-23 for the MAC625 and MAC635 series.

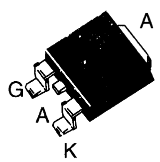
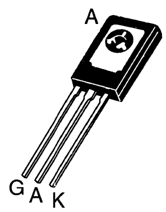
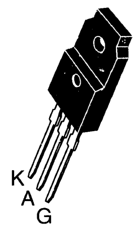
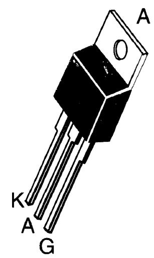
SCR's (continued)





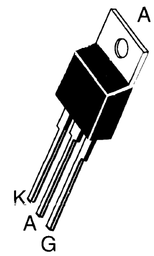


V_{DRM} V_{RRM} (Volts)	On-State (RMS) Current				
	1.6 AMPS		4 AMPS		
	T_C = 80°C	T_C = 65°C	T_C = 93°C	T_C = 30°C	
		Sensitive Gate			
	Case 79-04 TO-205AD (TO-39) Style 3		Case 77-07 TO-126 Style 2		Case 369 Style 5
50	2N1595		MCR106-2 2N6237	C106F	
100	2N1596		MCR106-3 2N6238	C106A	MCR703A1
200	2N1597	MCR1906-4	MCR106-4 2N6239	C106B	MCR704A1
400	2N1599	MCR1906-6	MCR106-6 2N6240	C106D	MCR706A1
600		MCR1906-8	MCR106-8 2N6241	C106M	MCR708A1
800					
Maximum Electrical Characteristics					
I_{TSM} (Amps) 60 Hz	15		25	20	25
I_{GT} (mA)	10	1	0.2		0.075
V_{GT} (V)	3	1		0.8	1
T_J Operating Range (°C)	–65 to +125	–65 to +110	–40 to +110		

On-State (RMS) Current					
4 AMPS	**6 AMPS**	**8 AMPS**			
T_C = 30°C		T_C = 70°C	T_C = 75°C		
					
Surface Mount	**Sensitive Gate**	**Isolated**			
Case 369A Style 5	**Case 77-07 TO-126 Style 2**	**Case 221C-02 Style 2**	**Case 221A-04 TO-220AB Style 3**		**V_{DRM} V_{RRM} (Volts)**
	MCR506-2	MCR218-2FP	MCR218-2	C122F1	**50**
MCR703A(1)	MCR506-3		MCR218-3	C122A1	**100**
MCR704A(1)	MCR506-4	MCR218-4FP	MCR218-4	C122B1	**200**
MCR706A(1)	MCR506-6	MCR218-6FP	MCR218-6	C122D1	**400**
MCR708A(1)	MCR506-8	MCR218-8FP	MCR218-8	C122M1	**600**
		MCR218-10FP	MCR218-10	C122N1	**800**
Maximum Electrical Characteristics					
25	40	80		90	**I_{TSM} (Amps) 60 Hz**
0.075	0.2	25		25	**I_{GT} (mA)**
1		1.5			**V_{GT} (V)**
–40 to +110		–40 to +125		–40 to +100	**T_J Operating Range (°C)**

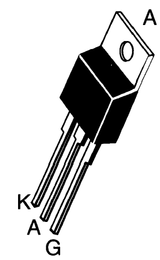
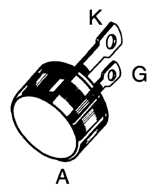
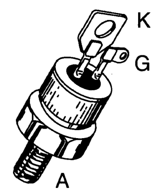
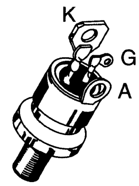
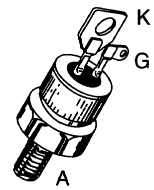
(1) For tape and reel, add suffix "RL."

SCR's (continued)

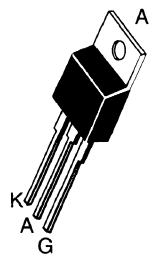
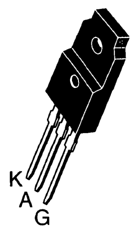
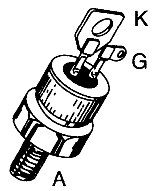


VDRM VRRM (Volts)	On-State (RMS) Current				
	8 AMPS	10 AMPS		12 AMPS	
	T_C = 83°C	T_C = 75°C		T_C = 85°C	T_C = 90°C
	Sensitive Gate				
	Case 221A-04 TO-220AB Style 3				
50	MCR72-2	MCR310-2	S2800F	MCR68-2	2N6394
100	MCR72-3	MCR310-3	S2800A	MCR68-3	2N6395
200	MCR72-4	MCR310-4	S2800B		2N6396
400	MCR72-6	MCR310-6	S2800D	MCR68-6	2N6397
600	MCR72-8	MCR310-8	S2800M		2N6398
800	MCR72-10	MCR310-10	S2800N		2N6399
Maximum Electrical Characteristics					
I_{TSM} (Amps) 60 Hz	100			300[1]	100
I_{GT} (mA)	0.2		15	30	
V_{GT} (V)	1.5				
T_J Operating Range (°C)	−40 to +110		−40 to +100	−40 to +125	

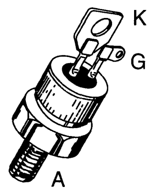
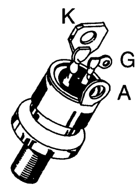
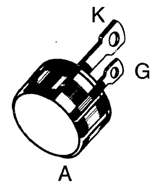
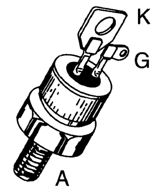
[1] Peak capacitor discharge current for t_w = 1 ms. t_w is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

On-State (RMS) Current					
16 AMPS	**20 AMPS**				
$T_C = 90°C$	$T_C = 65°C$			$T_C = 67°C$	
			 **Isolated**		
Case 221A-04 TO-220AB Style 3	**Case 174-04 Style 1**	**Case 263-04 Style 1**	**Case 311-02 Style 1**	**Case 263-04 Style 1**	**V_{DRM} V_{RRM} (Volts)**
2N6400		2N5168		MCR3918-2A	**50**
2N6401	MCR6200A	S6210A	2N6167 S6220A	MCR3918-3A	**100**
2N6402	MCR6200B	S6210B	2N6168 S6220B	MCR3918-4A	**200**
2N6403	MCR6200D	S6210D	2N6169 S6220D	MCR3918-6A	**400**
2N6404	MCR6200M	S6210M	2N6170 S6220M	MCR3918-8A	**600**
2N6405				MCR3918-10A	**800**
Maximum Electrical Characteristics					
160	MCR6200/S6210/S6220/2N 200/200/200/240			240	**I_{TSM} (Amps) 60 Hz**
30	MCR6200/S6210/S6220/2N 15/15/15/40			40	**I_{GT} (mA)**
1.5	MCR6200/S6210/S6220/2N . . . . 2/2/2/1.5 or 1.6			1.5	**V_{GT} (V)**
–40 to +125	–40 to +100		–40 to +100	–40 to +125	**T_J Operating Range (°C)**

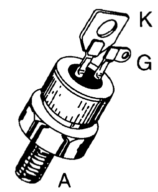
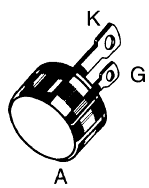
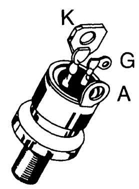
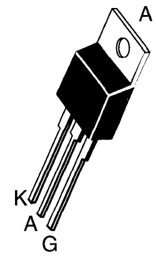
SCR's (continued)

V_{DRM} V_{RRM} (Volts)	On-State (RMS) Current				
	25 AMPS				
	T_C = 85°C			T_C = 65°C	T_C = 60°C
			 Isolated		
	Case 221A-04 TO-220AB Style 3		Case 221C-02 Style 3	Case 263-04 Style 1	
50	2N6504	MCR69-2	MCR225-2FP	2N682	MCR230F
100	2N6505	MCR69-3		2N683	MCR230A
200	2N6506		MCR225-4FP	2N685	MCR230B
400	2N6507	MCR69-6	MCR225-6FP	2N688	MCR230D
600	2N6508		MCR225-8FP	2N690	MCR230M
800	2N6509		MCR225-10FP	2N692	
Maximum Electrical Characteristics					
I_{TSM} (Amps) 60 Hz	300	750(1)	300	150	250
I_{GT} (mA)	40	30	40		25
V_{GT} (V)	1.5			2	
T_J Operating Range (°C)	–40 to +125			–65 to +125	–40 to +125

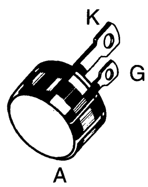
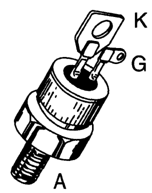
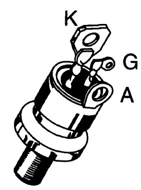
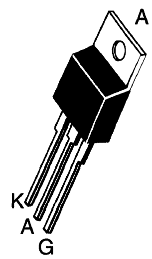
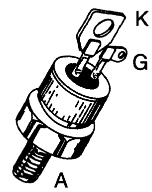
(1) Peak capacitor discharge current for t_w = 1 ms. t_w is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

On-State (RMS) Current					
25 AMPS				35 AMPS	
$T_C = 60°C$	$T_C = 65°C$		$T_C = 70°C$	$T_C = 65°C$	
	 Isolated				
Case 263-04 Style 1	**Case 311-02 Style 1**		**Case 174-04 Style 1**	**Case 263-04 Style 1**	**V_{DRM} V_{RRM} (Volts)**
MCR231F	MCR230F3	MCR231F3			**50**
MCR231A	MCR230A3	MCR231A3	2N3870		**100**
MCR231B	MCR230B3	MCR231B3	2N3871	MCR3935-4A	**200**
MCR231D	MCR230D3	MCR231D3	2N3872	MCR3935-6A	**400**
MCR231M	MCR230M3	MCR231M3	2N3873	MCR3935-8A	**600**
			MCR3835-10	MCR3935-10A	**800**
Maximum Electrical Characteristics					
250			350		**I_{TSM} (Amps) 60 Hz**
9	25	9	40		**I_{GT} (mA)**
2	1.5		MCR3835/MCR3935/2N 1.5/1.5/1.6		**V_{GT} (V)**
–40 to +125					**T_J Operating Range (°C)**

SCR's (continued)

	On-State (RMS) Current				
	35 AMPS				40 AMPS
	$T_C = 65°C$				$T_C = 80°C$
			 Isolated		
V_{DRM} V_{RRM} (Volts)	Case 263-04	Case 174-04 Style 1	Case 311-02 Style 1		Case 221A-04 TO-220AB Style 3
50	MCR70-2A				
100	MCR70-3A	MCR229A	2N6171	C228A3	
200		MCR229B	2N6172	C228B3	MCR264-4
400	MCR70-6A	MCR229D	2N6173	C228D3	MCR264-6
600		MCR229M	2N6174	C228M3	MCR264-8
800					MCR264-10
Maximum Electrical Characteristics					
I_{TSM} (Amps) 60 Hz	350 850(1)	300	350	300	400
I_{GT} (mA)	30	40			50
V_{GT} (V)	1.5	2.5	1.6	2.5	1.5
T_J Operating Range (°C)	–40 to +125				

(1) Peak capacitor discharge current for t_w = 1 ms. t_w is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

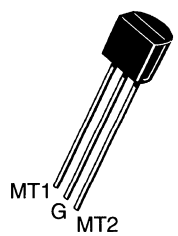
On-State (RMS) Current					
55 AMPS					
T_C = 75°C		T_C = 70°C		T_C = 85°C	
					
		Isolated			
Case 174-04 Style 1	Case 263-04 Style 1	Case 311-02 Style 1	Case 221A-04 TO-220AB Style 3	Case 263-04 Style 1	V_{DRM} V_{RRM} (Volts)
MCR63-2A	MCR64-2		MCR265-2	MCR71-2	50
MCR63-3A	MCR64-3	MCR65-3		MCR71-3	100
MCR63-4A	MCR64-4	MCR65-4	MCR265-4		200
MCR63-6A	MCR64-6	MCR65-6	MCR265-6	MCR71-6	400
MCR63-8A	MCR64-8	MCR65-8	MCR265-8		600
MCR63-10A	MCR64-10	MCR65-10	MCR265-10		800
Maximum Electrical Characteristics					
550				550 1700(1)	I_{TSM} (Amps) 60 Hz
40			50	30	I_{GT} (mA)
3			1.5		V_{GT} (V)
−40 to +125					T_J Operating Range (°C)

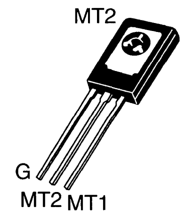
(1) Peak capacitor discharge current for t_w = 1 ms. t_w is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

TRIACs

Metal/Plastic Packages

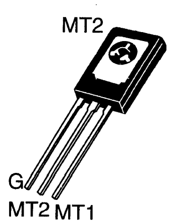
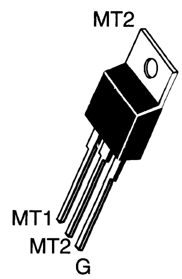
0.6 to 40 Amperes
25 to 800 Volts



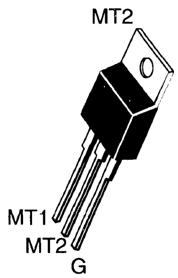
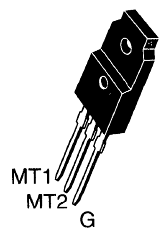
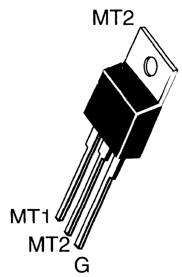


V_{DRM} (Volts)	On-State (RMS) Current				
	0.6 AMP		0.8 AMP		2.5 AMPS
	T_C = 50°C		T_C = 60°C		T_C = 70°C
	Sensitive Gate				
	Case 29-04 TO-226AA (TO-92) Style 12				Case 77-07 Style 5
200	MAC97-4	MAC97A4	LMAC94A2	LMAC94B2	T2322B
400	MAC97-6	MAC97A6	LMAC94A3	LMAC94B3	T2322D
600	MAC97-8	MAC97A8	LMAC94A4	LMAC94B4	T2322M
800					
Maximum Electrical Characteristics					
I_{TSM} (Amps)	8				25
I_{GT} @ 25°C (mA)					
MT2(+)G(+)	10	5	10	25	10
MT2(+)G(–)	10	5	10	25	10
MT2(–)G(–)	10	5	10	25	10
MT2(–)G(+)	10	7	10	25	10
V_{GT} @ 25°C (V)					
MT2(+)G(+)	2				2.2
MT2(+)G(–)	2				2.2
MT2(–)G(–)	2				2.2
MT2(–)G(+)	2.5				2.2
T_J Operating Range (°C)	–40 to +110				

NOTE: Industry Standards, with a variety of Custom Specifications and Leadforms available.

On-State (RMS) Current					
2.5 AMPS	4 AMPS			6 AMPS	
T_C = 70°C	T_C = 85°C			T_C = 80°C	
 Sensitive Gate					
Case 77-07 Style 5				Case 221A-04 TO-220AB Style 4	V_{DRM} (Volts)
T2323B	2N6071	2N6071A	2N6071B	T2500B	200
T2323D	2N6073	2N6073A	2N6073B	T2500D	400
T2323M	2N6075	2N6075A	2N6075B	T2500M	600
				T2500N	800
Maximum Electrical Characteristics					
25	30			60	I_{TSM} (Amps)
25 40 25 40	30 — 30 —	5 5 5 10	3 3 3 5	25 60 25 60	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
2.2 2.2 2.2 2.2	@ –40°C 2.5 — 2.5 —	@ –40°C 2.5 2.5 2.5 2.5		2.5 2.5 2.5 2.5	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
–40 to +110		–40 to +100			T_J Operating Range (°C)

TRIACs (continued)

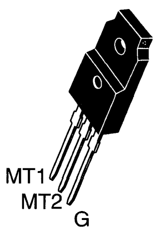
	On-State (RMS) Current				
	6 AMPS			8 AMPS	
	T_C = 80°C				
		 **Isolated**			
V_{DRM} (Volts)	**Case 221A-04 TO-220AB Style 4**	**Case 221C-02 Style 3**	**Case 221A-06 TO-220AB Style 4**		
200	T2801B	T2500BFP	SC141B	SC143B	MAC218-4 MAC218A4
400	T2801D	T2500DFP	SC141D	SC143D	MAC218-6 MAC218A6
600	T2801M	T2500MFP	SC141M	SC143M	MAC218-8 MAC218A8
800		T2500NFP	SC141N		MAC218-10 MAC218A10
Maximum Electrical Characteristics					
I_{TSM} (Amps)	80	100	80	100	
I_{GT} @ 25°C (mA) **MT2(+)G(+)** **MT2(+)G(–)** **MT2(–)G(–)** **MT2(–)G(+)**	80 — 80 —	25 60 25 60	50 50 50 —		50 50 50 75*
V_{GT} @ 25°C (V) **MT2(+)G(+)** **MT2(+)G(–)** **MT2(–)G(–)** **MT2(–)G(+)**	2.5 2.5 2.5 2.5		2.5 2.5 2.5 —		2 2 2 2.5*
T_J Operating Range (°C)	–40 to +100		–40 to +110		–40 to +125

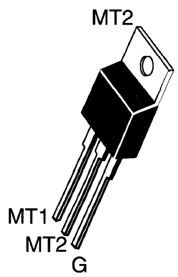
* Applied to A-version only.
Non A-version is unspecified.

On-State (RMS) Current

8 AMPS

$T_C = 80°C$





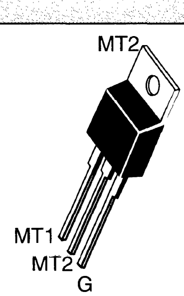
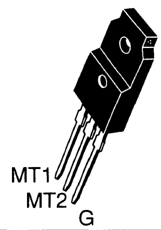
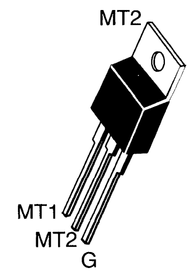
Isolated	High Noise Immunity				
Case 221C-02 Style 3	Case 221A-04 TO-220AB Style 4				V_{DRM} (Volts)
MAC218-4FP MAC218A4FP	MAC219-4	2N6342 2N6346	T2800B	T2802B	200
MAC218-6FP MAC218A6FP	MAC219-6	2N6343 2N6347	T2800D	T2802D	400
MAC218-8FP MAC218A8FP	MAC219-8	2N6344 2N6348	T2800M	T2802M	600
MAC218-10FP MAC218A10FP	MAC219-10	2N6345 2N6349			800

Maximum Electrical Characteristics

100					I_{TSM} (Amps)
50 50 50 75*	100 100 100 —	50 75# 50 75#	25 60 25 60	50 — 50 —	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
2 2 2 2.5*	2 2 2 —	2 2.5# 2.5 2.5#	2.5 2.5 2.5 2.5	2.5 — 2.5 —	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
–40 to +125			–40 to +100		T_J Operating Range (°C)

* Applied to A-version only.
Non A-version is unspecified.
\# Denotes 2N6346-49 Series only.

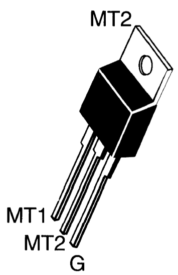
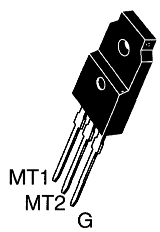
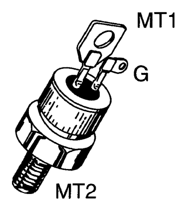
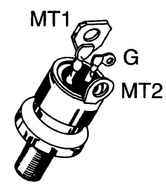
TRIACs (continued)

V_{DRM} (Volts)	On-State (RMS) Current				
	8 AMPS				10 AMPS
	T_C = 80°C				T_C = 70°C
					
			Isolated		
	Sensitive Gate				
	Case 221A-04 TO-220AB Style 4		Case 221C-02 Style 3		Case 221A-04 TO-220AB Style 4
200	MAC228-4 MAC228A4	MAC229-4 MAC229A4	MAC228-4FP MAC228A4FP	MAC229-4FP MAC229A4FP	MAC210-4 MAC210A4
400	MAC228-6 MAC228A6	MAC229-6 MAC229A6	MAC228-6FP MAC228A6FP	MAC229-6FP MAC229A6FP	MAC210-6 MAC210A6
600	MAC228-8 MAC228A8	MAC229-8 MAC228A8	MAC228-8FP MAC228A8FP	MAC229-8FP MAC2298FP	MAC210-8 MAC210A8
800	MAC228-10 MAC228A10	MAC229-10 MAC229A10	MAC228-10FP MAC228A10FP	MAC229-10FP MAC229A10FP	MAC210-10 MAC210A10
Maximum Electrical Characteristics					
I_{TSM} (Amps)	80				100
I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)	 5 5 5 10*	 10 10 10 20*	 5 5 5 10*	 10 10 10 20*	 50 50 50 75*
V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)	 2 2 2 2.5*				
T_J Operating Range (°C)	–40 to +110				–40 to +125

* Applied to A-version only.
Non A-version is unspecified.

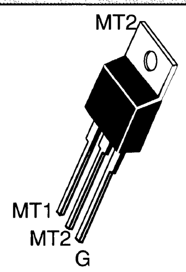
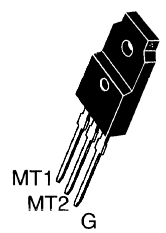
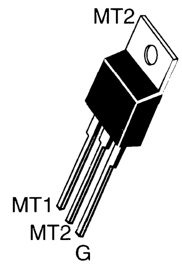
On-State (RMS) Current

10 AMPS

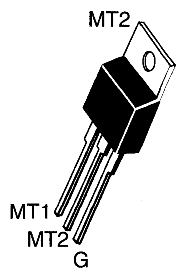
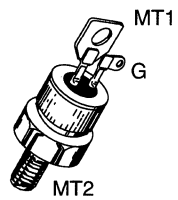
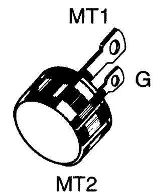
T_C = 80°C	T_C = 70°C	T_C = 85°C	T_C = 78°C	T_C = 85°C	
	 Isolated			 Isolated	
Case 221A-04 TO-220AB Style 4	Case 221C-02 Style 3	Case 263-04 Style 2		Case 311-02 Style 2	V_{DRM} (Volts)
SC146B	MAC210-4FP MAC210A4FP	MAC5569	MAC245B	MAC4121B	200
SC146D	MAC210-6FP MAC210A6FP	MAC5570	MAC245D	MAC4121D	400
SC146M	MAC210-8FP MAC210A8FP	MAC4111M	MAC245M	MAC4121M	600
SC146N	MAC210-10FP MAC210A10FP		MAC245N	MAC4121N	800
Maximum Electrical Characteristics					
120	100				I_{TSM} (Amps)
50 50 50 —	50 50 50 75*	25 40 25 40	50 50 50 —	25 40 25 40	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
2.5 2.5 2.5 —	2 2 2 2.5*	2.5 2.5 2.5 2.5	2.5 2.5 2.5 —	2.5 2.5 2.5 2.5	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
–40 to +125		–65 to +125	–40 to +125	–65 to +125	T_J Operating Range (°C)

* Applied to A-version only.
Non A-version is unspecified.

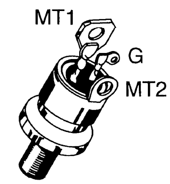
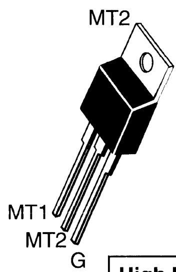
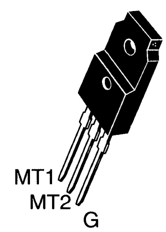
TRIACs (continued)

	On-State (RMS) Current				
	12 AMPS				
	$T_C = 75°C$	$T_C = 85°C$			$T_C = 80°C$
					
	Sensitive Gate	**Isolated**		**High Noise Immunity**	
V_{DRM} (Volts)	**Case 221A-04 TO-220AB Style 4**	**Case 221C-02 Style 3**	**Case 221A-04 TO-220AB Style 4**		
200	MAC310-4 MAC310A4	MAC212-4FP MAC212A4FP	MAC212-4 MAC212A4	MAC213-4	SC149B
400	MAC310-6 MAC310A6	MAC212-6FP MAC212A6FP	MAC212-6 MAC212A6	MAC213-6	SC149D
600	MAC310-8 MAC318A8	MAC212-8FP MAC212A8FP	MAC212-8 MAC212A8	MAC213-8	SC149M
800	MAC310-10 MAC310A10	MAC212-10FP MAC212A10FP	MAC212-10 MAC212A10	MAC213-10	
Maximum Electrical Characteristics					
I_{TSM} (Amps)	100				120
I_{GT} @ 25°C (mA) **MT2(+)G(+)** **MT2(+)G(–)** **MT2(–)G(–)** **MT2(–)G(+)**	5 5 5 10*	50 50 50 75*	50 50 50 75*	100 100 100 —	50 50 50 —
V_{GT} @ 25°C (V) **MT2(+)G(+)** **MT2(+)G(–)** **MT2(–)G(–)** **MT2(–)G(+)**	2 2 2 2.5*	2 2 2 2.5*		2 2 2 —	2.5 2.5 2.5 —
T_J Operating Range (°C)	–40 to +125				

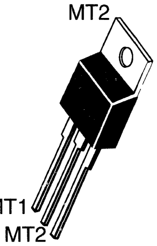
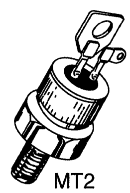
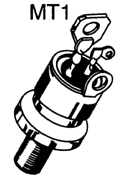
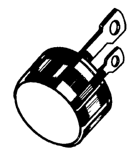
* Applied to A-version only.
Non A-version is unspecified.

On-State (RMS) Current					
12 AMPS		**15 Amps**			
T_C = 80°C		T_C = 85°C	T_C = 80°C		
					
Case 221A-04 TO-220AB Style 4		**Case 263-04 Style 2**	**Case 174-04 Style 3**		**V_{DRM} (Volts)**
2N6342A	2N6346A	MAC250B	2N5571	SC251B	**200**
2N6343A	2N6347A	MAC250D	2N5572	SC251D	**400**
2N6344A	2N6348A	MAC250M	T4100M	SC251M	**600**
2N6345A	2N6349	MAC250N			**800**
Maximum Electrical Characteristics					
120		100			**I_{TSM} (Amps)**
50 — 50 —	50 75 50 75	50 50 50 —	50 80 50 80		**I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)**
2 — 2 —	2 2.5 2 2.5	2.5 2.5 2.5 —	2.5 2.5 2.5 2.5		**V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)**
–40 to +125		–40 to +115	–40 to +100		**T_J Operating Range (°C)**

TRIACs (continued)

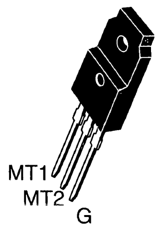
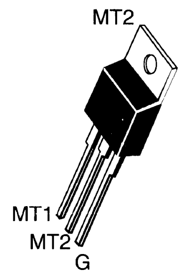
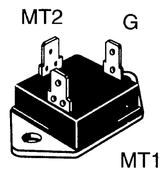
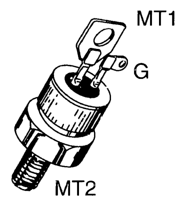
	On-State (RMS) Current				
	15 AMPS				20 AMPS
	$T_C = 75°C$	$T_C = 90°C$			$T_C = 75°C$
					
	Isolated		High Noise Immunity	Isolated UL Listed (1)	
V_{DRM} (Volts)	Case 311-02 Style 2	Case 221A-04 TO-220AB Style 4		Case 221C-02 Style 3	
200	MAC4120B	MAC15-4 MAC15A4	MAC16-4	MAC15-4FP MAC15A4FP	MAC320-4FP MAC320A4FP
400	MAC4120D	MAC15-6 MAC15A6	MAC16-6	MAC15-6FP MAC15A6FP	MAC320-6FP MAC320A6FP
600	MAC4120M	MAC15-8 MAC15A8	MAC16-8	MAC15-8FP MAC15A8FP	MAC320-8FP MAC320A8FP
800	MAC4120N	MAC15-10 MAC15A10	MAC16-10	MAC15-10FP MAC15A10FP	MAC320-10FP MAC320A10FP
Maximum Electrical Characteristics					
I_{TSM} (Amps)	100	150			
I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)	 50 80 50 80	 50 50 50 75*	 100 100 100 —	 50 50 50 75*	
V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)	 2.5 2.5 2.5 2.5	 2 2 2 2.5*	 2 2 2 —	 2 2 2 2.5*	
T_J Operating Range (°C)	–40 to +100	–40 to +125			

(1) UL #E69369
* Applied to A-version only.
Non A-version is unspecified.

On-State (RMS) Current					
20 AMPS	**25 AMPS**				
T_C = 75°C		T_C = 80°C	T_C = 75°C	T_C = 80°C	
					
	High Noise Immunity		**Isolated**		
Case 221A-04 TO-220AB Style 4		Case 263-04 Style 2	Case 311-02 Style 2	Case 174-04 Style 3	V_{DRM} (Volts)
MAC320-4 MAC320A4	MAC321-4	SC260B	SC260B3	MAC261B	200
MAC320-6 MAC320A6	MAC321-6	SC260D	SC260D3	MAC261D	400
MAC320-8 MAC320A8	MAC321-8	SC260M	SC260M3	MAC261M	600
MAC320-10 MAC320A10	MAC321-10				800
Maximum Electrical Characteristics					
150		250			I_{TSM} (Amps)
50 50 50 75*	100 100 100 —	50 50 50 —			I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
2 2 2 2.5*	2 2 2 —	2.5 2.5 2.5 —			V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
–40 to +125		–40 to +115			T_J Operating Range (°C)

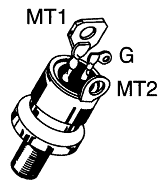
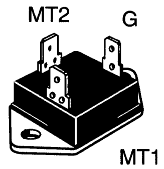
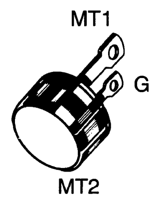
* Applied to A-version only.
Non A-version is unspecified.

TRIACs (continued)

V_{DRM} (Volts)	On-State (RMS) Current				
	25 AMPS			30 AMPS	
	T_C = 80°C		T_C = 85°C		T_C = 60°C
					
	Isolated		**Isolated UL Listed (1)**		
	Case 221C-02 Style 3	Case 221A-04 TO-220AB Style 4	Case 383-01 Style 1	Case 263-04 Style 2	
200	MAC223-4FP MAC223A4FP	MAC223-4 MAC223A4	MAC625-4	2N6160	T6411B
400	MAC223-6FP MAC223A6FP	MAC223-6 MAC223A6	MAC625-6	2N6161	T6411D
600	MAC223-8FP MAC223A8FP	MAC223-8 MAC223A8	MAC625-8	2N6162	T6411M
800	MAC223-10FP MAC223A10FP	MAC223-10 MAC223A10			T6411N
Maximum Electrical Characteristics					
I_{TSM} (Amps)	250				300
I_{GT} @ 25°C (mA)					
MT2(+)G(+)	50		50	60	50
MT2(+)G(–)	50		50	70	80
MT2(–)G(–)	50		50	70	50
MT2(–)G(+)	75*		—	100	80
V_{GT} @ 25°C (V)					
MT2(+)G(+)	2		3	2	2.5
MT2(+)G(–)	2		3	2.1	2.5
MT2(–)G(–)	2		3	2.1	2.5
MT2(–)G(+)	2.5*		—	2.5	2.5
T_J Operating Range (°C)	–40 to +125			–65 to +125	–65 to +100

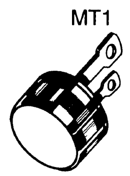
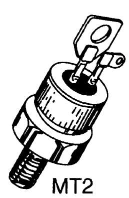
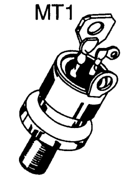
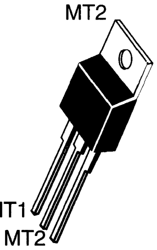
(1) UL #E69369

* Applied to A-version only.
Non A-version is unspecified.

On-State (RMS) Current					
30 AMPS		35 AMPS	40 AMPS		
T_C = 85°C	T_C = 55°C	T_C = 58°C	T_C = 65°C	T_C = 70°C	
					
Isolated		Isolated UL Listed (1)			
Case 311-02 Style 2		Case 383-01 Style 1	Case 174-04 Style 3		V_{DRM} (Volts)
2N6163	T6421B	MAC635-4	MAC6401B	MAC5441	200
2N6164	T6421D	MAC635-6	MAC6401D	MAC5442	400
2N6165	T6421M	MAC635-8	MAC6401M	MAC5443	600
	T6421N		MAC6401N		800
Maximum Electrical Characteristics					
250	300	330	300		I_{TSM} (Amps)
60 70 70 100	50 80 50 80	50 50 50 —	50 80 50 80	70 70 70 100	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
2 2.1 2.1 2.5	2.5 2.5 2.5 2.5	3 3 3 —	2.5 2.5 2.5 2.5	2 2 2 2.5	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(–) MT2(–)G(–) MT2(–)G(+)
–40 to +100	–65 to +100	–40 to +125	–65 to +125		T_J Operating Range (°C)

(1) UL #E69369

TRIACs (continued)

	On-State (RMS) Current			
	40 AMPS			
	T_C = 70°C	T_C = 65°C	T_C = 60°C	T_C = 75°C
				
			Isolated	
V_{DRM} (Volts)	Case 174-04 Style 3	Case 263-04 Style 2	Case 311-02 Style 2	Case 221A-04 TO-220AB Style 4
200	MAC6400B	2N5444	T6420B	MAC224-4 MAC224A4
400	MAC6400D	2N5445	T6420D	MAC224-6 MAC224A6
600	MAC6400M	2N5446	T6420M	MAC224-8 MAC224A8
800	MAC6400N		T6420N	MAC224-10 MAC224A10
Maximum Electrical Characteristics				
I_{TSM} (Amps)	300			350
I_{GT} @ 25°C (mA)				
MT2(+)G(+)	50	70	50	50
MT2(+)G(–)	80	70	80	50
MT2(–)G(–)	50	70	50	50
MT2(–)G(+)	80	100	80	75*
V_{GT} @ 25°C (V)				
MT2(+)G(+)	2.5	2	2.5	2
MT2(+)G(–)	2.5	2	2.5	2
MT2(–)G(–)	2.5	2	2.5	2
MT2(–)G(+)	2.5	2.5	2.5	2.5*
T_J Operating Range (°C)	–65 to +125	–65 to +110		–40 to +125

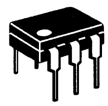
* Applied to A-version only.
Non A-version is unspecified.

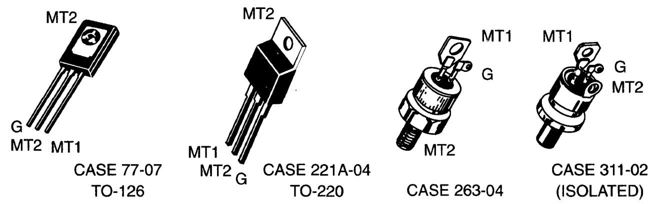
TRIACs

Optically Isolated

Triac Driver/Triac Combinations

This series of Triac Drivers consists of infrared LEDs optically coupled to photodetectors with Triac output. 7500 V isolation between input and output allows safe, economical triggering of higher power triacs from logic sources with output as low as 3 volts, 10 mA. Associated voltage-compatible triacs provide matched pairs for a variety of voltage/current requirements.





Triac Drivers — all in Case 730A

Peak Blocking Voltage Volts	LED Trigger Current I_{FT} mA, Max	Device
250	30 15 10	MOC3009 3010 3011
400	30 15	3020 3021
For Zero Crossover Firing		
250	30 15	MOC3030* 3031*
400	30 15	3040 3031
600	30 15	3060 3061

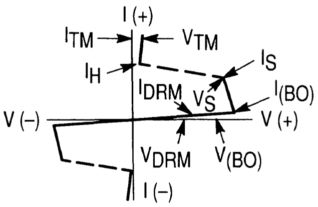
*Underwriters' Laboratories Recognition, File No. E54915.

Triacs

Output Current I_{RMS} A, Max	Peak Blocking Voltage Volts			Case
	250	400	600	
4	MAC3010-4	MAC3020-4	—	77
8	-8	-8	—	221A
15	-15	-15	—	221A
25	-25	-25	—	221A
40	-40	-40	—	263
40	-40I	-40I	—	311
For Zero Crossover Firing				
4	MAC3030-4	MAC3040-4	MAC3060-4	77
8	-8	-8	-8	221A
15	-15	-15	-15	221A
25	-25	-25	-25	221A
40	-40	-40		
40	-40I	-40I		

Thyristor Triggers

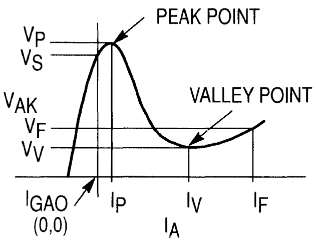
SIDACs



High voltage trigger devices similar in operation to a Triac. Upon reaching the breakover voltage in either direction, the device switches to a low-voltage on-state.

Device Type	I_{TSM} Amps	V_{BO} Volts	
		Min	Max
Case 267-03/1			
MK1V115	20	104	115
MK1V125	20	110	125
MK1V135	20	120	135
MK1V240	20	220	250
MK1V260	20	240	270
MK1V270	20	250	280
Case 59-04/1			
MKP9V120	4	110	125
MKP9V130	4	120	135
MKP9V240	4	220	250
MKP9V260	4	240	270
MKP9V270	4	250	280

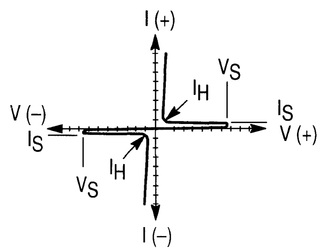
Programmable Unijunction Transistors — PUT



Similar to UJTs, except that I_V, I_P and intrinsic standoff voltage are programmable (adjustable) by means of external voltage divider. This stabilizes circuit performance for variations in device parameters. General operating frequency range is from 0.01 Hz to 10 kHz, making them suitable for long-duration timer circuits.

Device Type	I_P		I_{GAO} @ 40 V	I_V	
	R_G = 10 kΩ	R_G = 1 MΩ		R_G = 10 kΩ	`R_G = 1 MΩ
	μA Max		nA Max	μA Min	μA Max
Plastic TO-92 (Case 29-04/16)					
2N6027	5	2	10	70	50
2N6028	1	0.15	10	25	25

Silicon Bidirectional Switch (SBS)



This versatile trigger device exhibits highly symmetrical bidirectional switching characteristics which can be modified by means of a gate lead. Requires a gate trigger current of only 250 μAdc for triggering.

Device Type	V_S Volts		I_S μA Max	I_H mA Max
	Min	Max		
Plastic TO-92/TO-226AA (Case 29-04/12)7z				
MBS4991	6	10	500	1.5
MBS4992	7.5	9	120	0.5
MBS4993	7.5	9	250	0.75

Winner 1988

Malcolm Baldrige National Quality Award

Rectifiers

In Brief . . .

Continuing investment in research and development for discrete products has led to a rectifier manufacturing facility that matches the precision and versatility of the most advanced integrated circuits. As a result, Motorola's silicon rectifiers span all applications categories with quality levels capable of passing the most stringent environmental tests – including those for automotive under-hood applications.

Product Highlights:

- Application specific rectifiers; SCANSWITCH devices for high resolution monitors, MEGAHERTZ series rectifiers for high frequency switching power supplies and automotive transient suppressors.
- Schottky rectifiers for low voltage (15 to 200 volts), high current (to 600 amps) requirements in switching power supplies.
- Fast and Ultrafast rectifiers with reverse recovery times as low as 25 ns to complement the Schottky offering for higher voltage requirements in high frequency applications.
- A full line of low-cost, general purpose rectifiers with forward currents from 1 to 50 amps and breakdown voltages from 50 to 1000 volts.
- A wide variety of package options to match virtually any potential requirement.

Application Specific Rectifiers

The focus for Rectifier Products continues to be on Schottky and Ultrafast technologies, with process and packaging improvements to achieve greater efficiency in high frequency switching power supplies, high current mainframe supplies, and high resolution monitors. Our new product thrust is intended to be more "application specific" than in the past, while continuing to strive for broad market acceptance.

MEGAHERTZ Series — This group of Schottky and Ultrafast rectifiers are designed to provide improved efficiency in very high frequency switching power supplies with low V_F (0.41 volts), high voltage (to 200 volts) Schottkys and faster Ultrafast (t_{rr} = 28 nsec.).

MEGAHERTZ ™

Device	I_O (Amps)	V_{RRM} (Volts)	Maximum		t_{rr} (Nanosecond)
			V_F @ Rated I_O and Temp. (Volts)	I_R @ Rated V_{RRM} / 25°C (mAmps)	
MBR2015CTL	20	15	0.48	5	*
MBR2030CTL	20	30	0.48	5	*
MBR2530CTL	25	30	0.41	20	*
MBR2535CTL	25	35	0.41	20	*
MBR20150CT	20	150	0.9	1	*
MBR20200CT	20	200	0.9	1	*
MURH840CT	8	400	1.7	0.01	28
MURH860CT	8	600	2.0	0.01	28

*Schottky barrier device.

SCANSWITCH™ Series — This group of Fast and Ultrafast rectifiers are designed for improved performance in very high resolution monitors and work stations where forward recovery time (t_{fr}) and high voltage (1200–1500 volts) are primary considerations.

SCANSWITCH™

Device	I_O (Amps)	V_{RRM} (Volts)	Maximum		
			t_{fr} (Nanosecond)	t_{rr} (Nanosecond)	*V_{RFM} (Volts)
MUR5150E	5	1500	225	175	20
MR10120E	10	1200	175	1000	14
MUR10120E	10	1200	175	175	14
MR10150E	10	1500	175	1000	16
MUR10150E	10	1500	175	175	16

*V_{RFM} = Maximum Transient Overshoot Voltage.

Automotive transient suppressors are designed for protection against over-voltage conditions in the auto electrical system including the "LOAD DUMP" phenomenon that occurs when the battery open circuits while the car is running.

Device	I_O (Amps)	V_{RRM} (Volts)	$V_{(BR)}$ (Volts)	I_{RSM}* (Amps)	T (°C)
MR2535L	35	20	24–32	110	175

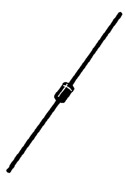
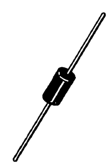
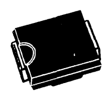
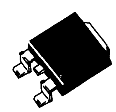
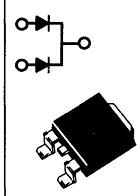
*Time constant = 10 ms, Duty Cycle ≤ 1%, T_C = 25°C.

Schottky Rectifiers

SWITCHMODE Schottky power rectifiers with the high speed and low forward voltage drop characteristic of Schottky's metal/silicon junctions are produced with ruggedness and temperature performance comparable to silicon-junction rectifiers. Ideal for use in low voltage, high frequency power supplies and as very fast clamping diodes, these devices feature switching times les than 10 ns, and are offered in current ranges from 1 to 600 amperes, and reverse voltages to 200 volts.

In some current ranges, devices are available with junction temperature specifications of 125°C, 150°C, 175°C. Devices with higher T_J ratings can have significantly lower leakage currents, but higher forward-voltage specifications. These parameter tradeoffs should be considered when selecting devices for applications that can be satisfied by more than one device type number.

All devices are connected cathode to case or cathode to heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)								
	1		3					5	6
	59-04 Plastic	403A-02 SMB	267-03 Plastic		403-03 SMC	369A-05 DPAK		60-01 Metal	369A-05 DPAK
									
20	1N5817	MBRS120T3	1N5820	MBR320	MBRS320T3	MBRD320		1N5823	MBRD620CT
25									
30	1N5818	MBRS130T3	1N5821	MBR330	MBRS330T3	MBRD330		1N5824	MBRD630CT
35									
40	1N5819	MBRS140T3	1N5822	MBR340	MBRS340T3	MBRD340		1N5825	MBRD640CT
45									
50	MBR150			MBR350		MBRD350			MBRD650CT
60	MBR160			MBR360		MBRD360			MBRD660CT
70	MBR170	MBRS170T3		MBR370					
80	MBR180	MBRS180T3		MBR380					
90	MBR190	MBRS190T3		MBR390					
100	MBR1100	MBRS1100T3		MBR3100					
I_{FSM} (Amperes)	25	40	80	80	80	75		500	75
Max V_F @ $I_{FM} = I_O$	*0.6 $T_L = 25°C$	*0.6 $T_C = 25°C$	*0.525 $T_L = 25°C$	**0.74 $T_L = 25°C$	*0.525 $T_L = 25°C$	0.45 $T_C = 125°C$		*0.38 $T_C = 25°C$	0.85 $T_C = 125°C$
T_J (Max) °C	125	125	125	150	125	150		125	150

* Values are for 40 volt units, lower voltage parts exhibit lower V_F.
** I_O is total device output current.

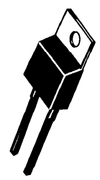
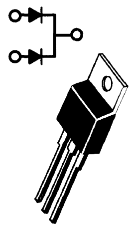
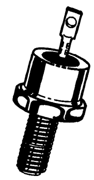
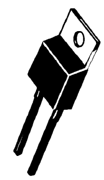
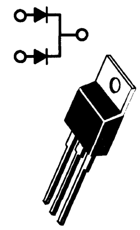
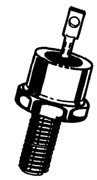
SCHOTTKY RECTIFIERS (continued)

There are many other standard features in Motorola Schottky rectifiers that give added performance and reliability.

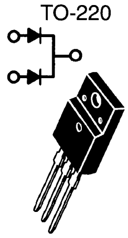
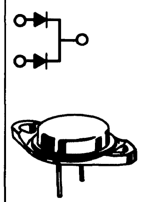
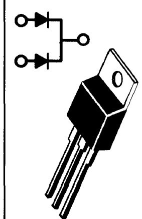
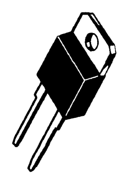
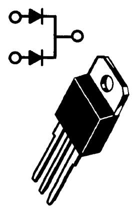
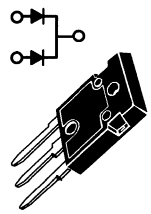
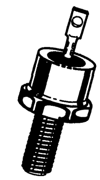
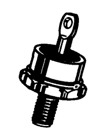
1. GUARDRINGS are included in all Schottky die for reverse voltage stress protection from high rates of dv/dt to virtually eliminate the need for snubber networks. The guardring also operates like a zener and avalanches when subjected to voltage transients.

2. MOLYBDENUM DISCS on both sides of the die minimize fatigue from power cycling in all metal products. The plastic TO-220 devices have a special solder formulation for the same purpose.

3. QUALITY CONTROL monitors all critical fabrication operations and performs selected stress tests to assure constant processes.

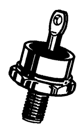
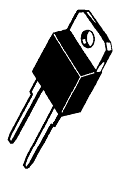
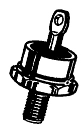
V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
	7.5	10	15		16	20	25	
	221B-01 (TO-220AC) 		221A-06 (TO-220AB) 	56-03 (DO-203AA) 	221B-01 (TO-220AC) 	221A-06 (TO-220AB) 	56-03 (DO-203AA) 	
15						MBR2015CTL		
20				1N5826			1N5829	
30				1N5827		MBR2030CTL	1N5830	1N6095
35	MBR735	MBR1035	MBR1535CT		MBR1635	MBR2035CT MBR2535CTL		
40				1N5828			1N5831	1N6096
45	MBR745	MBR1045	MBR1545CT		MBR1645	MBR2045CT		
50								
60		MBR1060				MBR2060CT		
70		MBR1070				MBR2070CT		
80		MBR1080				MBR2080CT		
90		MBR1090				MBR2090CT		
100		MBR10100				MBR20100CT		
200						MBR20200CT		
I_{FSM} (Amperes)	150	150	150	500	150	150	800	400
Max V_F @ $I_{FM} = I_O$	0.57 T_C = 125°C	0.57 T_C = 125°C	0.72 T_C = 125°C	0.5 T_C = 125°C	0.57 T_C = 125°C	*0.72 T_C = 125°C	*0.48 T_C = 25°C	0.86 @ 78.5 A T_C = 70°C
T_J (Max) °C	150	150	150	150	150	150	125	150

* Values are for 40 volt units, lower voltage parts exhibit lower V_F.
** I_O is total device output current.

V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
	25	30					35	50
	221D-02 ISOLATED TO-220 	11-03 (TO-204AA) 	221A-06 (TO-220AB) 	340E-01 (TO-218) 	340D-01 (TO-218AC) 	340F-01 (TO-247) 	56-03 (DO-203AA) 	257-01 (DO-203AB) 
15								
20		MBR3020CT					MBR3520	1N5832
25								
30								1N5833
35	MBRF2535CT	MBR3035CT	MBR2535CT		MBR3035PT	MBR3045WT	MBR3535	
40								1N5834
45	MBRF2545CT	MBR3045CT SD241	MBR2545CT	MBR3045	MBR3045PT	MBR3045WT	MBR3545 SD41	
50								
60								
70								
80								
90								
100								
I_{FSM} (Amperes)	150	400	300	300	400	350	600	800
Max V_F @ $I_{FM} = I_O$	0.62 @ 12.5 A T_C = 125°C	0.72 T_C = 125°C	0.73 T_C = 125°C	0.62 T_C = 100°C	0.72 T_C = 125°C	0.72 T_C = 125°C	0.55 T_C = 25°C	0.59 T_C = 25°C
T_J (Max) °C	150	150	150	150	150	150	150	125

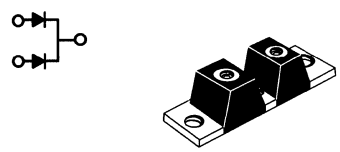
** I_O is total device output current.

SCHOTTKY RECTIFIERS (continued)

V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
	50		60		65	75	80
	257-01 (DO-203AB) 	340E-01 (TO-218) 	257-01 (DO-203AB) 				
15				MBR6015L			
20				MBR6020L			
25		MBR5025L		MBR6025L			
30	1N6097			MBR6030L			
35			MBR6035		MBR6535	MBR7535	MBR8035
40	1N6098						
45		MBR4045	MBR6045 SD51		MBR6545	MBR7545	MBR8045
50							
60							
70							
80							
90							
100							
I_{FSM} (Amperes)	800	500	800	1000	800	1000	1000
Max V_F @ $I_{FM} = I_O$	0.86 @ 157 A $T_C = 70°C$	*0.65 $T_C = 150°C$	*0.6 $T_C = 125°C$	0.38 $T_C = 150°C$	0.62 $T_C = 150°C$	*0.6 $T_C = 125°C$	0.59 $T_C = 150°C$
T_J (Max) °C	125	150	150	150	175	150	175

* Values are for 40 volt units, lower voltage parts exhibit lower V_F.

** I_O is total device output current.

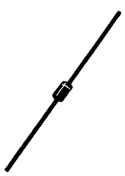
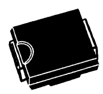
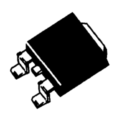
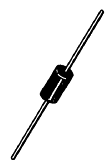
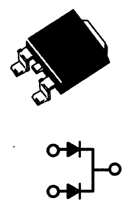
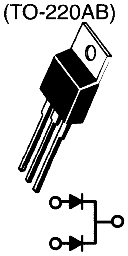
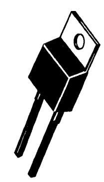
V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)		
	200	300	600
	357C-01 POWER TAP 		
15	MBR20015CTL		
20	MBR20020CTL		
25	MBR20025CTL		
30	MBR20030CTL		MBR60030CTL
35		MBR30035CT	MBR60035CTL
40			
45		MBR30045CT	
50			
60		MBR30050CT	
70		MBR30060CT	
80			
90			
100			
I_{FSM} (Amperes)	1500	2500	4000
Max V_F @ $I_{FM} = I_O$	0.48 $T_C = 150°C$	0.64 $T_C = 125°C$	0.48 $T_C = 150°C$
T_J (Max) °C	175	175	150

** I_O is total device output current.

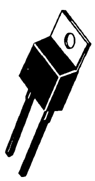
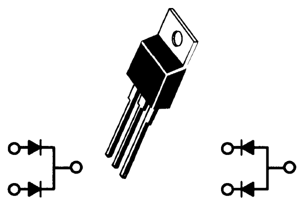
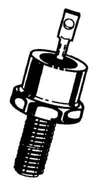
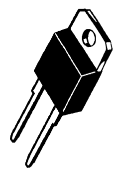
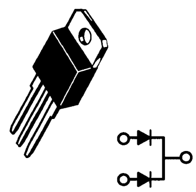
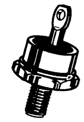
Ultrafast Recovery Rectifiers

EXPANDING the SWITCHMODE rectifier family are these ultrafast devices with reverse recovery times of 25 to 100 nanoseconds. They complement the broad Schottky offering for use in the higher voltage outputs and internal circuitry of switching power supplies as operating frequencies increase from 20 kHz to 250 kHz and beyond. Additional package styles and operating current levels are planned.

All devices are connected cathode to case or cathode to heatsink, except where noted. Contact your Motorola representative for more information.

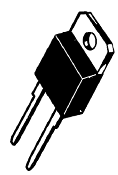
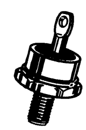
	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
	1		**3**		**4**	**6**		**8**
V_{RRM} (Volts)	59-04 Plastic 	403A-02 SMB 	403-03 SMC 	369A-05 DPAK 	267-03 Plastic 	369A-05 DPAK 	221A-06 (TO-220AB) 	221B-01 (TO-220AC) 
50	MUR105	MURS105T3	MURS305T3	MURD305	MUR405	MURD605CT	MUR605CT	MUR805
100	MUR110	MURS110T3	MURS310T3	MURD310	MUR410	MURD610CT	MUR610CT	MUR810
150	MUR115	MURS115T3	MURS315T3	MURD315	MUR415	MURD615CT	MUR615CT	MUR815
200	MUR120	MURS120T3	MURS320T3	MURD320	MUR420	MURD620CT	MUR620CT	MUR820
300	MUR130	MURS130T3	MURS330T3		MUR430			MUR830
400	MUR140	MURS140T3	MURS340T3		MUR440			MUR840
500	MUR150	MURS150T3	MURS350T3		MUR450			MUR850
600	MUR160	MURS160T3	MURS360T3		MUR460			MUR860
700	MUR170E				MUR470E			MUR870E
800	MUR180E				MUR480E			MUR880E
900	MUR190E				MUR490E			MUR890E
1000	MUR1100E				MUR4100E			MUR8100E
I_{FSM} (Amperes)	35	40	75	75	125	63	75	100
t_{rr} nsec	25/50/75	25/50	25/50	35	25/50/75	35	35	35/60/100
T_J (Max) °C	175	175	175	175	175	175	175	175

** I_O is total device output current.

V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
	15	16		25	30			50
	221B-01 (TO-220AC) 	221A-06 (TO-220AB) 		56-03 (DO-203AA) 	340E-01 (TO-218) 	340D-01 (TO-218AC) 		257-01 (DO-257-01) 
50	MUR1505	MUR1605CT	MUR1605CTR	MUR2505		R710XPT	MUR3005PT	MUR5005
100	MUR1510	MUR1610CT	MUR1610CTR	MUR2510		R711XPT	MUR3010PT	MUR5010
150	MUR1515	MUR1615CT	MUR1615CTR	MUR2515			MUR3015PT	MUR5015
200	MUR1520	MUR1620CT	MUR1620CTR	MUR2520	MUR3020	R712XPT	MUR3020PT	MUR5020
300	MUR1530	MUR1630CT			MUR3030		MUR3030PT	
400	MUR1540	MUR1640CT			MUR3040	R714XPT	MUR3040PT	
500	MUR1550	MUR1650CT					MUR3050PT	
600	MUR1560	MUR1660CT					MUR3060PT	
700								
800								
900								
1000					MUR30100E			
I_{FSM} (Amperes)	200	200	100	500	300	150	400	600
t_{rr} nsec	35/60	35	35	50	100	100	35	50
T_J (Max) °C	175	175	175	175	175	150	175	175

** I_O is total device output current.

ULTRAFAST RECOVERY RECTIFIERS (continued)

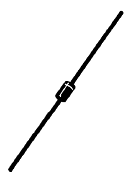
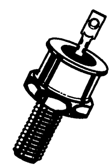
	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)	
	60	70
V_{RRM} (Volts)	340E-01 (TO-218) 	257-01 (DO-257-01) 
50		MUR7005
100		MUR7010
150		MUR7015
200	MUR6020	MUR7020
300	MUR6030	
400	MUR6040	
500		
600		
700		
800		
900		
1000		
I_{FSM} (Amperes)	600	1000
t_{rr} nec	100	50
T_J (Max) °C	175	175

** I_O is total device output current.

Fast Recovery Rectifiers

. . . available for designs requiring a power rectifier having maximum switching times ranging from 200 ns to 750 ns. These devices are offered in current ranges of 1 to 50 amperes and in voltages to 1000 volts.

All devices are connected cathode to case or cathode to heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

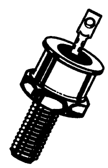
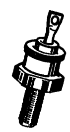
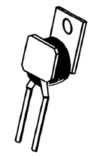
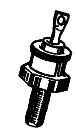
	****I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)**				
	1	**3**		**5**	**6**
V_{RRM} (Volts)	59-04 Plastic 	60-01 Metal 	267-02 Plastic 	194-04 Plastic 	245A-02 (DO-203AA) Metal 
50	†1N4933	MR830	MR850	MR820	1N3879
100	†1N4934	MR831	MR851	MR821	1N3880
200	†1N4935	MR832	MR852	MR822	1N3881
400	†1N4936	MR834	MR854	MR824	1N3883
600	†1N4937	MR836	MR856	MR826	MR1366
800					
1000					
I_{FSM} (Amps)	30	100	100	300	150
T_A @ Rated I_O (°C)	75		*90	*55	
T_C @ Rated I_O (°C)		100			100
T_J (Max) °C	150	150	175	175	150
t_{rr} (µs)	0.2	0.2	0.2	0.2	0.2

* Must be derated for reverse power dissipation. See data sheet.

† Package Size: 0.120″ max diameter by 0.260″ max length.

** I/O is total device output.

FAST RECOVERY RECTIFIERS (continued)

	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)			
	12	20	24	30
V_{RRM} (Volts)	245A-02 (DO-203AA) Metal 	42A-01 (DO-203AB) Metal 	339-02 Plastic Note 1 	42A-01 (DO-203AB) Metal 
50	1N3889	1N3899	MR2400F	1N3909
100	1N3890	1N3900	MR2401F	1N3910
200	1N3891	1N3901	MR2402F	1N3911
400	1N3893	1N3903	MR2404F	1N3913
600	MR1376	MR1386	MR2406F	MR1396
800				
1000				
I_{FSM} (Amps)	200	250	300	300
T_A @ Rated I_O (°C)				
T_C @ Rated I_O (°C)	100	100	125	100
T_J (Max) °C	150	150	175	150
t_{rr} (µs)	0.2	0.2	0.2	0.2

▒ TX versions available.

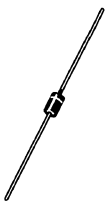
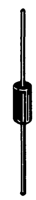
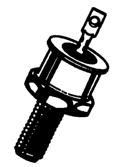
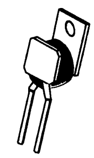
Note 1. Meets mounting configuration of TO-220 outline.

** I/O is total device output.

General-Purpose Rectifiers

Motorola offes a wide variety of low-cost devices, packaged to meet diverse mounting requirements. Avalanche capability is available in the axial lead 1.5, 3 and 6 amp packages shown below to provide protection from transients.

All devices are connected cathode to case or cathode to heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

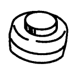
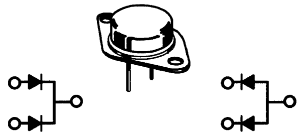
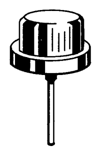
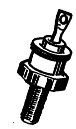
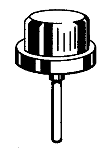
	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
	1	3		6	12	20	24
V_{RRM} (Volts)	59-03 (DO-41) Plastic 	60-01 Metal 	267-02 Plastic 	194-04 Plastic 	245A-02 (DO-203AA) Metal 		339-02 Plastic Note 1 
50	†1N4001	1N4719	1N5400	MR750	MR1120 1N1199,A,B	MR2000	MR2400
100	†1N4002	1N4720	1N5401	MR751	MR1121 1N1200,A,B	MR2001	MR2401
200	†1N4003	1N4721	1N5402	MR752	MR1122 1N1202,A,B	MR2002	MR2402
400	†1N4004	1N4722	1N5404	MR754	MR1124 1N1204,A,B	MR2004	MR2404
600	†1N4005	1N4723	1N5406	MR756	MR1126 1N1206,A,B	MR2006	MR2406
800	†1N4006	1N4724		MR758	MR1128	MR2008	
1000	†1N4007	1N4725		MR760	MR1130	MR2010	
I_{FSM} (Amps)	30	300	200	400	300 Note 2	400	400
T_A @ Rated I_O (°C)	75	75	T_L = 105	60			
T_C @ Rated I_O (°C)					150	150	125
T_J (Max) °C	175	175	175	175	190	175	175

† Package Size: 0.120″ max diameter by 0.260″ max length.

Note 1. Meets mounting configuration of TO-220 outline.

2. IFSM is for MR1120 series, 1N1199 = 100, -A = 240, -B = 250.

GENERAL-PURPOSE RECTIFIERS (continued)

V_{RRM} (Volts)	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
	25	30				40	50
	193-04 Plastic Note 2 	1-07 (TO-204AA) Metal 		43-02 (DO-21) Metal 		42A-01 (DO-203AB) Metal 	43-04 Metal 
50	MR2500			1N3491	1N3659	1N1183A	MR5005
100	MR2501	MR4422CT	MR4422CTR	1N3492	1N3660	1N1184A	MR5010
200	MR2502			1N3493	1N3661	1N1186A	MR5020
400	MR2504			1N3495	1N3663	1N1188A	MR5040
600	MR2506					1N1190A	
800	MR2508						
1000	MR2510						
I_{FSM} (Amps)	400	400	400	300	400	800	600
T_A @ Rated I_O (°C)							
T_C @ Rated I_O (°C)	150			130	100	150	150
T_J (Max) °C	175	150	150	175	175	190	195

Note 2. Request data sheet for mounting information.

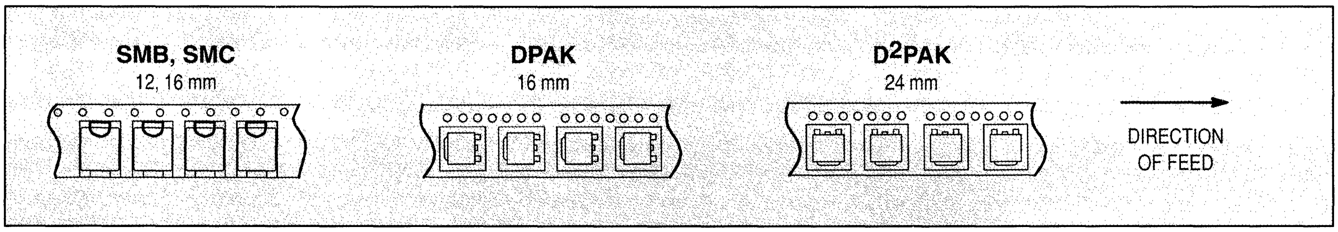
Tape and Reel Rectifier Products

Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the "peel-back" cover tape.

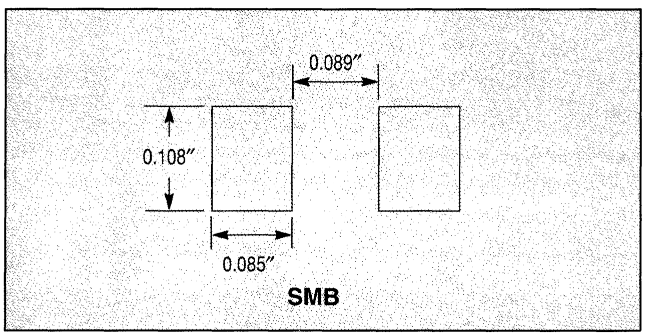
- Reel Size Available, 13″
- Used for Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481A
- DPAK, SMC in 16 mm Tape
- D²PAK in 24 mm Tape

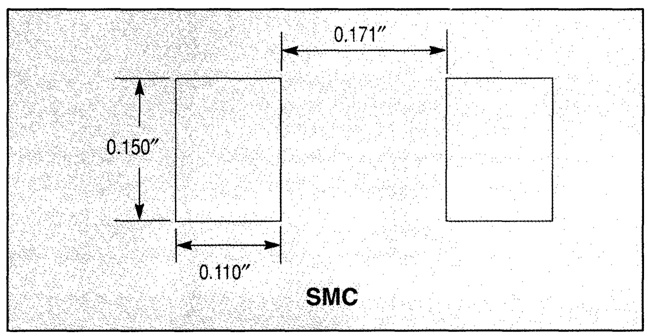
Use the standard device title and add the required suffix as listed in the option table below. Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity. Minimum order $200.00/line-line.

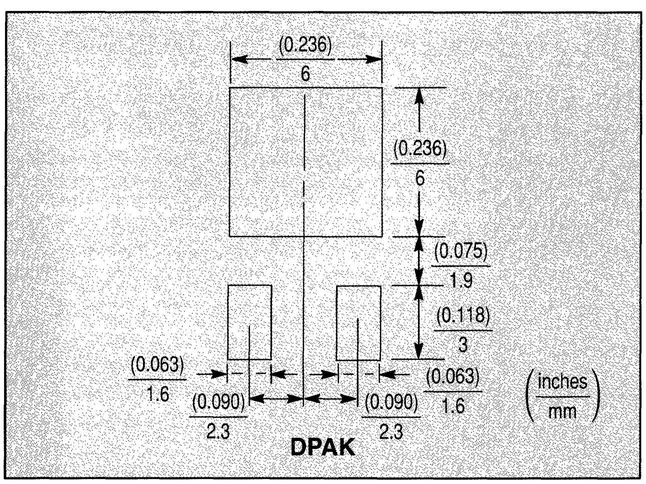
Package	Tape Width (mm)	Reel Size (inch)	Reel Qty (MPQ)	Device Suffix
SMB	12	13	2500	T3
SMC	16	13	2500	T3
DPAK	16 16	13 13	1800 2500	RL T4
D²PAK	24	13	800	T4

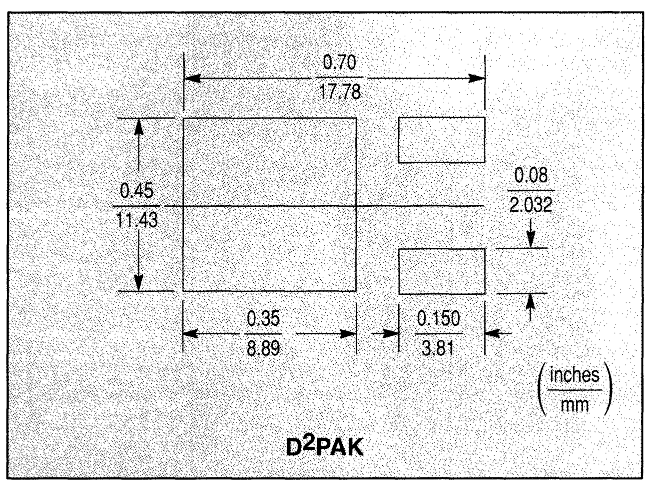


Solder Pad Geometries









Lead Tape Packaging Standards for Axial-Lead Components

1.0 SCOPE — This document covers packaging requirements for the following axial-lead components use in automatic testing and assembly equipment: Motorola Case 59 (DO-41), Case 267 and Case 59-04. Packaging, as covered in this document, shall consist of axial-lead components mounted by their leads on pressure-sensitive tape, wound onto a reel.

2.0 PURPOSE — This document establishes Motorola standard practices for lead-tape packaging of axial-lead components and meets the requirements of EIA Standard RS-296-D "Lead-taping of components on axial lead configuration for automatic insertion," level 1.

3.0 REQUIREMENTS

3.1 Component Leads

3.1.1 — Component leads shall not be bent beyond dimension E from their nominal position. See Figure 2.

3.1.2 — The "C" dimension shall be governed by the overall length of the reel packaged component. The distance between flanges shall be 0.059 inch to 0.315 inch greater than the overall component length. See Figures 2 and 3.

3.1.3 — Cumulative dimension "A" tolerance shall not exceed 0.059 over 5 in consecutive components.

ORIENTATION — All polarized components must be oriented in one direction. The cathode lead tape shall be blue, and the anode tape shall be white. See Figure 1.

3.3 Reeling

3.3.1 — Components on any reel shall not represent more than two date codes when date code identification is required.

3.3.2 — Components leads shall be positioned perpendicularly between pairs of 0.250 inch tape. See Figure 2.

3.3.3 — A minimum 1 inch leader of tape shall be provided before the first and last component on the reel.

3.3.4 — 50 lb. Kraft paper is wound between layers of components as far as necessary for component protection. Width of paper is 0.062 inch to 0.750 inch less than "C" dimension of reel. See Figure 3.

3.3.5 — Components shall be centered between tapes such that the difference between D1 and D2 does not exceed 0.055.

3.3.6 — Staple shall not be used for splicing. No more than 4 layers of tape shall be used in any splice area and no tape shall be offset from another by more than 0.031 inch noncumulative. Tape splices shall overlap at least 6 inches for butt joints and at least 3 inches for lap joints, and shall not be weaker than unspliced tape.

3.3.7 — Quantity per reel shall be as indicated in Table 1. Orders for tape and reeled product will only be processed and shipped in full reel increments. Scheduled orders must be in releases of full reel increments or multiples thereof. High volume orders and releases may be reeled on 14 inch reels at Motorola's option, therefore making the quantity per reel twice that shown for the 10.5 inch reels.

3.3.8 — A maximum of 0.25% of the components per reel quantity may be missing without consecutive missing per level 1 of RS-296-D.

3.3.9 — The single face roll pad shall be placed around the finished reel and taped securely. Each reel shall then be placed in an appropriate container.

3.4 MARKING — Minimum reel and carton marking shall consist of the following: See Figure 3.

Part number
Purchase order number
Quantity
Date of reeling (when applicable)
Manufacturer's name
Electrical value (when applicable)
Date codes (when applicable; see note 3.3.1)
Tape (when applicable)

4.0 — Requirements differing from this Motorola standard shall be negotiated with the factory.

The packages indicated in the following table are suitable for lead tape packaging. The table indicates the specific rectifier devices that can be obtained from Motorola in reel packaging, and provides the appropriate packaging specification.

TABLE 1 — PACKAGING DETAILS (ALL DIMENSIONS IN INCHES)

Case Type	Product Category	Quantity Per Reel (Item 3.3.7)	Component Spacing A	Tape Spacing B	Reel Dimensions C	Reel Dimensions D (max)	Max Off Alignment E	Item Number
Case 59-01 (DO-41)	Rectifiers	5000	0.2 ± 0.02	2.062 ± .059	3	14		6
Case 59-04	Rectifiers	5000	0.2 ± 0.02	2.062 ± .059	3	14		7
Case 267	Rectifiers	1500	0.4 ± 0.02	2.062 ± .059	3	14		9
Case 194-04	Rectifiers	800	0.4 ± 0.02	1.875 ± .059	3	14		12

LEAD TAPE PACKAGING STANDARDS FOR AXIAL-LEAD COMPONENTS (continued)

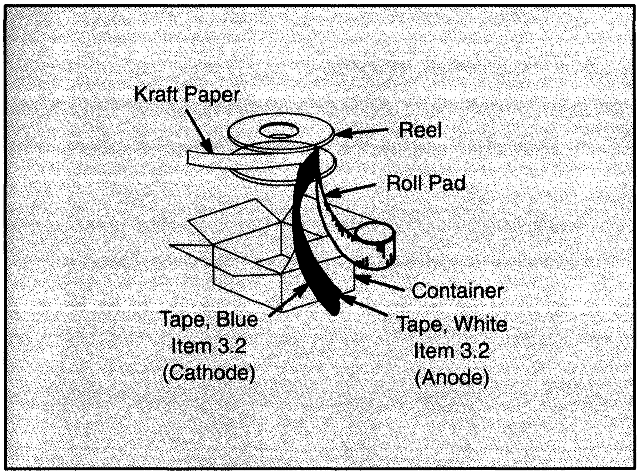


Figure 1. Reel Packing

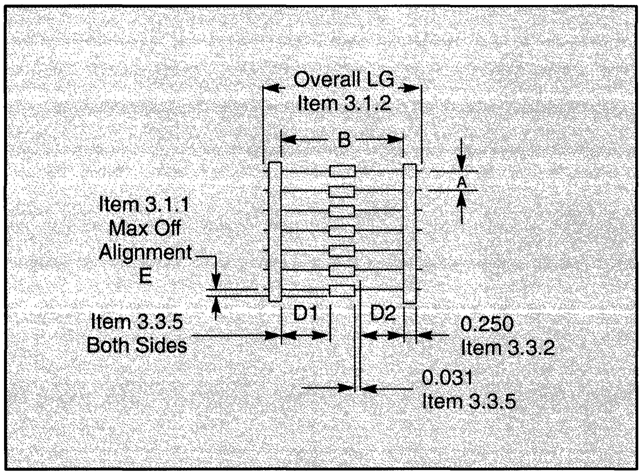


Figure 2. Component Spacing

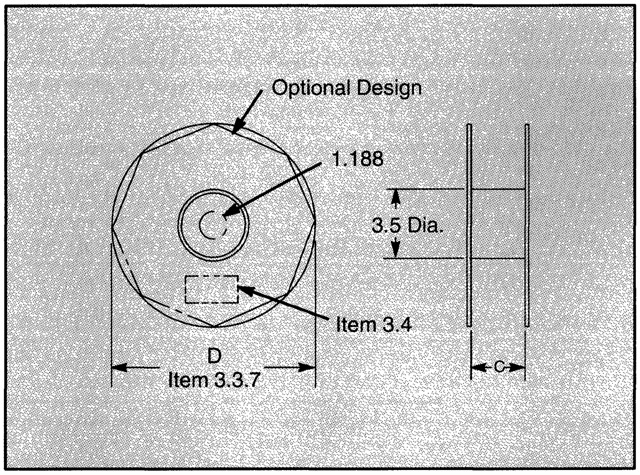
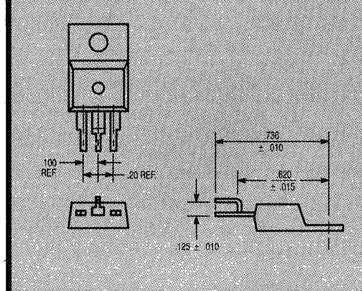


Figure 3. Reel Dimensions

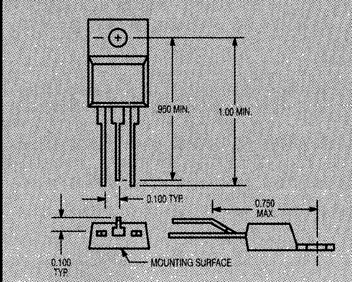
Primary TO-220 Leadform Dimensions

- Leadform options require assignment of a special part number before ordering.
- Contact your local Motorola representative for special part number and pricing.
- 10,000 piece minimum quantity orders are required.
- Leadform orders are non-cancellable after processing.
- Leadforms apply to both Motorola Case 221A-04 and 221A-06 except as noted.

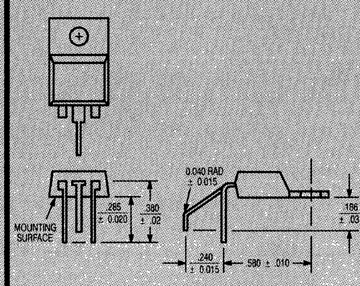
LEADFORM S



LEADFORM C

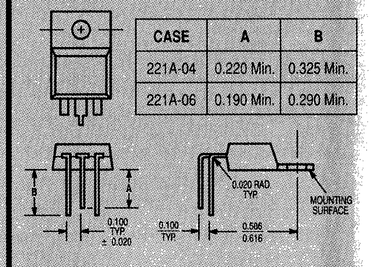


LEADFORM N

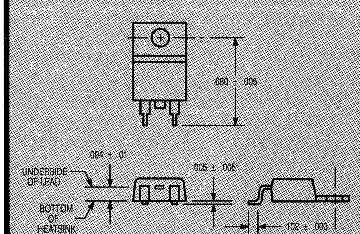


LEADFORM A

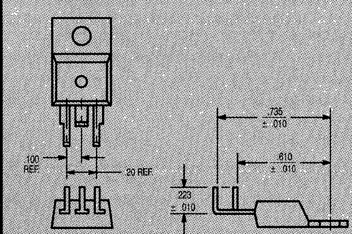
CASE	A	B
221A-04	0.220 Min.	0.325 Min.
221A-06	0.190 Min.	0.290 Min.



LEADFORM 16

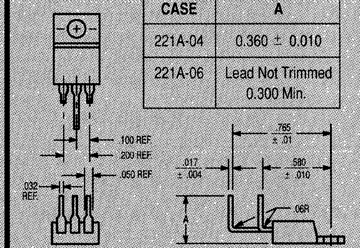


LEADFORM T



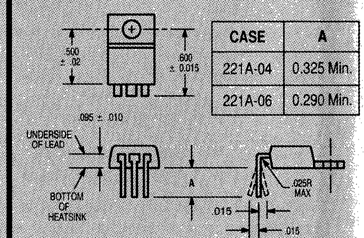
LEADFORM AJ

CASE	A
221A-04	0.360 ± 0.010
221A-06	Lead Not Trimmed 0.300 Min.

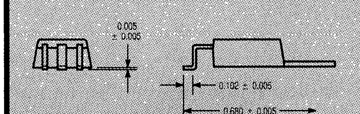


LEADFORM L

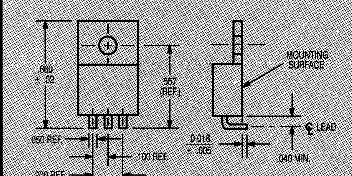
CASE	A
221A-04	0.325 Min.
221A-06	0.290 Min.



LEADFORM A16A

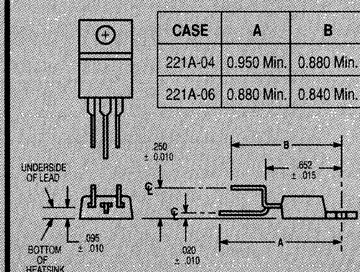


LEADFORM AF

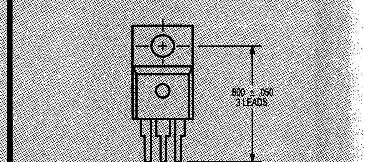


LEADFORM D1

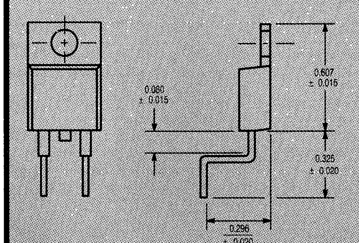
CASE	A	B
221A-04	0.950 Min.	0.880 Min.
221A-06	0.880 Min.	0.840 Min.



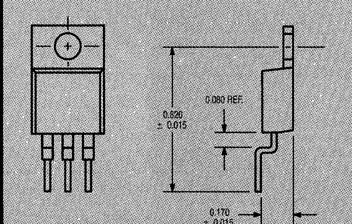
LEADFORM W



LEADFORM U2

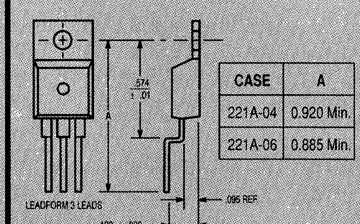


LEADFORM UA

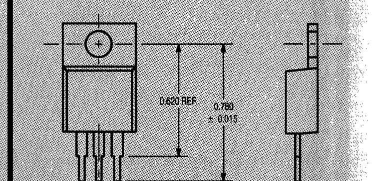


LEADFORM U

CASE	A
221A-04	0.920 Min.
221A-06	0.885 Min.



LEADFORM WC



Transient Voltage Suppressors/Zener Regulator and Reference Diodes

In Brief . . .

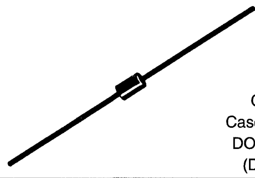
Motorola's standard Transient Voltage Suppressors and Zener diodes comprise the largest inventoried line in the industry. Continuous development of improved manufacturing techniques have resulted in computerized diffusion and test, as well as critical process controls learned from surface-sensitive MOS fabrication. Resultant high yields lower factory costs. Check the following features for application to your specific requirements:

- Wide selection of package materials and styles:
  - Plastic (Surmetic) for low cost, mechanical ruggedness
  - Glass for highest reliability, lowest cost
  - Surface Mount packages for state of the art designs
- Power Ratings from 0.25 to 5 Watts
- Breakdown voltages from 1.8 to 400 V in approximately 10% steps
- Available tolerances from 10% (low cost) to as tight as 1% (critical applications) with off-the-shelf delivery
- Special selection of electrical characteristics available at low cost due to high-volume lines (check your Motorola sales representative for special quotations)
- UL Recognition on many Transient Voltage Suppressor device types
- Tape and Reel options available on all axial leaded and surface mount types

Page

Zener Voltage Regulator Diodes

Axial Leaded for Thru-hole Designs

Nominal Zener Breakdown Voltage	500 mW Cathode = Polarity Band	500 mW Low Level Cathode = Polarity Band	500 mW Cathode = Polarity Band					500 mW Low Level Cathode = Polarity Band	500 mW Cathode = Polarity Band	
(*Note 1)	(*Note 2)	(*Note 3)	(*Note 4)	(*Note 5)	(*Note 6)	(*Note 7)	(*Note 8)	(*Note 9)	(*Note 10)	(*Note 8)
Volts	 Glass Case 299-02 DO-204AH (DO-35)									
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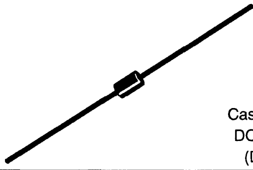
2.0		1N4679						MZ4615		
2.2		1N4680						MZ4616		
2.4	1N4370A	1N4681	1N5221B	1N5985B	BZX55C2V4	BZX79C2V4		MZ4617		
2.5			1N5222B							
2.7	1N4371A	1N4682	1N5223B	1N5986B	BZX55C2V7	BZX79C2V7	BZX83C2V7	MZ4618		ZPD2.7
2.8			1N5224B							
3.0	1N4372A	1N4683	1N5225B	1N5987B	BZX55C3V0	BZX79C3V0	BZX83C3V0	MZ4619		ZPD3.0
3.3	1N746A	1N4684	1N5226B	1N5988B	BZX55C3V3	BZX79C3V3	BZX83C3V3	MZ4620		ZPD3.3
3.6	1N747A	1N4685	1N5227B	1N5989B	BZX55C3V6	BZX79C3V6	BZX83C3V6	MZ4621		ZPD3.6
3.9	1N748A	1N4686	1N5228B	1N5990B	BZX55C3V9	BZX79C3V9	BZX83C3V9	MZ4622	MZ5520B	ZPD3.9
4.3	1N749A	1N4687	1N5229B	1N5991B	BZX55C4V3	BZX79C4V3	BZX83C4V3	MZ4623	MZ5521B	ZPD4.3
4.7	1N750A	1N4688	1N5230B	1N5992B	BZX55C4V7	BZX79C4V7	BZX83C4V7	MZ4624	MZ5522B	ZPD4.7
5.1	1N751A	1N4689	1N5231B	1N5993B	BZX55C5V1	BZX79C5V1	BZX83C5V1	MZ4625	MZ5523B	ZPD5.1
5.6	1N752A	1N4690	1N5232B	1N5994B	BZX55C5V6	BZX79C5V6	BZX83C5V6	MZ4626	MZ5524B	ZPD5.6
6.0			1N5233B							
6.2	1N753A	1N4691	1N5234B	1N5995B	BZX55C6V2	BZX79C6V2	BZX83C6V2	MZ4627	MZ5525B	ZPD6.2
6.8	1N754A 1N957B	1N4692	1N5235B	1N5996B	BZX55C6V8	BZX79C6V8	BZX83C6V8	MZ4099	MZ5526B	ZPD6.8
7.5	1N755A 1N958B	1N4693	1N5236B	1N5997B	BZX55C7V5	BZX79C7V5	BZX83C7V5	MZ4100	MZ5527B	ZPD7.5
8.2	1N756A 1N959B	1N4694	1N5237B	1N5998B	BZX55C8V2	BZX79C8V2	BZX83C8V2	MZ4101	MZ5528B	ZPD8.2
8.7		1N4695	1N5238B					MZ4102		
9.1	1N757A 1N960B	1N4696	1N5239B	1N5999B	BZX55C9V1	BZX79C9V1	BZX83C9V1	MZ4103	MZ5529B	ZPD9.1
10	1N758A 1N961B	1N4697	1N5240B	1N6000B	BZX55C10	BZX79C10	BZX83C10	MZ4104	MZ5530B	ZPD10
11	1N962B	1N4698	1N5241B	1N6001B	BZX55C11	BZX79C11	BZX83C11			ZPD11
12	1N759A 1N963B	1N4699	1N5242B	1N6002B	BZX55C12	BZX79C12	BZX83C12			ZPD12
13	1N964B	1N4700	1N5243B	1N6003B	BZX55C13	BZX79C13	BZX83C13			ZPD13
14		1N4701	1N5244B							
15	1N965B	1N4702	1N5245B	1N6004B	BZX55C15	BZX79C15	BZX83C15			ZPD15
16	1N966B	1N4703	1N5246B	1N6005B	BZX55C16	BZX79C16	BZX83C16			ZPD16
17		1N4704	1N5247B							
18	1N967B	1N4705	1N5248B	1N6006B	BZX55C18	BZX79C18	BZX83C18			ZPD18
19		1N4706	1N5249B							
20	1N968B	1N4707	1N5250B	1N6007B	BZX55C20	BZX79C20	BZX83C20			ZPD20
22	1N969B	1N4708	1N5251B	1N6008B	BZX55C22	BZX79C22	BZX83C22			ZPD22
24	1N970B	1N4709	1N5252B	1N6009B	BZX55C24	BZX79C24	BZX83C24			ZPD24
25		1N4710	1N5253B							
27	1N971B	1N4711	1N5254B	1N6010B	BZX55C27	BZX79C27	BZX83C27			ZPD27
28		1N4712	1N5255B							
30	1N972B	1N4713	1N5256B	1N6011B	BZX55C30	BZX79C30	BZX83C30			ZPD30
33	1N973B	1N4714	1N5257B	1N6012B	BZX55C33	BZX79C33	BZX83C33			ZPD33
36	1N974B	1N4715	1N5258B	1N6013B	BZX55C36	BZX79C36				
39	1N975B	1N4716	1N5259B	1N6014B	BZX55C39	BZX79C39				
43	1N976B	1N4717	1N5260B	1N6015B	BZX55C43	BZX79C43				
47	1N977B		1N5261B	1N6016B	BZX55C47	BZX79C47				
51	1N978B		1N5262B	1N6017B	BZX55C51	BZX79C51				
56	1N979B		1N5263B	1N6018B	BZX55C56	BZX79C56				
60			1N5264B							
62	1N980B		1N5265B	1N6019B	BZX55C62	BZX79C62				
68	1N981B		1N5266B	1N6020B	BZX55C68	BZX79C68				

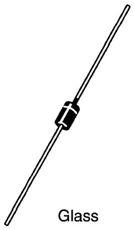
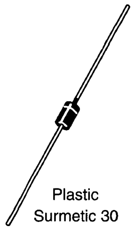
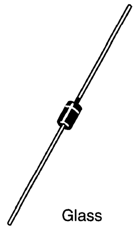
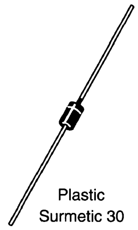
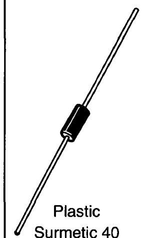
*See Notes — page 5-90

Axial Leaded for Thru-hole Designs (continued)

Nominal Zener Breakdown Voltage	500 mW Cathode = Polarity Band	500 mW Low Level Cathode = Polarity Band	500 mW Cathode = Polarity Band					500 mW Low Level Cathode = Polarity Band	500 mW Cathode = Polarity Band	
(*Note 1)	(*Note 2)	(*Note 3)	(*Note 4)	(*Note 5)	(*Note 6)	(*Note 7)	(*Note 8)	(*Note 9)	(*Note 10)	(*Note 8)
Volts	 Glass Case 299-02 DO-204AH (DO-35)									
75	1N982B		1N5267B	1N6021B	BZX55C75	BZX79C75				
82	1N983B		1N5268B	1N6022B	BZX55C82	BZX79C82				
87			1N5269B							
91	1N984B		1N5270B	1N6023B	BZX55C91	BZX79C91				
100	1N985B		1N5271B	1N6024B		BZX79C100				
110	1N986B		1N5272B	1N6025B		BZX79C110				
120	1N987B		1N5273B			BZX79C120				
130	1N988B		1N5274B			BZX79C130				
140			1N5275B							
150	1N989B		1N5276B			BZX79C150				
160	1N990B		1N5277B			BZX79C160				
170			1N5278B							
180	1N991B		1N5279B			BZX79C180				
190			1N5280B							
200	1N992B		1N5281B			BZX79C200				
220										
240										
270										
300										
330										
360										
400										

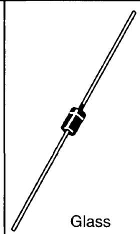
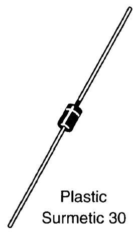
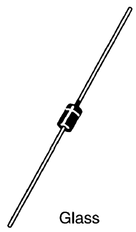
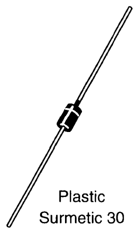
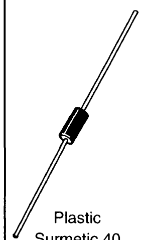
*See Notes — page 5-90

Axial Leaded for Thru-hole Designs (continued)

Nominal Zener Breakdown Voltage	1 Watt Cathode = Polarity Band		1.3 Watt Cathode = Polarity Band			1.5 Watt Cathode = Polarity Band	3 Watt Cathode = Polarity Band	5 Watt Cathode = Polarity Band
(*Note 1)	(*Note 11)	(*Note 12)	(*Note 13)	(*Note 14)	(*Note 15)	(*Note 16)	(*Note 17)	(*Note 18)
Volts	 Glass Case 59-03 (DO-41)	 Plastic Surmetic 30 Case 59-03 (DO-41)	 Glass Case 59-03 (DO-41)			 Plastic Surmetic 30 Case 59-03 (DO-41)		 Plastic Surmetic 40 Case 17-02
1.8								
2.0								
2.2								
2.4								
2.5								
2.7								
2.8								
3.0								
3.3	1N4728A	MZP4728A	BZX85C3V3			1N5913B		1N5333B
3.6	1N4729A	MZP4729A	BZX85C3V6			1N5914B		1N5334B
3.9	1N4730A	MZP4730A	BZX85C3V9	MZPY3.9	MZD3.9	1N5915B	3EZ3.9D5	1N5335B
4.3	1N4731A	MZP4731A	BZX85C4V3	MZPY4.3	MZD4.3	1N5916B	3EZ4.3D5	1N5336B
4.7	1N4732A	MZP4732A	BZX85C4V7	MZPY4.7	MZD4.7	1N5917B	3EZ4.7D5	1N5337B
5.1	1N4733A	MZP4733A	BZX85C5V1	MZPY5.1	MZD5.1	1N5918B	3EZ5.1D5	1N5338B
5.6	1N4734A	MZP4734A	BZX85C5V6	MZPY5.6	MZD5.6	1N5919B	3EZ5.6D5	1N5339B
6.0								1N5340B
6.2	1N4735A	MZP4735A	BZX85C6V2	MZPY6.2	MZD6.2	1N5920B	3EZ6.2D5	1N5341B
6.8	1N4736A	MZP4736A	BZX85C6V8	MZPY6.8	MZD6.8	1N5921B	3EZ6.8D5	1N5342B
7.5	1N4737A	MZP4737A	BZX85C7V5	MZPY7.5	MZD7.5	1N5922B	3EZ7.5D5	1N5343B
8.2	1N4738A	MZP4738A	BZX85C8V2	MZPY8.2	MZD8.2	1N5923B	3EZ8.2D5	1N5344B
8.7								1N5345B
9.1	1N4739A	MZP4739A	BZX85C9V1	MZPY9.1	MZD9.1	1N5924B	3EZ9.1D5	1N5346B
10	1N4740A	MZP4740A	BZX85C10	MZPY10	MZD10	1N5925B	3EZ10D5	1N5347B
11	1N4741A	MZP4741A	BZX85C11	MZPY11	MZD11	1N5926B	3EZ11D5	1N5348B
12	1N4742A	MZP4742A	BZX85C12	MZPY12	MZD12	1N5927B	3EZ12D5	1N5349B
13	1N4743A	MZP4743A	BZX85C13	MZPY13	MZD13	1N5928B	3EZ13D5	1N5350B
14							3EZ14D5	1N5351B
15	1N4744A	MZP4744A	BZX85C15	MZPY15	MZD15	1N5929B	3EZ15D5	1N5352B
16	1N4745A	MZP4745A	BZX85C16	MZPY16	MZD16	1N5930B	3EZ16D5	1N5353B
17							3EZ17D5	1N5354B
18	1N4746A	MZP4746A	BZX85C18	MZPY18	MZD18	1N5931B	3EZ18D5	1N5355B
19							3EZ19D5	1N5356B
20	1N4747A	MZP4747A	BZX85C20	MZPY20	MZD20	1N5932B	3EZ20D5	1N5357B
22	1N4748A	MZP4748A	BZX85C22	MZPY22	MZD22	1N5933B	3EZ22D5	1N5358B
24	1N4749A	MZP4749A	BZX85C24	MZPY24	MZD24	1N5934B	3EZ24D5	1N5359B
25								1N5360B
27	1N4750A	MZP4750A	BZX85C27	MZPY27	MZD27	1N5935B	3EZ27D5	1N5361B
28							3EZ28D5	1N5362B
30	1N4751A	MZP4751A	BZX85C30	MZPY30	MZD30	1N5936B	3EZ30D5	1N5363B
33	1N4752A	MZP4752A	BZX85C33	MZPY33	MZD33	1N5937B	3EZ33D5	1N5364B
36	1N4753A	MZP4753A	BZX85C36	MZPY36	MZD36	1N5938B	3EZ36D5	1N5365B
39	1N4754A	MZP4754A	BZX85C39	MZPY39	MZD39	1N5939B	3EZ39D5	1N5366B
43	1N4755A	MZP4755A	BZX85C43	MZPY43	MZD43	1N5940B	3EZ43D5	1N5367B
47	1N4756A	MZP4756A	BZX85C47	MZPY47	MZD47	1N5941B	3EZ47D5	1N5368B
51	1N4757A	MZP4757A	BZX85C51	MZPY51	MZD51	1N5942B	3EZ51D5	1N5369B
56	1N4758A	MZP4758A	BZX85C56	MZPY56	MZD56	1N5943B	3EZ56D5	1N5370B
60								1N5371B
62	1N4759A	MZP4759A	BZX85C62	MZPY62	MZD62	1N5944B	3EZ62D5	1N5372B
68	1N4760A	MZP4760A	BZX85C68	MZPY68	MZD68	1N5945B	3EZ68D5	1N5373B

*See Notes — page 5-90

Axial Leaded for Thru-hole Designs (continued)

Nominal Zener Breakdown Voltage	1 Watt Cathode = Polarity Band		1.3 Watt Cathode = Polarity Band			1.5 Watt Cathode = Polarity Band	3 Watt Cathode = Polarity Band	5 Watt Cathode = Polarity Band
(*Note 1)	(*Note 11)	(*Note 12)	(*Note 13)	(*Note 14)	(*Note 15)	(*Note 16)	(*Note 17)	(*Note 18)
Volts	 Glass Case 59-03 (DO-41)	 Plastic Surmetic 30 Case 59-03 (DO-41)	 Glass Case 59-03 (DO-41)			 Plastic Surmetic 30 Case 59-03 (DO-41)		 Plastic Surmetic 40 Case 17-02
75	1N4761A	MZP4761A	BZX85C75	MZPY75	MZD75	1N5946B	3EZ75D5	1N5374B
82	1N4762A	MZP4762A	BZX85C82	MZPY82	MZD82	1N5947B	3EZ82D5	1N5375B
87								1N5376B
91	1N4763A	MZP4763A	BZX85C91	MZPY91	MZD91	1N5948B	3EZ91D5	1N5377B
100	1N4764A	MZP4764A	BZX85C100	MZPY100	MZD100	1N5949B	3EZ100D5	1N5378B
110		1M110ZS5			MZD110	1N5950B	3EZ110D5	1N5379B
120		1M120ZS5			MZD120	1N5951B	3EZ120D5	1N5380B
130		1M130ZS5			MZD130	1N5952B	3EZ130D5	1N5381B
140							3EZ140D5	1N5382B
150		1M150ZS5			MZD150	1N5953B	3EZ150D5	1N5383B
160		1M160ZS5			MZD160	1N5954B	3EZ160D5	1N5384B
170							3EZ170D5	1N5385B
180		1M180ZS5			MZD180	1N5955B	3EZ180D5	1N5386B
190							3EZ190D5	1N5387B
200		1M200ZS5			MZD200	1N5956B	3EZ200D5	1N5388B
220							3EZ220D5	
240							3EZ240D5	
270							3EZ270D5	
300							3EZ300D5	
330							3EZ330D5	
360							3EZ360D5	
400							3EZ400D5	

*See Notes — page 5-90

NOTES — AXIAL LEADED CHART

1. *Zener Voltage* is the key parameter for each device type. It is specified at a particular test current applied at either thermal equilibrium (T.E.) or pulse test condition. The voltage tolerance for the device types listed is, in general ±5%; however, for some series, the voltage tolerance varies from device type to device type over a range of ±(5 to 8.5)%. Consult the complete data sheet to determine the exact test conditions and minimum/maximum limits for the zener voltage. Consult Application Note AN924 regarding measurement of Zener Voltage (pulse versus thermal equilibrium).

   Power Ratings represent the capability of the case size listed as supplied by Motorola. These ratings may be higher than the JEDEC registration and/or the same device types supplied by other manufacturers.

V_Z TEST CONDITIONS AND TOLERANCES

2. *1N4370A/1N746A Series*
   I_{ZT} = 20 mA (T.E.).
   No suffix = ±10%.
   A suffix = ±5%.
   C suffix = ±2%.
   D suffix = ±1%.

   1N957B Series
   I_{ZT} @ approximately 125 mW point (T.E.).
   A suffix = ±10%.
   B suffix = ±5%.
   C suffix = ±2%.
   D suffix = ±1%.

3. *1N4678 Series* — I_{ZT} = 50 µA (T.E.).
   No suffix = ±5%.
   C suffix = ±2%.
   D suffix = ±1%.
   Also has delta V_Z parameter and limit.

4. *1N5221B-42B* — I_{ZT} = 20 mA (T.E.).
   1N5243B-81B — I_{ZT} @ approximately 125 mW point (T.E.).
   A suffix = ±10%.
   B suffix = ±5%.
   C suffix = ±2%.
   D suffix = ±1%.

5. *1N5985B-6013B* — I_{ZT} = 5 mA (T.E.).
   1N6014B-23B — I_{ZT} = 2 mA (T.E.).
   1N6024B-25B — I_{ZT} = 1 mA (T.E.).
   A suffix = ±10%.
   B suffix = ±5%.
   C suffix = ±2%.
   D suffix = ±1%.

6. *BZX55C2V4-C36* — I_{ZT} = 5 mA (T.E.).
   BZX55C39-C82 — I_{ZT} = 2.5 mA (T.E.).
   BZX55C91 — I_{ZT} = 1 mA (T.E.).
   C indicates ±(5 to 8.5)% depending on type number.
   Replace C with B for ±2%.

7. *BZX79C2V4-C24* — I_{ZT} = 5 mA (pulse).
   BZX79C27-C91 — I_{ZT} = 2 mA (pulse).
   BZX79C100-C200 — I_{ZT} = 1 mA (pulse).
   C indicates ±(5 to 8.5)% depending on type number.
   Replace C with B for ±2%.
   Replace C with A for ±1%.

8. *BZX83C2V7-C33* — I_{ZT} = 5 mA (pulse).
   ZPD2.7-33 — I_{ZT} = 5 mA (pulse).
   Tolerance is ±(5 to 8.5)% depending on type number.

9. *MZ4614-27* — I_{ZT} = 250 µA (T.E.).
   MZ4099-4104 — I_{ZT} = 250 µA (T.E.).
   Tolerance is ±5%.

10. *MZ5520B-21B* — I_{ZT} = 20 mA (T.E.).
    MZ5522B — I_{ZT} = 10 mA (T.E.).
    MZ5523B — I_{ZT} = 5 mA (T.E.).
    MZ5524B — I_{ZT} = 3 mA (T.E.).
    MZ5525B-30B — I_{ZT} = 1 mA (T.E.).
    Tolerance is ±5%.
    Also has delta V_Z parameter and limit.

11. *1N4728A-64A*
    I_{ZT} @ approximately 250 mW point (T.E.).
    No suffix = ±10%.
    A suffix = ±5%.
    C suffix = ±2%.
    D suffix = ±1%.

12. *MZP4728A-64A*
    1M110ZS5-200ZS5
    I_{ZT} @ approximately 250 mW point (T.E.).
    MZP Series non suffix = ±10%.
    MZP Series A suffix = ±5%.
    1M Series 10 suffix = ±10%.
    1M Series 5 suffix = ±5%.

13. *BZX85C3V3-C100*
    I_{ZT} varies from 185 mW to 300 mW point depending on type number (pulse).
    C indicates ±(5 to 8.5)% depending on type number.
    Replace C with B for ±2%.

14. *MZPY3.9-8.2* — I_{ZT} = 100 mA (pulse).
    MZPY9.1-15 — I_{ZT} = 50 mA (pulse).
    MZPY16-33 — I_{ZT} = 25 mA (pulse).
    MZPY36-82 — I_{ZT} = 10 mA (pulse).
    MZPY91-100 — I_{ZT} = 5 mA (pulse).
    No suffix tolerance is approximately ±(5 to 8.5)% depending on type number.
    C suffix = ±2%.
    D suffix = ±1%.

15. *MZD3.9-8.2* — I_{ZT} = 100 mA (pulse).
    MZD9.1-15 — I_{ZT} = 50 mA (pulse).
    MZD16-33 — I_{ZT} = 25 mA (pulse).
    MZD36-82 — I_{ZT} = 10 mA (pulse).
    MZD91-200 — I_{ZT} = 5 mA (pulse).
    Tolerance is ±(5 to 8.5)% depending on type number.

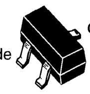
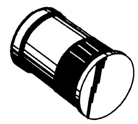
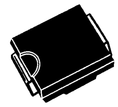
16. *1N5913B-56B*
    I_{ZT} @ approximately 375 mW point (T.E.).
    A suffix = ±10%.
    B suffix = ±5%.

17. *3EZ3.9D5-400D5*
    I_{ZT} @ approximately 750 mW point (pulse).
    Suffix 10= ±10%.
    Suffix 5 = ±5%.

18. *1N5333B-88B*
    I_{ZT} varies from 0.9 to 1.5 W point depending on type number (pulse)
    A suffix = ±10%.
    B suffix = ±5%.
    Also has delta V_Z parameter and limit.

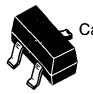
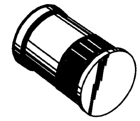
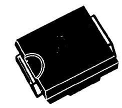
Zener Voltage Regulator Diodes

Surface Mount Packages

Nominal Zener Breakdown Voltage	225 mW Surface Mount SOT-23		500 mW Surface Mount Leadless MLL34	500 mW Low Level Surface Mount Leadless MLL34	500 mW Surface Mount Leadless MLL34	1.5 Watt Surface Mount SMB
(*Note 1)	(*Note 2)	(*Note 3)	(*Note 4)	(*Note 5)	(*Note 6)	(*Note 7)
Volts	 Anode Cathode No Connection Plastic Case 318-07 TO-236AB			 Glass Case 362-03 Cathode = Polarity Band		 Plastic Case 403A-03 Cathode = Notch
1.8				MLL4678		
2.0				MLL4679		
2.2				MLL4680		
2.4	BZX84C2V4L	MMBZ5221BL	BZV55C2V4	MLL4681	MLL5221B	
2.5		MMBZ5222BL			MLL5222B	
2.7	BZX84C2V7L	MMBZ5223BL	BZV55C2V7	MLL4682	MLL5223B	
2.8		MMBZ5224BL			MLL5224B	
3.0	BZX84C3V0L	MMBZ5225BL	BZV55C3V0	MLL4683	MLL5225B	
3.3	BZX84C3V3L	MMBZ5226BL	BZV55C3V3	MLL4684	MLL5226B	1SMB5913BT3
3.6	BZX84C3V6L	MMBZ5227BL	BZV55C3V6	MLL4685	MLL5227B	1SMB5914BT3
3.9	BZX84C3V9L	MMBZ5228BL	BZV55C3V9	MLL4686	MLL5228B	1SMB5915BT3
4.3	BZX84C4V3L	MMBZ5229BL	BZV55C4V3	MLL4687	MLL5229B	1SMB5916BT3
4.7	BZX84C4V7L	MMBZ5230BL	BZV55C4V7	MLL4688	MLL5230B	1SMB5917BT3
5.1	BZX84C5V1L	MMBZ5231BL	BZV55C5V1	MLL4689	MLL5231B	1SMB5918BT3
5.6	BZX84C5V6L	MMBZ5232BL	BZV55C5V6	MLL4690	MLL5232B	1SMB5919BT3
6.0		MMBZ5233BL			MLL5233B	
6.2	BZX84C6V2L	MMBZ5234BL	BZV55C6V2	MLL4691	MLL5234B	1SMB5920BT3
6.8	BZX84C6V8L	MMBZ5235BL	BZV55C6V8	MLL4692	MLL5235B	1SMB5921BT3
7.5	BZX84C7V5L	MMBZ5236BL	BZV55C7V5	MLL4693	MLL5236B	1SMB5922BT3
8.2	BZX84C8V2L	MMBZ5237BL	BZV55C8V2	MLL4694	MLL5237B	1SMB5923BT3
8.7		MMBZ5238BL		MLL4695	MLL5238B	
9.1	BZX84C9V1L	MMBZ5239BL	BZV55C9V1	MLL4696	MLL5239B	1SMB5924BT3
10	BZX84C10L	MMBZ5240BL	BZV55C10	MLL4697	MLL5240B	1SMB5925BT3
11	BZX84C11L	MMBZ5241BL	BZV55C11	MLL4698	MLL5241B	1SMB5926BT3
12	BZX84C12L	MMBZ5242BL	BZV55C12	MLL4699	MLL5242B	1SMB5927BT3
13	BZX84C13L	MMBZ5243BL	BZV55C13	MLL4700	MLL5243B	1SMB5928BT3
14		MMBZ5244BL		MLL4701	MLL5244B	
15	BZX84C15L	MMBZ5245BL	BZV55C15	MLL4702	MLL5245B	1SMB5929BT3
16	BZX84C16L	MMBZ5246BL	BZV55C16	MLL4703	MLL5246B	1SMB5930BT3
17		MMBZ5247BL		MLL4704	MLL5247B	
18	BZX84C18L	MMBZ5248BL	BZV55C18	MLL4705	MLL5248B	1SMB5931BT3
19		MMBZ5249BL		MLL4706	MLL5249B	
20	BZX84C20L	MMBZ5250BL	BZV55C20	MLL4707	MLL5250B	1SMB5932BT3
22	BZX84C22L	MMBZ5251BL	BZV55C22	MLL4708	MLL5251B	1SMB5933BT3
24	BZX84C24L	MMBZ5252BL	BZV55C24	MLL4709	MLL5252B	1SMB5934BT3
25		MMBZ5253BL		MLL4710	MLL5253B	
27	BZX84C27L	MMBZ5254BL	BZV55C27	MLL4711	MLL5254B	1SMB5935BT3
28		MMBZ5255BL		MLL4712	MLL5255B	
30	BZX84C30L	MMBZ5256BL	BZV55C30	MLL4713	MLL5256B	1SMB5936BT3
33	BZX84C33L	MMBZ5257BL	BZV55C33	MLL4714	MLL5257B	1SMB5937BT3
36	BZX84C36L	MMBZ5258BL	BZV55C36	MLL4715	MLL5258B	1SMB5938BT3
39	BZX84C39L	MMBZ5259BL	BZV55C39	MLL4716	MLL5259B	1SMB5939BT3
43	BZX84C43L	MMBZ5260BL	BZV55C43	MLL4717	MLL5260B	1SMB5940BT3

*See Notes — page 5-92

Surface Mount Packages (continued)

Nominal Zener Breakdown Voltage	225 mW Surface Mount SOT-23		500 mW Surface Mount Leadless MLL34	500 mW Low Level Surface Mount Leadless MLL34	500 mW Surface Mount Leadless MLL34	1.5 Watt Surface Mount SMB
(*Note 1)	(*Note 2)	(*Note 3)	(*Note 4)	(*Note 5)	(*Note 6)	(*Note 7)
Volts	 Plastic Case 318-07 TO-236AB		 Glass Case 362-03 Cathode = Polarity Band			 Plastic Case 403A-03 Cathode = Notch
47	BZX84C47L	MMBZ5261BL	BZV55C47		MLL5261B	1SMB5941BT3
51	BZX84C51L	MMBZ5262BL	BZV55C51		MLL5262B	1SMB5942BT3
56	BZX84C56L	MMBZ5263BL	BZV55C56		MLL5263B	1SMB5943BT3
60		MMBZ5264BL				
62	BZX84C62L	MMBZ5265BL				1SMB5944BT3
68	BZX84C68L	MMBZ5266BL				1SMB5945BT3
75	BZX84C75L	MMBZ5267BL				1SMB5946BT3
82		MMBZ5268BL				1SMB5947BT3
87		MMBZ5269BL				
91		MMBZ5270BL				1SMB5948BT3
100						1SMB5949BT3
110						1SMB5950BT3
120						1SMB5951BT3
130						1SMB5952BT3
150						1SMB5953BT3
160						1SMB5954BT3
170						
180						1SMB5955BT3
200						1SMB5956BT3

*See Notes on this page.

NOTES — SURFACE MOUNT CHART

1. *Zener Voltage* is the key parameter for each device type. It is specified at a particular test current applied at either thermal equilibrium (T.E.) or pulse test condition. The voltage tolerance for the device types listed is, in general ±5%; however, for some series, the voltage tolerance varies from device type to device type over a range of ±(5 to 8.5)%. Consult the complete data sheet to determine the exact test conditions and minimum/maximum limits for the zener voltage.

   Power Ratings represent the capability of the case size listed as supplied by Motorola. These ratings may be higher than the same device types supplied by other manufacturers.

V_Z TEST CONDITIONS AND TOLERANCES

2. *BZX84C2V4L-C24L* I_{ZT} = 5 mA (pulse).
   BZX84C27L-C75L I_{ZT} = 2 mA (pulse).

   Tolerance is ±(5 to 8.5)% depending on type number. Each device type also has other V_Z min/max limits at two other I_{ZT} pulse current values.

3. *MMBZ5221BL-42BL* I_{ZT} = 20 mA (pulse).
   MMBZ5243BL-70BL I_{ZT} @ approximately 125 mW point (pulse).

   BL suffix = ±5%.

4. BZV55C2V4-C24 I_{ZT} = 5 mA (pulse).
   BZV55C27-C56 I_{ZT} = 2 mA (pulse).

   Tolerance is ±(5 to 8.5)% depending on type number. Each device type also has other V_Z min/max limits at two other I_{ZT} pulse current values.

5. *MLL4678 Series* I_{ZT} = 50 μA (T.E.).

   No suffix = ±5%.

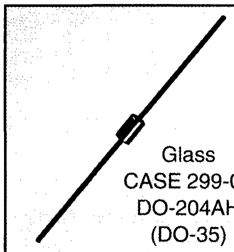
6. *MLL5221B-42B* I_{ZT} = 20 mA (T.E.).
   MLL5243B-63B
   I_{ZT} @ approximately 125 mW point (T.E.).

   A suffix = ±10%.
   B suffix = ±5%.

7. *1SMB5913BT3 Series*
   I_{ZT} @ approximately 375 mW point (T.E.).

   BT3 suffix = ±5%.

Voltage Reference Diodes



Glass
CASE 299-02
DO-204AH
(DO-35)

Temperature Compensated Reference Devices

For applications where output voltage must remain within narrow limits during changes in input voltage, load resistance and temperature. Motorola guarantees all reference devices to fall within the specified maximum voltage variations, ΔV_Z, at the specifically indicated test temperatures and test current (JEDEC Standard #5). Temperature coefficient is also specified but should be considered as a reference only — not a maximum rating.

Devices in this table are hermetically sealed structures.

V_Z Volts	Test Current mAdc	Test* Temp Points	AVERAGE TEMPERATURE COEFFICIENT OVER THE OPERATING RANGE										Case
			0.01 %/°C		0.005 %/°C		0.002 %/°C		0.001 %/°C		0.0005 %/°C		
			Device Type	ΔV_Z Max Volts	Device Type	ΔV_Z Max Volts	Device Type	ΔV_Z Max Volts	Device Type	ΔV_Z Max Volts	Device Type	ΔV_Z Max Volts	
6.2 △1	7.5	A	1N821	0.096	1N823	0.048	1N825	0.019	1N827	0.009	1N829	0.005	299-02
6.2 △1	7.5	A	1N821A	0.096	1N823A	0.048	1N825A	0.019	1N827A	0.009	1N829A	0.005	
6.4	0.5	B	1N4565	0.048	1N4566	0.024	1N4567	0.010	1N4568	0.005	1N4569	0.002	DO-204AH
	0.5	A	1N4565A	0.099	1N4566A	0.050	1N4567A	0.020	1N4568A	0.010	1N4569A	0.005	(DO-35)
	1	B	1N4570	0.048	1N4571	0.024	1N4572	0.010	1N4573	0.005	1N4574	0.002	Cathode
	1	A	1N4570A	0.099	1N4571A	0.050	1N4572A	0.020	1N4573A	0.010	1N4574A	0.005	= Polarity Band

△1 Non-suffix — Z_{ZT} = 15 ohms, "A" Suffix — Z_{ZT} = 10 ohms
***Test Temperature Points °C: A** = –55, 0, +25, +75, +100 **B** = 0, +25, +75

Transient Voltage Suppressors

General-Purpose

Transient Voltage Suppressors are designed for applications requiring protection of voltage sensitive electronic devices in danger of destruction by high energy voltage transients. Many of the zener voltage regulator diodes listed in the previous charts are in fact used in circuits as transient voltage suppressors. The purpose of this section is to present the families of Motorola Zeners that are specified with the key transient voltage suppressor parameters and limits, e.g., maximum clamping voltage at maximum surge current rating and working peak reverse (stand-off) voltage.

The selection sequence is to 1) select the package type (axial or surface mount), 2) select the peak surge power expected for the application, 3) select the working peak reverse stand-off voltage (or the breakdown voltage) and 4) select the maximum reverse clamping voltage.

Consult the factory for special electrical selections if there is no standard device type available to fit the application.

AXIAL LEADED FOR THRU-HOLE DESIGNS

PEAK POWER DISSIPATION* — 500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 59-04

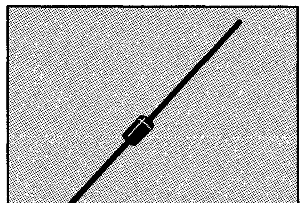
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 35 A Pulse (except bidirectional devices).

Working Peak Reverse Voltage V_{RWM} (Volts)	Device**	Breakdown Voltage V_{BR} (Volts) Min	Breakdown Voltage V_{BR} (Volts) Max	@ I_T Pulse (mA)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM} Figure 1 (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
5	SA5.0	6.4	7.3	10	600	52	9.6
5	SA5.0A	6.4	7	10	600	54.3	9.2
6	SA6.0	6.67	8.15	10	600	43.9	11.4
6	SA6.0A	6.67	7.37	10	600	48.5	10.3
6.5	SA6.5	7.22	8.82	10	400	40.7	12.3
6.5	SA6.5A	7.22	7.98	10	400	44.7	11.2
7	SA7.0	7.78	9.51	10	150	37.8	13.3
7	SA7.0A	7.78	8.6	10	150	41.7	12
7.5	SA7.5	8.33	10.2	1	50	35	14.3
7.5	SA7.5A	8.33	9.21	1	50	38.8	12.9
8	SA8.0	8.89	10.9	1	25	33.3	15
8	SA8.0A	8.89	9.83	1	25	36.7	13.6
8.5	SA8.5	9.44	11.5	1	5	31.4	15.9
8.5	SA8.5A	9.44	10.4	1	5	34.7	14.4
9	SA9.0	10	12.2	1	1	29.5	16.9
9	SA9.0A	10	11.1	1	1	32.5	15.4
10	SA10	11.1	13.6	1	1	26.6	18.8
10	SA10A	11.1	12.3	1	1	29.4	17
11	SA11	12.2	14.9	1	1	24.9	20.1
11	SA11A	12.2	13.5	1	1	27.4	18.2
12	SA12	13.3	16.3	1	1	22.7	22
12	SA12A	13.3	14.7	1	1	25.1	19.9
13	SA13	14.4	17.6	1	1	21	23.8
13	SA13A	14.4	15.9	1	1	23.2	21.5
14	SA14	15.6	19.1	1	1	19.4	25.8
14	SA14A	15.6	17.2	1	1	21.5	23.2
15	SA15	16.7	20.4	1	1	18.8	26.9
15	SA15A	16.7	18.5	1	1	20.6	24.4
16	SA16	17.8	21.8	1	1	17.6	28.8
16	SA16A	17.8	19.7	1	1	19.2	26
17	SA17	18.9	23.1	1	1	16.4	30.5
17	SA17A	18.9	20.9	1	1	18.1	27.6

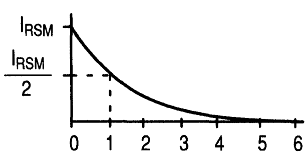
* Steady state power dissipation = 3 watt max rating

** For bidirectional types use C or CA suffix. Have cathode polarity band on each end. (consult factory for availability)

(continued)



CASE 59-04
PLASTIC
Cathode = Polarity Band



Time → (ms)
Surge Current Characteristics

Figure 1

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 59-04 (continued)

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 35 A Pulse (except bidirectional devices).

Working Peak Reverse Voltage V_{RWM} (Volts)	Device**	Breakdown Voltage V_{BR} (Volts) Min	Breakdown Voltage V_{BR} (Volts) Max	@ I_T Pulse (mA)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM} Figure 1 (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
18	SA18	20	24.4	1	1	15.5	32.2
18	SA18A	20	22.1	1	1	17.2	29.2
20	SA20	22.2	27.1	1	1	13.9	35.8
20	SA20A	22.2	24.5	1	1	15.4	32.4
22	SA22	24.4	29.8	1	1	12.7	39.4
22	SA22A	24.4	26.9	1	1	14.1	35.5
24	SA24	26.7	32.6	1	1	11.6	43
24	SA24A	26.7	29.5	1	1	12.8	38.9
26	SA26	28.9	35.3	1	1	10.7	46.6
26	SA26A	28.9	31.9	1	1	11.9	42.1
28	SA28	31.1	38	1	1	9.9	50
28	SA28A	31.1	34.4	1	1	11	45.4
30	SA30	33.3	40.7	1	1	9.3	53.5
30	SA30A	33.3	36.8	1	1	10.3	48.4
33	SA33	36.7	44.9	1	1	8.5	59
33	SA33A	36.7	40.6	1	1	9.4	53.3
36	SA36	40	48.9	1	1	7.8	64.3
36	SA36A	40	44.2	1	1	8.6	58.1
40	SA40	44.4	54.3	1	1	7	71.4
40	SA40A	44.4	49.1	1	1	7.8	64.5
43	SA43	47.8	58.4	1	1	6.5	76.7
43	SA43A	47.8	52.8	1	1	7.2	69.4
45	SA45	50	61.1	1	1	6.2	80.3
45	SA45A	50	55.3	1	1	6.9	72.7
48	SA48	53.3	65.1	1	1	5.8	85.5
48	SA48A	53.3	58.9	1	1	6.5	77.4
51	SA51	56.7	69.3	1	1	5.5	91.1
51	SA51A	56.7	62.7	1	1	6.1	82.4
54	SA54	60	73.3	1	1	5.2	96.3
54	SA54A	60	66.3	1	1	5.7	87.1
58	SA58	64.4	78.7	1	1	4.9	103
58	SA58A	64.4	71.2	1	1	5.3	93.6
60	SA60	66.7	81.5	1	1	4.7	107
60	SA60A	66.7	73.7	1	1	5.2	96.8
64	SA64	71.1	86.9	1	1	4.4	114
64	SA64A	71.1	78.6	1	1	4.9	103
70	SA70	77.8	95.1	1	1	4	125
70	SA70A	77.8	86	1	1	4.4	113
75	SA75	83.3	102	1	1	3.7	134
75	SA75A	83.3	92.1	1	1	4.1	121
78	SA78	86.7	106	1	1	3.6	139
78	SA78A	86.7	95.8	1	1	4	126
85	SA85	94.4	115	1	1	3.3	151
85	SA85A	94.4	104	1	1	3.6	137
90	SA90	100	122	1	1	3.1	160
90	SA90A	100	111	1	1	3.4	146
100	SA100	111	136	1	1	2.8	179
100	SA100A	111	123	1	1	3.1	162

* Steady state power dissipation = 3 watt max rating

** For bidirectional types use C or CA suffix. Have cathode polarity band on each end. (consult factory for availability)

(continued)

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 59-04 (continued)

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 35 A Pulse (except bidirectional devices).

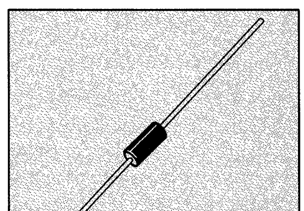
Working Peak Reverse Voltage V_{RWM} (Volts)	Device**	Breakdown Voltage V_{BR} (Volts) Min	Breakdown Voltage V_{BR} (Volts) Max	@ I_T Pulse (mA)	Maximum Reverse Leakage @ V_{RWM} I_R (µA)	Maximum Reverse Surge Current I_{RSM} Figure 1 (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
110	SA110	122	149	1	1	2.6	196
110	SA110A	122	135	1	1	2.8	177
120	SA120	133	163	1	1	2.3	214
120	SA120A	133	147	1	1	2.5	193
130	SA130	144	176	1	1	2.2	231
130	SA130A	144	159	1	1	2.4	209
150	SA150	167	204	1	1	1.9	268
150	SA150A	167	185	1	1	2.1	243
160	SA160	178	218	1	1	1.7	287
160	SA160A	178	197	1	1	1.9	259
170	SA170	189	231	1	1	1.6	304
170	SA170A	189	209	1	1	1.8	275

* Steady state power dissipation = 3 watt max rating
** For bidirectional types use C or CA suffix. Have cathode polarity band on each end. (consult factory for availability)

PEAK POWER DISSIPATION* — 600 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 17-02

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 50 A Pulse (except bidirectional devices).

Breakdown Voltage** V_{BR} (Volts) Nom	@ I_T Pulse (mA)	Device***†	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (µA)	Maximum Reverse Surge Current I_{RSM} Figure 1 (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
6.8	10	P6KE6.8	5.5	1000	56	10.8
6.8	10	P6KE6.8A	5.8	1000	57	10.5
7.5	10	P6KE7.5	6.05	500	51	11.7
7.5	10	P6KE7.5A	6.4	500	53	11.3
8.2	10	P6KE8.2	6.63	200	48	12.5
8.2	10	P6KE8.2A	7.02	200	50	12.1
9.1	1	P6KE9.1	7.37	50	44	13.8
9.1	1	P6KE9.1A	7.78	50	45	13.4
10	1	P6KE10	8.1	10	40	15
10	1	P6KE10A	8.55	10	41	14.5
11	1	P6KE11	8.92	5	37	16.2
11	1	P6KE11A	9.4	5	38	15.6
12	1	P6KE12	9.72	5	35	17.3
12	1	P6KE12A	10.2	5	36	16.7
13	1	P6KE13	10.5	5	32	19
13	1	P6KE13A	11.1	5	33	18.2
15	1	P6KE15	12.1	5	27	22
15	1	P6KE15A	12.8	5	28	21.2
16	1	P6KE16	12.9	5	26	23.5
16	1	P6KE16A	13.6	5	27	22.5
18	1	P6KE18	14.5	5	23	26.5
18	1	P6KE18A	15.3	5	24	25.2
20	1	P6KE20	16.2	5	21	29.1
20	1	P6KE20A	17.1	5	22	27.7



CASE 17-02
PLASTIC
Cathode = Polarity Band

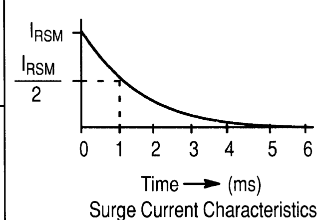


Figure 1

* Steady state power dissipation = 5 watts max rating (continued)
** Breakdown voltage tolerance is ±10% for no suffix. and ±5% for A suffix
*** For bidirectional types use C or CA suffix. Have cathode polarity band on each end. (consult factory for availability)
† UL recognition for classification of protectors (QVGV2) under the UL standard for safety 497B for entire series including C & CA suffixes.

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 600 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 17-02 (continued)

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 50 A Pulse (except bidirectional devices).

Breakdown Voltage** V_{BR} (Volts) Nom	@ I_T Pulse (mA)	Device***†	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM} Figure 1 (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
22	1	P6KE22	17.8	5	19	31.9
22	1	P6KE22A	18.8	5	20	30.6
24	1	P6KE24	19.4	5	17	34.7
24	1	P6KE24A	20.5	5	18	33.2
27	1	P6KE27	21.8	5	15	39.1
27	1	P6KE27A	23.1	5	16	37.5
30	1	P6KE30	24.3	5	14	43.5
30	1	P6KE30A	25.6	5	14.4	41.4
33	1	P6KE33	26.8	5	12.6	47.7
33	1	P6KE33A	28.2	5	13.2	45.7
36	1	P6KE36	29.1	5	11.6	52
36	1	P6KE36A	30.8	5	12	49.9
39	1	P6KE39	31.6	5	10.6	56.4
39	1	P6KE39A	33.3	5	11.2	53.9
43	1	P6KE43	34.8	5	9.6	61.9
43	1	P6KE43A	36.8	5	10.1	59.3
47	1	P6KE47	38.1	5	8.9	67.8
47	1	P6KE47A	40.2	5	9.3	64.8
51	1	P6KE51	41.3	5	8.2	73.5
51	1	P6KE51A	43.6	5	8.6	70.1
56	1	P6KE56	45.4	5	7.4	80.5
56	1	P6KE56A	47.8	5	7.8	77
62	1	P6KE62	50.2	5	6.8	89
62	1	P6KE62A	53	5	7.1	85
68	1	P6KE68	55.1	5	6.1	98
68	1	P6KE68A	58.1	5	6.5	92
75	1	P6KE75	60.7	5	5.5	108
75	1	P6KE75A	64.1	5	5.8	103
82	1	P6KE82	66.4	5	5.1	118
82	1	P6KE82A	70.1	5	5.3	113
91	1	P6KE91	73.7	5	4.5	131
91	1	P6KE91A	77.8	5	4.8	125
100	1	P6KE100	81	5	4.2	144
100	1	P6KE100A	85.5	5	4.4	137
110	1	P6KE110	89.2	5	3.8	158
110	1	P6KE110A	94	5	4	152
120	1	P6KE120	97.2	5	3.5	173
120	1	P6KE120A	102	5	3.6	165
130	1	P6KE130	105	5	3.2	187
130	1	P6KE130A	111	5	3.3	179

* Steady state power dissipation = 5 watts max rating

(continued)

** Breakdown voltage tolerance is ±10% for no suffix and ±5% for A suffix

*** For bidirectional types use C or CA suffix. Have cathode polarity band on each end. (consult factory for availability)

† UL recognition for classification of protectors (QVGV2) under the UL standard for safety 497B for entire series including C & CA suffixes.

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 600 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 17-02 (continued)

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 50 A Pulse (except bidirectional devices).

Breakdown Voltage** V_{BR} (Volts) Nom	@ I_T Pulse (mA)	Device***†	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM} Figure 1 (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
150	1	P6KE150	121	5	2.8	215
150	1	P6KE150A	128	5	2.9	207
160	1	P6KE160	130	5	2.6	230
160	1	P6KE160A	136	5	2.7	219
170	1	P6KE170	138	5	2.5	244
170	1	P6KE170A	145	5	2.6	234
180	1	P6KE180	146	5	2.3	258
180	1	P6KE180A	154	5	2.4	246
200	1	P6KE200	162	5	2.1	287
200	1	P6KE200A	171	5	2.2	274

* Steady state power dissipation = 5 watts max rating

** Breakdown voltage tolerance is ±10% for no suffix and ±5% for A suffix

*** For bidirectional types use C or CA suffix. Have cathode polarity band on each end. (consult factory for availability)

† UL recognition for classification of protectors (QVGV2) under the UL standard for safety 497B for entire series including C & CA suffixes.

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 1500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 41A-02

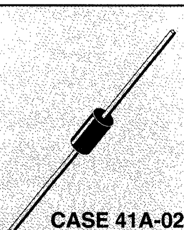
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 100 A Pulse)
(C suffix denotes standard back to back bidirectional versions. Test both polarities)

Maximum Reverse Stand-Off Voltage V_{RWM} (Volts)	JEDEC** Device	Device**	Breakdown Voltage V_{BR} Volts Min	Breakdown Voltage @ I_T Pulse (mA)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current Figure 1 I_{RSM} (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Clamping Voltage*** Peak Pulse Current @ I_{pp1} = 1 A Figure 1 V_{C1} (Volts max)	Clamping Voltage*** Peak Pulse Current @ I_{pp2} = 10 A Figure 1 V_{C2} (Volts max)
5	1N5908		6	1	300	120	8.5	7.6 @ 30 A	8 @ 60 A
5	1N6373	ICTE-5/MPTE-5	6	1	300	160	9.4	7.1	7.5
8	1N6374	ICTE-8/MPTE-8	9.4	1	25	100	15	11.3	11.5
8	1N6382	ICTE-8C/MPTE-8C	9.4	1	25	100	15	11.4	11.6
10	1N6375	ICTE-10/MPTE-10	11.7	1	2	90	16.7	13.7	14.1
10	1N6383	ICTE-10C/MPTE-10C	11.7	1	2	90	16.7	14.1	14.5
12	1N6376	ICTE-12/MPTE-12	14.1	1	2	70	21.2	16.1	16.5
12	1N6384	ICTE-12C/MPTE-12C	14.1	1	2	70	21.2	16.7	17.1
15	1N6377	ICTE-15/MPTE-15	17.6	1	2	60	25	20.1	20.6
15	1N6385	ICTE-15C/MPTE-15C	17.6	1	2	60	25	20.8	21.4
18	1N6378	ICTE-18/MPTE-18	21.2	1	2	50	30	24.2	25.2
18	1N6386	ICTE-18C/MPTE-18C	21.2	1	2	50	30	24.8	25.5
22	1N6379	ICTE-22/MPTE-22	25.9	1	2	40	37.5	29.8	32
22	1N6387	ICTE-22C/MPTE-22C	25.9	1	2	40	37.5	30.8	32
36	1N6380	ICTE-36/MPTE-36	42.4	1	2	23	65.2	50.6	54.3
36	1N6388	ICTE-36C/MPTE-36C	42.4	1	2	23	65.2	50.6	54.3
45	1N6381	ICTE-45/MPTE-45	52.9	1	2	19	78.9	63.3	70
45	1N6389	ICTE-45C/MPTE-45C	52.9	1	2	19	78.9	63.3	70

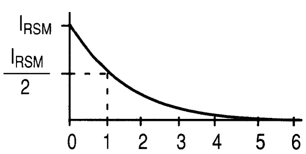
* Steady state power dissipation = 5 watts max rating.

*** 1N6382 thru 1N6389 and C suffix ICTE/MPTE device types are bidirectional. Have cathode polarity band on each end. All other device types are unidirectional only. (Consult factory for availability).

*** Clamping voltage peak pulse currents for 1N5908 are 30 Amps and 60 Amps.



CASE 41A-02
PLASTIC
Cathode = Polarity Band



Time ⟶ (ms)
Surge Current Characteristics

Figure 1

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 1500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 41A-02

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 100 A Pulse

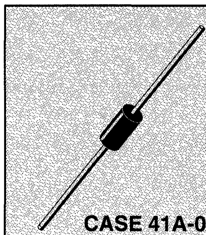
Breakdown Voltage** V_{BR} Volts Nom	@ I_T Pulse (mA)	JEDEC Device	Device*** †	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current Figure 1 I_{RSM} (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
6.8	10	1N6267	1.5KE6.8	5.5	1000	139	10.8
6.8	10	1N6267A	1.5KE6.8A	5.8	1000	143	10.5
7.5	10	1N6268	1.5KE7.5	6.05	500	128	11.7
7.5	10	1N6268A	1.5KE7.5A	6.4	500	132	11.3
8.2	10	1N6269	1.5KE8.2	6.63	200	120	12.5
8.2	10	1N6269A	1.5KE8.2A	7.02	200	124	12.1
9.1	1	1N6270	1.5KE9.1	7.37	50	109	13.8
9.1	1	1N6270A	1.5KE9.1A	7.78	50	112	13.4
10	1	1N6271	1.5KE10	8.1	10	100	15
10	1	1N6271A	1.5KE10A	8.55	10	103	14.5
11	1	1N6272	1.5KE11	8.92	5	93	16.2
11	1	1N6272A	1.5KE11A	9.4	5	96	15.6
12	1	1N6273	1.5KE12	9.72	5	87	17.3
12	1	1N6273A	1.5KE12A	10.2	5	90	16.7
13	1	1N6274	1.5KE13	10.5	5	79	19
13	1	1N6274A	1.5KE13A	11.1	5	82	18.2
15	1	1N6275	1.5KE15	12.1	5	68	22
15	1	1N6275A	1.5KE15A	12.8	5	71	21.2
16	1	1N6276	1.5KE16	12.9	5	64	23.5
16	1	1N6276A	1.5KE16A	13.6	5	67	22.5
18	1	1N6277	1.5KE18	14.5	5	56.5	26.5
18	1	1N6277A	1.5KE18A	15.3	5	59.5	25.2
20	1	1N6278	1.5KE20	16.2	5	51.5	29.1
20	1	1N6278A	1.5KE20A	17.1	5	54	27.7
22	1	1N6279	1.5KE22	17.8	5	47	31.9
22	1	1N6279A	1.5KE22A	18.8	5	49	30.6
24	1	1N6280	1.5KE24	19.4	5	43	34.7
24	1	1N6280A	1.5KE24A	20.5	5	45	33.2
27	1	1N6281	1.5KE27	21.8	5	38.5	39.1
27	1	1N6281A	1.5KE27A	23.1	5	40	37.5
30	1	1N6282	1.5KE30	24.3	5	34.5	43.5
30	1	1N6282A	1.5KE30A	25.6	5	36	41.4
33	1	1N6283	1.5KE33	26.8	5	31.5	47.7
33	1	1N6283A	1.5KE33A	28.2	5	33	45.7
36	1	1N6284	1.5KE36	29.1	5	29	52
36	1	1N6284A	1.5KE36A	30.8	5	30	49.9
39	1	1N6285	1.5KE39	31.6	5	26.5	56.4
39	1	1N6285A	1.5KE39A	33.3	5	28	53.9
43	1	1N6286	1.5KE43	34.8	5	24	61.9
43	1	1N6286A	1.5KE43A	36.8	5	25.3	59.3
47	1	1N6287	1.5KE47	38.1	5	22.2	67.8
47	1	1N6287A	1.5KE47A	40.2	5	23.2	64.8
51	1	1N6288	1.5KE51	41.3	5	20.4	73.5
51	1	1N6288A	1.5KE51A	43.6	5	21.4	70.1

(continued)

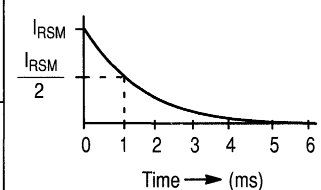
* Steady state power dissipation = 5 watts max rating

** Breakdown voltage tolerance is ±10% for no suffix and ±5% for A suffix

*** For bidirectional types use C or CA suffix on 1.5KE series only. Have cathode polarity band on each end. Consult factory for availability. (1N6267-6303A series do not have C or CA option).



CASE 41A-02
PLASTIC
Cathode = Polarity Band



Surge Current Characteristics

Figure 1

AXIAL LEADED FOR THRU-HOLE DESIGNS (continued)

PEAK POWER DISSIPATION* — 1500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 41A-02 (continued)

ELECTRICAL CHARACTERISTICS — continued (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 100 A Pulse

Breakdown Voltage** V_{BR} Volts Nom	@ I_T Pulse (mA)	JEDEC Device	Device*** †	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current Figure 1 I_{RSM} (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)
56	1	1N6289	1.5KE56	45.4	5	18.6	80.5
56	1	1N6289A	1.5KE56A	47.8	5	19.5	77
62	1	1N6290	1.5KE62	50.2	5	16.9	89
62	1	1N6290A	1.5KE62A	53	5	17.7	85
68	1	1N6291	1.5KE68	55.1	5	15.3	98
68	1	1N6291A	1.5KE68A	58.1	5	16.3	92
75	1	1N6292	1.5KE75	60.7	5	13.9	108
75	1	1N6292A	1.5KE75A	64.1	5	14.6	103
82	1	1N6293	1.5KE82	66.4	5	12.7	118
82	1	1N6293A	1.5KE82A	70.1	5	13.3	113
91	1	1N6294	1.5KE91	73.7	5	11.4	131
91	1	1N6294A	1.5KE91A	77.8	5	12	125
100	1	1N6295	1.5KE100	81	5	10.4	144
100	1	1N6295A	1.5KE100A	85.5	5	11	137
110	1	1N6296	1.5KE110	89.2	5	9.5	158
110	1	1N6296A	1.5KE110A	94	5	9.9	152
120	1	1N6297	1.5KE120	97.2	5	8.7	173
120	1	1N6297A	1.5KE120A	102	5	9.1	165
130	1	1N6298	1.5KE130	105	5	8	187
130	1	1N6298A	1.5KE130A	111	5	8.4	179
150	1	1N6299	1.5KE150	121	5	7	215
150	1	1N6299A	1.5KE150A	128	5	7.2	207
160	1	1N6300	1.5KE160	130	5	6.5	230
160	1	1N6300A	1.5KE160A	136	5	6.8	219
170	1	1N6301	1.5KE170	138	5	6.2	244
170	1	1N6301A	1.5KE170A	145	5	6.4	234
180	1	1N6302	1.5KE180	146	5	5.8	258
180	1	1N6302A	1.5KE180A	154	5	6.1	246
200	1	1N6303	1.5KE200	162	5	5.2	287
200	1	1N6303A	1.5KE200A	171	5	5.5	274
220	1		1.5KE220	175	5	4.3	344
220	1		1.5KE220A	185	5	4.6	328
250	1		1.5KE250	202	5	5	360
250	1		1.5KE250A	214	5	5	344

* Steady state power dissipation = 5 watts max rating

** Breakdown voltage tolerance is ±10% for no suffix and ±5% for A suffix

*** For bidirectional types use C or CA suffix on 1.5KE series only. Have cathode polarity band on each end. Consult factory for availability. (1N6267-6303A series do not have C or CA option).

† UL recognition for classification of protectors (QVGV2) under the UL standard for safety 497B for 1.5KE6.8,A,C,CA thru 1.5KE250,A,C,CA.

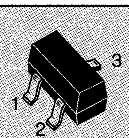
Surface Mount Packages

PEAK POWER DISSIPATION — 40 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 318-07
MMBZ15VDLT1* — SOT-23 BIPOLAR (for ESD protection)

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)
BIDIRECTIONAL (Circuit tied to pins 1 and 2)

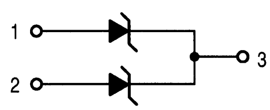
Breakdown Voltage V_{BR} †† (Volts) Min	Nom	Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM} (Volts)	Maximum Reverse Leakage Current I_{RWM} I_R (nA)	Maximum Reverse Surge Current I_{RSM} † (Amps)	Maximum Reverse Voltage @ I_{RSM} † (Clamping Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (mV/°C)
14.3	15	15.8	1.0	12.8	100	1.9	21.2	12

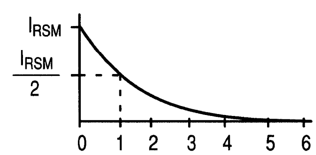
† Surge current waveform per Figure 1.
†† V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.
* T1 suffix designates tape and reel of 3000 units.



CASE 318-07, STYLE 9
TO-236AB
LOW PROFILE SOT-23
PLASTIC

Pinout: Terminal 1 — Anode
Terminal 2 — Anode
Terminal 3 — Cathode





Surge Current Characteristics

Figure 1

SURFACE MOUNT PACKAGES (continued)

PEAK POWER DISSIPATION — 600 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 403A-03

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted).

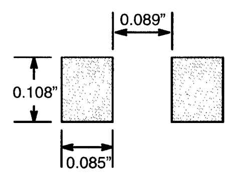
Reverse Stand-Off Voltage V_R Volts (1)	Device (2)	Breakdown Voltage V_{BR} @ I_T Volts Min	Breakdown Voltage V_{BR} @ I_T Pulse mA	Maximum Clamping Voltage V_C @ I_{pp} Volts	Peak Pulse Current (See Figure 1) I_{pp} Amps	Maximum Reverse Leakage @ V_R I_R µA	Device Marking
5	1SMB5.0AT3	6.4	10	9.2	65.2	800	KE
6	1SMB6.0AT3	6.67	10	10.3	58.3	800	KG
6.5	1SMB6.5AT3	7.22	10	11.2	53.6	500	KK
7	1SMB7.0AT3	7.78	10	12	50	200	KM
7.5	1SMB7.5AT3	8.33	1	12.9	46.5	100	KP
8	1SMB8.0AT3	8.89	1	13.6	44.1	50	KR
8.5	1SMB8.5AT3	9.44	1	14.4	41.7	10	KT
9	1SMB9.0AT3	10	1	15.4	39	5	KV
10	1SMB10AT3	11.1	1	17	35.3	5	KX
11	1SMB11AT3	12.2	1	18.2	33	5	KZ
12	1SMB12AT3	13.3	1	19.9	30.2	5	LE
13	1SMB13AT3	14.4	1	21.5	27.9	5	LG
14	1SMB14AT3	15.6	1	23.2	25.8	5	LK
15	1SMB15AT3	16.7	1	24.4	24	5	LM
16	1SMB16AT3	17.8	1	26	23.1	5	LP
17	1SMB17AT3	18.9	1	27.6	21.7	5	LR
18	1SMB18AT3	20	1	29.2	20.5	5	LT
20	1SMB20AT3	22.2	1	32.4	18.5	5	LV
22	1SMB22AT3	24.4	1	35.5	16.9	5	LX
24	1SMB24AT3	26.7	1	38.9	15.4	5	LZ
26	1SMB26AT3	28.9	1	42.1	14.2	5	ME
28	1SMB28AT3	31.1	1	45.4	13.2	5	MG
30	1SMB30AT3	33.3	1	48.4	12.4	5	MK
33	1SMB33AT3	36.7	1	53.3	11.3	5	MM
36	1SMB36AT3	40	1	58.1	10.3	5	MP
40	1SMB40AT3	44.4	1	64.5	9.3	5	MR
43	1SMB43AT3	47.8	1	69.4	8.6	5	MT
45	1SMB45AT3	50	1	72.7	8.3	5	MV
48	1SMB48AT3	53.3	1	77.4	7.7	5	MX
51	1SMB51AT3	56.7	1	82.4	7.3	5	MZ
54	1SMB54AT3	60	1	87.1	6.9	5	NE
58	1SMB58AT3	64.4	1	93.6	6.4	5	NG
60	1SMB60AT3	66.7	1	96.8	6.2	5	NK
64	1SMB64AT3	71.1	1	103	5.8	5	NM
70	1SMB70AT3	77.8	1	113	5.3	5	NP
75	1SMB75AT3	83.3	1	121	4.9	5	NR
78	1SMB78AT3	86.7	1	126	4.7	5	NT
85	1SMB85AT3	94.4	1	137	4.4	5	NV
90	1SMB90AT3	100	1	146	4.1	5	NX
100	1SMB100AT3	111	1	162	3.7	5	NZ
110	1SMB110AT3	122	1	177	3.4	5	PE
120	1SMB120AT3	133	1	193	3.1	5	PG
130	1SMB130AT3	144	1	209	2.9	5	PK
150	1SMB150AT3	167	1	243	2.5	5	PM
160	1SMB160AT3	178	1	259	2.3	5	PP
170	1SMB170AT3	189	1	275	2.2	5	PR

Note 1. A transient suppressor is normally selected according to the reverse "Stand Off Voltage" (V_R) which should be equal to or greater than the DC or continuous peak operating voltage level.

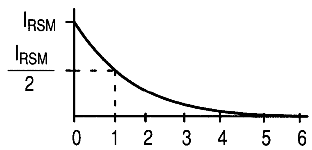
Note 2. T3 suffix designates tape and reel of 2500 units.

SMB
CASE 403A-03
PLASTIC
Cathode = Notch

RECOMMENDED SOLDER PAD (FOOTPRINT)



SMB



Time → (ms)
Surge Current Characteristics

Figure 1

SURFACE MOUNT PACKAGES (continued)

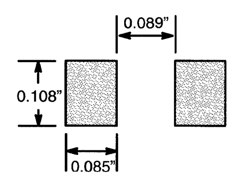
PEAK POWER DISSIPATION — 600 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 403A-03

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 50 A Pulse.

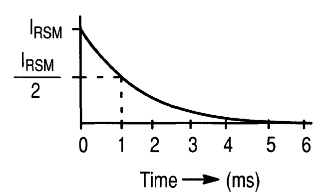
Breakdown Voltage* V_{BR} @ I_T Pulse Volts							
Nom	mA	Device**	Working Peak Reverse Voltage V_{RWM} Volts	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current Figure 1 I_{RSM} (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Device Marking
6.8	10	P6SMB6.8AT3	5.8	1000	57	10.5	6V8A
7.5	10	P6SMB7.5AT3	6.4	500	53	11.3	7V5A
8.2	10	P6SMB8.2AT3	7.02	200	50	12.1	8V2A
9.1	1	P6SMB9.1AT3	7.78	50	45	13.4	9V1A
10	1	P6SMB10AT3	8.55	10	41	14.5	10A
11	1	P6SMB11AT3	9.4	5	38	15.6	11A
12	1	P6SMB12AT3	10.2	5	36	16.7	12A
13	1	P6SMB13AT3	11.1	5	33	18.2	13A
15	1	P6SMB15AT3	12.8	5	28	21.2	15A
16	1	P6SMB16AT3	13.6	5	27	22.5	16A
18	1	P6SMB18AT3	15.3	5	24	25.2	18A
20	1	P6SMB20AT3	17.1	5	22	27.7	20A
22	1	P6SMB22AT3	18.8	5	20	30.6	22A
24	1	P6SMB24AT3	20.5	5	18	33.2	24A
27	1	P6SMB27AT3	23.1	5	16	37.5	27A
30	1	P6SMB30AT3	25.6	5	14.4	41.4	30A
33	1	P6SMB33AT3	28.2	5	13.2	45.7	33A
36	1	P6SMB36AT3	30.8	5	12	49.9	36A
39	1	P6SMB39AT3	33.3	5	11.2	53.9	39A
43	1	P6SMB43AT3	36.8	5	10.1	59.3	43A
47	1	P6SMB47AT3	40.2	5	9.3	64.8	47A
51	1	P6SMB51AT3	43.6	5	8.6	70.1	51A
56	1	P6SMB56AT3	47.8	5	7.8	77	56A
62	1	P6SMB62AT3	53	5	7.1	85	62A
68	1	P6SMB68AT3	58.1	5	6.5	92	68A
75	1	P6SMB75AT3	64.1	5	5.8	103	75A
82	1	P6SMB82AT3	70.1	5	5.3	113	82A
91	1	P6SMB91AT3	77.8	5	4.8	125	91A
100	1	P6SMB100AT3	85.5	5	4.4	137	100A
110	1	P6SMB110AT3	94	5	4	152	110A
120	1	P6SMB120AT3	102	5	3.6	165	120A
130	1	P6SMB130AT3	111	5	3.3	179	130A
150	1	P6SMB150AT3	128	5	2.9	207	150A
160	1	P6SMB160AT3	136	5	2.7	219	160A
170	1	P6SMB170AT3	145	5	2.6	234	170A
180	1	P6SMB180AT3	154	5	2.4	246	180A
200	1	P6SMB200AT3	171	5	2.2	274	200A

SMB
CASE 403A-03
PLASTIC
Cathode = Notch

RECOMMENDED SOLDER PAD (FOOTPRINT)



SMB



Surge Current Characteristics

Figure 1

* Breakdown voltage tolerance is ±5% for A suffix.
** T3 suffix designates tape and reel of 2500 units.

SURFACE MOUNT PACKAGES (continued)

PEAK POWER DISSIPATION — 1500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 403-03

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

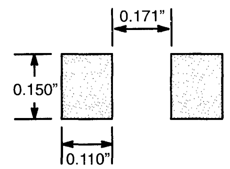
Reverse Stand-Off Voltage V_R Volts (1)	Device (2)	Breakdown Voltage V_{BR} @ I_T Volts Min	Pulse mA	Maximum Clamping Voltage V_C @ I_{pp} Volts	Peak Pulse Current (See Figure 1) I_{pp} Amps	Maximum Reverse Leakage @ V_R I_R μA	Device Marking
5	1SMC5.0AT3	6.4	10	9.2	163	1000	GDE
6	1SMC6.0AT3	6.67	10	10.3	145.6	1000	GDG
6.5	1SMC6.5AT3	7.22	10	11.2	133.9	500	GDK
7	1SMC7.0AT3	7.78	10	12	125	200	GDM
7.5	1SMC7.5AT3	8.33	1	12.9	116.3	100	GDP
8	1SMC8.0AT3	8.89	1	13.6	110.3	50	GDR
8.5	1SMC8.5AT3	9.44	1	14.4	104.2	20	GDT
9	1SMC9.0AT3	10	1	15.4	97.4	10	GDV
10	1SMC10AT3	11.1	1	17	88.2	5	GDX
11	1SMC11AT3	12.2	1	18.2	82.4	5	GDZ
12	1SMC12AT3	13.3	1	19.9	75.3	5	GEE
13	1SMC13AT3	14.4	1	21.5	69.7	5	GEG
14	1SMC14AT3	15.6	1	23.2	64.7	5	GEK
15	1SMC15AT3	16.7	1	24.4	61.5	5	GEM
16	1SMC16AT3	17.8	1	26	57.7	5	GEP
17	1SMC17AT3	18.9	1	27.6	53.3	5	GER
18	1SMC18AT3	20	1	29.2	51.4	5	GET
20	1SMC20AT3	22.2	1	32.4	46.3	5	GEV
22	1SMC22AT3	24.4	1	35.5	42.2	5	GEX
24	1SMC24AT3	26.7	1	38.9	38.6	5	GEZ
26	1SMC26AT3	28.9	1	42.1	35.6	5	GFE
28	1SMC28AT3	31.1	1	45.4	33	5	GFG
30	1SMC30AT3	33.3	1	48.4	31	5	GFK
33	1SMC33AT3	36.7	1	53.3	28.1	5	GFM
36	1SMC36AT3	40	1	58.1	25.8	5	GFP
40	1SMC40AT3	44.4	1	64.5	23.2	5	GFR
43	1SMC43AT3	47.8	1	69.4	21.6	5	GFT
45	1SMC45AT3	50	1	72.7	20.6	5	GFV
48	1SMC48AT3	53.3	1	77.4	19.4	5	GFX
51	1SMC51AT3	56.7	1	82.4	18.2	5	GFZ
54	1SMC54AT3	60	1	87.1	17.2	5	GGE
58	1SMC58AT3	64.4	1	93.6	16	5	GGG
60	1SMC60AT3	66.7	1	96.8	15.5	5	GGK
64	1SMC64AT3	71.1	1	103	14.6	5	GGM
70	1SMC70AT3	77.8	1	113	13.3	5	GGP
75	1SMC75AT3	83.3	1	121	12.4	5	GGR
78	1SMC78AT3	86.7	1	126	11.4	5	GGT

Note 1. A transient suppressor is normally selected according to the reverse "Stand Off Voltage" (V_R) which should be equal to or greater than the DC or continuous peak operating voltage level.

Note 2. T3 suffix designates tape and reel of 2500 units.

SMC
CASE 403-03
PLASTIC
Cathode = Notch

RECOMMENDED SOLDER PAD (FOOTPRINT)



SMC

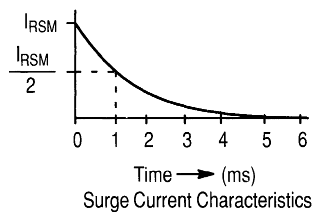


Figure 1

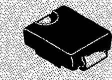
SURFACE MOUNT PACKAGES (continued)

PEAK POWER DISSIPATION — 1500 WATTS @ 1 ms SURGE (FIGURE 1) — CASE 403-03

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V Max, I_F = 100 A Pulse.

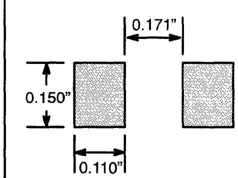
Breakdown Voltage* V_{BR} @ I_T Pulse Volts Nom	mA	Device**	Working Peak Reverse Voltage V_{RWM} Volts	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current Figure 1 I_{RSM} (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Device Marking
6.8	10	1.5SMC6.8AT3	5.8	1000	143	10.5	6V8A
7.5	10	1.5SMC7.5AT3	6.4	500	132	11.3	7V5A
8.2	10	1.5SMC8.2AT3	7.02	200	124	12.1	8V2A
9.1	1	1.5SMC9.1AT3	7.78	50	112	13.4	9V1A
10	1	1.5SMC10AT3	8.55	10	103	14.5	10A
11	1	1.5SMC11AT3	9.4	5	96	15.6	11A
12	1	1.5SMC12AT3	10.2	5	90	16.7	12A
13	1	1.5SMC13AT3	11.1	5	82	18.2	13A
15	1	1.5SMC15AT3	12.8	5	71	21.2	15A
16	1	1.5SMC16AT3	13.6	5	67	22.5	16A
18	1	1.5SMC18AT3	15.3	5	59.5	25.2	18A
20	1	1.5SMC20AT3	17.1	5	54	27.7	20A
22	1	1.5SMC22AT3	18.8	5	49	30.6	22A
24	1	1.5SMC24AT3	20.5	5	45	33.2	24A
27	1	1.5SMC27AT3	23.1	5	40	37.5	27A
30	1	1.5SMC30AT3	25.6	5	36	41.4	30A
33	1	1.5SMC33AT3	28.2	5	33	45.7	33A
36	1	1.5SMC36AT3	30.8	5	30	49.9	36A
39	1	1.5SMC39AT3	33.3	5	28	53.9	39A
43	1	1.5SMC43AT3	36.8	5	25.3	59.3	43A
47	1	1.5SMC47AT3	40.2	5	23.2	64.8	47A
51	1	1.5SMC51AT3	43.6	5	21.4	70.1	51A
56	1	1.5SMC56AT3	47.8	5	19.5	77	56A
62	1	1.5SMC62AT3	53	5	17.7	85	62A
68	1	1.5SMC68AT3	58.1	5	16.3	92	68A
75	1	1.5SMC75AT3	64.1	5	14.6	103	75A
82	1	1.5SMC82AT3	70.1	5	13.3	113	82A
91	1	1.5SMC91AT3	77.8	5	12	125	91A

* Breakdown voltage tolerance is ±5% for A suffix.
** T3 suffix designates tape and reel of 2500 units.

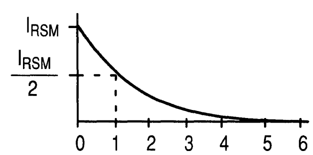


SMC
CASE 403-03
PLASTIC
Cathode = Notch

RECOMMENDED SOLDER PAD (FOOTPRINT)



SMC



Surge Current Characteristics

Figure 1

TRANSIENT VOLTAGE SUPPRESSORS (continued)

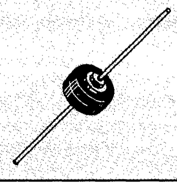
Automotive Transient Suppressors

Automotive transient suppressors are designed for protection against over-voltage conditions in the auto electrical system including the "LOAD DUMP" phenomenon that occurs when the battery open circuits while the car is running.

AUTOMOTIVE TRANSIENT SUPPRESSOR	
	CASE 194-04 MR2535L
V_{RRM} (Volts)	20
I_O (Amp)	35
$V_{(BR)}$ (Volts)	24–32
I_{RSM}* (Amp)	110
T_C @ Rated I_O (°C)	150
T (°C)	175

* Time constant = 10 ms, duty cycle ≤ 1%, T_C = 25°C.
Note: MR2535L is considered part of the rectifier product portfolio.

CASE 194-04



RF Products

In Brief . . .

While Motorola is considered to be the supermarket for semiconductor products, there is not category in which the selection is more diverse, or more complete, than in products designed for RF system applications. From MOS and bipolar power and signal transistors to tuning and switching diodes, Motorola's RF components cover the entire spectrum from HF to microwave. Yet, product expansion continues – not only to keep pace with the progressive needs of the industry, but to better serve the needs of designers for a reliable and comprehensive source of supply.

The immediate future will advance these Motorola objectives in two significant ways:

1. Through the acquisition of the TRW RF Devices Division Motorola immediately expands its existing product portfolio and manufacturing facilities in the important areas of high power **linear** transistors and **wave** devices. With continuing full-scale operation of these erstwhile TRW facilities, there will be no interruption of service for these components.

Recently patented process breakthroughs in the field of dielectric isolation will result in new monolithic integrated circuits with RF gain and power levels that substantially reduce the component count of VHF/UHF designs.

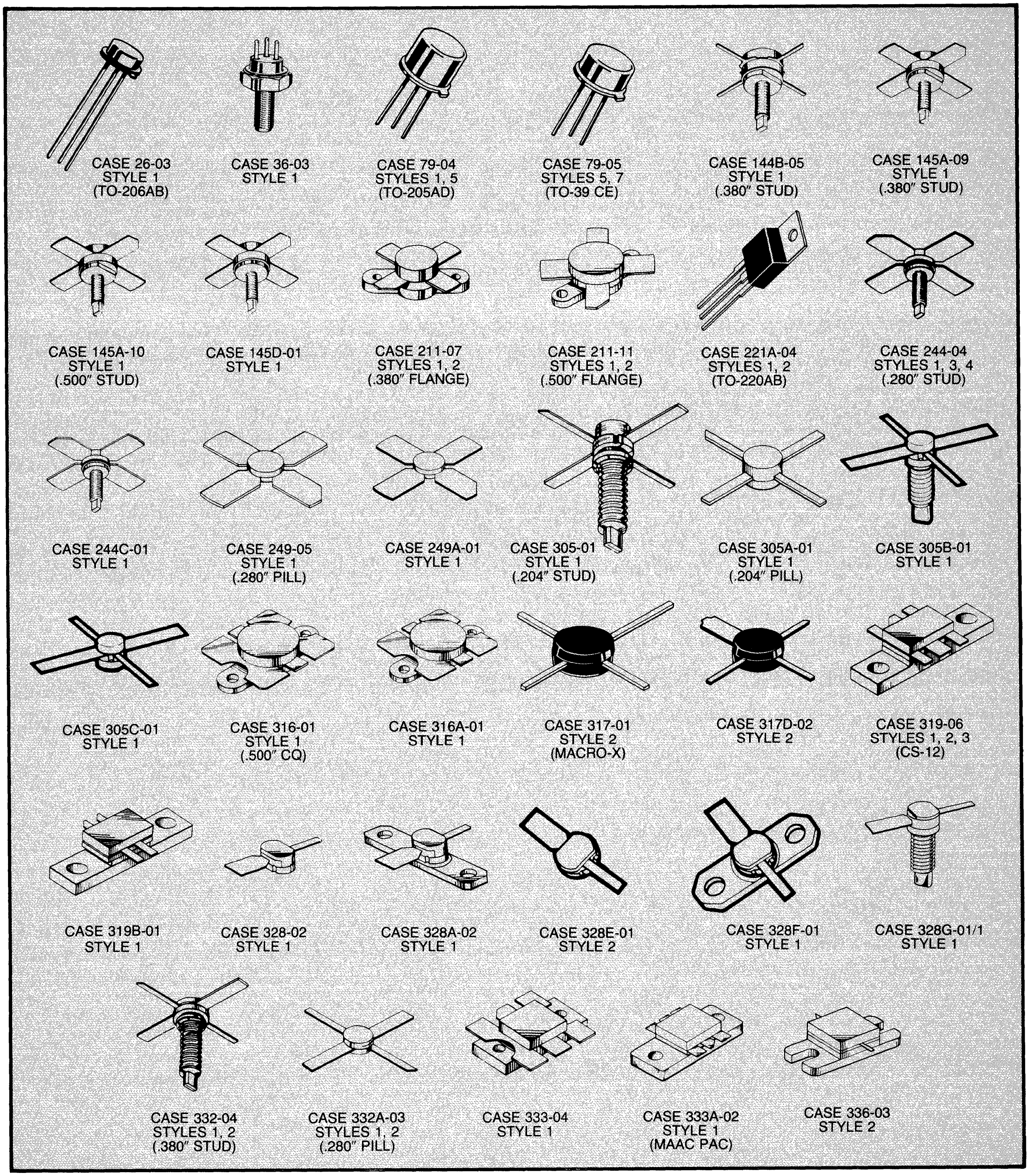
The selection tables on the subsequent pages include a number for products that have been recently introduced. The acquired TRW product lines are not yet included, however, and a number of significant new products are in the latter stages of development. For a detailed description of these, please consult your Motorola sales representative or distributor.

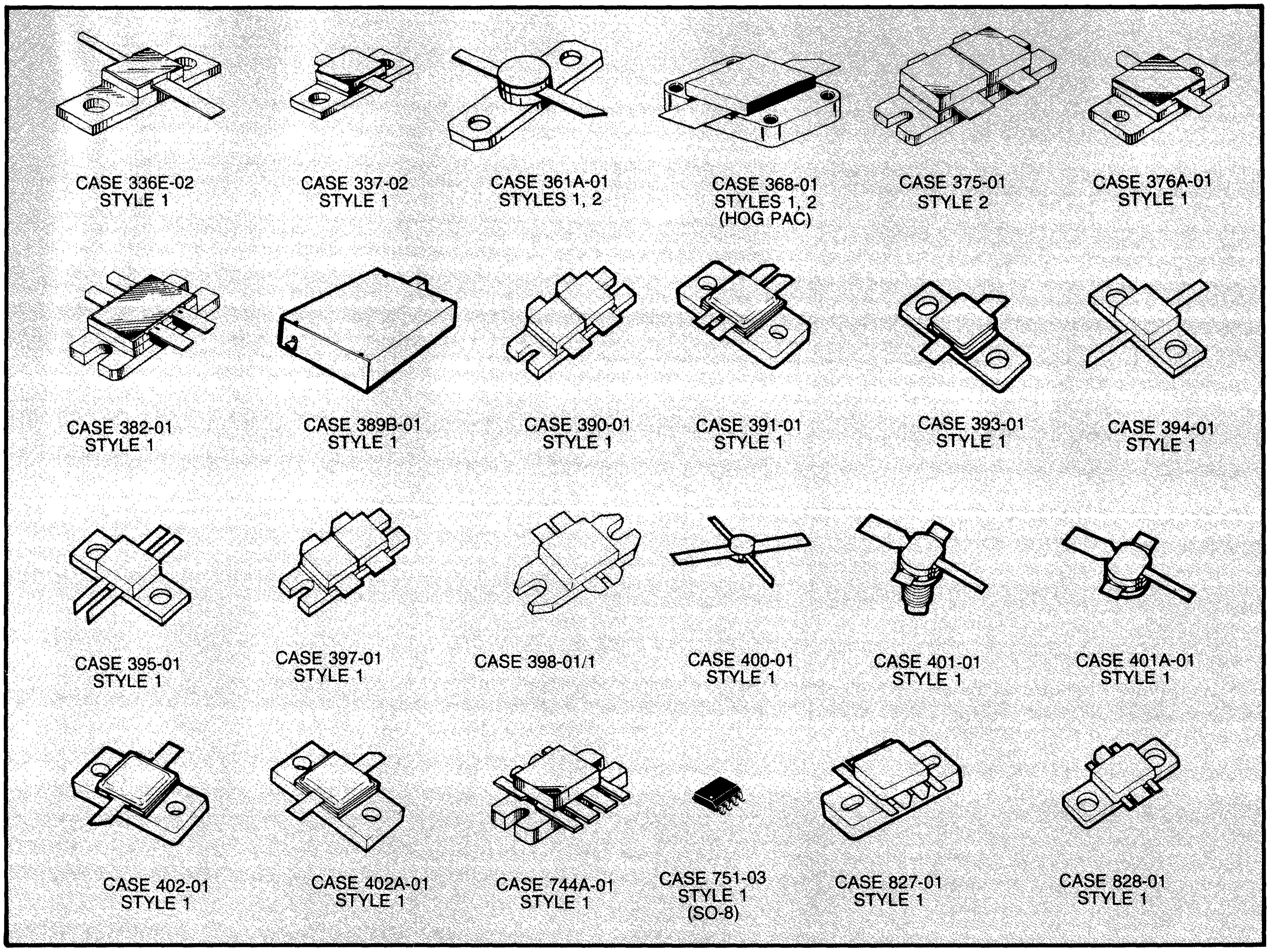
RF Discrete Transistors

In the following pages, the reader will find the most extensive group of RF Discrete Transistors offered by any semiconductor manufacturer anywhere in the world today.

From Bipolar to FET, from Low Power to High Power, the user can choose from a variety of packages. They include plastic, metal can and ceramic that are micro-strip circuit compatible or surface mountable. These are designed for automated assembly equipment.

Major sub-headings are TMOS FETs, Power Bipolar and Small Signal Bipolar.





RF Power TMOS FETs

Motorola RF Power MOSFETs, (trademark TMOS), are constructed using a planar process to enhance manufacturing repeatability. *They are N-channel field effect transistors* with an oxide insulated gate which controls vertical current flow.

Compared with bipolar transistors, RF Power FETs exhibit higher gain, higher input impedance, enhanced thermal stability and lower noise. The FETs listed in this section are specified for operation in RF Power Amplifiers and are grouped by frequency range of operation and type of application. Arrangement within each group is by order of first voltage then increasing output power.

TO 150 MHz HF/SSB

For military and commercial HF/SSB fixed, mobile, and marine transmitters.

Device	P_{out} Output Power Watts	P_{in} Input Power Typical Watts	G_{ps} Typical Gain dB @ 30 MHz	Typical IMD d_3 dB	Typical IMD d_{11} dB	θ_{JC} °C/W	Package/Style
V_{DD} = 28 Volts							
MRF138	30	0.6	17	−30	−60	1.5	211-07/2
MRF140	150	4.7	15	−30	−60	0.6	211-11/2
V_{DD} = 50 Volts							
MRF148	30	0.5	18	−35	−60	1.5	211-07/2
MRF150	150	2.9	17	−32	−60	0.6	211-11/2
MRF153	300	6	17	−25	—	0.25	368-01/2
MRF154	600	12	17	−25	—	0.13	368-01/2
MRF157 (1)	600	6	20	−25	—	0.13	368-01/2

(1) To be introduced

(continued)

New introductions

RF POWER TMOS FETs (continued)

TO 225 MHz VHF AM/FM

For VHF military and commercial aircraft radio transmitters.

Device	P_{out} Output Power Watts	P_{in} Input Power Typical Watts	G_{ps} (Typ)/Freq. dB/MHz	η Typical Efficiency %	θ_{JC} °C/W	Package/Style
V_{DD} = 28 Volts						
MRF134	5	0.2	14/150	55	10	211-07/2
MRF136	15	0.38	16/150	60	3.2	211-07/2
MRF136Y	30	1.2	14/150	54	1.8	319B-01/1
MRF137	30	0.75	16/150	60	1.8	211-07/2
MRF141	150	10	10/175	55	0.6	211-11/2
MRF141G	300	13	10/175	55	0.35	375-01/2
MRF171	45	1.4	15/150	60	1.5	211-07/2
MRF172	80	4.7	12.3/150	60	0.8	211-11/2
MRF174	125	8.3	11.8/150	60	0.65	211-11/2
MRF175GV	200	8	14/225	65	0.44	375-01/2
MRF175LV	100	4	14/225	65	0.65	333-04/1
V_{DD} = 50 Volts						
MRF151	150	7.5	13/175	45	0.6	211-11/2
MRF151G	300	7.5	16/175	55	0.35	375-01/2
MRF176GV	200	4	17/225	55	0.44	375-01/2

TO 500 MHz UHF AM/FM

For VHF/UHF military and commercial aircraft radio transmitters.

Device	P_{out} Output Power Watts	P_{in} Input Power Typical Watts	G_{ps} (Typ)/Freq. dB/MHz	η Typical Efficiency %	θ_{JC} °C/W	Package/Style
V_{DD} = 28 Volts						
MRF158R (1)	2	0.02	20/400	55	22	79-05/7
MRF160R (1)	4	0.04	20/400	55	12	79-05/7
MRF161	5	0.4	13.5/400	45	10	244-04/3
MRF162	15	0.65	13.6/400	50	3.5	244-04/3
MRF163	25	1.6	12/400	50	2	244-04/3
MRF166C (1)	20	0.4	17/400	55	2.5	319-06/3
MRF164W (1)	20	0.4	17/400	50	1.5	412-01/1
MRF175GU	150	9.5	12/400	55	0.44	375-01/2
MRF175LU	100	10	10/400	55	0.65	333-04/1
V_{DD} = 50 Volts						
MRF176GU	150	6	14/400	50	0.44	375-01/2

(1) To be introduced

New introductions

RF Power Bipolar Transistors

Motorola's broad line of bipolar RF power transistors are characterized for operation in RF power amplifiers. Typical applications are in military and commercial landmobile, avionics and marine radio transmitters. Groupings are by frequency band and type of application. Within each group, the arrangement of devices is by major supply voltage rating, then in the order of increasing output power. Details of package dimensions begin on Page 62. All devices are NPN polarity except where otherwise noted.

HF Transistors

1.5–30 MHz, HF/SSB

Designed for broadband operation, these devices feature specified Intermodulation Distortion at rated power output. Applications include mobile, marine, fixed station, and amateur HF/SSB equipment, operating from 12.5, 13.6, 28 or 50 volt supplies.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB @ 30 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 or 13.6 Volts					
MRF476	3 PEP/CW	0.1	15	17.5	221A-04/1
MRF475	12 PEP/CW	1.2	10	10	221A-04/1
MRF433	12.5 PEP/CW	0.125	20	8.8	211-07/1
MRF479	15 PEP/CW	0.95	12	5.9	221A-04/2
MRF406	20 PEP/CW	1.25	12	2.2	211-07/1
MRF477	40 PEP/CW	1.25	15	2	221A-04/2
MRF421	100 PEP/CW	10	10	0.6	211-11/1
V_{CC} = 28 Volts					
MRF410	10 PEP/CW	0.5	13	4.4	211-07/1
MRF485	15 PEP/CW	1.5	10	3.4	221A-04/1
MRF426	25 PEP/CW	0.16	22	2.5	211-07/1
MRF401	25 PEP/CW	1.25	13	3.5	145A-09/1
MRF466	40 PEP/CW	1.25	15	1	211-07/1
MRF486	40 PEP/CW	1.25	15	2	221A-04/2
MRF464	80 PEP/CW	2.53	15	0.7	211-11/1
MRF464A	80 PEP/CW	2.53	15	0.7	145A-10/1
MRF422	150 PEP/CW	15	10	0.6	211-11/1
V_{CC} = 50 Volts					
MRF427	25 PEP/CW	0.4	18	2.2	211-11/1
PT9798	75 PEP/CW	2.4	15 (3)	1	211-07/1
MRF428	150 PEP/CW	7.5	13	0.5	211-11/1
MRF429	150 PEP/CW	7.5	13	0.8	211-11/1
PT9790	150 PEP/CW	4.8	15 (3)	0.5	211-11/1
MRF448	250 PEP/CW	15.7	12	0.6	211-11/1
MRF430	600 PEP/CW	60	10	0.2	368-01/1

14–30 MHz, CB/AMATEUR BAND

These HF transistors are designed for economical, high-volume use in CW, AM and SSB applications.

V_{CC} = 12.5 or 13.6 Volts

MRF476	3	0.1	15	17.5	221A-04/1
MRF475	4	0.4	10	10	221A-04/1
MRF450	50	4	11	1.5	211-07/1
MRF450A	50	4	11	1.5	145A-09/1
MRF455	60	3	13	1	211-07/1
MRF455A	60	3	13	1	145A-09/1
MRF454	80	5	12	0.7	211-11/1

HF TRANSISTORS (continued)

27–50 MHz, LOW-BAND FM BAND

For use in the FM "Low-Band," for Mobile communications.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB @ 50 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 or 13.6 Volts					
MRF475	4	0.4	10	10	221A-04/1
MRF497	40	4	10	2	221A-04/2
MRF492	70	5.6	11	0.7	211-11/1

VHF Transistors

30–200 MHz BAND

Designed for Military Radio and Commercial Aircraft VHF bands, these 28-volt devices include the all-gold metallized MRF314/15/16/17 high-reliability series.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min)/Freq. Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts					
2N3553	2.5	0.25	10/175	25	79-04/1
PT9730	4	0.2	13/175	17.5	145D-01/1
2N5641	7	1	8.4/175	11.6	144B-05/1
MRF340	8	0.4	13/136	11.6	221A-04/2
PT9732	8	0.5	12/175	8.8	145D-01/1
PT9734	15	1	11.8/175	5.8	145D-01/1
2N5642	20	3	8.2/175	5.9	145A-09/1
MRF342	24	1.9	11/136	3.2	221A-04/2
PT9731	25	2.5	10/175	3.9	145D-01/1
MRF314	30	3	10/150	2.2	211-07/1
MRF314A	30	3	10/150	2.2	145A-09/1
2N5643	40	6.9	7.6/175	2.9	145A-09/1
MRF315	45	5.7	9/150	1.6	211-07/1
MRF315A	45	5.7	9/150	1.6	145A-09/1
PT9733	50	10	7/175	2.1	145D-01/1
MRF344	60	15	6/136	2	221A-04/2
MRF316 (4)	80	8	10/150	0.8	316-01/1
MRF317 (4)	100	12.5	9/150	0.65	316-01/1
TP9386	150	15	10/175	0.7	316A-01/1

(4) Internal Impedance Matched

66–88 MHz BAND

Power output chains up to 25 watts output are obtainable in the international VHF FM "Mid-Band" for which these transistors are optimized.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 Volts					
MRF229	1.5	0.15	10/90	35	79-05/5
MRF232	7.5	0.95	9/90	8.8	145A-09/1
MRF233	15	1.5	10/90	3.5	145A-09/1
MRF234	25	2.8	9.5/90	2.5	145A-09/1

88–108 MHz, FM BROADCAST BAND

These parts are designed for solid state transmitter applications in the FM broadcast band. They feature diffused ballast resistors and gold metallization that enhances long term reliability.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts Bipolar					
TP9380	75	7	10.3/108	1.5	211-11/1
TP9383	150	18	9.2/108	0.75	211-11/1
V_{CC} = 50 Volts TMOS					
TP1940	300	3	20/108	0.35	375-01/2

136–174 MHz HIGH BAND

The "workhorse" VHF FM High-Band is served by Motorola with the broadest range of devices and package combinations in the industry.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB @ 175 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 Volts					
2N4427	1	0.1	10	50	79-04/1
MRF604	1	0.1	10	91	26-03/1
MRF553	1.5	0.11	11.5	25	317D-02/2
MRF607	1.75	0.12	11.5	36	79-04/1
2N6080	4	0.25	12	14.6	145A-09/1
MRF220	4	0.25	12	14.6	211-07/1
MRF237	4	0.25	12	22	79-05/5
MRF260	5	0.5	10	14.6	221A-04/2
MRF212	10	1.25	9	4.7	145A-09/1
MRF261	10	3	5.2	5.9	221A-04/2
2N6081	15	3.5	6.3	5.7	145A-09/1

(continued)

VHF TRANSISTORS (continued)

136–174 MHz, HIGH BAND (continued)

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB @ 175 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 Volts — continued					
MRF221	15	3.5	6.3	5.7	211-07/1
MRF262	15	3.5	6.3	4.7	221A-04/2
MRF2628	15	0.95	12	4	244-04/1
TP2317	20	4	7	2.2	145D-01/1
2N6082	25	6	6.2	2.7	145A-09/1
TP2325	25	6	6.2	2.2	145D-01/1
2N6083	30	8.1	5.7	2.7	145A-09/1
MRF238	30	3.7	9	2.7	145A-09/1
MRF239	30	3	10	2.7	145A-09/1
MRF264	30	9.1	5.2	2.4	221A-04/2
MRF1946	30	3	10	1.6	211-07/1
MRF1946A	30	3	10	1.8	145A-09/1
TP2330	30	3	10	2.2	145D-01/1
TP2330F	30	3.8	9	2.2	211-07/1
TP2335	35	2.8	11	2.2	145D-01/1
2N6084	40	14.3	4.5	1.8	145A-09/1
MRF224	40	14.3	4.5	2.2	211-07/1
MRF240	40	5	9	2.2	145A-09/1
MRF240A	40	5	9	2.2	211-07/1
MRF4070 (4)	70	20	5	1.8	316-01/1
MRF247 (4)	75	15	7	0.7	316-01/1

225 MHz, ULTRA HIGH BAND

Specifically designed and characterized for the 225 MHz band, these devices eliminate the guesswork required when adapting 175 MHz characterized devices to this application.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB @ 225 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 Volts					
MRF207	1	0.15	8.2	50	79-04/1
MRF227	3	0.13	13.5	21.8	79-05/5
MRF208	10	1	10	4.7	145A-09/1
MRF226	13	1.6	9	3.9	145A-09/1
TP2033	30	3.9	8.9	2.2	145D-01/1
TP2037	35	4.5	8.9	2.2	145D-01/1

(4) Internal Impedance Matched

UHF Transistors

100–400 MHz BAND

Stringent requirements of the UHF Military band are met by MRF325, 326, 327, 329, 2N6439 and 2N6985 types, with all-gold metal systems, specified ruggedness and programmed wirebond construction, to assure consistent input impedances for internally matched parts. Hi-Rel versions of these transistors are available upon request.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PE} (Min) Power Gain dB @ 400 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts					
MRF525	0.02	0.001	13	60	79-05/5
TPM401	0.5	0.03	13	20	244C-01/1
2N3866	1	0.1	10	35	79-04/1
2N5160 (5)	1	0.16	8	35	79-04/1
MRF5174	2	0.125	12	36	244-04/1
MRF5175	5	0.4	11	12	244-04/1
PT9701B	5	0.63	9	17.5	244C-01/1
TPM405	5	0.13	16	9.5	244C-01/1
PT9703B	10	1.52	8.2	8.8	244C-01/1
PT9702B	20	4	7	4.4	244C-01/1
TPM425	25	4	8	5	244C-01/1
PT9704B	30	6	7	2.5	244C-01/1
MRF325 (4)	30	4.3	8.5	2.2	316-01/1
MRF326 (4)	40	8	9	1.6	316-01/1
TPM4040 (6)	40	4	10	2	827-01/1
JO2015A (4)	50	5	10	1.25	316A-01/1
2N6439 (4)	60	10	7.8	1.2	316-01/1
MRF390 (6)	60	6.8	7.5	1.3	744A-01/1
MRF327 (4)	80	14.9	7.3	0.7	316-01/1
MRF329 (4)	100	20	7	0.7	333-04/1
TPM4100 (6)	100	17.8	7.5	0.85	827-01/1
MRF392 (6)	125	19.8	8	0.7	744A-01/1
2N6985 (6)	125	19.8	8	0.7	382-01/1
TPM4130 (6)	130	24.8	7.2	0.85	827-01/1

100–500 MHz BAND

Similar to the 100–400 MHz transistors, these devices have bandwidth capabilities allowing their use to 500 MHz. All have nitride passivated die, gold metal systems, specified ruggedness and controlled wireband construction to meet the stringent requirements of military space applications. Hi-Rel versions are available upon request.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PE} (Min)/Freq. Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 V					
MRF313	1	0.03	15/400	28.5	305A-01/1
MRF321	10	0.62	12/400	6.4	244-04/1
MRF323	20	2	10/400	3.2	244-04/1
MRF393 (6)	100	18	7.5/500	0.7	744A-01/1
2N6986 (6)	100	18	7.5/500	0.7	382-01/1

(4) Internal Impedance Matched
(5) PNP
(6) Internal Impedance Matched Push-Pull Transistors

UHF TRANSISTORS (continued)

500–1000 MHz BAND

Capable of operation in either class AB or C, the following device is designed for operation to 1 GHz. Gold metallized die, diffused emitter ballast resistors and a hermetic package make the MRA0510-50H suitable for industrial or military applications.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PE} (Min) Power Gain dB @ 1 GHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts					
MRA0510-50H (6)	50	10	7	1.4	391-01/1

400–512 MHz BAND

Higher power output devices in this UHF power transistor series feature internally input-matched construction, are designed for broadband operation, and have guaranteed ruggedness under output mismatch and RF overdrive conditions. Devices are specified for handheld, mobile and base station operation.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PE} (Min)/Freq. Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 7.5 Volts					
TP251	0.2	0.01	12.4/470	60	305C-01/1
MRF750	0.5	0.05	10/470	29	305A-01/1
MRF752	2.5	0.4	8/470	12	249-05/1
MRF754	8	2	6/470	5	249-05/1
V_{CC} = 12.5 Volts					
MRF627	0.5	0.05	10/470	28.5	305A-01/1
MRF581 (7)	0.6	0.03	13/500	40	317-01/2
MRF515	0.75	0.12	8/470	70	79-04/1
MRF555	1.5	0.15	10/470	25	317D-02/2
2N5944	2	0.25	9/470	35	244-04/1
MRF629	2	0.32	8/470	35	79-05/5
TP2502	2	0.2	10/470	12	249A-01/1
MRF630	3	0.33	9.5/470	20	79-05/5
2N5945	4	0.64	8/470	11.7	244-04/1
MRF652	5	0.5	10/512	7	244-04/1
MRF652S	5	0.5	10/512	7	249-05/1
MRF660	7	2	5.4/470	7	221A-04/2
2N5946	10	2.5	6/470	4.7	244-04/1
MRF653	10	2	7/512	4	244-04/1
MRF653S	10	2	7/512	4	249-05/1
MRF641 (4)	15	2.5	7.8/470	4	316-01/1
MRF654 (4)	15	2.5	7.8/470	4	244-04/1
MRF644 (4)	25	5.9	6.2/470	1.7	316-01/1
JO3037 (4)	37	12	4.9/512	2.1	316A-01/1
MRF646 (4)	40	13.3	4.8/470	1.5	316-01/1
MRF650 (4)	50	11.7	6.3/470	0.9	316-01/1
MRF648 (4)	60	22	4.4/470	1	316-01/1

(4) Internal Impedance Matched
(6) Internal Impedance Matched Push-Pull Transistors
(7) Small signal gain. P_O is Typ.

New introductions

400–512 MHz BAND (continued)

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PE} (Min)/Freq. Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 24 Volts					
TP5002	1.5	0.075	13/470	21	244C-01/1
TP5002S	1.5	0.075	13/470	21	249A-01/1
TP5015	15	1.34	11/470	7	319-06/2
TP5025	25	3	9/470	4	319-06/2
TP5040	40	5	9/470	2	395-01/1
TP5060	50	11.2	6.5/470	0.7	827-01/1
V_{CC} = 28 Volts					
TP5050	50	11.2	6.5/470	1.5	316A-01/1
TP5060	60	13.4	6.5/470	0.7	827-01/1
MRF338	80	15	7.3/470	0.7	333-04/1

800 MHz Transistors

806–960 MHz BAND

Designed specifically for the 800 MHz mobile radio band, types MRF840 through 847 offer superior gain and ruggedness, using the unique CS-12 package, which minimizes common-element impedance, and thus maximizes gain and stability. Devices are listed for mobile and base station applications.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_p (Min)/Freq. Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 12.5 Volts — Class C (Except as Noted)					
MRF559 (8)	0.5	0.08	8/870	50	317-01/2
MRF581 (8)	0.6	0.06	10/870	40	317-01/2
MRF837 (8)	0.75	0.11	8/870	40	317-01/1
MRF8372 (8)	0.75	0.11	8/870	45	751-02/1
TP3009 (8)	0.75	0.14	7.5/900	26	305B-01/1
TP3009S (8)	0.75	0.14	7.5/900	26	305C-01/1
MRF838 (8)	1	0.22	6.5/870	70	305A-01/1
MRF838A (8)	1	0.22	6.5/870	70	305-01/1
MRF557 (8)	1.5	0.23	8/870	25	317D-02/2
TP3010 (8)	1.5	0.3	7/900	14	305B-01/1
TP3010S (8)	1.5	0.3	7/900	14	305C-01/1
MRF839 (8)	3	0.46	8/870	9	305A-01/1
MRF839F (8)	3	0.46	8/870	9	319-06/2
MRF841 (42)	5	0.7	8.5/870	7	244-04/4
MRF840 (4)(42)	10	2.5	6/870	3.1	319-06/1
TP3012 (4)(9)	10	2	7/900	4	319-06/2
TP3015 (9)	18	3.2	7.5/915	2.5	319-06/2
MRF873 (4)(8)	15	3	7	4	319-06/2
MRF873S (8)	15	3	7/870	4	319A-02/2
MRF842 (4)(42)	20	5	6/870	1.5	319-06/1
MRF844 (4)(42)	30	9	5.2/870	1.5	319-06/1
MRF846 (4)(42)	40	15	4.3/870	1.2	319-06/1
MRF847 (4)(42)	45	16	4.5/870	1	319-06/1

(4) Internal Impedance Matched
(8) Common Emitter
(9) Common Emitter — Class AB
(42) Common Base

New introductions

806–960 MHz BAND (continued)

Device	P_{out} Output Power Watts	Class	P_{in} Input Power Watts	Gp (Min)/Freq. Power Gain dB/MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 24 Volts						
MRF890	2	C	0.25	9/900	25	305-01/1
TP3019	2	AB or A	0.25	9/960	14	305-01/1
TP3019S	2	AB or A	0.25	9/960	14	305A-01/1
MRF891 (4)	5	C	0.63	9/900	7	319-06/2
TP3021	10	AB or A	1	10/960	5	319-06/2
MRF892 (4)	14	C	2	8.5/900	3.5	319-06/1
MRF894 (4)	30	C	6	7/900	1.5	319-06/1
MRF898 (4)	60	C	12	7/900	1	333A-04/1
V_{CC} = 26 Volts						
TP3020A	2.2	A	0.28	9/960	20	244C-01/1
TP3005	4	AB or A	0.57	8.5/960	7	319-06/2
TP3004	5	AB or A	0.63	9/900	7	319-06/2
TP3022A	15	AB	2.12	8.5/960	6	319-06/2
TP3030	23	AB	3.65	8/900	2.5	319-06/2
TP3031	25	AB	4	8/960	2.5	319-06/2
TP3024A (6)	35.5	AB	6.35	7.5/960	3	395-01/1
TP3040 (4)	40	AB	7.11	7.5/960	1.8	319-06/2
TP3061 (4)	45	AB	7.13	8/960	1.2	333A-02/2
TP3060 (4)	60	AB	10.67	7.5/900	1.2	333A-02/2
TP3062 (6)	60	AB	12	7/960	1.2	398-01/1

Microwave Transistors

L-BAND PULSE POWER

These products are designed to operate in short pulse width, 10 μs, low duty cycle, 1%, power amplifiers operating in the 960 to 1215 MHz band. All devices have internal impedance matching. The prime application is avionics equipment for distance measuring (DME), area navigation (TACAN) and interrogation (IFF). All devices offered with hermetic option.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	Gp (Min) Power Gain dB @ 1090 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 18 Volts — Class A & AB Common Emitter					
MRF1000MA	0.2	0.02	10	25	332-04/2
MRF1000MB	0.2	0.02	10	25	332A-03/2

(4) Internal Impedance Matched
(6) Internal Impedance Matched Push-Pull Transistors

L-BAND PULSE POWER (continued)

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_p (Min) Power Gain dB @ 1090 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 35 Volts — Class B & C Common Base					
MRF1002MA	2	0.2	10	25	332-04/1
MRF1002MB	2	0.2	10	25	332A-03/1
MRF1004MA	4	0.4	10	25	332-04/1
MRF1004MB	4	0.4	10	25	332A-03/1
MRF1008MA	8	0.8	10	15	332-04/1
MRF1008MB	8	0.8	10	15	332A-03/1
V_{CC} = 50 Volts — Class C Common Base					
MRF1015MA	15	1.5	10	10	332-04/1
MRF1015MB	15	1.5	10	10	332A-03/1
MRF1035MA	35	3.5	10	5	332-04/1
MRF1035MB	35	3.5	10	5	332A-03/1
MRF1090MA	90	9	10	0.6	332-04/1
MRF1090MB	90	9	10	0.6	332A-03/1
MRF1150M	150	25	7.8	0.3	336-03/2
MRF1150MA	150	25	7.8	0.3	332-04/1
MRF1150MB	150	25	7.8	0.3	332A-03/1
MRF1250M	250	63	6	0.15	336-03/2
MRF1325M	325	81	6	0.15	336-03/2

L-BAND LONG PULSE POWER

These products are designed for pulse power amplifier applications in the 960 to 1215 MHz frequency range. They are capable of handling up to 10 μs pulses in long pulse trains resulting in up to a 50% duty cycle over a 3.5 millisecond interval. Overall duty cycle is limited to 25% maximum. The primary applications for devices of this type are military systems, specifically JTIDS and commercial systems, specifically Mode S. Package type is hermetic.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PB} (Min) Power Gain dB @ 1215 MHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts — Class C Common Base					
MRF10005	5	0.71	8.5	8	336E-02/1
V_{CC} = 36 Volts — Class C Common Base					
MRF10030	30	11.2	9.5	3	376A-01/1
MRF10120	120	19	8	0.6	355C-01/1

New introductions

MICROWAVE TRANSISTORS (continued)

2 GHz NARROWBAND CW

The MRF2000 Series of NPN Silicon microwave power transistors are designed for common base service in amplifier or oscillator applications in the 1 to 2.3 GHz frequency range.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PB} (Min) Power Gain dB @ 2 GHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts — Class B & C Common Base					
MRW2001 (10)	1	0.13	9	35	328F-01/2
MRW2003 (10)	3	0.48	8	15	328F-01/2
MRW2005 (10)	5	0.8	8	8.5	328F-01/2
MRW2010 (10)	10	2	7	6	328F-01/2
MRW2015 (10)	15	3.8	6	3.5	393-01/1
MRW2020 (10)	20	6	5.2	3	393-01/1

2.3 GHz NARROWBAND CW

The MRW2300 Series are common-base configured transistors in hermetic packages with guaranteed performance characteristics at 2.3 GHz. They feature diffused ballast resistors and gold metallization for extreme ruggedness and reliability. All are available with TX equivalent screening.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PB} (Min) Power Gain dB @ 2.3 GHz	θ_{JC} °C/W	Package/Style
V_{CC} = 20 Volts					
MRW2301	1.5	0.24	8	35	328F-01/2
MRW2304	4	0.64	8	17	328F-01/2
MRW2307	7	1	8.5	8.5	328F-01/2

3 GHz NARROWBAND CW

The MRW3000 Series are the industry's first 100% VSWR tolerant 3 GHz devices. They are common-base configured in hermetic packages (with or without flanges) and rated for 28 volt operation.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PB} (Min) Power Gain dB @ 3 GHz	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts					
MRW3001	1	0.2	7	35	328F-01/2
MRW3003	3	0.75	6	17	328F-01/2
MRW3005	5	1.6	5	8.5	328F-01/2

(10) Available in flangeless package (Case 328-02/1) by placing suffix "F" after device number

0.6–2.7 GHz BROADBAND COMMON BASE

The MicRoAmp transistor employs MOS capacitors and other matching elements to transform the input, and in some devices, the output impedance to a more manageable level prior to the point where package parasitics can reduce the bandwidth capability (U.S. Patent 3,713,006). These devices are assembled in common-base configuration and include an all-gold metal system and diffused ballast resistors for long life. Those epoxy-sealed devices followed by Note 11 are also available in hermetic packages and TX equivalent.

Device	Instantaneous Frequency Range F_L-F_H (MHz)	Min Output Power Watts	Min Gain dB	θ_{JF} °C/W	Package/Style
V_{CC} = 22 V					
MRAL1417-2	1400–1700	2	8	15	394-01/1
MRAL1417-6	1400–1700	6	7.4	8	394-01/1
MRAL1417-11	1400–1700	11	7.4	4.5	394-01/1
MRAL1417-25	1400–1700	25	7	2.5	394-01/1
MRAL1720-2	1700–2000	2	7.5	15	394-01/1
MRAL1720-5	1700–2000	5	6.5	8	394-01/1
MRAL1720-9	1700–2000	9	6.5	4.5	394-01/1
MRAL1720-20	1700–2000	20	6	2.5	394-01/1
MRAL2023-1.5 (11)	2000–2300	1.5	8	30	394-01/1
MRAL2023-3 (11)	2000–2300	3	8	16	394-01/1
MRAL2023-6 (11)	2000–2300	6	6.8	8	394-01/1
MRAL2023-12 (11)	2000–2300	12	6.8	4.5	394-01/1
MRAL2023-18 (11)	2000–2300	18	6.5	2.5	394-01/1
MRAL2327-1.3	2300–2700	1.3	5.5	30	394-01/1
MRAL2327-3	2300–2700	3	6.6	16	394-01/1
MRAL2327-6	2300–2700	6	7	8	394-01/1
MRAL2327-12	2300–2700	12	7	4.5	394-01/1
V_{CC} = 28 Volts					
MRA0610-3 (11)	600–1000	3	7.8	15	394-01/1
MRA0610-9 (11)	600–1000	9	7.8	6	394-01/1
MRA0610-18A (11)	600–1000	18	7.8	4	394-01/1
MRA0610-40A	600–1000	40	7	2.5	394-01/1
MRA1014-2 (11)	1000–1400	2	8.2	15	394-01/1
MRA1014-6 (11)	1000–1400	6	7.4	8	394-01/1
MRA1014-12 (11)	1000–1400	12	7.8	4.5	394-01/1
MRA1014-35	1000–1400	35	7	2.5	394-01/1
MRA1214-55H	1200–1400	50	6.5	1.4	402-01/1
MRA1300-10L	500–1500	10	7	2.1	360A-01/1
MRA1417-2 (11)	1400–1700	2	8	15	394-01/1
MRA1417-6 (11)	1400–1700	6	7.4	8	394-01/1
MRA1417-11 (11)	1400–1700	11	7.4	4.5	394-01/1
MRA1417-25A	1400–1700	25	7	2.5	394-01/1
MRA1720-2	1700–2000	2	7.5	15	394-01/1
MRA1720-5	1700–2000	5	6.5	8	394-01/1
MRA1720-9	1700–2000	9	6.5	4.5	394-01/1
MRA1720-20	1700–2000	20	6	2.5	394-01/1

(11) Hermetic package (393-01/1) is available by placing suffix "H" after device number

MICROWAVE TRANSISTORS (continued)

L-BAND CW, NARROWBAND, COMMON BASE

The MRA1600 Series microwave power transistors is primarily intended for large-signal output and driver amplifier stages for satellite up/down links. Each is designed for Class C, common base amplifier applications.

Device	Instantaneous Frequency Range F_L-F_H (MHz)	Min Output Power Watts	Min Gain dB	θ_{JF} °C/W	Package/Style
V_{CC} = 28 Volts					
MRA1600-2	1600–1660	2	8.4	15	394-01/1
MRA1600-6	1600–1660	6	7.4	4.5	394-01/1
MRA1600-13	1600–1660	13	7.6	4.5	394-01/1
MRA1600-30	1600–1660	30	7	2.5	394-01/1

POWER OSCILLATORS

These oscillator devices are common collector configuration with diffused ballast resistors, gold metallization and hermetic packages to provide high reliability in severe environmental conditions. Each is fully characterized for power oscillator applications.

Device	Operating Conditions V_{CE}/I_C V/mA	Output Power — Watts/@ Freq. — GHz				Package/Style
		Minimum	Typ @ Low F	Typ @ Mid F	Typ @ High F	
TP62601	20/220	1.25/2	1.85/2.5	1.35/2	0.85/3	328F-01/3
TP62602	20/440	2.5/2	2.5/2	2/2.5	1.3/3	328F-01/3
TP63601	20/120	0.6/2.3	0.75/2.3	0.5/2.8	0.28/3.3	328F-01/3
TP63602	20/230	1.2/2.3	1.5/2.3	1/2.8	0.55/3.3	328F-01/3
TP64601	20/120	0.3/4	0.55/3	0.35/4	0.15/5	328F-01/3
TP64602	20/240	0.55/4	1.2/3	0.65/4	0.15/5	328F-01/3

Linear Transistors

The following sections describe a wide variety of devices specifically characterized for linear amplification. Included are low power and high power parts covering frequencies from 100 MHz to 4 GHz.

TO 1 GHz, CLASS A

These devices offer a selection of performance and price for linear amplification to 1 GHz. The "MRA" prefix parts are input matched and feature high overdrive and extreme ruggedness capability.

Device	P_o @ 1 dB Comp. Point Watts	G_{SS} (Min)/Freq. Small Signal Gain dB/MHz	Bias Point (Vdc/A)	θ_{JC} °C/W	Package/Style
V_{CC} = 19 Volts					
MRA1000-3.5L	3.5	10/1000	19/0.6	8	145D-01/1
MRA1000-7L	7	9/1000	19/1.2	4	145D-01/1
MRA1000-14L	14	8/1000	19/2.4	2.1	145D-01/1
MRA0500-19L	19	8/500	19/3.5	1.5	145D-01/1
V_{CC} = 25 Volts					
RF1029	1.5	8/1000	—	12	244A-01/1
RF1030	3	7.5/1000	—	6	244A-01/1
RF1031	4.5	7/1000	—	3.5	244A-01/1
RF1032	6	6.5/1000	—	3.5	244A-01/1

TO 2 GHz, CLASS A

The "RF" series offer low cost alternatives to matched devices primarily for use as pre-drivers and drivers to 2 GHz.

V_{CC} = 20 Volts

RF3094	0.5	10.5	—	40	328F-01/1
RF3095	0.8	9	—	35	328F-01/1
RF3096	1.6	9	—	22	328F-01/1

New introductions

VHF ULTRA LINEAR FOR TV APPLICATIONS

The following devices have been characterized for ultra-linear applications such as low-power TV transmitters in Band III. Each features diffused ballast resistors and an all-gold metal system to provide enhanced reliability and ruggedness.

Device	P_{ref} Watts	Gp (Min)/Freq. Power Gain dB/MHz	3 Tone IMD (12) dB	θ_{JC} °C/W	Package/Style
V_{CC} = 28 Volts					
TPV394A	5	15/225	−58	2.5	244C-01/1
TPV364	10	10/225	−54	2	145D-01/1
TPV385	14	14/225	−53	1.5	316A-01/1
TPV375	20	8/225	−51	1.5	211-11/1
TPV387	24	13/225	−50	1	316A-01/1
TPV376	30	7.5/225	−53	1	316A-01/1
TPV3100	28	14/225	−51	0.8	827-01/1
TPV387	90 (13)	10/225	—	1	316A-01/1
TPV3100	100 (13)	13/225	—	0.8	827-01/1
V_{CC} = 50 Volts TMOS					
TPV1325B	250 (13)	13/225	—	0.35	375-01/2

UHF ULTRA LINEAR FOR TV APPLICATIONS

The following devices have been characterized for ultra-linear applications such as low-power TV transmitters in Band IV and V. Each features diffused ballast resistors and an all-gold metal system to provide enhanced reliability and ruggedness.

Device	P_{ref} Watts	Gp (Min)/Freq. Power Gain dB/MHz	3 Tone IMD (12) dB	θ_{JC} °C/W	Package/Style
V_{CC} = 20 Volts					
TPV590	0.25	14/860	−58	30	305B-01/1
TPV591	0.5	13/860	−58	16	305B-01/1
TPV596	0.5	11.5/860	−58	20	244C-01/1
TPV597	1	10.5/860	−58	9	244C-01/1
TPV598	4	7/860	−60	5	244C-01/1
V_{CC} = 25 Volts					
TPV693	1.8	9.5/860	−60	8	244C-01/1
TPV593	2	8.5/860	−60	11	244C-01/1
TPV698	4	8.5/860	−54	6.2	244C-01/1
TPV657	6	8/860	−58	2.5	827-01/1
TPV595A	14	8.5/860	−47	2.5	395-01/1
TPV695A	14	9.5/860	−47	2.5	395-01/1
TPV7025	25	8.5/860	−45	1.5	398-01/1
TPV8100B	110	9/860	—	0.6	398-01/1
V_{CC} = 26 Volts					
TPV695B	30 (13)	8.5/860	—	2.5	395-01/1
V_{CC} = 28 Volts					
TPV5051	50 (13)	6.5/860	—	1.8	395-01/1
TPV5055B	50 (13)	7/860	—	1.5	398-01/1
TPV8200B	180 (13)	7.5/860	—	0.4	397-01/1

(12) Vision Carrier: −8 dB; Sound Carrier: −7 dB, Sideband Carrier: −16 dB
(13) Output power at 1 dB compression in Class AB

MICROWAVE LINEAR POWER

Common emitter microwave devices are offered for a wide variety of uses in small and medium signal, Class A, AB and C applications up to 4 GHz. The use of all-gold metal systems, diffused ballast resistors and hermetic packaging results in devices that display excellent reliability even in military environment. Many part types are available with off-the-shelf TX equivalent screening.

Device	G_{SS} (Min) @ Freq. Small Signal Gain dB/GHz	1 dB Comp. Watts	P_{sat} Watts	−30 dB IMD Watts	Emitter Current mA	Package/Style
V_{CE} = 20 V						
MRW52001	6/2	1.8	2.5	1.5	220	400-01/1
MRW52101	6/2	1.8	2.5	1.5	220	328E-01/2
MRW52201	5/2	1.8	2.5	1.5	220	401A-01/1
MRW52401	5/2	1.8	2.5	1.5	220	328G-01/1
MRW52501 (14)	5/2	1.8	2.5	1.5	220	401-01/1
MRW52601 (14)	6/2	1.8	2.5	1.5	220	328F-01/1
MRW52102	6/2	3.6	5	3	440	328E-01/2
MRW52202	5/2	3.6	5	3	440	401A-01/1
MRW52402	5/2	3.6	5	3	440	328G-01/1
MRW52502 (14)	5/2	3.6	5	3	440	401-01/1
MRW52602	6/2	3.6	5	3	440	328F-01/1
MRW52104	5/2	7.2	10	6	880	328E-01/2
MRW52204	5/2	7.2	10	6	880	401A-01/1
MRW52504	5/2	7.2	10	6	880	401-01/1
MRW52604 (14)	5/2	7.2	10	6	880	328F-01/1
MRW53001	6/3	0.8	1	0.8	120	400-01/1
MRW53101	6/3	0.8	1	0.8	120	328E-01/2
MRW53201	5/3	0.8	1	0.8	120	401A-01/1
MRW53401	5/3	0.8	1	0.8	120	328G-01/1
MRW53501 (14)	5/3	0.8	1	0.8	120	401-01/1
MRW53601 (14)	6/3	0.8	1	0.8	120	328F-01/1
MRW53102	6/3	1.6	2	1.5	230	328E-01/2
MRW53202	5/3	1.6	2	1.5	230	401A-01/1
MRW53402	5/3	1.6	2	1.5	230	328G-01/1
MRW53502	5/3	1.6	2	1.5	230	401-01/1
MRW53602 (14)	5/3	1.6	2	1.5	230	328F-01/1
MRW53505	5/3	4	5	4	600	401-01/1
MRW53605	6/3	4	5	4	600	328F-01/1
MRW54001	5/4	0.5	0.8	0.5	120	400-01/1
MRW54101	6/4	0.5	0.8	0.5	120	328E-01/2
MRW54201	5/4	0.5	0.8	0.5	120	401A-01/1
MRW54501 (14)	5/4	0.5	0.8	0.5	120	401-01/1
MRW54601 (14)	6/4	0.5	0.8	0.5	120	328F-01/1
MRW54602	9/2	1	2	1	240	328F-01/1

BIAS DEVICES

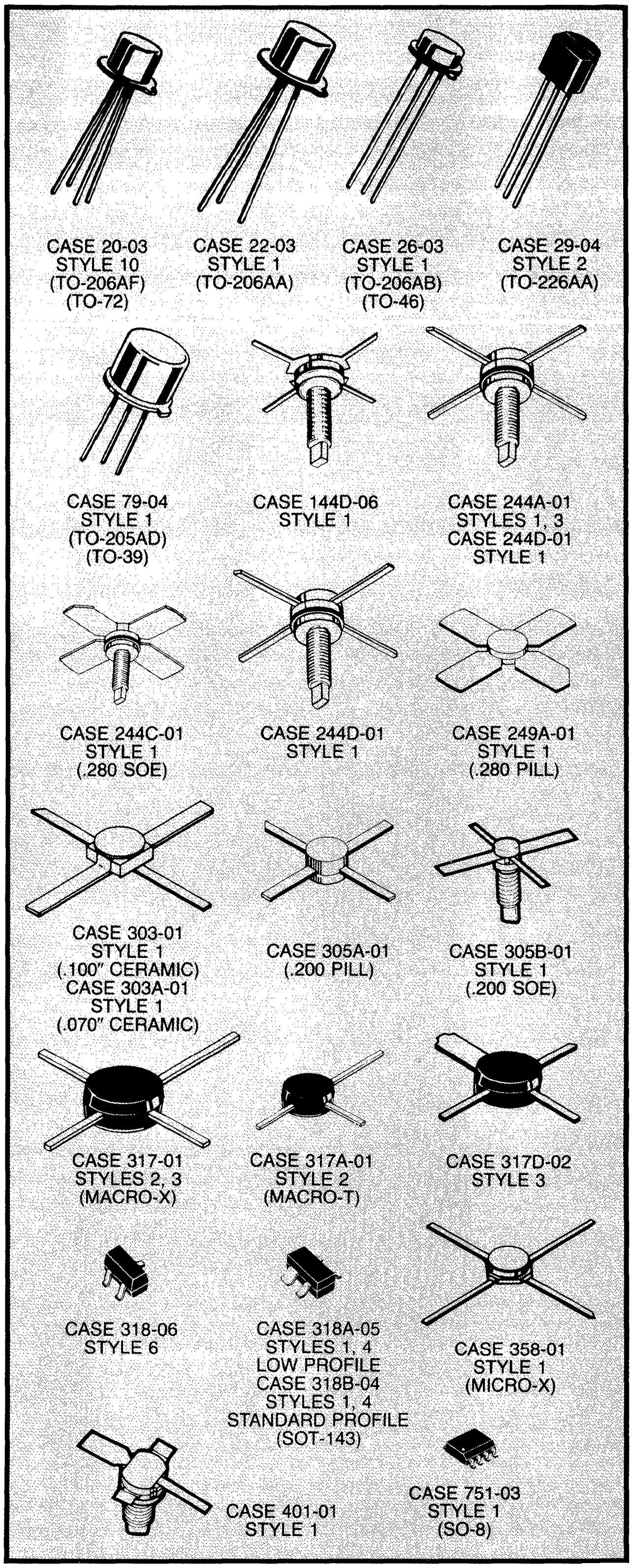
The BT500 and BT500F bias devices are used to provide the proper bias point for Class AB linear amplifiers. They feature excellent thermal tracking and simple external circuitry. The BT500 is a hermetic, metal sealed device.

Device	I_F Typ mA	h_{FE} Min-Max	$V_{(BR)EBO}$ Min V	Package/Style
Bias Devices for Class AB 28–50 Volt Transistors				
BT500	500	20–100	4	036-03/1
BT500F	500	20–100	4	211-07/1

(14) Available in JTX equivalent by replacing "MRW" with "TX" prefix

New introductions

RF Small-Signal Bipolar Transistors

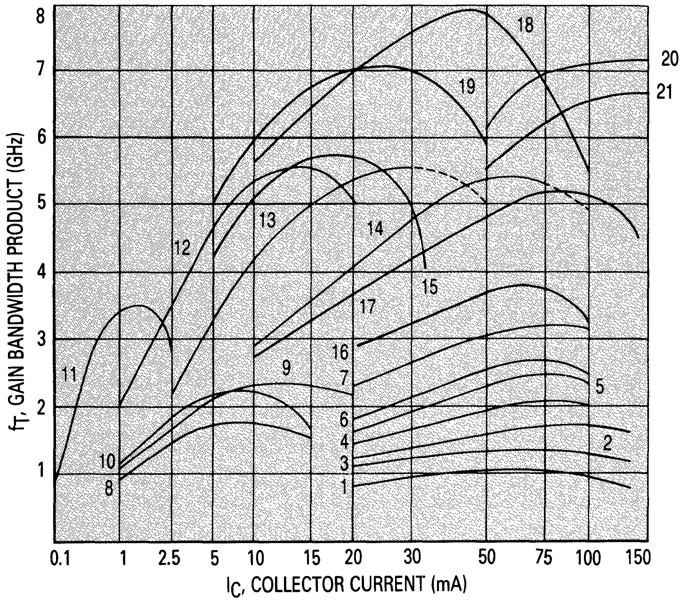


Motorola's broad line of RF Small-Signal Transistors includes NPN and PNP Silicon Bipolar Transistors characterized for low noise amplifiers, mixers, oscillators, multipliers, non-saturated switches and low-power drivers.

These devices are available in a wide variety of package types: metal can, plastic Macro-X and Macro-T, Micro-X, ceramic and surface mounted. Most of these transistors are fully characterized with y or s parameters; and, in addition, parts with Hi Rel processing are available to meet unique customer requirements.

RF Small-Signal Transistor Gain Characteristics

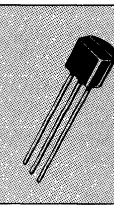
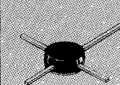
Curve numbers apply to transistors listed in the subsequent tables.



Selection by Package

In small-signal RF applications, the package style is often determined by the end application or circuit construction technique. To aid the circuit designer in device selection, the Motorola broad range of RF small-signal amplifier transistors is organized by package. Devices for other applications such as oscillators or switches are shown in the appropriate preceding tables. **These devices are NPN polarity unless otherwise designated.**

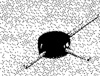
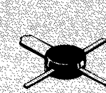
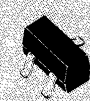
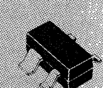
PLASTIC SOE CASE

Device	Gain-Bandwidth f_T @ GHz Typ	I_C mA	Curve No. Page 36	Noise Figure NF @ dB Typ	f MHz	Gain dB Typ @	f MHz	Maximum Ratings $V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
Case 29-04/2, TO-226AA											
MPS536 (5)	5	−20	19	4.5	500	14	500	−10	−30	625	
MPS571	6	50	18	2	500	14	500	10	80	625	
MPS901	4.5	15	12	2.5	900	12	900	15	30	625	
MPS911	7	30	13	1.7	500	16.5	500	12	40	625	
MPS3866	0.8	50	1	—	—	10	400	30	400	625	
Case 317-01/2 — MACRO-X											
MRF521 (5)	4.2	−50	—	2.8	1000	11	1000	−10	−70	750	
MRF536 (5)	6	−20	19	4.5	1000	10	1000	−10	−30	300	
MRF559	3	100	16	—	—	13	512	18	150	2000	
MRF571	8	50	18	1.5	1000	12	1000	10	70	1000	
MRF581	5	75	17	2	500	15.5	500	18	200	2500	
MRF581A	5	75	17	1.8	500	15.5	500	15	200	2500	
MRF837	5	75	17	—	—	10	870	16	200	2500	
MRF901	4.5	15	12	2	1000	12	1000	15	30	375	
MRF911	5	30	13	2.5	1000	12.5	1000	12	40	400	
MRF931	3	1	11	3.8	500	16	500	5	5	50	
MRF941	8	15	—	1.7	2000	12.5	2000	10	50	400	
MRF951	7.5	30	—	1.7	2000	12.5	2000	10	100	1000	
MRF961	4.5	50	14	2	500	15	500	15	100	500	
MRF2369	6	40	18	1.5	1000	12	1000	15	70	750	

(5) PNP

(continued)

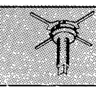
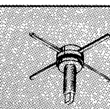
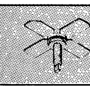
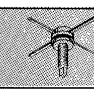
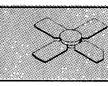
PLASTIC SOE CASE (continued)

Device	Gain-Bandwidth f_T @ GHz Typ	I_C mA	Curve No. Page 36	Noise Figure NF @ dB Typ	f MHz	Gain @ dB Typ	f MHz	Maximum Ratings $V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
Case 317A-01/2 — MACRO-T — continued											
BFR90	5	14	12	2.4	500	18	500	15	30	180	
BFR91	5	30	13	1.9	500	16	500	12	35	180	
BFR96	4.5	50	14	2	500	14.5	500	15	100	500	
BFW92A	4.5	10	15	2.7	500	16	500	15	35	180	
MRF580	5	75	17	2	500	14	500	18	200	2500	
MRF580A	5	75	17	1.8	500	14	500	15	200	2500	
Case 317D-02/2,3											
MRF542 (15)	—	—	2	—	—	5.5	250	70	400	3000	
MRF543 (5) (15)	—	—	2	—	—	5.5	250	70	400	3000	
MRF553	—	—	—	—	—	13	175	16	500	3000	
MRF555	—	—	—	—	—	12.5	470	16	400	3000	
MRF557	—	—	—	—	—	9	870	16	400	3000	
Case 318-07/6 — SOT-23											
BFR92	3.4	14	—	30	500	—	—	15	25	350	
BFR93	3.4	30	—	2.5	30	—	—	12	35	350	
BFS17	1.3	25	—	5	30	—	—	15	—	350	
MMBR536L (5)	5.5	−20	19	4.5	500	14	500	−10	−30	350	
MMBR571L	8	50	18	2	500	16.5	500	10	80	350	
MMBR901L	4	15	12	1.9	1000	12	1000	15	30	350	
MMBR911L	6	30	13	2	500	17	500	12	40	350	
MMBR920L	4.5	14	—	2.4	500	15	500	15	35	350	
MMBR930L	5.5	30	—	1.9	500	11	500	12	35	350	
MMBR941L	8	15	—	2.1	2000	8.5	2000	10	50	400	
MMBR951L	8	30	—	2.1	2000	7.5	2000	10	100	500	
MMBR931L	3	1	11	4.3	1000	10	1000	5	5	350	
MMBR2060L	1	20	—	3.5	450	12.5	450	14	50	350	
MMBR2857L	1	4	—	4.5	450	12.5	450	15	40	350	
MMBR4957L (5)	1.2	−2	10	3	450	17	450	−30	−30	350	
MMBR5031L	1	5	—	2.5	450	17	450	10	20	350	
MMBR5179L	1.4	5	8	4.5	200	15	200	12	50	350	
Case 318A-05/1 — SOT-143											
MRF0211L	5.5	40	18	1.8	1000	9.5	1000	15	70	580	
MRF5211L (5)	4.2	−50	—	2.8	1000	11	1000	−10	−70	580	
MRF5711L	8	50	18	1.6	1000	13.5	1000	10	70	580	
MRF9011L	3.8	15	12	2.3	1000	10.2	1000	15	30	300	
MRF9331L	5	1	—	2.5	1000	12.5	1000	8	1	50	
MRF9411L	8	15	—	2.1	2000	9.5	2000	10	50	400	
MRF9511L	8	30	—	2.1	2000	9	2000	10	100	500	

(5) PNP
(15) Common Base Configuration

SELECTION BY PACKAGE (continued)

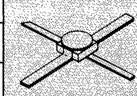
PLASTIC SOE CASE (continued)

Device	Gain-Bandwidth f_T @ GHz Typ	Gain-Bandwidth I_C mA	Curve No. Page 36	Noise Figure NF @ dB Typ	Noise Figure f MHz	Gain @ dB Typ	Gain f MHz	Maximum Ratings $V_{(BR)CEO}$ Volts	Maximum Ratings I_C mA	Maximum Ratings P_T mW	Package
Case 751-02/1 — SO-8											
MRF3866	0.8	50	1	—	—	10.5	400	30	400	1000	
MRF4427	1.6	50	1	—	—	18	175	20	400	1000	
MRF5160 (5)	0.8	−50	1	—	—	10	400	−40	−400	1000	
MRF5583 (5)	2.1	−35	5	—	—	1.5	250	−30	−500	1000	
MRF5812	5.5	75	17	2	500	15.5	500	15	200	1500	
MRF5943	1.5	35	4	3.4	200	12	250	30	400	1000	
MRF8372	5	75	17	—	—	10	870	16	200	1500	
MRFQ17	2.25	50	5	—	—	12	500	25	300	1000	
MRFQ19	5.3	50	14	3.5	500	14.6	500	15	150	1000	
CERAMIC SOE CASE											
Case 144D-06/1											
2N5947	1.5	75	3	3.8	200	11	250	30	400	5000	
MRF511	2.1	80	7	7.3	200	11	250	25	250	5000	
Case 244A-01/1,3											
LT2001	3	90	7	2.5	300	11.5	300	20	200	5000	
MRF548 (15)	—	—	2	—	—	5.5	250	70	400	5000	
PT4572A	2.5	90	6	2.3	300	14	300	25	200	5000	
Case 244C-01/1											
TP3401	5	150	—	—	—	14	500	13	200	4300	
TP3402	5	300	—	—	—	10.5	500	13	400	9500	
Case 244D-01/1											
LT4217	5.5	90	17	2.5	500	15	500	12	400	5000	
TP3098	2.6	100	6	6.5	500	11.5	500	20	200	5000	
Case 249A-01/1											
TP3401S	5	150	—	—	—	14	500	13	200	4300	

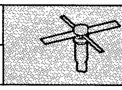
(5) PNP
(15) Common Base Configuration

CERAMIC SOE CASE (continued)

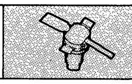
Case 303-01/1

Device	Gain-Bandwidth f_T @ GHz Typ	I_C mA	Curve No. Page 36	Noise Figure NF @ dB Max	f MHz	Gain @ dB Min	f MHz	Maximum Ratings $V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
2N6603	5.5	15	12	2	1000	13	1000	15	30	400	
2N6604	5.5	30	13	2.7	1000	12	1000	15	50	500	
2N6618	—	—	—	2.2	2000	11	2000	20	20	300	
2N6679	($f_{1\ dB}$ is 18.5 dBm Typ @ 4 GHz)					9	4000	20	70	900	
MRF522 (5)	4.2	−50	—	2.8	1000	11	1000	−10	−50	620	
MRF572	8	50	18	1.5	1000	12	1000	10	70	750	
MRF942	8	15	—	1.7	2000	12.5	2000	10	50	300	
MRF952	7.5	30	—	1.7	2000	12.5	2000	10	100	600	
MRF962	4.5	50	14	2	500	16.5	500	15	100	750	

Case 305B-01/1

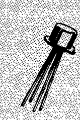
Device	f_T GHz Typ	I_C mA	Curve No. Page 36	NF dB Max	f MHz	Gain dB Min	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
LT3005	3	90	7	2.5	300	14	300	20	200	5000	
TP3400	3	125	—	7	500	14.5	860	20	400	5000	

Case 401-01/1

Device	f_T GHz Typ	I_C mA	Curve No. Page 36	NF dB Max	f MHz	Gain dB Min	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
LT3014	3	90	7	3.1	300	14	500	20	200	5000	

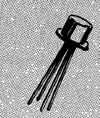
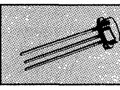
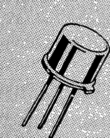
METAL CAN

Case 20-03/10, TO-206AF

Device	f_T GHz Typ	I_C mA	Curve No. Page 36	NF dB Max	f MHz	Gain dB Min	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
2N2857	1.6	8	8	4.5	450	12.5	450	15	40	200	
2N4957 (5)	1.6	−2	10	3	450	17	450	−30	−30	200	
2N4958 (5)	1.5	−2	10	3.3	450	16	450	−30	−30	200	
2N4959 (5)	1.5	−2	10	3.8	450	15	450	−30	−30	200	
2N5031	1.6	5	8	2.5	450	14	450	10	20	200	
2N5032	1.5	5	8	3	450	14	450	10	20	200	
2N5179	1.4	10	8	4.5	200	15	200	12	50	200	
2N6304	1.8	10	9	4.5	450	15	450	15	50	200	
2N6305	1.8	10	9	5.5	450	12	450	15	50	200	
BFR99 (5)	1.7	−10	9	6	800	—	—	−25	−50	225	
BFX89	1.6	25	9	6.5	500	19	200	15	50	200	

(5) PNP

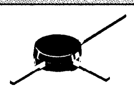
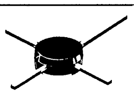
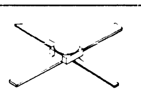
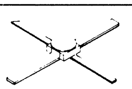
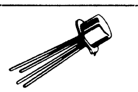
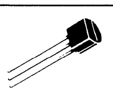
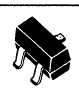
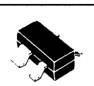
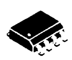
METAL CAN (continued)

	Gain-Bandwidth			Noise Figure		Gain		Maximum Ratings			
Device	f_T @ GHz Typ	I_C mA	Curve No. Page 36	NF @ dB Max	f MHz	@ dB Min	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
Case 20-03/10, TO-206AF											
BFY90	1.7	25	9	5	500	21 (16)	200	15	50	200	
MM4049 (5)	5	−20	19	3 (16)	500	11.5	500	−10	−30	200	
MRF501	1	5	8	4.5 (16)	200	15 (16)	200	15	50	200	
MRF502	1.2	5	8	4 (16)	200	17 (16)	200	15	50	200	
MRF524 (5)	4.2	−50	—	2.5	500	9	500	−10	−50	200	
MRF904	4	15	12	1.5 (16)	450	16 (16)	450	15	30	200	
MRF914	4.5	20	13	2 (16)	500	15 (16)	500	12	40	200	
Case 26-03/1											
LT3046	3	40	7	2.5	300	15.5	300	20	150	2500	
MRF965	4.5	50	—	2 (16)	500	12	500	15	100	750	
Case 79-04/1, TO-205AD											
2N3553	0.5	100	—	—	—	10	175	40	1000	7000	
2N3866	0.7	50	—	—	—	10	400	30	400	5000	
2N3866A	1	50	—	—	—	10	400	30	400	5000	
2N5109	1.5	50	4	3 (16)	200	11	216	20	400	2500	
2N5583 (5)	1.5	−100	5	—	—	—	—	−30	−500	5000	
2N5943	1.5	50	4	3.4 (16)	200	11.4 (16)	200	30	400	3500	
LT1001A	3	90	7	2.5	300	13.5	300	20	200	3000	
LT4239	5	90	21	2.5	500	14	500	12	400	3000	
MM8000	0.8	50	1	2.7 (16)	200	11.4 (16)	200	30	400	3500	
MM8001	1	50	4	2.7 (16)	200	11.4 (16)	200	30	400	3500	
MRF517	2.7	60	7	7.5	300	10 (16)	300	20	150	2500	
MRF525 (TO-39CE)	3	50	7	4	400	13	400	20	150	2500	
MRF544	1.4	50	2	—	—	16.5 (16)	250	70	400	3500	
MRF545 (5)	1.2	−50	2	—	—	15.5 (16)	250	−70	−400	3500	
MRF586	4.5	90	17	4	500	9	500	17	200	2500	
PT4579	2.5	90	6	2.3	300	12	300	25	200	3000	

(5) PNP
(16) Typical

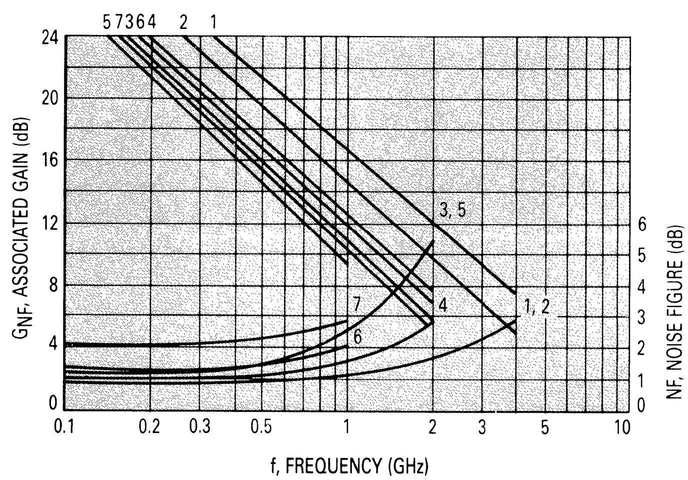
Low-Noise

The Small-Signal devices listed are designed for low noise and high gain amplifier mixer, and multiplier applications. Each transistor type is available in various packages. **Polarity is NPN unless otherwise noted.**

Package	Name	Case Number	Curve Number 1	2	3(5)	4	5	6	7
	MACRO-T	317A-01/2	—	—	—	—	MRF580	—	BFR91
	MACRO-X	317-01/2	—	MRF941 MRF951(18)	MRF521	MRF571 MRF2369(17)	MRF581	MRF901	MRF911
	.1″ Ceramic	303-01/1	2N6618 2N6679(18)	MRF942 MRF952(18)	MRF522	MRF572	—	2N6603	2N6604
	.07″ Ceramic	303A-01/1	2N6617	—	—	—	—	—	—
	TO-206AF	20-03/10	—	—	MRF524	—	—	MRF904	MRF914
	TO-226AA	29-04/2	—	—	—	MPS571	—	MPS901	MPS911
	SOT-23	318-07/6	—	MMBR941L MMBR951L(18)	—	MMBR571L	—	MMBR901L	MMBR911L
	SOT-143	318A-05/1	—	MRF9411L MRF9511L(18)	MRF5211L	MRF5711L MRF0211L(17)	—	MRF9011L	—
	SO-8	751-03/1	—	—	—	—	MRF5812	—	—

(5) PNP
(17) Higher Voltage Version
(18) Higher Current Version

Gain and Noise Figure versus Frequency



CATV, MATV and Class A Linear

For Class A linear CATV/MATV applications. Listed according to increasing gain-bandwidth (f_T).

Device	Nominal Test Conditions V_{CE}/I_C Volts/mA	f_T MHz Typ	Noise Figure	Distortion Specifications				$V_{(BR)CEO}$ V	Package/ Style
			Typ/Freq. dB/MHz	2nd Order IMD	3rd Order IMD	12 Ch. Cross-Mod.	Output Level dBmV		
MRF501	6/5	1000	4.5/200					15	20-03/10
MRF502	6/5	1200	4/200					15	20-03/10
2N5179	6/10	1400	3.2/200					12	20-03/10
MMBR5179L	6/5	1500	4/450					12	318-06/6
2N5109	15/50	1500	3/200					20	79-04/1
2N5943	15/50	1500	3.4/200	−50		−4	+50	30	79-04/1
MRF5943	15/50	1500	3.4/200					30	751-02/1
MRF5583 (5)	10/−100	1500						−30	751-02/1
BFX89	5/25	1600	2.5/500					15	20-03/10
BFY90	5/25	1700	2.5/500					15	20-03/10
2N6304	5/10	1800	3.2/450					15	20-03/10
2N6305	5/10	1800	4/450					15	20-03/10
MMBR4957L (5)	10/−2	2000	3/450					−30	318-06/6
MMBR5031L	6/5	2000	1.9/450					10	318-06/6
MRF511	20/80	2100	7.3/200	−50	−65	−57	+50	25	144D-06/1
MRFQ17	12.5/50	2200						25	751-02/1
PT4572A	14/90	2500	2.3/300					25	244A-01/1
PT4579	14/90	2500	2.3/300					25	79-04/1
TP3098	15/100	2600	6.5/500				1 (28)	20	244A-01/1
MRF517	15/60	2700	6.5/300	−60	−72	−57	+45	20	79-04/1
LT1001A (19)	14/90	3000	2.5/300					20	79-04/1
LT2001	14/90	3000	2.5/300					20	244A-01/1
LT3005	14/90	3000	2.5/300					20	305B-01/1
LT3014 (19)	14/90	3000	3.1/300					20	401-01/1
LT3046	14/90	3000	2.5/300					20	26-03/1
TP3400	18/125	3000	7/500				1.2 (28)	20	305B-01/1
MMBR920L	10/14	4500	2.4/500					15	318-06/6
BFW92A	10/10	4500	2.7/500					15	317A-01/2
MRF586	15/90	4500	3/500	−50	−72		+50	17	79-04/1
BFR96	10/50	4500	2/500					15	317A-01/2
MRF961	10/50	4500	2/500					15	317-01/2
MRF962	10/50	4500	2/500					15	303-01/1
MRF965	10/50	4500	2/500					15	26-03/1

(5) PNP
(19) Available in JTX equivalent by replacing "LT" with "TX" prefix
(28) Output in volts according to DIN45004B

(continued)

Device	Nominal Test Conditions V_{CE}/I_C Volts/mA	f_T MHz Typ	Noise Figure	Distortion Specifications				$V_{(BR)CEO}$ V	Package/ Style
			Typ/Freq. dB/MHz	2nd Order IMD	3rd Order IMD	12 Ch. Cross-Mod.	Output Level dBmV		
BFR90	10/14	5000	2.4/500					15	317A-01/2
BFR91	5/30	5000	1.9/500					12	317A-01/2
LT4217	14/90	5000	4/500					12	244D-01/1
LT4239 (19)	14/90	5000	4/500					12	79-04/1
MRF581	10/75	5000	2/500		−65		+50	18	317-01/2
MRF581A	10/75	5000	1.8/500		−65		+50	15	317-01/2
MRF5812	10/75	5000	1.8/500		−65		+50	15	751-02/1
MRF587	15/90	5500	3/500	−52	−72		+50	17	144D-06/1
TP3401	12.5/150	5000					1.2 (20)	13	244C-01/1
TP3401S	12.5/150	5000					1.2 (20)	13	249A-01/1
TP3402	12.5/300	5000					1.6 (20)	13	244C-01/1
2N6679	(Has $P_{1\ dB}$ of 18.5 dBm Typ @ 4 GHz)							20	303-01/1

High-Voltage

These discrete devices are specially designed for CRT driver applications requiring high frequency response and high voltage, such as high resolution color graphics video monitors. Gold metallized dice are used to insure high reliability and improved ruggedness.

Device	$V_{(BR)CEO}$ V	$V_{(BR)CBO}$ V	$I_{C(max)}$ mA	h_{FE}	$f_T/V_{CE}, I_C$ (GHz) V, I	C_{CB}/V_{CE} pF/V	Package/ Style
NPN							
LT1814 (19)	70	120	400	20–60	1/15, 50	3.5/15	401-01/2
LT1839 (19)	70	120	300	20–60	1/15, 50	2.5/15	79-04/1
MRF544	70	120	400	15–	1.4/10, 50	1.8/10	79-04/1
MRF542	70	120	400	15–	—	2/10	317D-01/3
MRF548	70	120	400	15–	—	2/10	244A-01/3
PNP							
LT5817	−65	−80	−400	15–60	1.5/10, −60	1.5/−10	244D-01/2
LT5839 (19)	−65	−80	−300	15–60	1.5/10, −60	1.5/−10	79-04/1
MRF545	−70	−100	−400	15–	1.2/25, −50	2/−10	79-04/1
MRF543	−70	−100	−400	15–	—	2/−10	317D-02/3
NPN-PNP Pair							
CR820	70/−65	120/−80	—	40(16)	1/±15, ±50	2.5/±15	

(16) Typical
(19) Available in JTX equivalent by replacing "LT" and "TX" prefix
(20) Output in volts according to DIN45004B

New introductions

High-Speed Switches

The transistors listed below are for use as high-frequency current-mode switches. They are also suitable for RF amplifier and oscillator applications. The devices are listed in ascending order of collector current. These devices are NPN polarity unless otherwise designated.

Device	Test Conditions I_C/V_{CE} mA/Volts	f_T MHz Min	r_b' C_C ps Max	Package/Style
2N3959	10/10	1300	25	22-03/1
2N3960	10/10	1600	40	22-03/1
2N5835	10/6	2500	5 (16)	20-03/10
MM4049 (5)	20/5	4000	15	20-03/10
MRF914	20/10	4500 (16)	—	20-03/10
2N5583 (5)	50/10	1000	8 (16)	79-04/1
2N5836	50/6	2000	6 (16)	26-03/1
2N5943	50/15	1200	5.5 (16)	79-04/1
2N5837	100/3	1700	6 (16)	26-03/1

UHF and Microwave Oscillators

The transistors listed below are for UHF and microwave oscillator applications as initial signal sources or as output stages of limited range transmitters. Devices are listed in order of increasing output power.

Device	Test Conditions		P_{out} mW Min	f_T MHz Typ	Package/Style
	f MHz	V_{CC} Volts			
2N5179	500	10	20	1400	20-03/10
2N2857	500	10	30	1600	20-03/10
MM8009	1680	20	200	1400	79-04/1
2N5108	1680	20	300	1400	79-04/1
MRF905	1680	20	500 (16)	2200	26-03/1
2N3866	400	15	1000	800	79-04/1
MPS3866	400	15	1000	800	29-04/2
MRF3866	400	15	1000	800	751-02/1

Complementary Devices

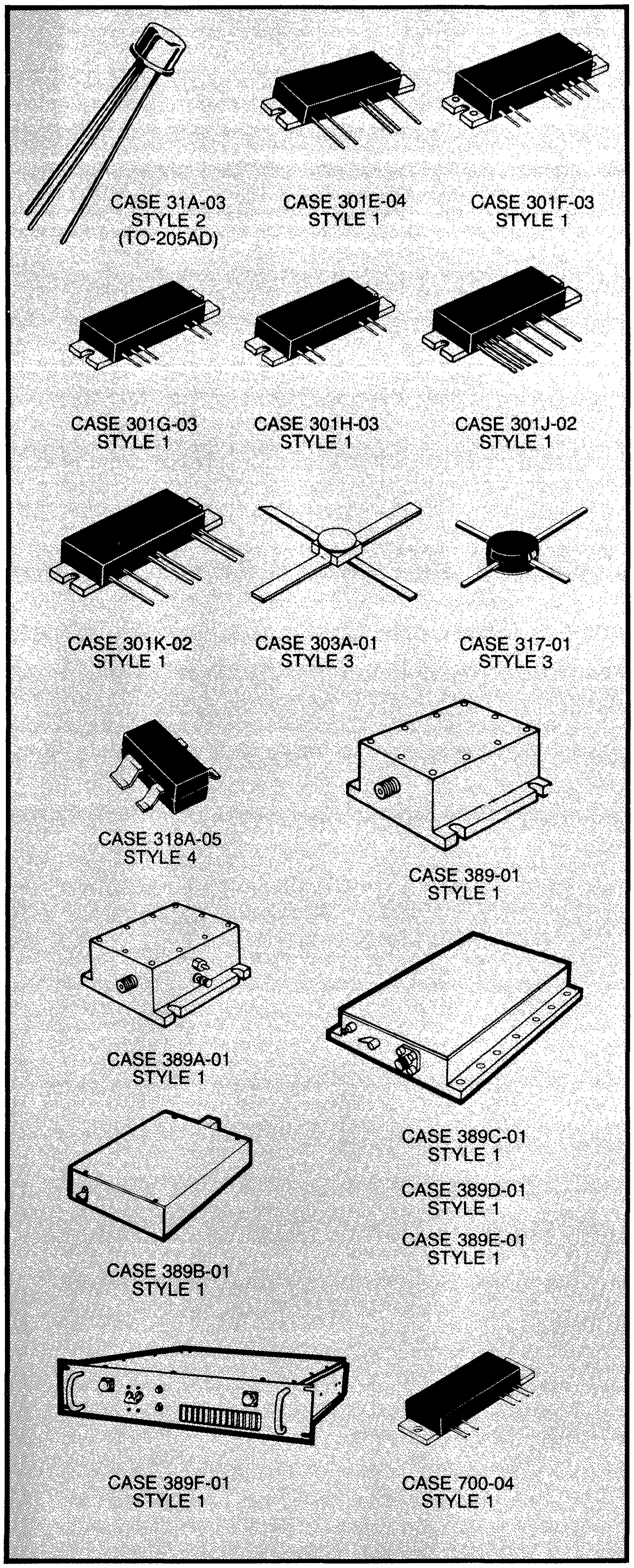
The transistor complements listed are suitable for most applications requiring NPN and PNP devices of similar RF characteristics. Special matching of complementary transistors is available upon request. See indicated pages for specifications.

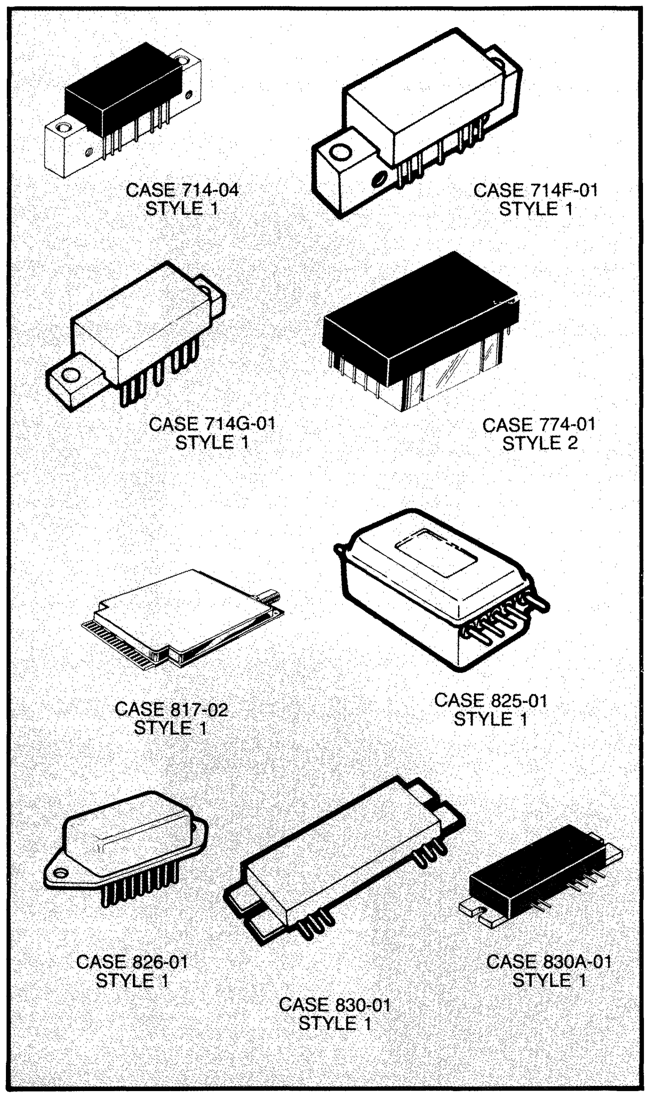
NPN	Page #	PNP	Page #
2N2857	39	2N4958	39
2N3866	25	2N5160	25
2N5943	40	2N5583	40
MRF904	40	MM4049	40
MRF571	36	MRF521	36

RF Amplifiers

Motorola's line of RF amplifiers is designed and specified for use in land mobile radios, CATV distribution systems and general purpose wideband amplification applications. They feature small size, matched inputs and outputs, high stability and guaranteed performance specifications. For the user they offer the benefits of smaller and less complex system designs, in less time and at lower overall cost.

Each amplifier uses modern transistor chips which are gold metallized and have silicon nitride passivation for increased reliability and long life. Chip and wire construction features MOS capacitors and laser trimmed nichrome resistors. Circuit substrates and metallization have been selected for optimum performance cost and reliability.





RF AMPLIFIERS (continued)

High Power

Complete amplifiers with 50 ohm in/out impedances are available for a variety of applications including land mobile radios, base stations, TV transmitters and other uses requiring large-signal amplification, both linear and Class C. Frequencies covered range from 66 MHz to 960 MHz with power levels extending to 70 watts.

Land Mobile/Portable

The advantages of small size, reproducibility and overall lower cost become more pronounced with increasing frequency of operation. These amplifiers offer a wide range in power levels and gain, with guaranteed performance specifications for bandwidth, stability and ruggedness.

136–174 MHz, VHF BAND — Class C

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	f Frequency MHz	G_p Power Gain dB Min	V_{CC} Supply Voltage Volts	Package/Style
MHW607-1	7	0.001	136–150	38.4	7.5	301K-02/3
MHW607-2	7	0.001	146–174	38.4	7.5	301K-02/3
MHW607-3	7	0.001	174–195	38.4	7.5	301K-02/3
MHW607-4	7	0.001	184–210	38.4	7.5	301K-02/3

400–512 MHz, UHF BAND — Class C

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	f Frequency MHz	G_p Power Gain dB Min	V_{CC} Supply Voltage Volts	Package/Style
MHW707-1	7	0.001	403–440	38.4	7.5	301J-02/1
MHW707-2	7	0.001	440–470	38.4	7.5	301J-02/1
MHW709-1	7.5	0.1	400–440	18.8	12.5	700-04/1
MHW709-2	7.5	0.1	440–470	18.8	12.5	700-04/1
MHW709-3	7.5	0.1	470–512	18.8	12.5	700-04/1
MHW710-1	13	0.15	400–440	19.4	12.5	700-04/1
MHW710-2	13	0.15	440–470	19.4	12.5	700-04/1
MHW710-3	13	0.15	470–512	19.4	12.5	700-04/1
MHW720-1	20	0.15	400–440	21	12.5	700-04/1
MHW720-2	20	0.15	440–470	21	12.5	700-04/1
MHW720A1 (21)	20	0.15	400–440	21	12.5	700-04/1
MHW720A2 (21)	20	0.15	440–470	21	12.5	700-04/1
MHW721A2 (1)	20	0.15	450–460	21	12.5	700-04/1
MX20-1	20	0.15	400–440	21	12.5	830-01/1
MX20-2	20	0.15	440–470	21	12.5	830-01/1
MHW703	2.3	0.002	450–460	30.6	7.2	301J-02/1

806–960 MHz, UHF BAND — Class C

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	f Frequency MHz	G_p Power Gain dB Min	V_{CC} Supply Voltage Volts	Package/Style
MHW801-1	1.6	0.001	820–850	32	6	413-02/1
MHW801-2	1.6	0.001	870–905	32	6	413-02/1
MHW801-3	2	0.001	890–915	33	6	413-02/1
MHW801-4	1.6	0.001	915–925	32	6	413-02/1
MHW803-1	2	0.001	820–850	33	7.5	301E-04/1
MHW803-2	2	0.001	806–870	33	7.5	301E-04/1
MHW803-3	2	0.001	870–905	33	7.5	301E-04/1
MHW806A1 (21)	6	0.03	820–850	23	12.5	301H-03/2
MHW806A2 (21)	6	0.03	806–870	23	12.5	301H-03/2
MHW806A3 (21)	6	0.04	890–915	21.7	12.5	301H-03/2
MHW806A4 (21)	6	0.04	870–950	21.7	12.5	301H-03/2
MHW807-1	6	0.001	820–850	38	12.5	301L-02/2
MHW807-2	6	0.001	870–905	38	12.5	301L-02/2
MHW812A3 (21)	12	0.1	870–950	20.8	13	301H-03/1
MHW820-3	18	0.35	870–950	17.1	12.5	301G-03/1
MHW820-1	20	0.25	806–870	19	12.5	301G-03/1
MHW820-2	20	0.25	806–890	19	12.5	301G-03/1
MHW851-1	1.6	0.001	820–850	32	6	301N-01/1
MHW851-2	1.6	0.001	870–905	32	6	301N-01/1
MHW851-3	2	0.001	890–915	33	6	301N-01/1
MHW851-4	1.6	0.001	915–925	32	6	301N-01/1
MHW857-1 (1)	6	0.001	820–850	37.8	12.5	301L-02/2
MHW857-2 (1)	6	0.001	870–905	37.8	12.5	301L-02/2

(1) To be introduced
(21) Designed for Wide Range P_{out} Level Control

New introductions

Base Station

The convenience of complete amplifiers for base station transmitters is offered for many two-way radio bands from VHF through the high-UHF cellular bands (806–960 MHz). Power levels to 120 W are available operating from 24 to 26 volt supplies. Class AB or Class A operation provides linear performance suitable in both analog and digital systems.

The AMR/ACR series can optionally be modified in frequency, power and mechanical outline. Please contact your local MOTOROLA field sales office.

145–225 MHz BAND — Class AB

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	f Frequency MHz	G_P Power Gain dB Min	V_{CC} Supply Voltage Volts	Package/Style
AMR175-60	60	6	145–175	10	28	389K-01/1
AMR225-60	60	6	180–225	10	28	389K-01/1

400–512 MHz BAND — Class AB

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	f Frequency MHz	G_P Power Gain dB Min	V_{CC} Supply Voltage Volts	Package/Style
AMR440-60	60	12	400–440	7	28	389L-02/1
AMR470-60	60	12	440–470	7	28	389L-02/1

806–960 MHz BAND — Class A and/or AB

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	f Frequency MHz	G_P Power Gain dB Min	V_{CC} Supply Voltage Volts	Package/Style
AMR900-60A (22)	20	2.25	800–960	9.5	26	389B-02/1
ACR900-30E	30	0.48	890–960	18	25	389J-02/1
AMR900-60	60	12	800–960	7	24	389B-02/2
AMR900-80	80	16	865–900	7	26	389M-01/1
AMR960-80	80	16	935–960	7	26	389M-01/1
AMR960-100	100	20	860–960	7	26	389M-01/1

(22) Class A device

TV Transmitters

These amplifiers are characterized for ultra-linear applications in Band IV and V TV transmitters.

Device	Frequency MHz	P_{ref} Watts	Gp (Min)/Freq. Power Gain dB/MHz	3 Tone (12) IMD 1 dB	3 Tone (24) IMD 2 dB	V_{CC} Volts	Package/ Style
ATV5030	470–860	20	7.5/860	−51	−54	26	389B-02/1
ATV5090B	470–860	90 (13)	7/860	—	—	28	389N-01/1
ATV6031	470–860	20	10.5/860	−50	−53	26.5	389B-02/1
ATV7050	470–860	30	8/860	−51	−54	25	389P-01/1
ATV7060	470–860	40	10/860	−51	−54	25.5	389H-01/1

PAM Series — Ultra Linear

PAM devices are class A and class AB linear amplifiers with medium and high output powers in the VHF and UHF frequency range. They feature a wide dynamic range and a high third order intercept point. These high quality amplifiers are offered in a heavy-duty machined housing and are ideal for applications in instrumentation, communications and electronic warfare.

VHF BAND — Class A

Device	Frequency MHz	P_O Min Watts	Gain Typ dB	V_{CC} Volts	3rd Order Intercept Typ dBm	Package/ Style
PAM225-42-10L	172–225	10	46	24	−58 (25)	389C-01/1
PAM225-42-10LA	172–225	10	46	28	−58 (25)	389C-01/1

VHF/UHF BAND — Class A

Device	Frequency MHz	P_O Min Watts	Gain Typ dB	V_{CC} Volts	3rd Order Intercept Typ dBm	Package/ Style
PAM0105-29-6L	100–500	6	31	24	+48.5	389C-01/1
PAM0105-29-6LA	100–500	6	31	28	+48.5	389C-01/1
PAM0105-7-25L	100–500	25	7.5	24	+53.5	389E-01/1
PAM0105-7-25LA	100–500	25	7.5	28	+53.5	389E-01/1
PAM0105-6-50L	100–500	50	7	24	+56.5	389D-01/1
PAM0105-6-50LA	100–500	50	7	28	+56.5	389D-01/1

UHF BAND — Class A

Device	Frequency MHz	P_O Min Watts	Gain Typ dB	V_{CC} Volts	3rd Order Intercept Typ dBm	Package/ Style
PAM0510-25-6L	500–1000	6	27	24	48.5	389C-01/1
PAM0810-24-3L	800–1000	3	26	24	+45	389C-01/1
PAM0810-24-3LA	800–1000	3	26	28	+45	389C-01/1
PAM0810-24-5L	800–1000	5	26	24	+47.5	389C-01/1
PAM0810-24-5LA	800–1000	5	26	28	+47.5	389C-01/1
PAM0810-8-10L	800–1000	10	10	24	+50	389E-01/1
PAM0810-8-10LA	800–1000	10	10	28	+50	389E-01/1
PAM0810-7-25L	800–1000	25	8	24	+55	389E-01/1
PAM0810-7-25LA	800–1000	25	8	28	+55	389E-01/1
PAM0810-6-50L	800–1000	50	7	24	+56.5	389D-01/1
PAM0810-6-50LA	800–1000	50	7	28	+56.5	389D-01/1

(12) Vision Carrier = −8 dB; Sound Carrier = −7 dB; Sideband Carrier = −16 dB
(13) Output power at 1 dB compression, in Class AB
(17) Higher Voltage Version
(24) Vision Carrier = −8 dB; Sound Carrier = −10 dB; Sideband Carrier = −16 dB
(25) Composite Triple Beat in dB. Tones: −8, −11 and −16 dB

New introductions

PAA Series — Ultra Linear Integrated Amplifier Assemblies

PAA and PAE integrated assemblies are class A amplifiers with internal power supply. Available in either 115 Vac or 220 Vac operation. They provide high-gain, excellent linearity and can withstand any load VSWR.

WIDE BAND, MEDIUM POWER — Class A

Device	Frequency MHz	P_O Min Watts	Gain Typ dB	V_{AC} Volts	3rd Order Intercept Typ dBm	Package/ Style
PAA0200-34-1.5L	1–200	1.5	36	115	+45	389R-01/1
PAA0200-34-3.1L	1–200	3.1	35	115	+48	389R-01/1
PAA0450-33-0.4L	30–450	0.4	34	115	+38	389R-01/1
PAA0500-17-1.0L	30–500	1	18	115	+42	389R-01/1
PAA0500-35-1.0L	30–500	1	36.5	115	+42	389R-01/1
PAA0500-17-2.0L	30–500	2	18	115	+33	389R-01/1
PAA1000-14-0.6L	10–1000	0.6	15	115	+42	389R-01/1
PAA1000-30-0.6L	10–1000	0.6	32	115	+42	389R-01/1
PAA1000-14-1.3L	10–1000	1.3	15	115	+44	389R-01/1
PAE0200-34-1.5L	1–200	1.5	36	220	+45	389R-01/1
PAE0200-34-3.1L	1–200	3.1	35	220	+48	389R-01/1
PAE0450-33-0.4L	30–450	0.4	34	220	+38	389R-01/1
PAE0500-17-1.0L	30–500	1	18	220	+42	389R-01/1
PAE0500-35-1.0L	30–500	1	36.5	220	+42	389R-01/1
PAE0500-17-2.0L	30–500	2	18	220	+33	389R-01/1
PAE1000-14-0.6L	10–1000	0.6	15	220	+42	389R-01/1
PAE1000-30-0.6L	10–1000	0.6	32	220	+42	389R-01/1
PAE1000-14-1.3L	10–1000	1.3	15	220	+44	389R-01/1

WIDE BAND, HIGH POWER — Class A

PAA1000-42-5L	25–1000	5	42	115	+46.5	389F-01/1
PAE1000-42-5L	25–1000	5	42	220	+46.5	389F-01/1

VHF BAND, HIGH POWER — Class A

PAA225-42-10L	172–225	10	46	115	−58 (25)	389F-01/1
PAE225-42-10L	172–225	10	46	220	−58 (25)	389F-01/1

VHF/UHF BAND, HIGH POWER — Class A

PAA0105-29-6L	100–500	6	31	115	+48.5	389F-01/1
PAA0105-45-25L	100–500	25	47	115	+53	389F-01/1
PAA0105-50-50LAS (40)	100–500	50	52	115	+56.5	389G-01/1
PAE0105-29-6L	100–500	6	31	220	+48.5	389F-01/1
PAE0105-45-25L	100–500	25	47	220	+53	389F-01/1
PAE0105-50-50LAS	100–500	50	52	220	+56.5	389G-01/1

UHF BAND, HIGH POWER — Class A

PAA0510-25-6L	500–1000	6	27	115	48.5	389F-01/1
PAA0810-24-5L	800–1000	4.5	26	115	+47.5	389F-01/1
PAA0810-38-5LAS	800–1000	4.5	42	115	+47.5	389F-01/1
PAA0810-32-10L	800–1000	10	35	115	+50	389F-01/1
PAA0810-31-25L	800–1000	25	33	115	+55	389F-01/1
PAA0810-40-50L (40)	800–1000	50	42	115	+56.5	389G-01/1
PAA0810-40-50LAM (26)(40)	800–1000	50	42	115	+56	389G-01/1
PAA0810-54-50LAS (40)	800–1000	50	56	115	+56.5	389G-01/1
PAA0810-54-50LSM (26)(40)	800–1000	50	56	115	+56	389G-01/1
PAA0810-38-100AB (40)	800–1000	100	38	115	—	389G-01/1
PAA0810-38-100AM (26)(40)	800–1000	100	38	115	—	389G-01/1
PAA0810-52-100AB (40)	800–1000	100	52	115	—	389G-01/1
PAA0810-52-100AM (26)(40)	800–1000	100	52	115	—	389G-01/1
PAE0810-24-5L	800–1000	4.5	26	220	+47.5	389F-01/1
PAE0810-38-5LAS	800–1000	4.5	42	220	+47.5	389F-01/1
PAE0810-32-10L	800–1000	10	35	220	+50	389F-01/1
PAE0810-31-25L	800–1000	25	33	220	+55	389F-01/1
PAE0810-40-50L	800–1000	50	42	220	+56.5	389G-01/1
PAE0810-40-50LAM (26)	800–1000	50	42	220	+56	389G-01/1
PAE0810-54-50LAS	800–1000	50	56	220	+56.5	389G-01/1
PAE0810-54-50LSM (26)	800–1000	50	56	220	+56	389G-01/1
PAE0810-38-100AB	800–1000	100	38	220	—	389G-01/1
PAE0810-52-100AM (26)	800–1000	100	52	220	—	389G-01/1

(25) Composite triple beat in dB. Tones: −8, −11 and −16 dB
(26) Includes directional wattmeter, filter and directional coupler

(40) Available in 19″ rackmount (Case 389T-01/1) by changing prefix to "PAN."

New introductions

Low Power

The following categories describe a wide range of complete amplifier assemblies both hybrid and monolithic for use in CATV distribution systems, instrumentation, communications and military equipment. A variety of power levels and frequencies of operation are offered for many applications.

CATV Distribution

Motorola Hybrids are manufactured using fourth generation technology which has set new standards for CATV system performance and reliability. These hybrids have been optimized to provide premium performance in all CATV systems up to 77 channels.

HYBRIDS UP TO 60 CHANNELS AND 450 MHz

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test (28) dB	Composite Triple Beat dB 60 CH	Cross Modulation dB 60 CH	Noise Figure @ 450 MHz dB Max	Typ	Package/Style
MHW5122A	12	60	+46	−72	−58	−61	8	7	714-04/1
MHW5141A	14	60	+46	−72	−56	−59	7	—	714-04/1
MHW5142A	14	60	+46	−74	−61	−62	7	6	714-04/1
MHW5162A	16	60	+46	−72	−58	−61	7	6	714-04/1
MHW5171A	17	60	+46	−72	−58	−59	7	—	714-04/1
MHW5172A (36)	17	60	+46	−74	−60	−62	7	6	714-04/1
MHW5181A (36)	18	60	+46	−72	−57	−56	6.5	5.5	714-04/1
MHW5182A (36)	18	60	+46	−72	−61	−59	6.5	5.5	714-04/1
MHW5222A (36)	22	60	+46	−72	−60	−59	5	4.5	714-04/1
MHW5272A	27	60	+46	−72	−59	−60	6	—	714-04/1
MHW5342A	34	60	+46	−72	−59	−59	6	5	714-04/1
MHW5382A	38	60	+46	−70	−59	−59	5	4	714-04/1
MHW5332	33	60	+46	−70	−60	−59	6	5	714-04/1
CA7901	21	60	+46	−61	−58	−60	—	5.6	714F-01/1

(28) Channels 2 and M13 @ M22
(36) Available in reverse voltage (−24 V) version (in Case 714C-04) by placing Suffix "R" after device number.

HYBRIDS UP TO 77 CHANNELS AND 550 MHz

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test (29) dB	Composite Triple Beat dB 77 CH	Cross Modulation dB 77 CH	Noise Figure @ 550 MHz dB Max	Typ	Package/Style
MHW6122	12	77	+44	−74	−56	−62	8.5	7	714-04/1
MHW6141	14	77	+44	−72	−56	−59	7.5		714-04/1
MHW6142	14	77	+44	−72	−59	−62	7.5		714-04/1
MHW6171	17	77	+44	−68	−56	−59	7		714-04/1
MHW6172	17	77	+44	−70	−59	−62	7		714-04/1
MHW6181	18	77	+44	−70	−56	−59	7		714-04/1
MHW6182	18	77	+44	−72	−58	−62	7		714-04/1
MHW6222	22	77	+44	−66	−57	−57	6		714-04/1
MHW6272	27	77	+44	−64	−57	−57	6.5	6	714-04/1
MHW6342	34	77	+44	−64	−57	−57	6.5	5.5	714-04/1

HYBRIDS UP TO 860 MHz

Device	Gain dB	Frequency MHz	V_{CC} Volts	2nd Order IMD dB @ V_{out} = 50 dBmV/ch	Composite Triple Beat dB @ V_{out}/Freq. (dBmV/MHz)	DIN45004B dBmV @ Freq. (MHz)	NF @ 860 MHz dB Max	Package/Style
CA901	17	40–860	24	−60		60 (860)	9	714P-01/2
CAB914	23	470–860	24		−51 (61/860)	62 (860)	8.5	830A-01/1

REVERSE AMPLIFIER HYBRIDS

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB (30)	Composite Triple Beat dB 12 CH	22 CH	26 CH	Cross Modulation dB 12 CH	22 CH	26 CH	Noise Figure @ 175 MHz dB Max	Package/Style
MHW1134	13	22	+50	−72	—	−73	−71 (16)	—	−65	−65 (16)	7	714-04/1
MHW1184 (36)	18	22	+50	−72	—	−72	−70 (16)	—	−64	−64 (16)	5.5	714-04/1
MHW1224	22	22	+50	−72	—	−71	−68 (16)	—	−62	−62 (16)	5.5	714-04/1
MHW1244	24	22	+50	−72	—	−70	−68 (16)	—	−61	−61 (16)	5	714-04/1

(16) Typical
(29) Channels 2 and M30 @ M39
(30) Channels 2 and A @ 7
(36) Available in reverse voltage (−24 V) version (in Case 714C-04) by placing Suffix "R" after device number.

New introductions

450/550 MHz POWER DOUBLING HYBRIDS

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 60 CH	Composite Triple Beat dB 77 CH	Cross Modulation dB 60 CH	Cross Modulation dB 77 CH	Noise Figure @ 450/550 MHz dB Max	Noise Figure Typ	Package/Style
MHW5185(36)	18	60	+46	−74 (28)	−65	—	−66	—	7	—	714-04/1
MHW6185(36)	18	77	+44	−71 (29)	—	−63	—	−63	7.5	—	714-04/1
MHW5225(36)	22	60	+46	−69 (28)	−62	—	−60	—	6	5	714-04/1
MHW5205(36)	20	60	+46	−58 (41)	−64	—	−64	—	6.5	5.5	714-04/1

450/550 MHz FEEDFORWARD HYBRIDS (Case 774-01/2)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 60 CH	Composite Triple Beat dB 77 CH	Cross Modulation dB 60 CH	Cross Modulation dB 77 CH	Noise Figure @ 450/550 MHz dB Max	Noise Figure Typ	Package/Style
FF124	24	60	+46	−84	−79	—	−75	—	10	—	825-03/1
FF124B	24	60	+46	−84	−79	—	−75	—	10	—	825A-02/1
FF224	24	77	+44	−86	—	−75	—	−70	11	—	825-03/1
FF224B	24	77	+44	−86	—	−75	—	−70	11	—	825A-02/1

General Purpose Wideband

A wide range of hybrid and silicon monolithic amplifiers is offered for low level signal amplification. Package type, gain, frequency of operation, output level and supply voltage combinations can be selected to fit the design engineer's specific requirements.

50 Ω HYBRIDS (Case 31A-03/2)

The MWA Series features excellent gain versus frequency flatness, temperature stability and are cascadable for high gain lineups. Construction techniques include thin film gold metal circuitry and hermetic TO-205AD package. MWA devices processed similarly to MIL-S-883, Method 5004.4, Class B, are available to special order.

Device	Frequency Range MHz	Gain dB Min/Typ	Supply Voltage Vdc	Output Level 1 dB Compression dBm	Noise Figure @ 250 MHz dB
MWA110	0.1–400	13/14	2.9	−2.5	4
MWA120	0.1–400	13/14	5	+8.2	5.5
MWA130	0.1–400	13/14	5.5	+18	7
MWA131 (1)	0–400	13/14	5.5	+20	5 (39)
MWA210	0.1–600	9/10	1.75	+1.5	6
MWA220	0.1–600	9/10	3.2	+10.5	6.5
MWA230	0.1–600	9/10	4.4	+18.5	7.5
MWA310	0.1–1000	7/8	1.6	+3.5	6.5
MWA320	0.1–1000	7/8	2.9	+11.5	6.7
MWA330	0.1–1000	—/6.2	4	+15.2	9

(1) To be introduced
(28) Channels 2 and M13 @ M22
(29) Channels 2 and M30 @ M39
(36) Available in reverse voltage (−24 V) version (in Case 714C-04) by placing Suffix "R" after device number.
(39) NF @ f = 400 MHz
(41) Composite 2nd order IMD, 60 channel flat.

New introductions

50 Ω–100 Ω HYBRIDS (Case 714-04/1)

The general purpose hybrid amplifiers listed are for broadband system applications requiring superior gain and current stability with temperature. The 50 to 100 ohm input and output impedances help simplify designs.

Device	Frequency Range MHz	Gain dB Min/Typ	Supply Voltage Vdc	Output Level 1 dB Compression mW/f (MHz)	Noise Figure @ 250 MHz dB
MHW591	1–250	34.5/36.5	13.6	700/100	5
MHW593	10–400	33/34.5	13.6	600/200	5
MHW590	10–400	31.5/34	24	800/200	5
MHW592	1–250	33.5/35	24	900/100	5

50 Ω MONOLITHIC

These monolithic amplifiers are fully cascadable and usable to frequencies over 3 GHz. External blocking capacitors are required along with an external bias resistor. Hermetic versions are available to special order in Case 303-01.

Device	Frequency Range MHz	Gain dB Typ @ 1 GHz	Recommended Operating Current mA	Output Level 1 dB Compression dBm Typ	Noise Figure @ 1500 MHz dB
Case 317-01/3					
MWA0204	DC–3000	11.5	25	7	6
MWA0304	DC–3000	11.5	35	12	6
Case 318A-05/4					
MWA0211L	DC–3000	11.5	25	7	6
MWA0311L	DC–3000	11.5	35	12	6
Case 303A-01/3					
MWA0270	DC–3000	12	25	7	6
MWA0370	DC–3000	12	35	12	6

LOW POWER (continued)

STANDARD LINEAR HYBRIDS

The CA series of RF linear hybrid amplifiers consists of a family of medium power, broadband gain blocks in the CATV industry standard "CA" package. These amplifiers were designed for multi-purpose RF applications where linearity, dynamic range and wide bandwidth are of primary concern. Each amplifier is available in various package options. For hermetic package option add suffix "H" to part number except where noted (32). Four parts are available as indicated in a low profile package. Hermetic package parts are in Case 826-01/1 (for positive supply) or 826-01/2 (for negative supply).

Device	BW MHz	Gain Flatness ±dB	Gain/Freq. dB/MHz	P_{1dB} dBm	NF/Freq. dB/MHz	3rd Order Intercept Point/Freq. dBm/MHz	VSWR 50 Ω/75 Ω	V_S/I_S V/mA	Case/ Style
CA2800 (31)	10–400	1	17/50	29	8.5/300	44/300	2/1.3	24/200	714F-01/1
CA2810 (31)	10–350	1.5	33/50	29	8/300	43/300	2/1.3	24/300	714F-01/1
CA2813 (31)	40–300	1.25	34/50	22	5/300	40/300	2/1.3	15/160	714F-01/1
CA2818 (31)	1–200	1	18.5/50	29.5	5.5/150	47/150	2/1.3	24/205	714F-01/1
CA2820 (31)	1–520	1.5	30/100	26.5	8/500	37/500	2/	24/330	714M-01/2
CA2830 (31)	5–200	1	34.5/100	29	4.7/200	46/200	2/	24/300	714F-01/1
CA2833 (31)	5–200	1	34.5/100	29	4.7/200	46/200	2/	24/300	714G-01/1
CA2832 (31)	1–200	1	35.5/100	33	6/200	47/200	2/	28/435	714F-01/1
CA2842 (31)	30–300	1	22/100	30	5/100	46/300	1.5/	24/230	714F-01/1
CA2846 (31)	30–300	1	22/100	30	5/100	46/300	1.5/	24/230	714G-01/1
CA2850R (31)	40–100	0.2	17.5/100	25	4.5/70	40/70	1.3/	–19/125	714H-01/1
CA2851R (31)	40–100	0.2	17.5/100	25	4.5/70	40/70	1.3/	–19/125	714L-01/1
CA2870 (31)	20–400	1	34/100	27	7.5/400	45/300	2/	24/300	714M-01/1
CA2875R (31)	40–100	0.2	17.5/100	26	4.5/70	43/70	/1.07	–19/155	714H-01/1
CA2880R (31)	40–100	0.3	22/100	22	3/70	36/70	/1.2	–19/73	714L-01/1
CA2885 (32)	40–550	1	17.7/50	33	7/500	43/500	2/1.3	24/425	714F-01/1
CA4800 (31)	10–1000	0.5	17/100	26	7.5/1000	40/1000	2/	24/220	714P-01/2
CA4812 (31)	10–1000	0.5	17/100	26	7.5/1000	40/1000	2/	12/380	714P-01/3
CA4815 (31)	10–1000	0.5	17/100	26	7.5/1000	40/1000	2/	15/380	714P-01/3
CA5800 (31)	10–1000	0.5	15/100	30	8.5/1000	41/1000	2/	28/400	714P-01/2
CA5815 (31)	10–1000	0.5	16/100	30	8/1000	41/1000	2/	15/700	714P-01/3
CA5900	10–1200	0.5	15/100	30	8.5/1200	41/1200	2/	26/400	714P-01/2
CA5915	10–1200	0.5	15/100	30	8.5/1200	41/1200	2/	15/700	714P-01/3

(31) Available in Hi-Rel hermetic package manufactured compliant to MIL-A-28875. To order, insert an "R" in the part number following the prefix "CA" (Example, CAR2800).
(32) Not available in hermetic package

New introductions

SHP and DHP Linear

The SHP and DHP series of linear amplifiers consist of medium power, broadband, high gain amplifiers operating from 15 to 28 volt supplies. Both their wide dynamic and frequency ranges make them suitable for use in instrumentation, communications and military equipments.

SHP (Case 389A-01/1)

Device	BW (MHz)	Gain (dB)	VSWR 50 Ohms	DC Power	1 dB Compression W @ MHz	Third Order Intercept dBm @ MHz	Noise Figure dB @ MHz
SHP02-36-20	1–200	36	2:1	28 V/430 mA	2 @ 50 1.5 @ 200	+50 @ 50 +43 @ 200	5 @ 100 6 @ 200
SHP06-18-04	30–550	18	1.5:1	24 V/220 mA	0.8 @ 300 0.3 @ 550	+44 @ 300 +36 @ 550	6 @ 300 7.5 @ 550
SHP05-22-04	30–450	22	1.5:1	24 V/220 mA	0.8 @ 300 0.4 @ 450	+44 @ 300 +38 @ 450	5 @ 300 6 @ 450
SHP05-34-04	30–450	34	1.5:1	24 V/330 mA	0.8 @ 300 0.4 @ 450	+43 @ 300 +38 @ 450	5.5 @ 300 6 @ 450
SHP05-20-10	30–500	20	1.5:1	24 V/430 mA	2 @ 300 1 @ 500	+48 @ 300 +41 @ 500	5 @ 300 6 @ 500
SHP10-17-04	10–1000	17	2:1	24 V/220 mA	0.4 @ 500 0.4 @ 1000	+40 @ 500 +39 @ 1000	6.5 @ 500 7.5 @ 1000
SHP10-17-04-15	10–1000	17	2:1	15 V/400 mA	0.4 @ 500 0.4 @ 1000	+40 @ 500 +39 @ 1000	6.5 @ 500 7.5 @ 1000
SHP10-15-08	10–1000	15	2:1	28 V/400 mA	0.8 @ 500 0.7 @ 1000	+43 @ 500 +42 @ 1000	7.5 @ 500 8.5 @ 1000
SHP10-15-08-15	10–1000	15	2:1	15 V/700 mA	0.8 @ 500 0.7 @ 1000	+43 @ 500 +42 @ 1000	7.5 @ 500 8.5 @ 1000

DHP (Case 389-01/1)

Device	BW (MHz)	Gain (dB)	VSWR 50 Ohms	DC Power	1 dB Compression W @ MHz	Third Order Intercept dBm @ MHz	Noise Figure dB @ MHz
DHP02-36-40	1–200	36	2:1	28 V/870 mA	4 @ 50 3 @ 200	+53 @ 50 +46 @ 200	5.5 @ 100 6.5 @ 200
DHP05-36-10	30–500	36	1.5:1	24 V/600 mA	2 @ 300 1 @ 500	+48 @ 300 +41 @ 500	5 @ 300 6 @ 500
DHP05-18-20	30–500	18	1.5:1	24 V/830 mA	4 @ 300 2 @ 500	+51 @ 300 +44 @ 500	5.5 @ 300 6.5 @ 500
DHP10-14-15	10–1000	14	2:1	28 V/800 mA	1.5 @ 500 1.5 @ 1000	+45 @ 500 +44 @ 1000	8 @ 500 9 @ 1000
DHP10-32-08	10–1000	32	2:1	28 V/600 mA	0.8 @ 500 0.7 @ 1000	+43 @ 500 +42 @ 1000	6.5 @ 500 7.5 @ 1000

CRT Driver

These complete hybrid amplifiers are specifically designed for CRT driver applications requiring high frequency response and high voltage, such as high resolution color graphics video monitors. Gold metallized dice and substrates are used to insure high reliability and improved ruggedness.

Device	V_{CC} Volts	Gain (34) V/V	3 dB BW MHz	V_{out} (Max) Volts	Load	Package/Style
CR2424 (33)	60	12	145	50 P-P	6 to >20 pF	714G-01/1
CR2424R	−60	12	145	50 P-P	6 to >20 pF	714H-01/1
CAR2424H (35)	60	12	145	50 P-P	6 to >20 pF	826-01/1
CR2424H	60	12	145	50 P-P	6 to >20 pF	826-01/1
CR2425 (33)	60	12	145	50 P-P	6 to >20 pF	714F-01/1
CR3424	80	12	115	40 P-P	6 to >20 pF	714G-01/1
CR3424H	80	12	115	40 P-P	6 to > 20 pF	826-01/1
CR3425	80	12	115	40 P-P	6 to > 20 pF	714F-01/1
CR3424R	−80	12	115	40 P-P	6 to >20 pF	714H-01/1
CR3425R	−80	12	115	40 P-P	6 to >20 pF	714H-01/1

RF Transceiver Modules

These modules are designed for use in PC networks handling data rates up to 2 Mbps. Surface mount construction results in extremely small size — < 8 square inches of circuit board area. Each module provides high spectral purity and selectivity to prevent interference when used with other CATV signals on the cable interconnect system.

Device	Transmit P_O dBmV @ 75 Ohms Typ	Transmit Freq. MHz	Receive Freq. MHz	Input Level dBmV @ 75 Ohms Typ	Package/Style
MHW10000	54	50.75	219	8.5	817-02/1
MHW10001	54	56.75	249	8.5	817-02/1
MHW10002	54	62.75	255	8.5	817-02/1
MHW10003	54	50.75	243	8.5	817-02/1

Carrier Band Module

This module is designed for use in MAP/IEEE 802.4 token bus LAN applications. Surface mount construction results in extremely small size and ruggedness. Modulation used is phase coherent FSK with the low tone being 5 MHz and the high tone 10 MHz.

Device	Signalling Rate mbps	Signal Rise/Fall Times Nanoseconds	Operating Input Level Range dBmV	Bit Error Rate	Package/Style
MHW11005	5	15–35	10–66	$\leq 10^{-9}$	817A-01/1

(33) Text fixtures available. To order add "TF" suffix to device number
(34) Insertion gain; 50 ohm source
(35) Hi-Rel Hermetic packaged amplifier, manufactured compliant to MIL-A-28875

New introductions

RF Chips

Ordering and Shipping Information

Minimum Order Requirements:

In conjunction with Motorola corporate policy the minimum order, release or line/line shipment of standard product is $200.

The minimum order, release or line item shipment of nonstandard product is $2500 **unless** otherwise stated at the time of quotation, order entry or acknowledgement.

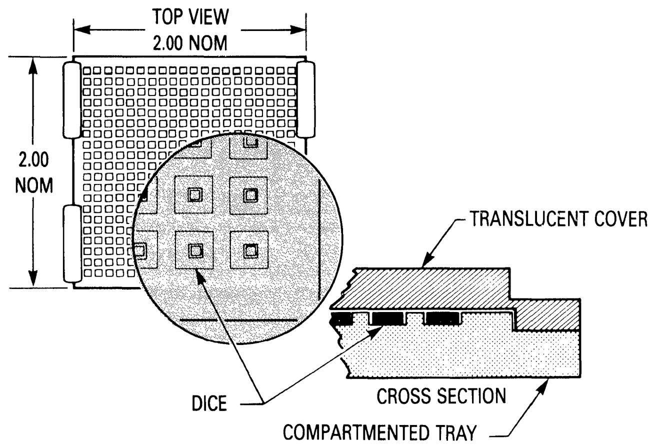


Figure 1. Multi-Pak (No Suffix)

Packaging:

Multi-Pak — Motorola supplies all discrete semiconductors in the industry standard multi-pak. (Waffle type carrier, Figure 1.) This is a 2 x 2 or 4 x 4 waffle type carrier with a separate hole for each die. Chips are 100% visually inspected with the rejects removed. There is no suffix associated with the multi-pak carrier.

Circle Pak (CP Suffix) (See Figure 2) — The wafer is placed on a sticky film before being sawed. Each wafer is completely sawed through with the back side against the PVC film. The die stick to the PVC film and maintain exact wafer orientation and spacing. This packaging method also offers the convenience of storage with original orientation and spacing even after a portion of the wafer is used. The evacuated plastic bag is thermally sealed holding the contents securely with no die movement. Die can be removed from the sticky film by a sharp ejector-pin pushing a die up and a vacuum needle manually picking it up. This package can also be handled by an automatic die loader with some minor adjustments. To order this package, the suffix CP must appear with the part number.

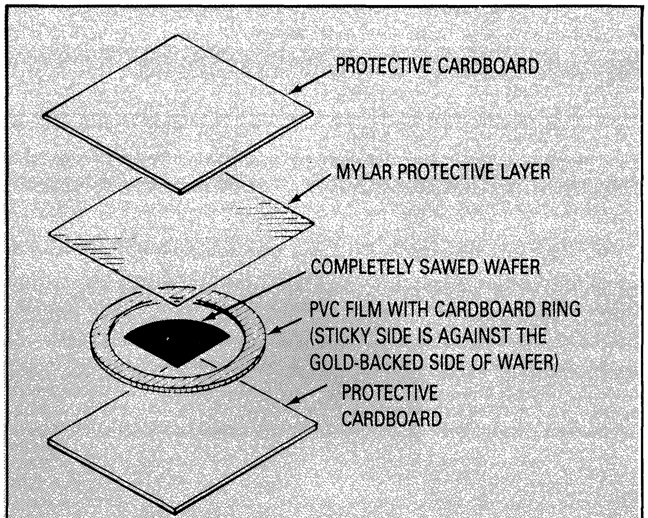


Figure 2. Circle Pak (CP Suffix)

Wafer Pak (WP Suffix) (See Figure 3) — The pak contains a wafer that is 100% electrically tested. With the rejects inked, the wafer is left unsawed and is packaged with protective cardboard in a vacuum sealed plastic bag. The WP suffix must appear after the chip part number.

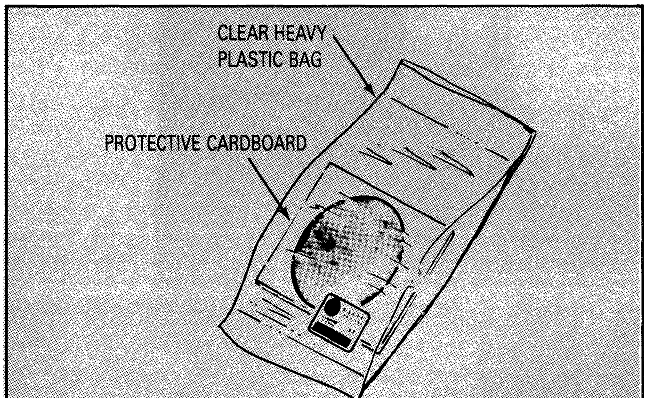


Figure 3. Wafer Pak (WP Suffix)

Heatspreader (See Figure 4) — Some chips (indicated by footnote in the preferred parts list) are also available mounted with eutectic bonding to copper heatspreaders that have been plated with nickel and gold. The use of heatspreaders increases thermal conductivity and allows solder reflow attachment of the die-heatspreader assembly.

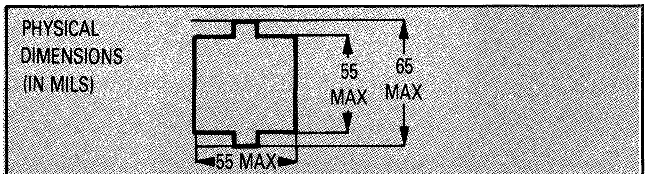
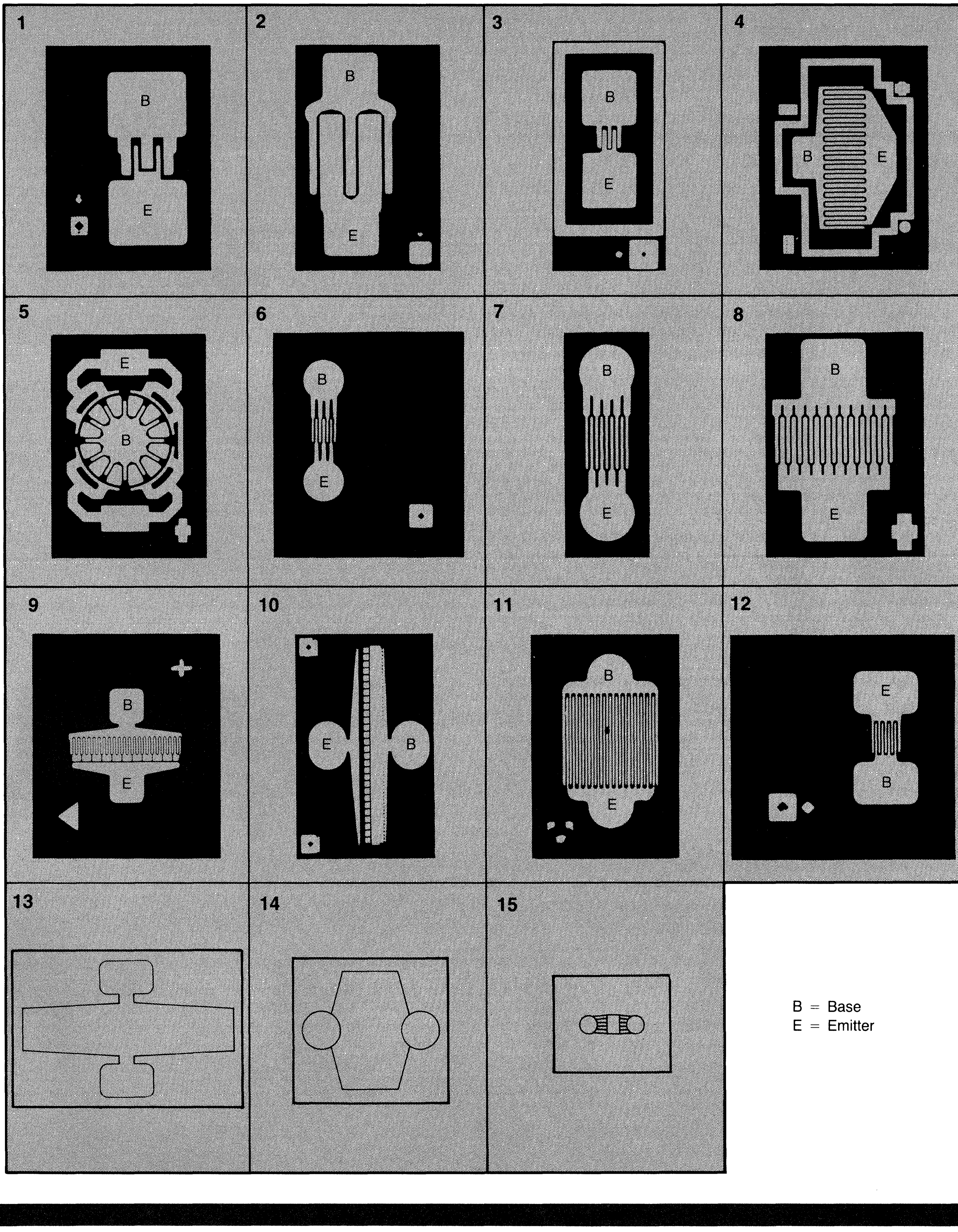


Figure 4. Heatspreader

Die Geometries



B = Base
E = Emitter

Preferred Parts List

Standard D.C. Parameters (at 25°C) — $V_{(BR)CBO}$, $V_{(BR)CEO}$, $V_{(BR)EBO}$, h_{FE} (d.c. current gain)
Special Request Parameters — I_{CEO}, I_{CES}, I_{CEX}, I_{EBO}, $V_{CE(sat)}$, $V_{BE(sat)}$, f_T, C_{CB}, C_{EB}, h_{FE} (ac), NF (Noise Figure), G_{PE}
Front Metallization Thickness — a minimum of 10,000 Å
Back Metallization Thickness — a minimum of 3,000 Å–24,000 Å

Standard Part #	Chip Part #	Die Geometry Reference #	Die Size inches 1/1000	Die Thickness inches 1/1000	Bond Pad Size inches 1/1000 Base	Bond Pad Size inches 1/1000 Emitter	Metallization Front	Metallization Back	Packaging Multi (none)	Packaging Wafer (WP)	Packaging Circle (CP)	Heat-spreader
2N2857	2C2857	1	14x16	4–8	4.0x4.8	4.0x4.8	Al	Au	*	*	*	
2N3866	2C3866	2	15x22	4–8	4x4	4x4	Al	Au	*	*	*	
2N4957	2C4957	3	12x22	4–8	4x4	4x4	Al	Au	*	*	*	
2N5108	2C5108	11	12x17	4–8	2.5x2.1	2.5x2.1	Au	Au	*	*	*	
2N5160	2C5160	4	15x20	4–8	2.2x3.2	2.2x3.2	Al	Au	*	*	*	
2N5583	2C5583	4	15x20	4–8	2.2x3.2	2.2x3.2	Au	Au	*	*	*	
2N5943	2C5943	2	15x22	4–8	4x4	4x4	Al	Au	*	*	*	
BFR90	BFRC90	6	14x16	4–8	2.8 dia.	2.8 dia.	Au	Au	*	*	*	
BFR91	BFRC91	7	14x16	4–8	2.8 dia.	2.8 dia.	Au	Au	*	*	*	
BFR96	BFRC96	8	13x16	4–8	3.4x3.4	3.4x3.4	Au	Au	*	*	*	
LT1817	CD1880 (35)(36)	14	22x22	4–5	3.6 dia.	3.6 dia.	Au	Au	*			*
LT3005	CD3240 (35)(36)	13	16x25	4–5	2.75x3.75	2.75x3.75	Au	Au	*			*
LT5217	CD4880 (35)(36)	13	16x25	4–5	2.75x3.75	2.75x3.75	Au	Au	*			*
LT5817	CD5890 (35)(36)	14	22x22	4–5	3.6 dia.	3.6 dia.	Au	Au	*			*
MM4049	MMC4049	3	12x22	4–8	4x4	4x4	Al	Au	*	*	*	
MRF2369	MRFC2369	9	15x16	4–8	2.2x2.2	2.2x2.2	Au	Au	*	*	*	
MRF559	MRFC559	5	15x24	4–8	3.5 dia.	2.16x4	Au	Au	*	*	*	
MRF544	MRFC544	10	34x27	4–8	3x4	3x4	Au	Au	*	*	*	
MRF545	MRFC545	10	34x27	4–8	3x4	3x4	Au	Au	*	*	*	
MRF901	MRFC901	12	15x15	4–8	4.0x2.6	4.0x2.6	Au	Au	*	*	*	
MRF904	MRFC904	12	15x15	4–8	4.0x2.6	4.0x2.6	Au	Au	*	*	*	

Samples available upon request, contact the Motorola Sales Office. *Available Packaging

(35) To order CHIP mounted on a heatspreader, change prefix to "CH."

(36) To order high reliability chip with SEM qualifications and lot acceptance per MIL-STD-750 and 883, change prefix to "HD" or "HH" for die alone or die mounted on heatspreader respectively.

Storage and Handling Information

It is recommended that all Motorola die be stored at room temperature in an inert environment after removal of the seal from the original shipping package.

Special Electro-Static Discharge (ESD) precautions should be taken to avoid damaging the chips. Motorola recommends storage in the original ESD shipping package.

Literature

Application Notes and Engineering Bulletins of special interest to designers of RF equipment are listed below and are available through Motorola sales offices or distributors.

AN555	Mounting Stripline-Opposed-Emitter (SOE) Transistors
AN593	Broadband Linear Power Amplifiers Using Push-Pull Transistors
AN721	Impedance Matching Networks Applied to RF Power Transistors
AN758	A Two-Stage 1 kW Solid-State Linear Amplifier
AN779	Low-Distortion 1.6 to 30 MHz SSB Driver Design
AN790	Thermal Rating of RF Power Transistors
AN791	A Simplified Approach to VHF Power Amplifier Design
AN793	A 15-Watt AM Aircraft Transmitter Power Amplifier Using Low-Cost Plastic Transistors
AN860	Power MOSFETs versus Bipolar Transistors
AN878	VHF MOS Power Applications
AN923	800 MHz Test Fixture Design
AN938	Mounting Techniques for PowerMacro Transistor
AN955	A Cost Effective VHF Amplifier for Land Mobile Radios
AN1020	A High Performance Video Amplifier for High Resolution CRT Applications
AN1021	A Hybrid Video Amplifier for High Resolution CRT Applications
AN1022	Mechanical and Thermal Considerations In Using RF Linear Hybrid Amplifiers
AN1023	Mounting Techniques for RF Hermetic Packages
AN1024	RF Linear Hybrid Amplifiers
AN1025	Reliability Considerations in Design and Use of RF Integrated Circuits
AN1026	Extending the Range of an Intermodulation Distortion Test
AN1027	Reliability/Performance Aspects of CATV Amplifier
AN1028	35/50 Watt Broadband (160–240 MHz) Push-Pull TV Amplifier Band III
AN1029	TV Transposers Band IV and V, P_O = 0.5 W/1 W
AN1030	1 W/2 W Broadband TV Amplifier, Band IV and V
AN1032	How Load VSWR Affects Non-Linear Circuits
AN1033	Match Impedances in Microwave Amplifiers
AN1034	Three Balun Designs for Push-Pull Amplifiers
AN1037	Solid State Power Amplifier — 300 Watt, FM
AN1038	1.2 V, 40–900 MHz Broadband Amplifier With the TP3400 Transistor
AN1039	470–860 MHz — Broadband Amplifier — 5 W
AN1040	Mounting Considerations for Power Semiconductors
AN1041	Mounting Procedures for Very High Power RF Transistors
AN1103	Using the CR3424 for High Resolution CRT Applications
AN1106	Considerations in Using the MHW801/851 Series RF Power Modules
AN1107	Understanding RF Datasheet Parameters

AR141	Applying Power MOSFETs in Class D/E RF Power Amplifier Design
AR144S	Switching MOSFETs Suit Linear 500-W HF Amp
AR165S	RF Power MOSFETs
AR176	New MOSFETs Simplify High Power RF Amplifier Design
AR179	RF Power Transistors Catapult Into High-Power Systems
AR305	Building Push-Pull, Multioctave, VHF Power Amplifiers
AR313	Wideband RF Power Amplifier
AR346	RF POWER FETs, Their Characteristics and Applications
AR347	A Compact 1-kW 2-50 MHz Solid State Linear Amplifier

EB17A	Simple VHF Broadband Design Uses CQ Transistor Lineup
EB27A	Get 300 Watts PEP Linear Across 2 to 30 MHz from this Push-Pull Amplifier
EB29	The Common Emitter TO-39 and Its Advantages
EB46	A Single-Device, 80-Watt, 50 Ohm VHF Amplifier
EB53	Two VHF High Band Gain Blocks from 20 dB, 30 Watt Amplifier Chain
EB63	140 Watt (PEP) Amateur Radio Linear Amplifier 2–30 MHz
EB70A	Frequency Multiplication Simplified by Internal Shield in MRF629
EB74	A Ten Watt 225–400 MHz Amplifier
EB77	A 60-Watt 225–400 MHz Amplifier-2N6439
EB89	A 1-Watt, 2.3 GHz Amplifier
EB90	Low-Cost VHF Amplifier has Broadband Performance
EB93	60-Watt VHF Amplifier uses Splitting/Combining Techniques
EB104	Get 600 Watts RF from Four Power FETs
EB105	A 30 Watt, 800 MHz Amplifier Design
EB107	Mounting Considerations for Motorola RF Power Modules

Consult your nearest Motorola sales office or franchised distributor for copies of desired notes. Copies may also be obtained by sending a check or money order to: Motorola Semiconductor Products Inc., Literature Distribution Center, P.O. Box 20924, Phoenix, Arizona 85036. A maximum of ten are available free of charge. Quantities exceeding ten are $.15 each under 40 pages or $.80 each for ap notes over 40 pages, or a complete set is available for $30.00. A complete set includes each note listed in the index that is still current and available at the time of request as well as any documents produced since the printing of the Ap Note Catalog.

Winner 1988 Malcolm Baldrige National Quality Award

Small-Signal Transistors, FETs and Diodes

In Brief . . .

The following selector guides highlight semiconductors that are the most popular and have a history of high usage for the most applications.

These selector guides cover a wide range of small-signal plastic and metal can semiconductors.

A large selection of encapsulated plastic transistors, FETs and diodes are available for surface mount and insertion assembly technology. Plastic packages include TO-92 (TO-226A), 1-Watt TO-92 (TO-226AE), SOT-23, SC-59, and SOT-223. Plastic multiples are available in 14-pin and 16-pin dual-in-line packages for insertion applications: SO-8, SO-14 and SO-16 for surface mount applications.

Metal can packages are available for applications requiring higher power dissipation or having hermetic requirements. TO-18 (TO-206AA) and TO-39 (TO-205AD).

Plastic-Encapsulated Transistors

Motorola's small-signal TO-226 plastic transistors encompass hundreds of devices with a wide variety of characteristics for general-purpose, amplifier and switching applications. The popular high-volume package combines proven reliability, performance, economy and convenience to provide the perfect solution for industrial and consumer design problems. All devices are laser marked for ease of identification and shipped in antistatic containers, as part of Motorola's ongoing practice of maintaining the highest standards of quality and reliability.

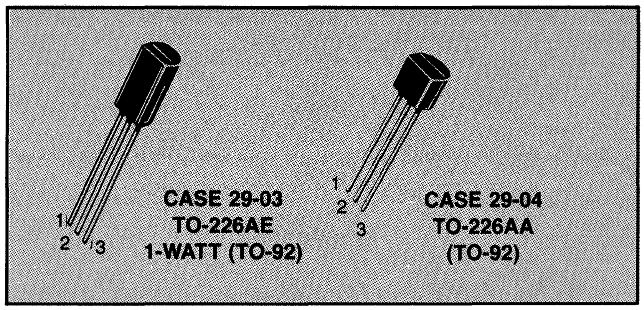


Table 1. Plastic-Encapsulated General-Purpose Transistors

These general-purpose transistors are designed for small-signal amplification from dc to low radio frequencies. They are also useful as oscillators and general-purpose switches. Complementary devices shown where available (Tables 1–4).

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	f_T @ I_C MHz Min	mA	I_C mA Max	h_{FE} @ I_C Min	Max	mA	NF dB Max
Case 29-04 — TO-226AA (TO-92)										
MPS8099	MPS8599	EBC	80	150	10	200	100	300	1.0	—
MPSA06	MPSA56	EBC	80	100	10	500	100	—	100	—
2N4410	—	EBC	80	60	10	250	60	400	10	—
BC546	BC556	CBE	65	150	10	100	120	450	2.0	10
BC546A	BC556A	CBE	65	150	10	100	120	220	2.0	10
BC546B	BC556B	CBE	65	150	10	100	180	450	2.0	10
MPSA05	MPSA55	EBC	60	100	10	500	50	—	100	—
	MPS2907A	EBC	60	200	50	600	100	300	150	—
BC182	BC212	ECB	50	200	10	100	120	460	2.0	10
BC237B	BC307B	CBE	45	150	10	100	200	460	2.0	10
BC337	BC327	CBE	45	210*	10	800	100	600	100	—
BC547	BC557	CBE	45	150	10	100	120	450	2.0	10
BC547A	BC557A	CBE	45	150	10	100	120	220	2.0	10
BC547B	BC557B	CBE	45	150	10	100	180	450	2.0	10
BC547C	BC557C	CBE	45	150	10	100	380	800	2.0	10
MPSA20	MPSA70	EBC	40	125	5.0	100	40	400	5.0	—
MPS2222A		EBC	40	300	20	600	100	300	150	—
2N4401	2N4403	EBC	40	200	20	600	100	300	150	—
2N4400	2N4402	EBC	40	150	20	600	50	150	150	—
MPS6602	MPS6652	EBC	40	100	50	1000	50	—	500	—
2N3903	2N3905	EBC	40	200	10	200	50	150	10	6
2N3904	2N3906	EBC	40	250	10	200	100	300	10	5
BC548		CBE	30	300*	10	100	120	300	2.0	10
BC548A		CBE	30	300*	10	100	120	220	2.0	10
BC548B	BC558B	CBE	30	300*	10	100	180	450	2.0	10
BC548C		CBE	30	300	10	100	380	800	2.0	10
2N4123	2N4125	EBC	30	200	10	200	50	150	2.0	6
2N4124	2N4126	EBC	25	250	10	200	120	360	2.0	5
BC338	BC328	CBE	25	210*	10	800	100	600	100	—

*Typical

Table 1. Plastic-Encapsulated General-Purpose Transistors (continued)

Case 29-03 — TO-226AE (1-WATT TO-92)

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	f_T @ I_C MHz Min	mA	I_C A Max	h_{FE} @ I_C Min	Max	mA	$V_{CE(sat)}$ @ I_C @ I_B Volts Max	mA	mA
BDB01D	BDB02D	EBC	100	50	200	0.5	40	400	100	0.7	1000	100
BDC01D	BDC02D	ECB	100	50	200	0.5	40	400	100	0.7	1000	100
BDB01C	BDB02C	EBC	80	50	200	0.5	40	400	100	0.7	1000	100
BDC01C	BDC02C	ECB	80	50	200	0.5	40	400	100	0.7	1000	100
MPS6717		EBC	80	50	200	0.5	80	—	50	0.5	250	10
MPSW06	MPSW56	EBC	80	50	200	0.5	80	—	50	0.4	250	10

Table 2. Plastic-Encapsulated Low-Noise and Good h_{FE} Linearity

These devices are designed to use on applications where good h_{FE} linearity and low-noise characteristics are required: Instrumentation, hi-fi preamplifier.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts	h_{FE} @ I_C Min	Max	mA	V_T[1] mV Typ	NF[2] dB Max	f_T MHz Typ
Case 29-04 — TO-226AA (TO-92)									
—	MPS4249	EBC	60	100	300	0.1	—	3.0	100
—	2N5087	EBC	50	250	800	0.1	—	2.0	40
—	2N5086	EBC	50	150	500	0.1	—	3.0	40
MM6428	—	EBC	50	250	650	0.1	7.0**	3.5***	100†
BC239	BC309	CBE	45	120	800	2.0	9.5	2.0	240
BC550B	BC560B	CBE	45	180	460	2.0	8.0	2.5	250
BC550C	BC560C	CBE	45	380	800	2.0	8.0	2.5	250
MPSA18	—	EBC	45	500	—	2.0	7.0	—	160
MPS3904	MPS3906	EBC	40	100	300	10	—	5.0	200
—	MPS4250	EBC	40	250	—	10	—	2.0	250
BC549B	BC559B	CBE	30	180	800	2.0	8.0	2.5	250
BC549C	BC559C	CBE	30	380	800	2.0	8.0	2.5	250
2N5088	—	EBC	30	350	—	2.0	—	3.0	150
2N5089*	—	EBC	25	450	—	2.0	—	2.0	150
MPS6521	MPS6523	EBC	25	300	—	2.0	—	3.0	340*

1 V_T: Total Input Noise Voltage (see BC413/BC414 and BC415/BC416 Data Sheets) at R_S = 2.0 kΩ, I_C = 200 μA, V_{CE} = 5.0 Volts.
2 N_F: Noise Figure at R_S = 2.0 k, I_C = 200 μA, V_{CE} = 5.0 Volts. f = 30 Hz to 15 kHz.
* "S" version.
** R_S = 10 kΩ, BW = 1.0 Hz, f = 100 MHz
*** R_S = 500 Ω, BW = 1.0 Hz, f = 10 MHz
† Min

Table 3. Plastic-Encapsulated Darlington Transistors

Darlington amplifiers are cascade transistors used in applications requiring very high-gain and input impedance. These devices have monolithic construction.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts	I_C Max	h_{FE} @ I_C Min	Max	mA	$V_{CE(sat)}$ Volts Max	I_C mA	I_B mA	f_T Min	I_C
Case 29-03 — TO-226AE (1-WATT TO-92)												
MPSW45	—	EBC	40	1000	25K	—	200	1.5	1000	2.0	100	200
MPSW13	MPSW63	EBC	30	1000	10K	—	100	1.5	100	0.1	125	10
Case 29-04 — TO-226AA (TO-92)												
MPSA29	—	EBC	100	500	10K	—	100	1.4	100	0.1	125	10
BC373	—	EBC	80	1000	25K	160K	100	1.0	250	0.25	100	100
MPSA27	MPSA77	EBC	60	500	10K	—	100	1.5	100	0.1	125	10
BC618	—	CBE	55	1000	10K	50K	200	1.1	200	0.2	150	500
	MPSA75	EBC	40	500	10K	—	100	1.5	100	0.1	125	10
2N6427	—	EBC	40	500	20K	200K	100	1.5	500	0.5	125	10
2N6426	—	EBC	40	500	30K	300K	100	1.5	500	0.5	125	10
MPSA14	MPSA64	EBC	30	500	20K	—	100	1.5	100	0.1	125	10
MPSA13	MPSA63	EBC	30	500	10K	—	100	1.5	100	0.1	125	10
BC517	—	CBE	30	400	30K	—	20	1.0	100	0.1	125	10

Table 4. Plastic-Encapsulated High-Current Transistors

The following table is a listing of devices that are capable of handling a higher current range for small-signal transistors.

Case 29-03 — TO-226AE (1-WATT TO-92)

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	f_T @ I_C MHz Min	mA	I_C mA Max	h_{FE} @ I_C Min	Max	mA	$V_{CE(sat)}$ @ I_C @ I_B Volts Max	mA	mA
MPS6715	MPS6727	EBC	40	50	50	1000	50	—	1000	0.5	1000	100
MPSW01A	MPSW51A	EBC	40	50	50	1000	50	—	1000	0.5	1000	100

Case 29-04 — TO-226AA (TO-92)

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	f_T @ I_C MHz Min	mA	I_C mA Max	h_{FE} @ I_C Min	Max	mA	$V_{CE(sat)}$ @ I_C @ I_B Volts Max	mA	mA
BC489	BC490	CBE	80	200/150*	50	1000	60	400	100	0.3/0.5	1000	100
BC639	BC640	ECB	80	60	10	1000	40	160	150	0.5	500	50
MPS651	MPS751	EBC	60	75	50	2000	75	—	1000	0.5	2000	200
MPS650	MPS750	EBC	40	70	50	2000	75	—	1000	0.5	2000	200
BC368	BC369	EBC	20	60	10	1000	60	—	1000	0.5	1000	100

*Typical

Table 5. Plastic-Encapsulated High-Voltage Amplifier Transistors

These high-voltage transistors are designed for driving neon bulbs and indicator tubes, for direct line operation, and for other applications requiring high-voltage capability at relatively low collector current. These devices are listed in order of decreasing breakdown voltage ($V_{(BR)CEO}$).

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Max	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ @ I_C & I_B Volts Max	mA	mA	f_T @ I_C MHz Min	mA
Case 29-03 — TO-226AE (1-WATT TO-92) — NPN										
BDC05	ECB	300	0.5	40	25	2.0	20	2.0	60	10
MPSW42	EBC	300	0.3	40	30	0.5	20	2.0	50	10
Case 29-03 — TO-226AE (1-WATT TO-92) — PNP										
BDC06	ECB	300	0.5	40	25	2.0	20	2.0	60	10
MPSW92	EBC	300	0.3	25	30	0.5	20	2.0	50	10
Case 29-04 — TO-226AA (TO-92) — NPN										
BF844	EBC	400	0.5	40	30	0.5	10	1.0	50	10
MPSA44	EBC	400	0.3	40	100	0.75	50	5.0	20	10
2N6517	EBC	350	0.5	30	30	0.3	10	1.0	40	10
BF393	EBC	300	0.5	40	10	0.2	20	2.0	50	10
MPSA42	EBC	300	0.5	40	10	0.5	20	2.0	50	10
2N5551	EBC	160	0.6	80	10	0.15	10	1.0	100	10
Case 29-04 — TO-226AA (TO-92) — PNP										
BF493S	EBC	350	0.5	40	10	20	20	2.0	50	10
2N6520	EBC	350	0.5	30	30	0.3	10	1.0	40	10
MPSA92	EBC	300	0.5	40	10	0.5	20	2.0	50	10
2N6519	EBC	300	0.5	45	30	0.3	10	1.0	40	10
2N5401	EBC	150	0.6	60	10	0.2	10	1.0	100	10

Case 29-04 — TO-226AA (TO-92)

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Cont	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ @ I_C @ I_B Volts Max	mA	mA	f_T @ I_C MHz Min	mA
BF420	BF421	ECB	300	0.1	40	25	2.0	20	2.0	60	10
BF422	BF423	ECB	250	0.1	50	25	2.0	20	2.0	60	10

Table 6. Plastic-Encapsulated RF Transistors

The RF transistors are designed for small-signal amplification from RF to VHF/UHF frequencies. They are also used as mixers and oscillators in the same frequency ranges.

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} @ I_C Min	mA	V_{CE} V	f_T MHz Typ	CRE/CRB pF Max	NF dB Typ	f MHz
Case 29-04 — TO-226AA (TO-92) — NPN										
BF224	CEB	30	50	30	7.0	10	600	0.28	2.5	100
MPSH24	BEC	30	100	30	8.0	10	400*	0.36	—	—
MPSH20	BEC	30	100	25	4.0	10	400*	0.65	—	—
MPSH07A	EBC	30	25	20	3.0	10	400*	0.3	3.2(1)	100
MPS3866	EBC	30	400	10	50	5.0	500*	—	—	—
MPSH11	BEC	25	25	60	4.0	10	660*	—	—	—
MPSH10	BEC	25	100	60	4.0	10	1500	0.7	—	—
BF199	CEB	25	100	40	7.0	10	750	0.35	2.5	35
BF959	CEB	20	100	40	20	10	800	0.65	3.0	200
MPS6568A	BEC	20	50	20	4	5	375*	0.65	3.3(1)	200
MPSH17	BEC	15	100	25	5.0	10	1600	0.9	6.0(1)	200
MPS918	EBC	15	50	20	8.0	10	800	1.7	6.0(1)	60
MPS5179	EBC	12	50	25	3.0	1.0	2000	—	4.5(1)	200
MPS3563	EBC	12	50	20	8.0	10	800	1.7	6.0(1)	60
MPS6595	EBC	12	50	25	10	5	1200*	1.3	—	—
Case 29-04 — TO-226AA (TO-92) — PNP										
MPSH81	BEC	20	50	60	5.0	10	700	0.85	—	—
MPSH69	EBC	15	50	30	10		2000	0.3	—	—

*Min
(1)Max
(2)AGC Capable

Table 7. Plastic-Encapsulated High-Speed Saturated Switching Transistors

The transistors listed in this table are specially optimized for high-speed saturated switches. They are heavily gold doped and processed to provide very short switching times and low output capacitance (below 6.0 pF). The transistors are listed in order of decreasing turn-on time (t_{on}).

Device Type	t_{on} & t_{off} @ I_C ns Max	ns Max	mA	$V_{(BR)CEO}$ Volts Min	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ @ I_C & I_B Volts Max	mA	mA	f_T @ I_C MHz Min	mA
Case 29-04 — TO-226AA (TO-92) — NPN											
2N4264	25	35	10	15	40	10	0.22	10	1.0	300	10
2N4265	25	35	10	12	100	10	0.22	10	1.0	300	10
MPS3646	18	28	300	15	30	30	0.2	30	3.0	350	30
MPS2369A	12	18	10	15	40	10	0.2	10	1.0	500	10
Case 29-04 — TO-226AA (TO-92) — PNP											
MPS3640	25	35	50	12	30	10	0.2	10	1.0	500	10
MPS4258	15	20	10	12	30	50	0.15	10	1.0	700	10
MPS5771	15	20	10	15	35	10	0.18	10	1.0	850	10

Table 8. Plastic-Encapsulated Choppers

Devices are listed in decreasing $V_{(BR)EBO}$.

Device Type	Pin Out	$V_{(BR)EBO}$ Volts Min	I_C Amp* Max	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ @ I_C & I_B Volts Max	mA	mA	f_T @ I_C MHz Min	mA
Case 29-04 — TO-226AA (TO-92) — NPN										
MPSA17	EBC	15	100	200	5.0	0.25	10	1.0	100	5.0
MPSA16	EBC	12	100	200	5.0	0.25	10	1.0	80	5.0
Case 29-04 — TO-226AA (TO-92) — PNP										
MPS404A	EBC	−25	−150	30	−12	−0.2	−24	1.0	—	—

*Typ

Table 9. Plastic-Encapsulated Telecom Transistors

These devices are special product ranges intended for use in telecom applications.

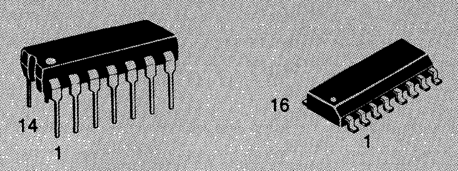
Device Type	Pin Out	$V_{(BR)CEO}$ Volts	P_D mW 25°C Amb	I_C mA Cont	h_{FE} @ I_C @ V_{CE} Min	Max	mA	Volts	f_T MHz Min
Case 29-04 — TO-226AA (TO-92) — NPN									
P2N2222A	CBE	40	625	600	75	—	10	10	300
PBF259,S*	EBC	300	625	500	25	—	1.0	10	40
Case 29-04 — TO-226AA (TO-92) — PNP									
P2N2907A	CBE	60	625	600	100	—	10	10	200
PBF493,S**	EBC	300	625	500	40	—	1.0	10	40

*"S" version, h_{FE} Min 60 @ I_C = 20 mA, V_{CE} = 10 V.
**"S" version, h_{FE} Min 40 @ I_C = 0.1 mA, V_{CE} = 1.0 V.

Plastic-Encapsulated Multiple Transistors

The manufacturing trend has been toward printed circuit board design with requirements for smaller packages with more functions. In the case of discrete components the use of the multiple device package helps to reduce board space requirements and assembly costs.

Many of the most popular devices are offered in the standard plastic DIP and surface mount IC packages. This includes small-signal NPN and PNP bipolar transistors, N-channel and P-channel FETs, as well as diode arrays.



CASE 646-06
(TO-116)

CASE 751B-03
SO-16

Specification Tables

The following short form specifications include Quad and Dual bipolar transistors listed in alphanumeric order. Some columns denote two different types of data indicated by either **bold** or *italic* typeface. See key and headings for proper identification. This applies to Table 1 and 2 of this section only.

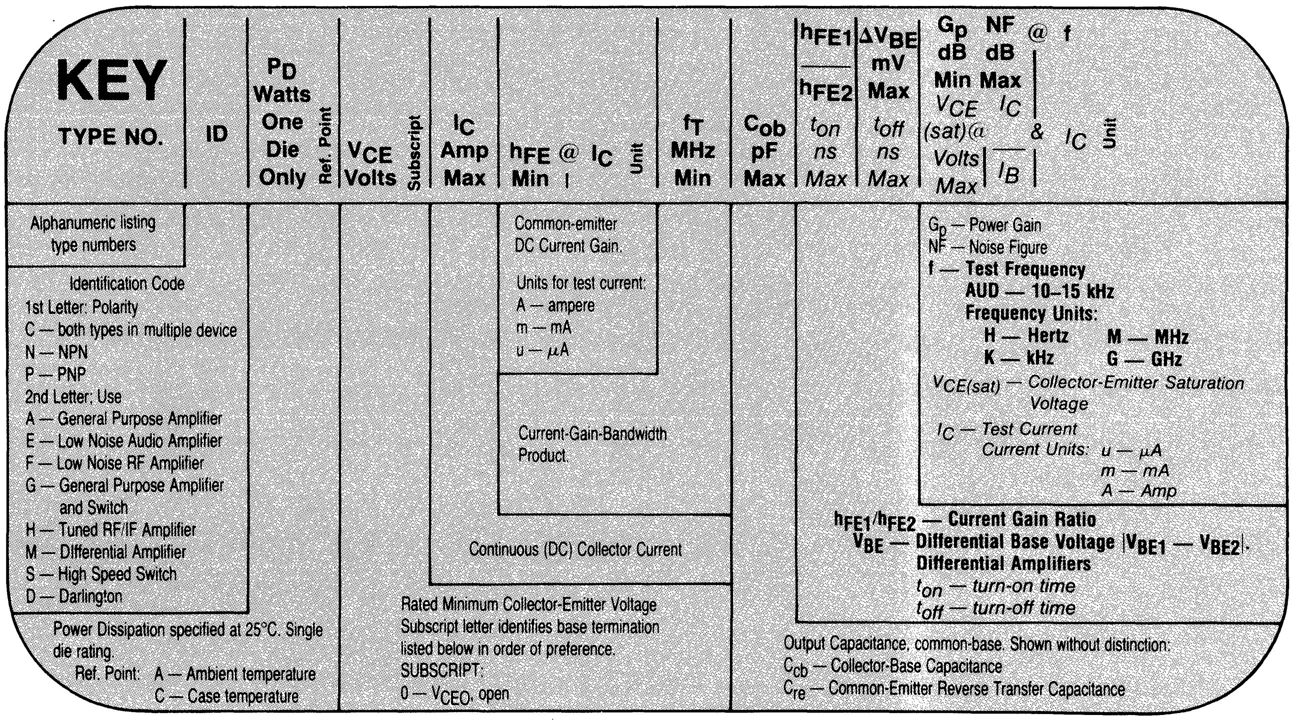


Table 1. Plastic-Encapsulated Multiple Transistors — Quad

The following table is a listing of the most popular multiple devices available in the plastic DIP package. These devices are available in NPN, PNP, and NPN/PNP configurations. (See note.)

Type No.	I_D	P_D Watts One Die Only	V_{CE}- Volts	I_C Amp Max	h_{FE} @ Min	I_C	f_T MHz Min	C_{ob} pF Max	**h_{FE1}/h_{FE2}** / _t_{on} ns Max_	**ΔV_{BE} mV Max** / _t_{off} ns Max_	**G_p dB Min** / _V_{CE} (sat) @ Volts Max_	**NF dB Max Typ*** @ / _I_C/I_B_	**f** / _I_C_
Case 646-06 — TO-116													
MPQ2222A	**NA**	0.65 A	40 O	0.5	100	150 m	200	8.0	_35*_	_285*_	_0.3_	_10_	_150 m_
MPQ2369	**NS**	0.5 A	15 O	0.5	40	10 m	450	4.0	_9.0*_	_15*_	_0.25_	_10_	_10 m_
MPQ2483	**NA**	0.625 A	40 O	0.05	150	1.0 m	50					__3.0*__	**AUD**
MPQ2484	**NA**	0.625 A	40 O	0.05	300	1.0 m	50					__2.0*__	**AUD**
MPQ2907A	**PA**	0.65 A	60 O	0.6	100	150 m	200	8.0	_45*_	_180*_	_0.4_	_10_	_150 m_
MPQ3467	**PS**	0.75 A	40 O	1.0	20	500 m	125	25	_40_	_90_	_0.5_	_10_	_500 m_
MPQ3725	**NS**	1.0 A	40 O	1.0	25	500 m	250	10	_35_	_60_	_0.45_	_10_	_500 m_
MPQ3762	**PS**	0.75 A	40 O	1.5	35	150 m	150	15	_50_	_120_	_0.55_	_10_	_500 m_
MPQ3798	**PA**	0.625 A	40 O	0.05	150	0.1 m	60	4.0				__3.0*__	**AUD**
MPQ3799	**PA**	0.625 A	60 O	0.05	300	0.1 m	60	4.0				__2.0*__	**AUD**
MPQ3904	**NG**	0.5 A	40 O	0.2	75	10 m	250	4.0	_37*_	_136*_	_0.2_	_10_	_10 m_
MPQ3906	**PG**	0.5 A	40 O	0.2	75	10 m	200	4.5	_43*_	_155*_	_0.25_	_10_	_10 m_
MPQ6001	**CG**	0.65 A	30 O	0.5	40	150 m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150 m_
MPQ6002	**CG**	0.65 A	30 O	0.5	100	150 m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150 m_
MPQ6100A	**CA**	0.5 A	45 O	0.05	150	1.0 m	50	4.0				__4.0*__	**AUD**
MPQ6426	**ND**	0.5 A	30 O	0.5	10K	100 m	125	8.0	_—_	_—_	_1.5_	_10_	_100 m_
MPQ6501	**CG**	0.65 A	30 O	0.5	40	150 m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150 m_
MPQ6502	**CG**	0.65 A	30 O	0.5	100	150 m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150 m_
MPQ6600A1	**CA**	0.5 A	45 O	0.05	150	1.0 m	50	4.0	_0.8_	_20_	_0.25_	_10_	_1.0 m_
MPQ6700	**CA**	0.5 A	40 O	0.2	70	10 m	200	4.5			_0.25_	_10_	_1.0 m_
MPQ6842	**CA**	0.75 A	40 O	0.5	70	10 m	300	4.5	_45_	_150_	_0.15_	_10_	_0.5 m_
MPQ7041	**NA**	0.75 A	150 O	0.5	25	1.0 m	50	5.0			_0.5_	_10_	_20 m_
MPQ7042	**NA**	0.75 A	200 O	0.5	25	1.0 m	50	5.0			_0.5_	_10_	_20 m_
MPQ7051	**CG**	0.75 A	150 O	0.5	25	1.0 m	50	6.0			_0.7_	_10_	_20 m_
MPQ7091	**PA**	0.75 A	150 O	0.5	25	1.0 m	50	5.0			_0.5_	_10_	_20 m_

*Typ

NOTE: Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Table 2. Plastic-Encapsulated Multiple Transistors — Quad Surface Mount

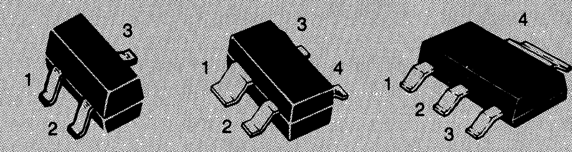
The following table is a listing of the most popular multiple devices available in the plastic SOIC surface mount package. These devices are available in NPN, PNP, and NPN/PNP configurations.

Device	$V_{(BR)CEO}$	$V_{(BR)CBO}$	h_{FE} @ I_C Min	mA	f_T @ I_C MHz Min	mA
Case 751B-03 — SO-16						
MMPQ2222A	40	75	40	500	350*	20
MMPQ2369	15	40	20	100	450	10
MMPQ2907A	50	60	50	500	350*	50
MMPQ3467	40	40	20	500	125	50
MMPQ3725	40	60	25	500	250	50
MMPQ3799	60	60	300	0.5	60	1
MMPQ3904	40	60	75	10	250	10
MMPQ3906	40	40	75	10	200	10
MMPQ6700**	40	40	70	10	200	10

**NPN/PNP

Plastic-Encapsulated Surface Mount Transistors

This section of the selector guide lists the small-signal plastic devices that are available for surface mount applications. These devices are encapsulated with the latest state-of-the-art mold compounds that enhance reliability and exhibit excellent performance in high temperature and high humidity environments. This package offers higher power dissipation capability for small-signal applications.



CASE 318-07 TO-236AB SOT-23 | CASE 318A-05 SOT-143 | CASE 318E-04 SOT-223

Table 1. Plastic-Encapsulated Surface Mount General-Purpose Transistors

The following table is a listing of small-signal general-purpose transistors in the SOT-23 surface mount package. These devices are intended for small-signal amplification for DC, audio, and lower RF frequencies. They also have applications as oscillators and general-purpose, low voltage switches.

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending breakdown voltage.

Device	Marking	$V_{(BR)CEO}$	h_{FE} @ I_C Min	Max	mA	f_T MHz Min
Case 318-07 — TO-236AB (SOT-23) — NPN						
BC846A	1A	65	110	220	2	100
BC846B	1B	65	200	450	2	100
BC817-16	6A	45	100	250	100	200
BC817-25	6B	45	160	400	100	200
BC817-40	6C	45	250	600	100	200
BC847A	1E	45	110	220	2	100
BC847B	1F	45	200	450	2	100
BC847C	1G	45	420	800	2	100
MMBT2222A	1P	40	100	300	150	200
MMBT3904	1AM	40	100	300	10	200
BC848A	1J	30	110	220	2	100
BC848B	1K	30	200	450	2	100
BC848C	1L	30	420	800	2	100
MMBT4401	2X	40	100	300	150	250
MMBT8099	KB	80	100	300	1	150
Case 318-07 — TO-236AB (SOT-23) — PNP						
MMBT8599	2W	80	75	—	100	150
BC856A	3A	65	125	250	2	100
BC856B	3B	65	220	475	2	100
MMBT2907A	2F	60	50	—	500	200
BC807-16	5A	45	100	250	100	200
BC807-25	5B	45	160	400	100	200
BC807-40	5C	45	250	600	100	200
BC857A	3E	45	125	250	2	100
BC857B	3F	45	220	475	2	100
BC857C	3G	45	420	800	2	100
MMBT3906	2A	40	100	300	10	250
MMBT4403	2T	40	100	300	150	200
BC858A	3J	30	125	250	2	100
BC858B	3K	30	220	475	2	100
BC858C	3L	30	420	800	2	100

Table 2. Plastic-Encapsulated Surface Mount Switching Transistors

The following table is a listing of devices intended for high-speed, low saturation voltage, switching applications. These devices have very fast switching times and low output capacitance for optimized switching performance.

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	Switching Time (ns) t_{on}	t_{off}	$V_{(BR)CEO}$	h_{FE} @ I_C Min	Max	mA	f_T MHz Min
Case 318-07 — TO-236AB (SOT-23) — NPN								
MMBT2369	M1J	12	18	15	20	—	100	—
BSV52	B2	12	18	12	40	120	10	400
MMBT2222A	1P	35	385	40	40	—	500	200
MMBT3904	1AM	70	250	40	30	—	100	200
Case 318-07 — TO-236AB (SOT-23) — PNP								
MMBT3638	AM	75	170	25	20	—	300	—
MMBT3640	2J	25	35	12	20	—	50	500
MMBT4403	2T	35	225	40	90	180	1	150
MMBT2907A	2F	45	100	60	50	—	500	200
MMBT3906	2A	70	300	40	100	300	10	250

Table 3. Plastic-Encapsulated Surface Mount VHF/UHF Amplifiers, Mixers, Oscillators

The following table is a listing of devices intended for small-signal RF amplifier applications to VHF/UHF frequencies. These devices may also be used as VHF/UHF oscillators and mixers.

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)CEO}$	C_{ob} pF Max	f_T @ I_C GHz Min	mA
Case 318-07 — TO-236AB (SOT-23) — NPN					
MMBT3960A	1T	8	2	1.6	30
MMBT3960	15	3	2	1.6	30
MMBTH10	3E	25	0.7	0.65	4
MMBC1321Q5	Q5	25	1.8	0.6	2
MMBT918	3B	15	1.7	0.6	4
MMBTH24	3A	30	0.36	0.4	8
Case 318-07 — TO-236AB (SOT-23) — PNP					
MMBTH81	3D	20	0.85	0.6	5

Table 4. Plastic-Encapsulated Surface Mount Choppers

The following table is a listing of small-signal devices intended for chopper applications where a higher than normal $V_{(BR)CEO}$ is required in the circuit application.

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)EBO}$	$V_{(BR)CEO}$	h_{FE} @ I_C Min	Max	mA
Case 318-07 — TO-236AB (SOT-23) — PNP						
MMBT404A	2N	25	35	75	400	12

SMALL-SIGNAL BIPOLAR TRANSISTORS — PLASTIC-ENCAPSULATED SURFACE MOUNT TRANSISTORS (continued)

Table 5. Plastic-Encapsulated Surface Mount Darlingtons

The following table is a listing of small-signal devices that have very high h_{FE} and input impedance characteristics. These devices utilize monolithic, cascade transistor construction.

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending h_{FE}.

Device	Marking	$V_{(BR)CEO}$	$V_{CE(sat)}$ Volts Max	h_{FE} @ I_C Min	Max	mA
Case 318-07 — TO-236AB (SOT-23) — NPN						
MMBTA14	1N	40	1.5	20K	—	100
MMBTA13	1M	30	1.5	10K	—	100
Case 318-07 — TO-236AB (SOT-23) — PNP						
MMBTA64	2V	30	1.5	20K	—	100

Table 6. Plastic-Encapsulated Surface Mount Low-Noise Transistors

The following table is a listing of small-signal devices intended for low noise applications in the audio range. These devices exhibit good linearity and are candidates for hi-fi and instrumentation equipment.

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of ascending NF.

Device	Marking	NF dB Typ	$V_{(BR)CEO}$	h_{FE} @ I_C Min	Max	mA	f_T MHz Min
Case 318-07 — TO-236AB (SOT-23) — NPN							
MMBT5089	1R	1	30	400	—	10	50
MMBT2484	1U	3	60	—	800	10	50
MMBT6428	1K	3	50	250	—	10	100
MMBT6429	1L	3	45	500	—	10	100
Case 318-07 — TO-236AB (SOT-23) — PNP							
MMBT5086	2P	1	50	150	—	10	40
MMBT5087	2Q	1	50	250	—	10	40

*Max

Table 7. Plastic-Encapsulated Surface Mount High-Voltage Transistors

The following table is a listing of small-signal high-voltage devices designed for direct line operation requiring high voltage breakdown and relatively low current capability.

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending breakdown voltage.

Device	Marking	$V_{(BR)CEO}$	h_{FE} @ I_C Min	Max	mA	f_T MHz Min
Case 318-07 — TO-236AB (SOT-23) — NPN						
MMBT6517	1Z	350	15	—	100	40
MMBTA42	1D	300	40	—	30	50
MMBT5551	G1	160	30	—	50	100
Case 318-07 — TO-236AB (SOT-23) — PNP						
MMBT6520	2Z	350	15	—	100	40
MMBTA92	2D	300	25	—	30	50
MMBT5401	2L	150	50	—	50	100

Table 8. Plastic-Encapsulated Surface Mount Drivers

The following is a listing of small-signal devices intended for medium voltage driver applications at fairly high current levels.

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)CEO}$	h_{FE} @ I_C Min	Max	mA	f_T MHz Min
Case 318-07 — TO-236AB (SOT-23) — NPN						
MMBTA06	1G	80	50	—	100	100
BSS64	AM	80	20	80	4	50
Case 318-07 — TO-236AB (SOT-23) — PNP						
BSS63	BM	100	30	—	25	50
MMBTA56	2G	80	50	—	100	50

Table 9. Plastic-Encapsulated Surface Mount RF Transistors

The following table is a listing of small-signal RF transistors intended for low-noise, high-power gain, Class A, AB or C amplifiers. These devices are used as pre-drivers in power amplifier applications.

Pinout: 1-Base, 2-Emitter, 3-Collector

		f_T @ I_C @ V_{CE}			NF @ I_C @ V_{CE}			MAG @ I_C @ V_{CE} @ f			
Device	Marking	GHz Typ	mA	V	dB Typ	mA	V	dB Typ	mA	V	MHz
Case 318-07 — TO-236AB (SOT-23) — NPN											
MMBR571	7X	8	50	5	2	10	6	16.5	5	6	500
MMBR941	7Y	8	15	6	2.1	5	6	8.5	5	6	2000
MMBR951	7Z	8	30	8	2.1	5	6	7.5	5	6	2000
MMBR911	7P	6	30	10	2	10	10	17	10	10	500
MMBR930	7C	5.5	30	5	1.9	2	5	11	30	5	500
MMBR920	7B	4.5	14	10	2.4	2	10	15	2	10	500
MMBR901	7A	4	15	10	1.9	5	6	12	5	6	1000
BFR92	P1	3.4	14	10	3	3	1.5	—	—	—	500
BFR93	R1	3.4	30	5	2.5	2	5	—	—	—	30
MMBR931	7D	3	1	1	4.3	0.25	1	10	0.25	1	1000
MMBR5179	7H	1.4	5	6	4.5	1.5	6	15	5	6	200
MMBR2060	7E	1	20	1	3.5	1.5	10	13	1.5	10	450
MMBR5031	7G	1	5	6	2.5	1	6	17	1	6	450
MMBR2857	7K	1	4	10	4.5	1.5	6	12.5	1.5	6	450
BFS17	E1	1	2	5	5	2	5	—	—	—	30
Case 318-07 — TO-236AB (SOT-23) — PNP											
MMBR536	7R	5.5	20	5	4.5	10	5	14	10	5	500
MMBR4957	7F	1.2	2	10	3	2	10	17	2	10	450

Table 10. Plastic-Encapsulated Surface Mount Switching Transistors

Pinout: 1-Base, 2-Collector, 3-Emitter, 4-Collector

					h_{FE}		f_T	
Device	Marking	t_{on}	t_{off}	$V_{(BR)CEO}$	Min	Max	@ I_C (mA)	Min (MHz)
Case 318E-04 — SOT-223 — NPN								
PZT2222A	2222A	35	285	40	100	300	20	300
Case 318E-04 — SOT-223 — PNP								
PZT2907A	2907A	45	100	60	100	300	50	200

Table 11. Plastic-Encapsulated Surface Mount Darlingtons

Pinout: 1-Base, 2-Collector, 3-Emitter, 4-Collector

Device	Marking	$V_{(BR)CEO}$	$V_{CE(sat)}$ Max (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)
Case 318E-04 — SOT-223 — NPN						
PZTA14	ZTA14	30	1.5	20k	—	100
BSP52	BSP52	80	1.3	2k	—	500
Case 318E-04 — SOT-223 — PNP						
PZTA64	ZTA64	30	1.5	20k	—	100

Table 12. Plastic-Encapsulated Surface Mount High-Voltage Transistors

Pinout: 1-Base, 2-Collector, 3-Emitter, 4-Collector

Device	Marking	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)	f_T Min (MHz)
Case 318E-04 — SOT-223 — NPN						
PTZA42	TZA42	300	40	—	10	50
BSP19	BSP19	350	40	—	10	70
BF720	BF720	250	50	—	10	60
Case 318E-04 — SOT-223 — PNP						
PTZA92	TZA92	300	40	—	10	50
BF721	BF721	250	50	—	10	60
PZTA96	ZTA96	450	50	150	10	50
BSP16	BSP16	300	30	150	10	15

Table 13. Plastic-Encapsulated Surface Mount RF Transistors

Device	Marking	f_T Typ (GHz)	f_T I_C (mA)	f_T V_{CE} (V)	NF Typ (dB)	NF I_C (mA)	NF V_{CE} (V)	Gain Typ (dB)	Gain I_C (mA)	Gain V_{CE} (V)	f (MHz)
Case 318A-05 — SOT-143 — NPN											
MRF9411	10	8	15	6	2.1	5	6	9.5	5	6	2000
MRF5711	02	8	50	8	1.6	10	6	13.5	10	6	1000
MRF9511	11	8	30	8	2.1	5	6	9	5	6	2000
MRF0211	15	5.5	40	10	1.8	5	10	9.5	5	10	1000
MRF9331	05	5	1	1	2.5	0.5	1	12.5	0.5	1	1000
MRF9011	01	3.8	15	10	2.3	5	10	10.2	5	10	1000
Case 318A-05 — SOT-143 — PNP											
MRF5211	04	4.2	50	8	2.8	5	6	11	5	6	1000

Metal-Can Transistors

Metal-can packages are intended for use in industrial applications where harsh environmental conditions are encountered. These packages enhance reliability of the end products due to their resistance to varying humidity and extreme temperature ranges.

CASE 22-03
TO-206AA
(TO-18)

CASE 79-04
TO-205AD
(TO-39)

Table 1. Metal-Can General-Purpose Transistors

These transistors are designed for DC to VHF amplifier applications, general-purpose switching applications, and complementary circuitry. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package group.

Device Type	$V_{(BR)CEO}$ Volts Min	f_T @ I_C MHz Min	mA	I_C mA Max	h_{FE} @ I_C Min	Max	mA
Case 22-03 — TO-206AA (TO-18) — NPN							
2N720A	80	50	50	150	40	120	150
2N3700	80	80	1.0	1000	50	—	500
BC107	45	150	10	200	110	450	2.0
BC107A	45	150	10	200	110	220	2.0
BC107B	45	150	10	200	200	450	2.0
BCY59-IX	45	125	10	200	250	460	2.0
BCY59-VIII	45	125	10	200	180	310	2.0
2N2222A	40	300	20	800	100	300	150
2N3947	40	300	10	300	100	300	10
BCY58-VIII	32	125	10	200	180	310	2.0
BC109C	25	150	10	100	420	800	2.0
Case 22-03 — TO-206AA (TO-18) — PNP							
2N2906A	60	200	50	600	40	120	150
2N2907A	60	200	50	600	100	300	150
2N3251A	60	300	10	200	100	300	10
BC177B	45	200	10	200	180	460	2.0
BCY79-IX	45	180	10	200	250	460	2.0
BCY79-VIII	45	180	10	200	180	310	2.0
Case 79-04 — TO-205AD (TO-39) — NPN							
2N3019	80	100	50	1000	100	300	150
2N3020	80	80	50	1000	40	120	150
2N1893	80	50	50	500	40	120	150
2N2219A	40	300	20	800	100	300	150
2N2218A	40	250	20	800	40	120	150
Case 79-04 — TO-205AD (TO-39) — PNP							
MM5007	100	30	50	2000	50	250	250
2N4033	80	150	50	1000	25	—	100
2N4036	65	60	50	1000	40	140	150
2N2904A	60	200	50	600	40	120	150
2N2905A	60	200	50	600	100	300	150
2N4030	60	100	50	1000	15	—	100
2N4032	60	150	50	1000	40	—	100
BSV16-10	60	50	50	1000	63	160	100

Table 2. Metal-Can High-Gain/Low-Noise Transistors

These transistors are characterized for high-gain and low-noise applications. Devices are listed in decreasing order of NF.

Device Type	NF Wideband dB Typ* Max	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} @ I_C Min	Max	µA mA*	f_T @ I_C MHz Min	mA
Case 22-03 — TO-206AA (TO-18) — NPN								
2N2484	8.0*	60	50	100	500	10	15	0.05
2N930A	3.0	45	30	100	300	10	45	0.5
2N930	3.0	45	30	100	300	10	30	0.5
Case 22-03 — TO-206AA (TO-18) — PNP								
2N3963	10	80	200	100	450	1.0*	40	0.5
2N3964	4.0	45	200	250	600	1.0*	50	0.5
2N3799	2.5	60	50	300	900	500	30	0.5

Table 3. Metal-Can High-Voltage/High-Current Transistors

The following table lists Motorola standard devices that have high collector-emitter breakdown voltage. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package type.

Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ @ I_C & I_B Volts Max	mA	mA	f_T @ I_C MHz Min	mA
Case 22-03 — TO-206AA (TO-18) — NPN									
2N6431	300	50	50	30	0.5	20	2.0	50	10
BSS73	300	500	40	30	0.5	50	5.0	100	20
Case 22-03 — TO-206AA (TO-18) — PNP									
2N6433	300	500	30	30	0.5	20	20	50	10
BSS76	300	500	35	30	0.5	50	5.0	100	20
2N3497	120	100	40	10	0.35	10	1.0	150	20
Case 79-04 — TO-205AD (TO-39) — NPN									
2N5058	300	150	35	30	1.0	30	3.0	30	10
BF259	300	100	25	30	1.0	30	6.0	110	30
2N4927	250	50	20	30	2.0	30	3.0	30	10
BF258	250	100	25	30	1.0	30	6.0	110	30
2N3500	150	300	40	150	0.4	150	15	150	20
2N3501	150	300	100	150	0.4	150	15	150	20
2N3499	100	500	100	150	0.6	300	30	150	20
MM3007	100	2500	50	250	0.35	150	15	50	50
Case 79-04 — TO-205AD (TO-39) — PNP									
2N4931	250	500	20	20	5.0	10	1.0	20	20
2N3636	175	1000	50	50	0.5	50	5.0	150	30
2N3637	175	1000	100	50	0.5	50	5.0	200	30
MM5007	100	2000	50	250	0.5	150	15	30	50

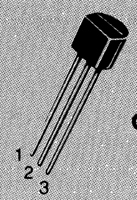
Table 4. Metal-Can Switching Transistors

The following devices are intended for use in general-purpose switching and amplifier applications. Within each package group shown, the devices are listed in order of decreasing turn-on time (t_{on}).

Device Type	t_{on} & t_{off} @ I_C ns Max	ns Max	mA	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ @ I_C @ I_B Volts Max	mA	mA	f_T MHz Min	I_C mA
Case 22-03 — TO-206AA (TO-18) — NPN												
2N4014	35	60	500	50	1000	35	500	0.52	500	50	300	50
2N2369A	12	18	10	15	200	40	10	0.2	10	1.0	500	10
BSX20	7.0	18	100	15	500	20	10	0.25	10	1.0	400	10
Case 22-03 — TO-206AA (TO-18) — PNP												
2N2894	60	90	30	12	200	40	30	0.2	30	3.0	400	30
2N869A	50	80	30	18	200	40	30	0.2	30	3.0	400	10
2N3546	40	30	50	12	—	25	50	0.25	50	5.0	700	10
MM4209	15	20	10	15	200	35	10	0.6	50	5.0	850	10
Case 79-04 — TO-205AD (TO-39) — NPN												
MM3725	35	60	500	40	2000	35	500	0.52	500	50	300	50
Case 79-04 — TO-205AD (TO-39) — PNP												
2N3467	40	90	500	40	100	40	500	0.5	500	50	175	50
2N3468	40	90	500	50	1000	25	500	0.6	500	50	150	50
2N3762	11.5	65	100	40	1500	30	1000	0.9	1000	100	180	50

JFETs

JFETs operate in the depletion mode. They are available in both P- and N-channel and are offered in both Thruhole and Surface Mount packages. Applications include general-purpose amplifiers, switches and choppers, and RF amplifiers and mixers. These devices are economical and very rugged. The drain and source are interchangeable on many typical FETs.



CASE 29-04
TO-226AA
(TO-92)

Table 1. JFET Low-Frequency/Low-Noise

The following table is a listing of small-signal JFETs intended for low-noise applications in the audio range. These devices exhibit good linearity and are candidates for hi-fi and instrumentation equipment.

Device	$R_e \lvert Y_{fs} \rvert$ @ f mmho Min	MHz	$R_e \lvert Y_{os} \rvert$ @ f µmho Max	MHz	C_{iss} pF Max	C_{rss} pF Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ V Min	$V_{GS(off)}$ V Min	Max	I_{DSS} mA Min	Max
Case 29-04 — TO-226AA (TO-92) — N-Channel											
J202	1.0	20	3.5*	20	5.0*	2.0*	40	0.8	4.0	0.9	4.5
2N5458	1.5	15	50	15	7.0	3.0	25	1.0	7.0	2.0	9.0
J203	1.5	20	10*	20	5.0*	2.0*	40	2.0	10	4.0	20
MPF3821	1.5	15	10	15	6.0	3.0	50	—	4.0	0.5	2.5
2N5457	2.0	15	50	15	7.0	3.0	25	0.5	6.0	1.0	5.0
2N5459	2.0	15	50	15	7.0	3.0	25	2.0	8.0	4.0	16
MPF3822	2.0	15	20	15	6.0	3.0	50	—	6.0	2.0	10
Case 29-04 — TO-226AA (TO-92) — P-Channel											
2N5460	1.0	0.001	50	0.001	7.0	2.0	40	0.75	6.0	1.0	5.0
2N5461	1.5	0.001	50	0.001	7.0	2.0	40	1.0	7.5	2.0	9.0
2N5462	2.0	0.001	50	0.001	7.0	2.0	40	1.8	9.0	4.0	16

*Typical

Table 2. JFET High-Frequency Amplifiers

The following is a listing of small-signal JFETs that are intended for hi-frequency applications. These are candidates for VHF/UHF oscillators, mixers and front-end amplifiers.

Device	$R_e \lvert Y_{fs} \rvert$ @ f mmho Min	MHz	$R_e \lvert Y_{os} \rvert$ @ f µmho Max	MHz	C_{iss} pF Max	C_{rss} pF Max	NF @ R_G = 1K dB Max	f MHz	$V_{(BR)GSS}$ $V_{(BR)GDO}$ V Min	$V_{GS(off)}$ V Min	Max	I_{DSS} mA Min	Max
Case 29-04 — TO-226AA (TO-92) — N-Channel													
2N5669	1.6	100	100	100	7.0	3.0	2.5	100	25	1.0	6.0	4.0	10
MPF102	1.6	100	200	100	7.0	3.0	—	—	25	—	8.0	2.0	20
2N5668	1.0	100	50	100	7.0	3.0	2.5	100	25	0.2	4.0	1.0	5.0
2N5484	2.5	100	75	100	5.0	1.0	3.0	100	25	0.3	3.0	1.0	5.0
2N5670	2.5	100	150	100	7.0	3.0	2.5	100	25	2.0	8.0	8.0	20
2N5485	3.0	400	100	400	5.0	1.0	4.0	400	25	1.0	4.0	4.0	10
J305	3.0*	400	80*	100	3.0*	0.8*	4.0*	400	30	0.5	3.0	1.0	8.0
2N5486	3.5	400	100	400	5.0	1.0	4.0	400	25	2.0	6.0	8.0	20
J300	4.5	0.001	200	0.001	5.5	1.1	—	—	25	—	1.0**	6.0	30
2N5245	4.0	400	100	400	4.5	1.0	4.0	400	30	1.0	6.0	5.0	15
2N5247	4.0	400	150	400	4.5	1.0	4.0	400	30	1.5	8.0	8.0	24
J304	4.2	400	80*	100	3.0*	0.8*	4.0*	400	30	2.0	6.0	5.0	15
J308	12*	100	250*	100	7.5	2.5	1.5*	100	25	1.0	6.5	12	60
J309	12*	100	250*	100	7.5	2.5	1.5*	100	25	1.0	4.0	12	30
J310	12*	100	250*	100	7.5	2.5	1.5*	100	25	2.0	6.5	24	60

*Typical

Table 3. JFET Switches and Choppers

The following is a listing of JFETs intended for switching and chopper applications.

Device	$r_{ds(on)}$ @ I_D Ω Max	μA	$V_{GS(off)}$ V Min	Max	I_{DSS} mA Min	Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
Case 29-04 — TO-226AA (TO-92) — N-Channel											
MPF4856	25	—	4.0	10	50	—	40	10	8.0	9.0	25
MPF4859	25	—	4.0	10	50	—	30	18	8.0	9.0	25
2N5638	30	1.0	—	(12)	50	—	30	10	4.0	9.0	15
J111	30	1.0	3.0	10	20	—	35	10*	5.0*	13	35
MPF4857	40	—	2.0	6.0	20	100	40	18	8.0	10	50
MPF4860	40	—	2.0	6.0	20	100	30	18	8.0	10	50
J112	50	1.0	1.0	5.0	5.0	—	35	10*	5.0*	13*	35*
MPF4392	60	1.0	2.0	5.0	25	75	20	10	3.5	15	35
2N5639	60	1.0	—	(8.0)*	25	—	30	10	4.0	14	30
MPF4858	60	—	0.8	4.0	8.0	80	40	18	8.0	20	100
MPF4861	60	—	0.8	4.0	8.0	80	30	18	8.0	20	100
MPF4393	100	1.0	0.5	3.0	5.0	30	20	10	3.5	15	55
2N5640	100	1.0	—	(6.0)	5.0	—	30	10	4.0	18	45
J113	100	1.0	0.5	3.0	2.0	—	35	10*	5.0*	13*	35*
2N5555	150	—	—	1.0**	15	—	25	5.0	1.2	10	25
BF246	—	—	0.5	14	10	300	25	—	—	—	—
BF246A	35*	1.0	1.5	4.0	30	80	25	—	—	—	—
BF246B	50*	1.0	3.0	7.0	60	140	25	—	—	—	—
BF246C	65*	1.0	5.5	12	110	250	25	—	—	—	—
J107	8.0	—	0.5	4.5	100	—	25	—	—	—	—
J108	8.0	—	3.0	10	80	—	25	—	—	—	—
J109	12	—	2.0	6.0	40	—	25	—	—	—	—
J110	18	—	0.5	4.0	10	—	25	—	—	—	—
Case 29-04 — TO-226AA (TO-92) — P-Channel											
MPF970	100	1.0	5.0	12	15	100	30	12	5.0	8.0	25
MPF971	250	1.0	1.0	7.0	2.0	80	30	12	5.0	10	120
J174	85	—	5.0	10	2.0	100	30	—	—	—	—
J175	125	—	3.0	6.0	7.0	60	30	—	—	—	—
J176	250	—	1.0	4.0	2.0	25	30	—	—	—	—
J177	300	—	0.8	2.5	1.5	20	30	—	—	—	—

*Typical
**$V_{GS(f)}$

MOSFETs

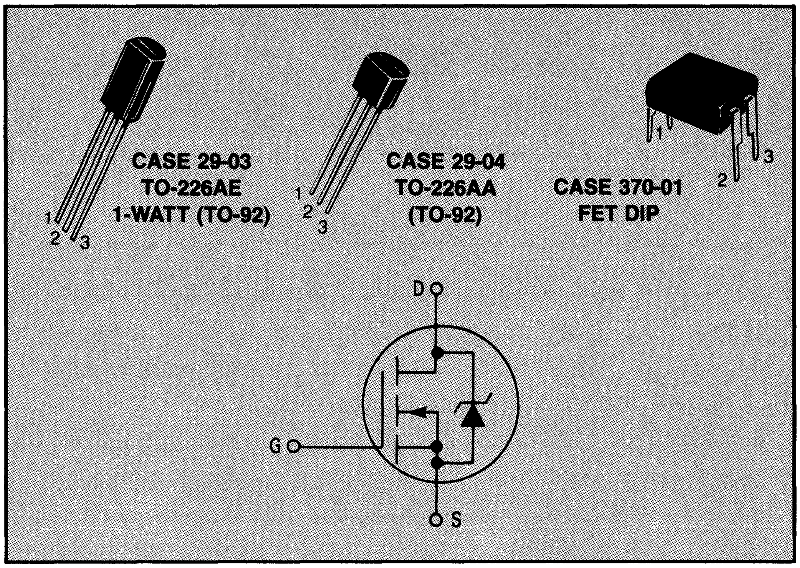


Table 1. TMOS Switches and Choppers

The following is a listing of small-signal TMOS devices that are intended for switching and chopper applications. These devices offer low $r_{DS(on)}$ characteristics.

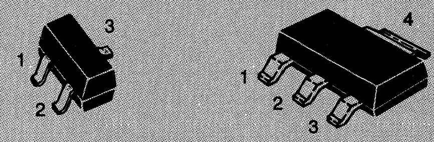
Device	$r_{DS(on)}$ @ I_D Ω Max	A	$V_{GS(th)}$ V Min	Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
Case 29-03 — TO-226AE (1-WATT TO-92) — N-Channel									
MPF930	1.4	1.0	1.0	3.5	35	70	18	15	15
MPF960	1.7	1.0	1.0	3.5	60	70	18	15	15
MPF6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
MPF990	2.0	1.0	1.0	3.5	90	70	18	15	15
MPF6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
MPF6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
MPF910	5.0	0.5	0.8	2.5	60	50	10	10	10
VN10LM	5.0	0.5	0.8	2.5	60	60	5	10	10
MPF89	6.4	0.25	1.0	2.7	200	90	3.5	15	15
Case 29-04 — TO-226AA (TO-92) — N-Channel									
VN0300	1.2	1.0	0.8	2.5	30	100	25	30	30
2N7000	5.0	0.5	0.8	3.0	60	60	6.0	10	10
BS170	5.0	0.2	0.8	3.0	60	25 Typ	3.0 Typ	10	10
VN0610LL	5.0	0.5	0.8	2.5	60	60	5.0	10	10
VN2406	6.0	0.5	0.8	2.0	240	125	20	16	30
BSS89	6.4	0.25	1.0	2.7	200	90	3.5	15	15
BS107A	6.4	0.25	1.0	3.0	200	70 Typ	6.0 Typ	15	15
2N7008	7.5	0.5	1.0	2.5	60	50	5.0	20	20
VN2222LL	7.5	0.5	0.6	2.5	60	60	5.0	10	10
BS107	14	0.2	1.0	3.0	200	70 Typ	6.0 Typ	15	15

Table 1. TMOS Switches and Choppers (continued)

Device	$r_{DS(on)}$ Ω Max	@ mA	$V_{(BR)DSS}$ Volt Min	$I_{D(on)}$ Amp	G_{fs} mho Min	@ Amp	C_{iss} pF Max	C_{oss} pF Max	C_{rss} pF Max	$t_{d(on)}$ ns Max	t_r ns Max	$t_{d(off)}$ ns Max	t_f ns Max
Case 370-01 (FETDIP) — N-Channel													
IRFD120	0.3	600	100	1.3	0.9	0.6	600	400	100	40	70	100	70
IRFD123	0.4	600	60	1.1	0.9	0.6	600	400	100	40	70	100	70
IRFD110	0.6	800	100	1.0	0.8	0.8	200	100	25	20	25	25	20
IRFD113	0.8	800	60	0.8	0.8	0.8	200	100	25	20	25	25	20
IRFD1Z0	2.4	250	100	0.5	0.25	0.25	70	30	10	20	25	25	20
IRFD1Z3	3.2	250	60	0.4	0.25	0.25	70	30	10	20	25	25	20
Case 370-01 (FETDIP) — P-Channel													
IRFD9120	0.6	800	100	1.0	0.8	0.8	450	350	100	50	100	100	100
IRFD9123	0.8	800	60	0.8	0.8	0.8	450	350	100	50	100	100	100

Surface Mount FETs

This section contains the FET plastic packages available for surface mount applications. Most of these devices are the most popular metal-can and insertion type parts carried over to the new surface mount packages.



CASE 318-07
TO-236AB
SOT-23

CASE 318E-04
SOT-223

Table 1. JFET Surface Mount RF

The following is a list of surface mount FETs which are intended for UHF/VHF RF amplifier applications.

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	NF dB Typ	NF f MHz	Y_{fs} @ V_{DS} mmhos Min	mmhos Max	V	$V_{(BR)GSS}$
Case 318-07 — TO-236AB (SOT-23) — N-Channel							
MMBFJ309	6U	1.5	450	10	20	10	25
MMBFJ310	6T	1.5	450	8	18	10	25
MMBFU310	M6C	1.5	450	10	18	10	25
MMBF4416	M6A	2**	100	4.5	7.5	15	30
MMBF5484	M6B	2	100	3	6	15	25
MMBF5486	6H	2	100	4	8	15	25

**Max

Table 2. JFET Surface Mount General-Purpose

The following table is a listing of surface mount small-signal general purpose FETs. These devices are intended for small-signal amplification for DC, audio, and lower RF frequencies. They also have applications as oscillators and general-purpose, low-voltage switches.

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	$V_{(BR)GSS}$	Y_{fs} @ V_{DS} mmhos Min	mmhos Max	V	I_{DSS} mA Min	mA Max
Case 318-07 — TO-236AB (SOT-23) — N-Channel							
MMBF5457	6D	25	1	5	15	1	5
MMBF5459	6L	25	2	6	15	4	16
Case 318-07 — TO-236AB (SOT-23) — P-Channel							
MMBF5460	M6E	40	1	4	15	1	5

Table 3. JFET Surface Mount Choppers/Switches

The following is a listing of small-signal surface mount JFET devices intended for switching and chopper applications.

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	$r_{DS(on)}$ Ohms Max	t_{off} ns Max	$V_{(BR)GSS}$	$V_{GS(off)}$ V Min	$V_{GS(off)}$ V Max	I_{DSS} mA Min	I_{DSS} mA Max
Case 318-07 — TO-236AB (SOT-23) — N-Channel								
MMBF4391	6J	30	20	30	−4	−10	50	150
MMBF4860	6F	40	50	30	−2	−6	20	100
MMBF4392	6K	60	35	30	−2	−5	25	75
MMBF4393	6G	100	50	30	−0.5	−3	5	30
Case 318-07 — TO-236AB (SOT-23) — P-Channel								
MMBFJ175	6W	125	30(t)	−30	3	6	−7	−60
MMBFJ177	6Y	300	45(t)	−30	0.8	2.5	−1.5	−20

Table 4. TMOS FET Surface Mount

The following is a listing of small-signal surface mount TMOS FETs which exhibit low $r_{DS(on)}$ characteristics.

Pinout: 1-Gate, 2-Source, 3-Drain

Device	Marking	$r_{DS(on)}$ @ I_D Ohm	mA	V_{DSS}	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	Switching Time t_{on} ns	t_{off} ns
Case 318-07 — TO-236AB (SOT-23) — N-Channel								
MMBF170	6Z	5	200	60	0.8	3	10	10
BSS123	SA	6	100	100	0.8	2.8	20	40
2N7002	702	7.5	500	60	1	2.5	20	20

Table 5. TMOS Surface Mount FETs

Pinout: 1-Gate, 2-Drain, 3-Source, 4-Drain

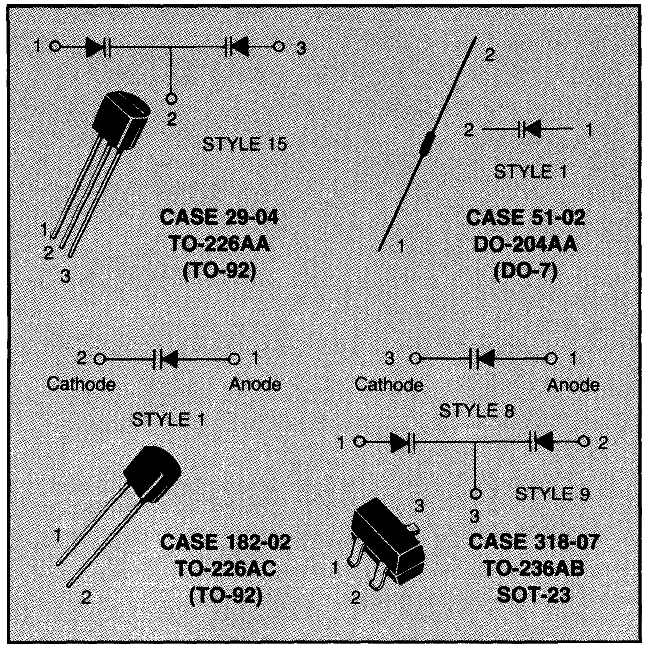
Device	Marking	$r_{DS(on)}$ Ohm	mA	V_{DSS}	$V_{GS(th)}$ Min (V)	Max (V)	Switching Time (ns) t_{on}	t_{off}
Case 318E-04 — SOT-223 — N-Channel								
MMFT107	FT107	14	200	200	1	3	15	15
MMFT960	FT960	1.7	1000	60	1	3.5	15	15
MMFT6661	T6661	4	1000	90	0.8	2	5	5

Tuning Diodes — Abrupt Junction

Motorola supplies voltage-variable capacitance diodes serving the entire range of frequencies from HF through UHF. Used in RF receivers and transmitters, they have a variety of applications, including:

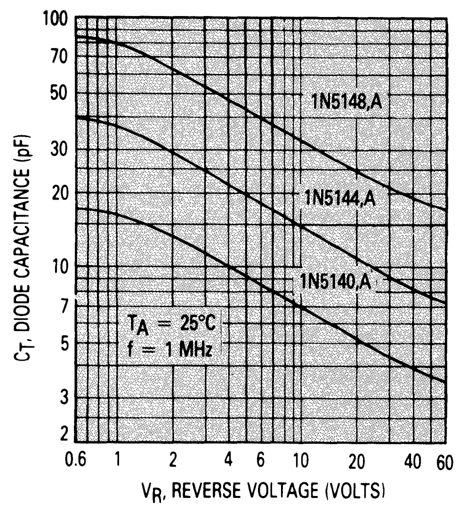
- Phase-locked loop tuning systems
- Local oscillator tuning
- Tuned RF preselectors
- RF filters
- RF phase shifters
- RF amplifiers
- Automatic frequency control
- Video filters and delay lines
- Harmonic generators
- FM modulators

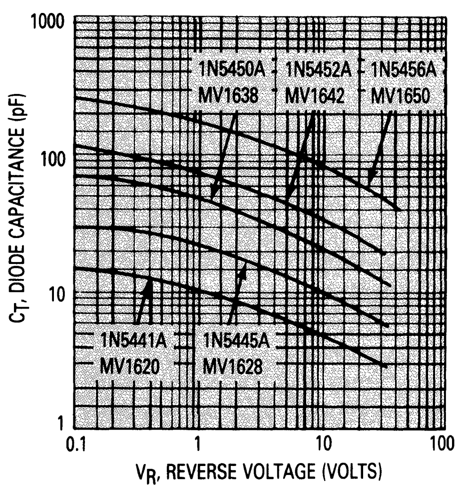
Two families of devices are available: Abrupt Junction and Hyper Abrupt Junction. The Abrupt Junction family includes devices suitable for virtually all tuned-circuit and narrow-range tuning applications throughout the spectrum.



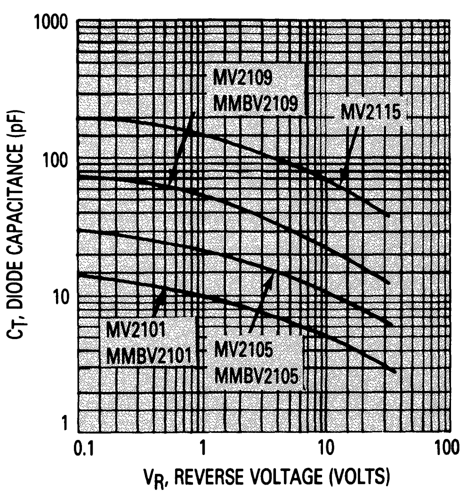
Typical Characteristics

Diode Capacitance versus Reverse Voltage

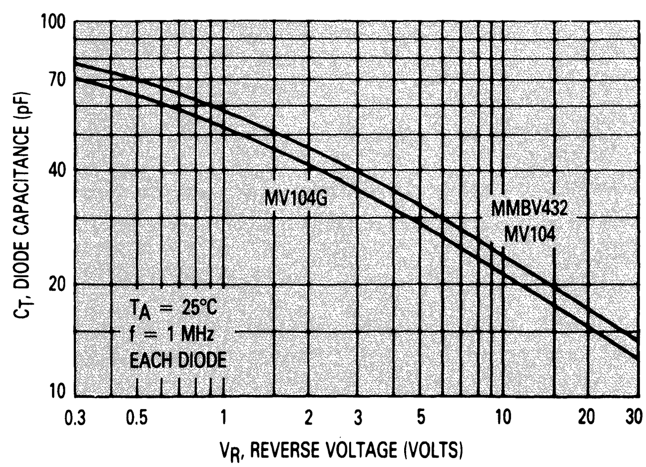




(See Tables 1 Thru 3)



(See Tables 4 And 5)



(See Table 6)

Table 1. General-Purpose Glass Abrupt Tuning Diodes

High Q Capacitance Ratio @ 4.0 Volts/60 Volts

The following is a listing of axial leaded, general-purpose, abrupt tuning diodes. These devices exhibit high Q characteristics.

Device*	C_T @ V_R = 4.0 V, 1.0 MHz pF Min	pF Nominal	pF Max	$V_{(BR)R}$ Volts	Cap Ratio C4/C60 Min	Q 4.0 V, 60 MHz Min
Case 51-02 — DO-204AA (DO-7)						
1N5139	6.1	6.8	7.5	60	2.7	350
1N5140	9.0	10	11	60	2.8	300
1N5141	10.8	12	13.2	60	2.8	300
1N5142	13.5	15	16.5	60	2.8	250
1N5143	16.2	18	19.8	60	2.8	250
1N5144	19.8	22	24.2	60	3.2	200
1N5145	24.3	27	29.7	60	3.2	200
1N5146	29.7	33	36.3	60	3.2	200
1N5147	35.1	39	42.9	60	3.2	200
1N5148	42.3	47	51.7	60	3.2	200

*Suffix A = 5.0%

Table 2. General-Purpose Glass Abrupt Tuning Diodes

High Q Capacitance Ratio @ 2.0 Volts/30 Volts

The following is a listing of axial leaded, general-purpose, abrupt tuning diodes. These devices exhibit very high Q characteristics.

Device*	C_T @ V_R = 4.0 V, 1.0 MHz pF Min	pF Nominal	pF Max	$V_{R(BR)R}$ Volts	Cap Ratio C2/C30 Min	Q 4.0 V, 50 MHz Min
Case 51-02 — DO-204AA (DO-7)						
1N5441A	6.1	6.8	7.5	30	2.5	450
1N5443A	9.0	10	11	30	2.6	400
1N5444A	10.8	12	13.2	30	2.6	400
1N5445A	13.5	15	16.5	30	2.6	400
1N5446A	16.2	18	19.8	30	2.6	350
1N5448A	19.8	22	24.2	30	2.6	350
1N5449A	24.3	27	29.7	30	2.6	350
1N5450A	29.7	33	36.3	30	2.6	350
1N5451A	35.1	39	42.9	30	2.6	300
1N5452A	42.3	47	51.7	30	2.6	250
1N5453A	50.4	56	61.6	30	2.6	200
1N5455A	73.8	82	90.2	30	2.7	175
1N5456A	90	100	110	30	2.7	175

*Suffix B = 5.0%

Table 3. General-Purpose Glass Abrupt Tuning Diodes

Capacitance Ratio @ 2.0 Volts/20 Volts

The following is a listing of axial leaded, general-purpose, abrupt tuning diodes. These devices exhibit high Q characteristics.

Device	C_T @ V_R = 4.0 V, 1.0 MHz pF Min	pF Nominal	pF Max	$V_{R(BR)R}$ Volts	Cap Ratio C2/C20 Min	Q 4.0 V, 50 MHz Typ
Case 51-02 — DO-204AA (DO-7)						
MV1620	6.1	6.8	7.5	20	2.0	300
MV1624	9.0	10	11	20	2.0	300
MV1626	10.8	12	13.2	20	2.0	300
MV1628	13.5	15	16.5	20	2.0	250
MV1630	16.2	18	19.8	20	2.0	250
MV1634	19.8	22	24.2	20	2.0	250
MV1636	24.3	27	29.7	20	2.0	200
MV1638	29.7	33	36.3	20	2.0	200
MV1640	35.1	39	42.9	20	2.0	200
MV1642	42.3	47	51.7	20	2.0	200
MV1644	50.4	56	61.6	20	2.0	150
MV1648	73.8	82	90.2	20	2.0	150
MV1650	90	100	110	20	2.0	150

Table 4. General-Purpose Plastic Abrupt Tuning Diodes

Capacitance Ratio @ 2.0 Volts/30 Volts

The following is a listing of plastic package, general-purpose, abrupt tuning diodes. These devices exhibit high Q characteristics.

Device	C_T @ V_R = 4.0 V, 1.0 MHz pF Min	pF Nominal	pF Max	$V_{R(BR)R}$ Volts	Cap Ratio C4/C30 Min	Q 4.0 V, 50 MHz Typ
Case 182-02 — TO-226AC (TO-92) — 2-Lead						
MV2101	6.1	6.8	7.5	30	2.5	450
MV2103	9.0	10	11	30	2.5	400
MV2104	10.8	12	13.2	30	2.5	400
MV2105	13.5	15	16.5	30	2.5	400
MV2106	16.2	18	19.8	30	2.5	350
MV2107	19.8	22	24.2	30	2.5	350
MV2108	24.3	27	29.7	30	2.5	300
MV2109	29.7	33	36.3	30	2.5	200
MV2111	42.3	47	51.7	30	2.5	150
MV2113	61.2	68	74.8	30	2.5	150
MV2114	73.8	82	90.2	30	2.5	100
MV2115	90	100	110	30	2.6	100

Table 5. Surface Mount Abrupt Tuning Diodes

Capacitance Ratio 2.0 Volts/30 Volts

The following is a listing of surface mount abrupt junction tuning diodes intended for general-purpose variable capacitance circuit applications.

Device	C_T @ V_R = 4.0 V, 1.0 MHz pF Min	pF Nominal	pF Max	$V_{R(BR)R}$ Volts	Cap Ratio C2/C30 Min	Q 4.0 V, 50 MHz Typ
Case 318-07 — TO-236AB (SOT-23)						
MMBV2101***	6.1	6.8	7.5	30	2.5	400
MMBV2103***	9.0	10	11	30	2.5	350
MMBV2104***	10.8	12	13.2	30	2.5	350
MMBV2105***	13.5	15	16.5	30	2.5	350
MMBV2106***	16.2	18	19.8	30	2.5	300
MMBV2107***	19.8	22	24.2	30	2.5	300
MMBV2108***	24.3	27	29.7	30	2.5	250
MMBV2109***	29.7	33	36.3	30	2.5	200

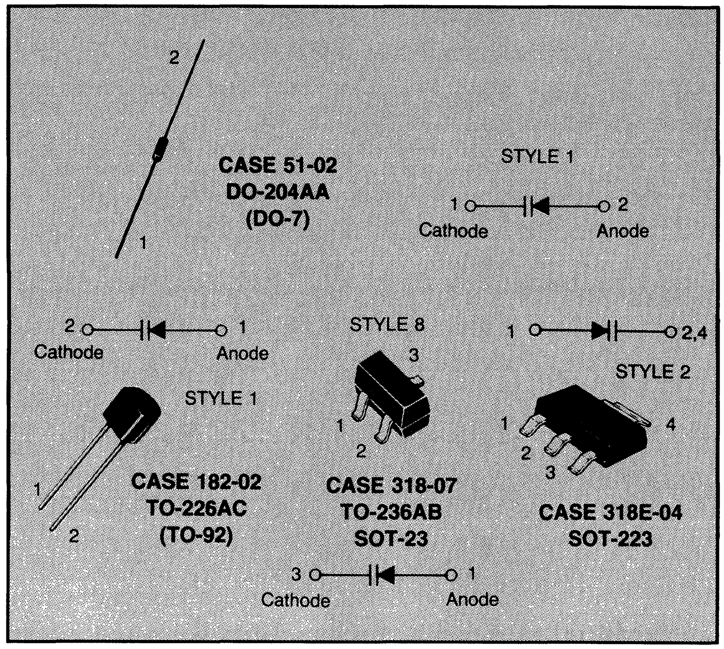
Table 6. Abrupt Tuning Diodes — Dual

The following is a listing of abrupt tuning diodes that are available as dual units in a single package.

Device	C_T @ V_R** pF Min	pF Max	Volts	Cap Ratio C3/C30 Min	Q 3.0 V, 50 MHz Min	$V_{(BR)R}$ Volts	Device Marking	Style
Case 29-04 — TO-226AA (TO-92)								
MV104G	34	39	3.0	2.5	100	32	—	15
MV104	37	42	3.0	2.5	100	32	—	15
Case 318-07 — TO-236AB (SOT-23)								
MMBV432***	43	48.1	2.0	1.5*	100	14	M4B	9

*C2/C8
**Each Diode
***NOTE: Add a "T1" suffix to the part number to order the 7 inch/3000 unit reel.
Add a "T3" suffix to the part number to order the 13 inch/10,000 unit reel.

Tuning Diodes — Hyper-Abrupt Junction



The Hyper Abrupt family exhibits higher capacitance, and a much larger capacitance ratio. It is particularly well suited for wider-range applications such as AM/FM radio and TV tuning.

Typical Characteristics

Diode Capacitance versus Reverse Voltage

Figure 1. Diode Capacitance

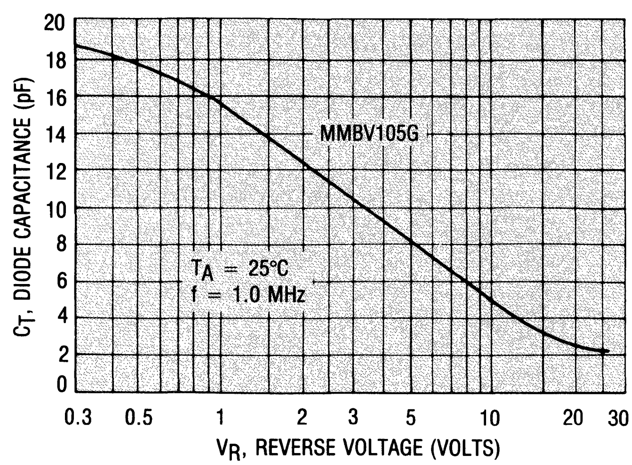


Figure 2. Diode Capacitance

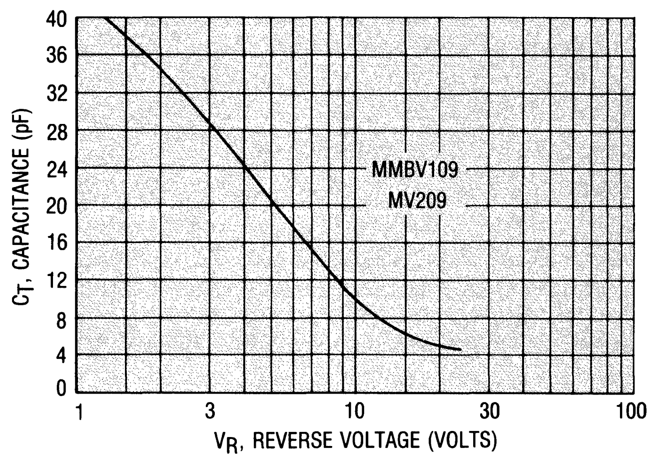


Figure 3. Diode Capacitance

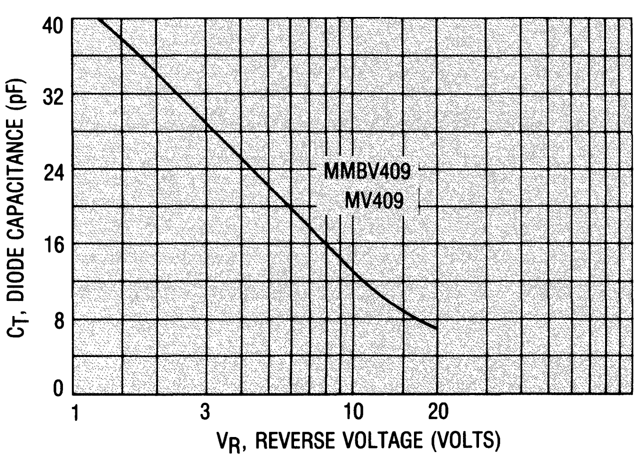


Figure 4. Diode Capacitance

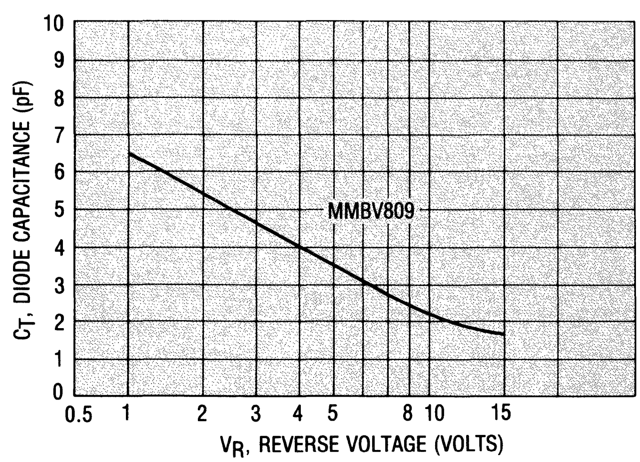


Figure 5. Diode Capacitance

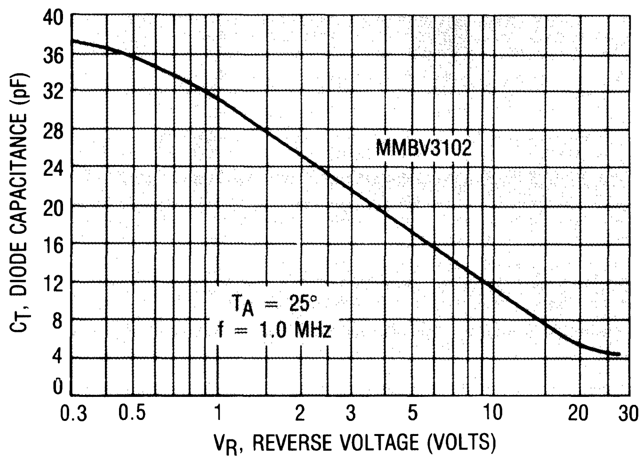
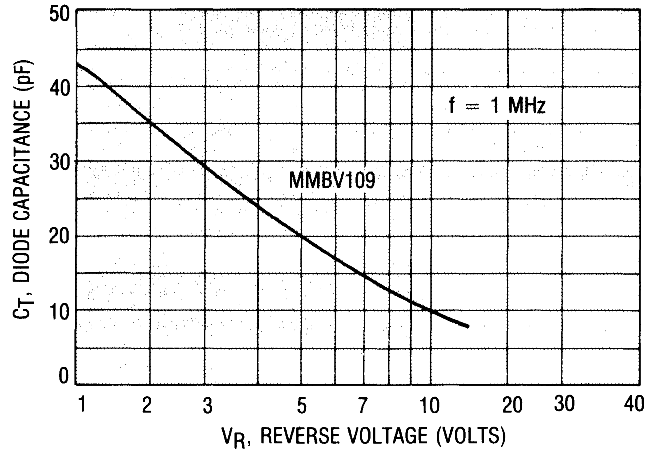
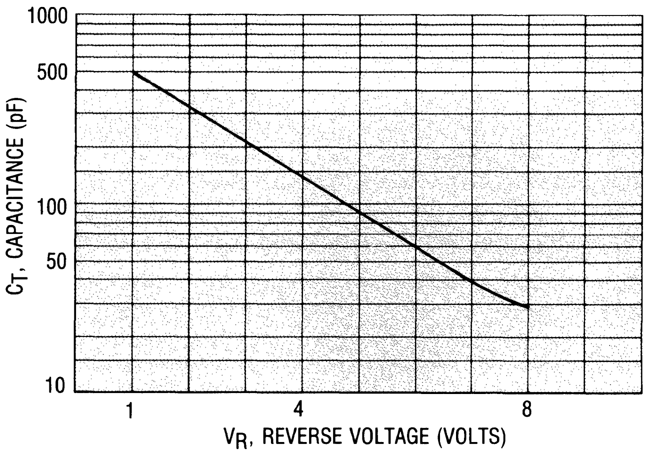


Figure 6. Diode Capacitance Each Die



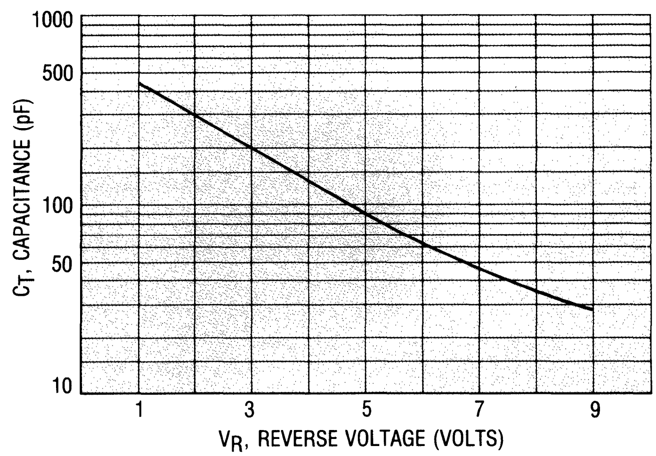
MVAM108

Figure 7. Capacitance versus Reverse Voltage



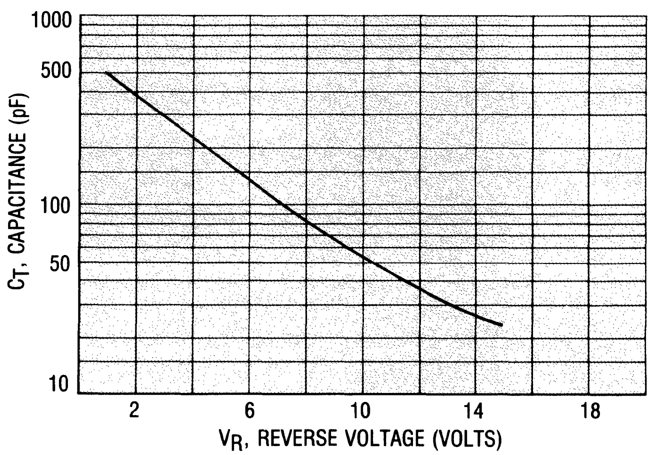
MVAM109/MV7005

Figure 8. Capacitance versus Reverse Voltage



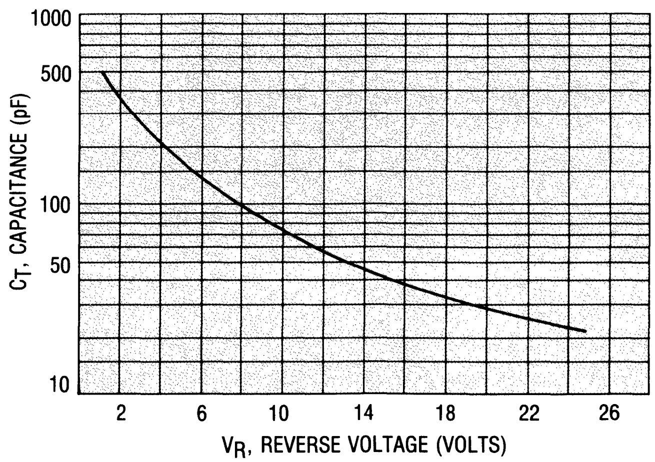
MVAM115

Figure 9. Capacitance versus Reverse Voltage



MVAM125

Figure 10. Capacitance versus Reverse Voltage



SMALL-SIGNAL TUNING AND SWITCHING DIODES — TUNING DIODES/ HYPER-ABRUPT JUNCTION (continued)

Figure 11. Diode Capacitance versus Reverse Voltage

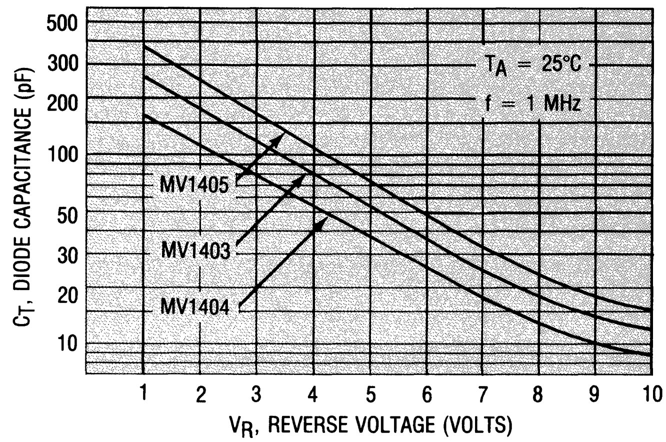


Table 1. Hyper-Abrupt Tuning Diodes for FM Radio and TV — Single

The following is a listing of hyper-abrupt tuning diodes intended for high frequency, FM radio, and TV tuner applications.

Device	C_T @ V_R (f = 1.0 MHz) pF Min	pF Max	Volts	Cap Ratio @ V_R Min	Max	Volts	Q 3V Min	50 MHz Max	$V_{(BR)R}$ Volts	Device Marking	Case Style	CV Curve Fig
Case 182-02 — TO-226AC (TO-92)												
MV209	26	32	3.0	5.0	6.5	3/25	200	—	30	—	1	2
MV409	26	32	3.0	1.5	2.0	3/8	200	—	20	—	1	3
Case 318-07 — TO-236AB (SOT-23)												
MMBV105G*	1.8	2.8	25	4.0	6.0	3/25	200	—	30	M4E	8	1
MMBV109*	26	32	3.0	5.0	6.5	3/25	200	—	30	M4A	8	2
MMBV409*	26	32	3.0	1.5	2.0	3/8	200	—	20	X5	8	3
MMBV809*	4.5	6.1	2.0	1.8	2.6	2/8	300	—	20	5K	8	4
MMBV3102*	20	25	3.0	4.5	—	3/25	200	—	30	M4C	8	5

Table 2. Hyper-Abrupt Tuning Diodes for FM Radio and TV — Dual

Device	C_T @ V_R (f = 1.0 MHz) pF Min	pF Max	Volts	Cap Ratio @ V_R Min	Max	Volts	Q 3V Min	50 MHz Max	$V_{(BR)R}$ Volts	Device Marking	Case Style	CV Curve Fig
Case 318-07 — TO-236AB (SOT-23)												
MMBV609*	26	32	3	1.8	2.4	3/8	250	—	20	5L	9	6

*NOTE Add a "T1" suffix to the part number to order the 7 inch/3000 unit reel.
Add a "T3" suffix to the part number to order the 13 inch/10,000 unit reel.

Table 3. Hyper-Abrupt Tuning Diodes for AM Radio — Single

The following is a listing of AM, hyper-abrupt tuning diodes that have a large capacity range and are designed for low frequency circuit applications.

Device	C_T @ 1.0 MHz pF Min	pF Max	Volts	Cap Ratio @ V_R Min	Volts	$V_{(BR)R}$ Volts	Style	CV Curve Figure
Case 182-02 — TO-226AC (TO-92)								
MVAM108	440	560	1.0	15	1.0/8.0	12	1	7
MVAM109	400	520	1.0	12	1.0/9.0	15	1	8
MVAM115	440	560	1.0	15	1.0/15	18	1	9
MVAM125	440	560	1.0	15	1.0/25	28	1	10

Table 4. Hyper-Abrupt High Capacitance Voltage Variable Diode — Surface Mount

The following is a high capacitance voltage variable diode intended for AM radio applications and circuits requiring large tuning capacitance.

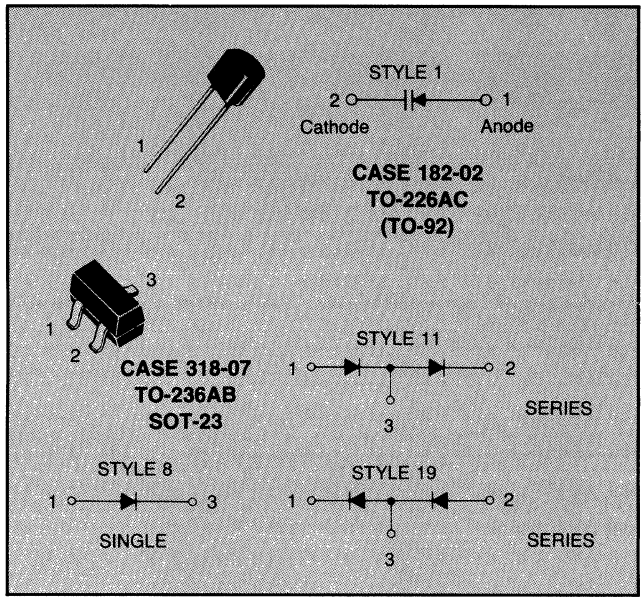
Device	$V_{(BR)R}$ Volts	I_R nA	C_T Diode Capacitance Min pF	Max pF	Cap Ratio Min	Q Min	Style	CV Curve Figure
Case 318E-04 — SOT-223								
Pinout: 1-Anode, 2, 4-Cathode, 3-NC								
MV7005	15	100	400	520	12	150	2	8

Table 5. Hyper-Abrupt High Capacitance Tuning Diodes

Device	C_T @ V_R pF Min	pF Max	Volts	Cap Ratio C2/C10 Min	Q 2.0 V, 1.0 MHz Min	$V_{(BR)R}$ Volts	Style	CV Curve Figure
Case 51-02 — DO-204AA (DO-7)								
MV1404	96	144	2.0	10	200	12	1	11
MV1403	140	210	2.0	10	200	12	1	11
MV1405	200	300	2.0	10	200	12	1	11

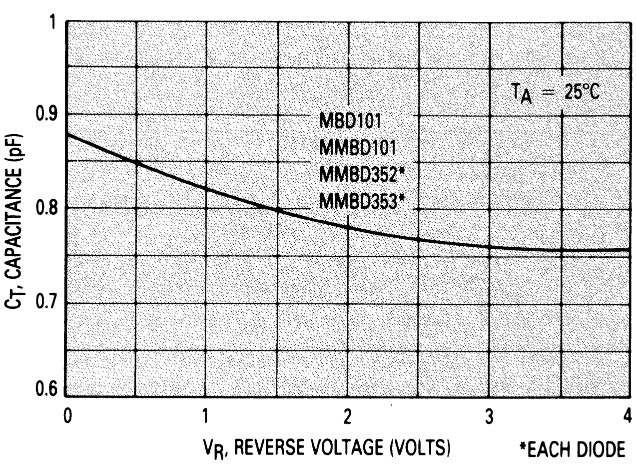
Hot-Carrier (Schottky) Diodes

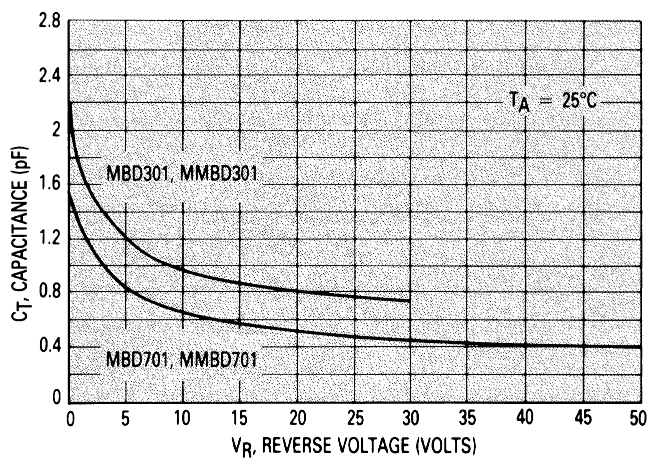
Hot-Carrier diodes are ideal for VHF and UHF mixer and detector applications as well as many higher frequency applications. They provide stable electrical characteristics by eliminating the point-contact diode presently used in many applications.



Typical Characteristics

Capacitance versus Reverse Voltage





(See Table 1)

Table 1. Hot-Carrier (Schottky) Diodes

The following is a listing of hot carrier (Schottky) diodes that exhibit low forward voltage drop for improved circuit efficiency.

Device	$V_{(BR)R}$ Volts	C_T @ V_R pF Max	V_F @ 10 mA Volts Max	I_R @ V_R nA Max	Minority Lifetime pS	Device Marking	Style
Case 182-02 — TO-226AC (TO-92)							
MBD701	70	1.0 @ 20 V	1.2	200 @ 35 V	15	—	1
MBD301	30	1.5 @ 15 V	0.6	200 @ 25 V	15	—	1
MBD101	4.0	1.0 @ 0 V	0.6	250 @ 3.0 V	—	—	1
Case 318-07 — TO-236AB (SOT-23)							
MMBD701	70	1.0 @ 20 V	1.2	200 @ 35 V	15	5H	8
MMBD301	30	1.5 @ 15 V	0.6	200 @ 25 V	15	4T	8
MMBD101	4.0	1.0 @ 0 V	0.6	250 @ 3.0 V	—	4M	8
MMBD352*	4.0	1.0 @ 0 V	0.6	250 @ 3.0 V	—	M5G	11
MMBD353*	4.0	1.0 @ 0 V	0.6	250 @ 3.0 V	—	M4F	19

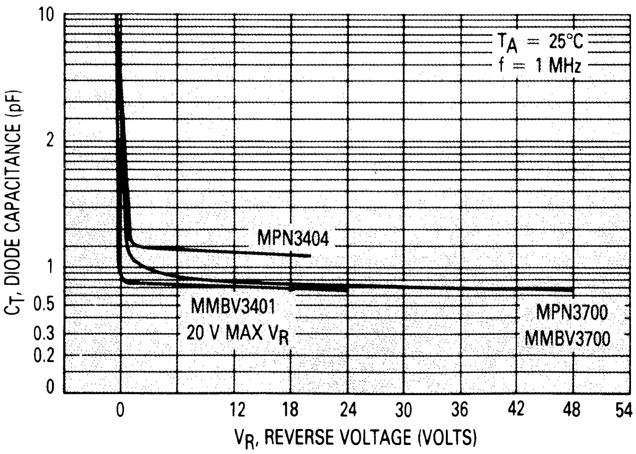
*Dual Diodes

Switching Diodes

Small-signal switching diodes are intended for low current switching and steering applications. Hot-Carrier, PIN and general-purpose diodes allow a wide selection for specific application requirements.

Typical Characteristics

Capacitance versus Reverse Voltage



(See Table 1)

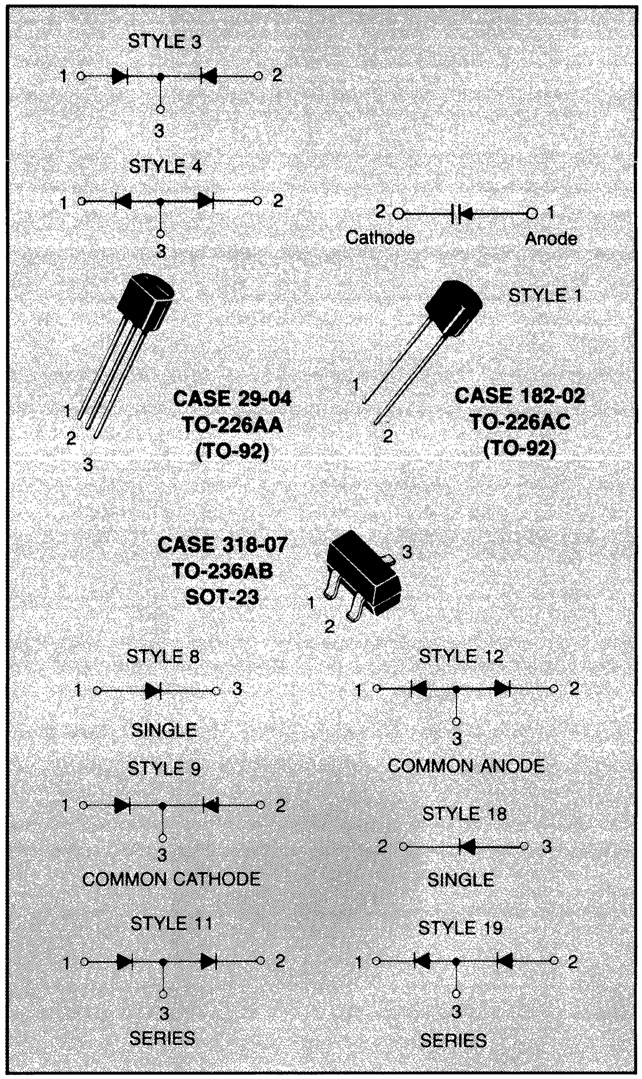


Table 1. PIN Switching Diodes

The following PIN diodes are designed for VHF band switching and general-purpose low current switching applications.

Device	$V_{(BR)R}$ Volts Min	C_T @ V_R @ 1.0 MHz pF Max	Volts	I_R @ V_R nA Max	Series Resistance Ohm Max	Device Marking	Style
Case 182-02 — TO-226AC (TO-92)							
MPN3700	200	1.0	20	0.1 @ 150	1.0 @ 10 mA	—	1
MPN3404	20	2.0	15	0.1 @ 25 V	0.85 @ 10 mA	—	1
Case 318-07 — TO-236AB (SOT-23)							
MMBV3700*	200	1.0	20	0.1 @ 150	1.0 @ 10 mA	4R	8
MMBV3401*	35	1.0	20	0.1 @ 25 V	0.7 @ 10 mA	4D	8

*NOTE: Add a "T1" suffix to the part number to order the 7 inch/3000 unit reel.
Add a "T3" suffix to the part number to order the 13 inch/10,000 unit reel.

Table 2. General-Purpose Signal and Switching Diodes — Single

The following is a listing of small-signal switching diodes in surface mount packages. These diodes are intended for low current switching and signal steering applications.

Device	Marking	$V_{(BR)R}$ Min (V)	$V_{(BR)R}$ @ I_{BR} (μA)	I_R Max (μA)	I_R @ V_R (V)	V_F Min (V)	V_F Max (V)	V_F @ I_F (mA)	C_T Max (pF)	t_{rr} Max (ns)	Pin Out Case Style
Case 318-07 — TO-236AB (SOT-23)											
BAS21*	A82	250	100	0.1	200		1	100	5	50	8
BAS20*	A81	200	100	0.1	150		1	100	5	50	8
BAS19*	A8	120	100	0.1	100		1	100	5	50	8
MMBD914*	5D	100	100	5	75		1	10	4	4	8
BAS16*	A6	75	100	1	75		1	50	2	6	8
MMBD6050*	5A	70	100	0.1	50	0.85	1.1	100	2.5	4	8
BAL99*	JF	70	100	2.5	70		1	50	1.5	6	18

Table 3. General-Purpose Signal and Switching Diodes — Dual

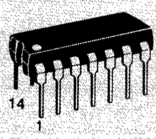
The following is a listing of small-signal switching diodes in surface mount packages. These diodes are intended for low current switching and signal steering applications.

Device	Marking	$V_{(BR)R}$ Min (V)	$V_{(BR)R}$ @ I_{BR} (μA)	I_R Max (μA)	I_R @ V_R (V)	V_F Min (V)	V_F Max (V)	V_F @ I_F (mA)	C_T Max (pF)	t_{rr} Max (ns)	Pin Out Case Style
Case 318-07 — TO-236AB (SOT-23)											
MMBD7000*	M5C	100	100	0.3	50	0.75	1.1	100	1.5	4	11
MMBD2836*	A2	75	100	0.1	50		1	10	4	4	12
MMBD2838*	A6	75	100	0.1	50		1	10	4	4	9
BAV70*	A4	70	100	5	70		1	50	1.5	6	9
BAV99*	A7	70	100	2.5	70		1	50	1.5	4	11
BAW56*	A1	70	100	2.5	70		1	50	2	6	12
MMBD6100*	5BM	70	100	0.1	50	0.85	1.1	100	2.5	4	9
BAV74*	JA	50	5	0.1	50		1	100	2	4	9
MMBD2835*	A3	35	100	0.1	30		1	10	4	4	12
MMBD2837*	A5	35	100	0.1	30		1	10	4	4	9

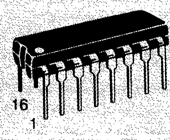
*NOTE: Add a "T1" suffix to the part number to order the 7 inch/3000 unit reel.
Add a "T3" suffix to the part number to order the 13 inch/10,000 unit reel.

Multiple Switching Diodes

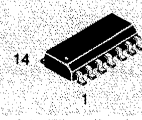
Multiple diode configurations utilize monolithic structures fabricated by the planar process. They are designed to satisfy fast switching requirements as in core driver and encoding/decoding applications where their monolithic configurations offer lower cost, higher reliability and space savings.



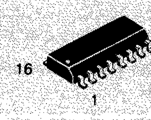
CASE 646-06
PIN DIP
PLASTIC



CASE 648-08
PIN DIP
PLASTIC

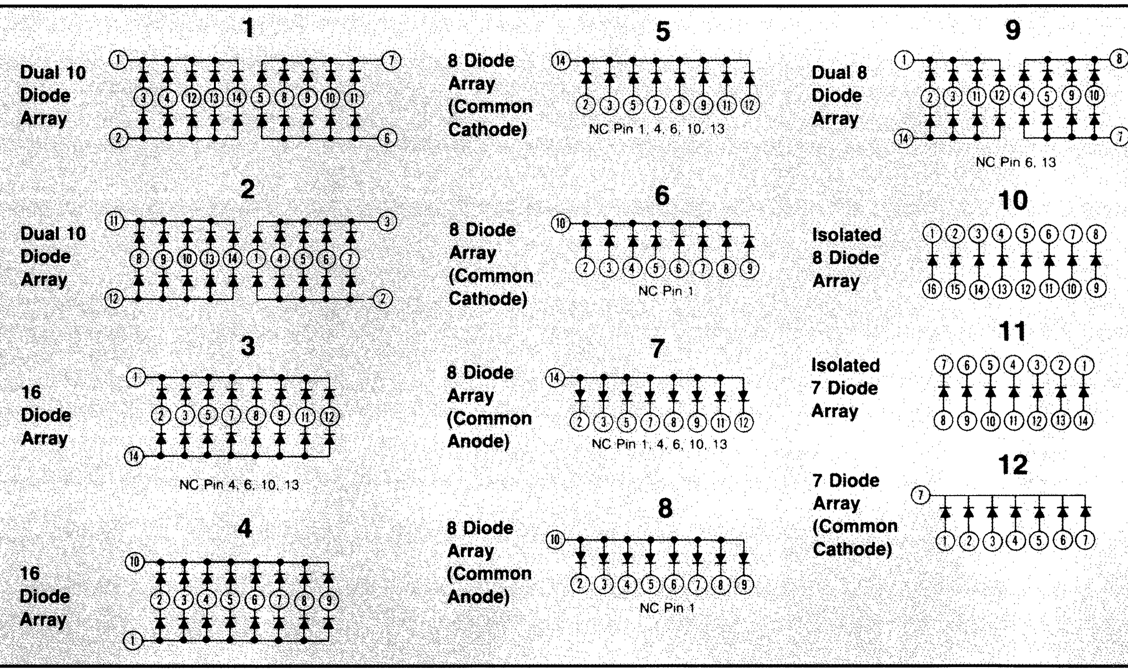


CASE 751A-02
SO-14
PLASTIC



CASE 751B-03
SO-16
PLASTIC

Diode Array Diagrams



MULTIPLE SWITCHING DIODES (continued)

Table 1. Diode Arrays

Case 646-06 — TO-116

Device	Function	Pin Connections Diagram No.
MAD130P	Dual 10 Diode Array	1
MAD1103P	16 Diode Array	3
MAD1105P	8 Diode Common Cathode Array	5
MAD1106P	8 Diode Common Anode Array	7
MAD1107P	Dual 8 Diode Array	9
MAD1109P	7 Isolated Diode Array	11
Case 648-08		
MAD1108P	8 Isolated Diode Array	10
Case 751A-02 — SO-14		
MMAD130	Dual 10 Diode Array	2
MMAD1103	16 Diode Array	3
MMAD1105	8 Diode Common Cathode Array	5
MMAD1106	8 Diode Common Anode Array	7
MMAD1107	Dual 8 Diode Array	9
MMAD1109	7 Isolated Diode Array	11
MMAD1185	7 Diode Common Cathode Array	12
Case 751B-03 — SO-16		
MMAD1108	8 Isolated Diode Array	10

Optoelectronic Devices

Page

In Brief . . .

Motorola's families of optoelectronic components encompass red and infrared GaAs emitters and silicon detectors that are well matched for a variety of applications.

Emitters and Detectors

Motorola emitters (LEDs) are manufactured to operate at wavelengths of 660, 850 or 940 nanometers (nm).

The 940 nm emitters are least expensive. They are well suited for aplications where close proximity to the detector tolerates a moderate mismatch in spectral response in exchange for lower cost.

The 850 nm emitters have peak emission which almost exactly matches that of silicon detectors. These emitters are widely used where efficiency and high speed are of primary importance.

The 660 nm emitters are well matched to the characteristics of low-cost plastic fiber and find wide use in fiber optics communications.

Coupled with a line of silicon photodetectors with outputs tailored for specific applications (diodes, transistors, Darlingtons, triacs and Schmitt triggers). Motorola's product line offers the engineer a choice of components that can result in optimum system design.

Optoisolators

Infrared emitting diodes optically coupled to silicon detectors with a wide selection of outputs provide at least 7500-volt isolation between input and output. UL recognition and VDE approval attest to their suitability under the most stringent conditions.

Optointerrupters

Infrared LEDs facing photodetectors in a wide range of slotted packages permit custom design of systems to virtually any physical requirement. A wide selection of outputs (transistor, Darlington, logic thyristor, etc.) offers an excellent match for a variety of applications.

Fiber Optics

Low cost components offer 10 MHz bandwidth for short distance communications. High performance emitter detector components provide transmission up to several kilometers with bandwidths in excess of 100 MHz.

Chips

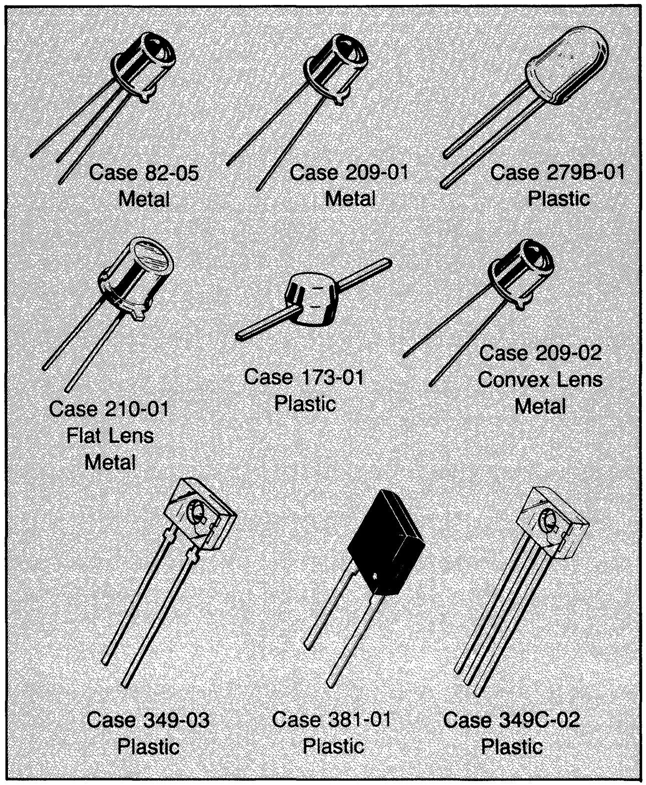
A number of LED and detector functions are available in chip form for hybrid system designs.

Optoelectronic Devices

Infrared Emitting Diodes

Motorola's infrared emitting diodes are made by the liquid phase epitaxial process for long life and stability. They provide high power output and quick response at 660 nm, 850 nm or 940 nm with low input drive current.

Device	Power Output $\mu W_{@}$ Typ	I_F mA	Emission Angle Typ	Peak Emission Wavelength nm Typ	Forward Voltage Max	$@ I_F$ mA	Case/ Style
MLED71	2500	50	60°	940	1.8	50	349-03/1
MLED76	4000	100	60°	660	2.2	60	349-03/4
MLED77	2500	100	60°	850	2	100	349-03/4
MLED81	16000	100	60°	940	1.7	100	279B-01/1
MLED930	650	100	30°	940	1.5	50	209-01/1



Silicon Photodetectors

A variety of silicon photodetectors are available, varying from simple PIN diodes to complex, single chip 400 volt triac drivers. They offer choices of viewing angle and size in either economical plastic cases or rugged, hermetic metal cans. They are spectrally matched for use with Motorola infrared emitting diodes.

PIN Photodiodes — Response Time = 1 ns Typ

Device	Light Current @ V_R = 20 V, H = 5 mW/cm^2 μA	Dark Current @ V_R = 20 V nA (Max)	Case/ Style
MRD500	9	2	209-02/1
MRD510	2	2	210-01/1
MRD721	4	10	349-03/1
MRD821	250	60	381-01/1

Phototransistors

Device	Light Current @V_{CC}=20, H=5 mW/cm^2 mA (Typ)	$V_{(BR)CEO}$ Volts (Min)	t_r/t_f @V_{CC}=20, I_L=1000 μA μs (Typ)	Case/ Style
MRD150	2.2	40	2.5/4	173-01/1
MRD310 MRD300 MRD3050 MRD3051 MRD3054 MRD3055 MRD3056	3.5 8 0.1 Min 0.2 Min 0.5 Min 1.5 Min 2 Min	50 50 30 30 30 30 30	2/2.5 2/2.5 2/2.5 2/2.5 2/2.5 2/2.5 2/2.5	82-05/1
			t_{on}/t_{off} @V_{CC}=5 V	
MRD701	0.5	30	10/60	349-03/2

Photodarlingtons

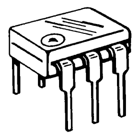
Device	Light Current @ V_{CC} = 5, H = 0.5 mW/cm^2 mA (Typ)	$V_{(BR)CEO}$ Volts (Min)	t_r/t_f @V_{CC}=5 V μs (Typ)	Case/ Style
MRD370 MRD360	10 20	40 40	15/40 15/65	82-05/1
MRD711	25	60	125/150	349-03/2

Photothyristors — Triac Drivers

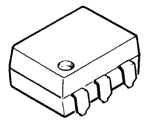
Device	H_{FT} mW/cm^2 Max	$I_{T(RMS)}$ mA Max	V_{DRM} Volts Peak Min	I_{DRM} nA Typ	Case/ Style
MRD3010 MRD3011	5 2	100 100	250 250	10 10	82-05/3

Photo Schmitt Triggers

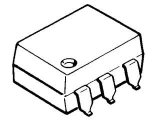
Device	Threshold Current mA ON Max	OFF Min	$\frac{I_{F(off)}}{I_{F(on)}}$ Typ	V_{CC} Volts	t_r/t_f μs Typ	Case/Style
MRD750	20	1.0	0.75	3–15	0.1	349C-02/3
MRD5009	20	1.0	0.75	3–15	0.1	82-05/1



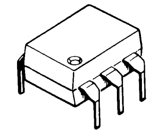
Case 730A



Surface-mountable butt-lead option Suffix R



Surface-mountable gull-wing option Suffix S



Wide-spaced (0.400″) lead form option Suffix T

Optoisolators

An optoisolator consists of a gallium arsenide infrared emitting diode, IRED, optically coupled to a monolithic silicon photo-detector in a light-shielding package. Motorola offers a wide array of standard devices and encourages the use of special designs and selections for special applications. All Motorola optoisolators are UL Recognized per File Number 54915 and VDE approved per Certificate Number 41853; **all have V_{ISO} rating of 7500 Vac(pk).**

Transistor Output

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Emitter, 5-Collector, 6-Base

Device	Current Transfer Ratio (CTR) % Min/Max	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
TIL112	2/—	10	5	0.5	50	2	2/2	2		10	20	1.5	10
TIL111	8/—	16	0.4	0.4	16	2	5/5	2		10	30	1.4	16
4N27	10/—	10	10	0.5	50	2	1.2/1.3		10	10	30	1.5	10
4N28	10/—	10	10	0.5	50	2	1.2/1.3		10	10	30	1.5	10
4N38,A	10/—	10	10	1	20	4	1.6/2.2	2		10	80	1.5	10
H11A4	10/—	10	10	0.4	10	0.5	1.2/1.3		10	10	30	1.5	10
4N25,A	20/—	10	10	0.5	50	2	1.2/1.3		10	10	30	1.5	10
4N26	20/—	10	10	0.5	50	2	1.2/1.3		10	10	30	1.5	10
H11A2	20/—	10	10	0.4	10	0.5	1.2/1.3		10	10	30	1.5	10
H11A3	20/—	10	10	0.4	10	0.5	1.2/1.3		10	10	30	1.5	10
H11A520	20/—	10	10	0.4	20	2	5*/5*	2		10	30	1.5	10
H11AV3,A	20/—	10	10	0.4	20	2	5*/4*	2		10	70	1.5	10
MCT2	20/—	10	10	0.4	16	2	1.2/1.3		10	5	30	1.5	20
MCT2E	20/—	10	10	0.4	16	2	1.2/1.3		10	10	30	1.5	20
TIL116	20/—	10	10	0.4	15	2.2	5/5	2		10	30	1.5	60
H11A5	30/—	10	10	0.4	10	0.5	1.2/1.3		10	10	30	1.7	10
CNY17-1	40/80	10	5	0.4	10	2.5	1.6/2.3		10	5	70	1.65	60
MCT271	45/90	10	10	0.4	16	2	4.9*/4.5*	2		5	30	1.5	20
MOC8100	50/—	1	5	0.5	1	0.1	3.8/5.6	2		10	30	1.4	1
H11A1	50/—	10	10	0.4	10	0.5	1.2/1.3		10	10	30	1.5	10
H11A550	50/—	10	10	0.4	20	2	5*/5*	2		10	30	1.5	10
H11AV2,A	50/—	10	10	0.4	20	2	5*/4*	2		10	70	1.5	10
TIL117	50/—	10	10	0.4	10	0.5	5/5	2		10	30	1.4	16
TIL126	50/—	10	10	0.4	10	1	2/2	2		10	30	1.4	10
CNY17-2	63/125	10	5	0.4	10	2.5	1.6/2.3		10	5	70	1.65	60
MCT275	70/210	10	10	0.4	16	2	4.5*/3.5*	2		5	80	1.5	20
MCT272	75/150	10	10	0.4	16	2	6*/5.5*	2		5	30	1.5	20
4N35	100/—	10	10	0.3	10	0.5	3.2/4.7	2		10	30	1.5	10
4N36	100/—	10	10	0.3	10	0.5	3.2/4.7	2		10	30	1.5	10
4N37	100/—	10	10	0.3	10	0.5	3.2/4.7	2		10	30	1.5	10
H11A5100	100/—	10	10	0.4	20	2	5*/5*	2		10	30	1.5	10
CNY17-3	100/200	10	5	0.4	10	2.5	1.6/2.3		10	5	70	1.65	60
H11AV1,A	100/300	10	10	0.4	20	2	5*/4*	2		10	70	1.5	10
MCT273	125/250	10	10	0.4	16	2	7.6*/6.6*	2		5	30	1.5	20
MCT274	225/400	10	10	0.4	16	2	9.1*/7.9*	2		5	30	1.5	20

* t_{on}, t_{off}

OPTOISOLATORS (continued)

Transistor Output with No Base Connection

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Emitter, 5-Collector, 6-N.C.

Device	Current Transfer Ratio (CTR) % Min	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
MOC8111	20	10	10	0.4	10	0.5	3.2/4.7	2		10	30	1.5	10
MOC8112	50	10	10	0.4	10	0.5	3.2/4.7	2		10	30	1.5	10
MOC8113	100	10	10	0.4	10	0.5	3.2/4.7	2		10	30	1.5	10

AC Input — Transistor Output

Pinout: 1-LED 1 Anode/LED 2 Cathode, 2-LED 1 Cathode/LED 2 Anode, 3-N.C., 4-Emitter, 5-Collector, 6-Base

Device	Current Transfer Ratio (CTR) % Min	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
H11AA1	20	±10	10	0.4	±10	0.5					30	1.5	±10
H11AA2	10	±10	10	0.4	±10	0.5					30	1.8	±10
H11AA3	50	±10	10	0.4	±10	0.5					30	1.5	±10
H11AA4	100	±10	10	0.4	±10	0.5					30	1.5	±10

Darlington Output

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Emitter, 5-Collector, 6-Base

Device	Current Transfer Ratio (CTR) % Min	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
4N31	50	10	10	1.2	8	2	0.6*/17*	50	200	10	30	1.5	10
4N29,A	100	10	10	1	8	2	0.6*/17*	50	200	10	30	1.5	10
4N30	100	10	10	1	8	2	0.6*/17*	50	200	10	30	1.5	10
H11B255	100	10	5	1	50	50	125*/100*	10		10	55	1.5	20
MCA230	100	10	5	1	50	50	10/35		50	10	30	1.5	20
MCA255	100	10	5	1	50	50	10/35		50	10	55	1.5	20
H11B2	200	1	5	1	1	1	1/2	10		10	25	1.5	10
MCA231	200	1	1	1.2	10	50	80	10		10	30	1.5	10
TIL113	300	10	1.25	1	50	125	300	125		15	30	1.5	10
4N32,A	500	10	10	1	8	2	0.6*/45*	50	200	10	30	1.5	10
4N33	500	10	10	1	8	2	0.6*/45*	50	200	10	30	1.5	10
H11B1	500	1	5	1	1	1	1/2		5	10	25	1.5	10
MOC8080	500	10	5	1	1	1	1/2		5	10	55	1.5	10

Darlington Output with No Base Connection

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Emitter, 5-Collector, 6-N.C.

Device	Current Transfer Ratio (CTR) % Min	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
MOC119	300	10	2	1	10	10	1/2	2.5		10	30	1.5	10
TIL119	300	10	2	1	10	10	300	2.5		10	30	1.5	10
MOC8030	300	10	1.5				1/2		5	10	80	2	10
MOC8020	500	10	5				1/2		5	10	50	2	10
MOC8050	500	10	1.5				1/2		5	10	80	2	10
MOC8021	1000	10	5				1/2		5	10	50	2	10

Resistor-Darlington Output

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Emitter, 5-Collector, 6-Base

Device	Current Transfer Ratio (CTR) % Min	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
H11G1	1000	10	1	1	1	1	5*/100*		10	5	100	1.5	10
H11G2	1000	10	1	1	1	1	5*/100*		10	5	80	1.5	10
H11G3	200	1	5	1.2	50	20	5*/100*		10	5	55	1.5	10

High Voltage Transistor Output

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Emitter, 5-Collector, 6-Base

Device	Current Transfer Ratio (CTR) % Min	@ I_F mA	& V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_r/t_f Typ µs	@ I_C mA	I_F mA	& V_{CC} Volts	$V_{(BR)CEO}$ Volts Min	V_F Volts Max	@ I_F mA
MOC8204	20	10	10	0.4	10	0.5	5*/5*	2		10	400	1.5	10
H11D1	20	10	10	0.4	10	0.5	5*/5*	2		10	300	1.5	10
H11D2	20	10	10	0.4	10	0.5	5*/5*	2		10	300	1.5	10
H11D3	20	10	10	0.4	10	0.5	5*/5*	2		10	200	1.5	10
H11D4	10	10	10	0.4	10	0.5	5*/5*	2		10	200	1.5	10
4N38	10	10	10	1	20	4	1.2/2.2	2		10	80	1.5	10
4N38A	10	10	10	1	20	4	1.6/2.2	2		10	80	1.5	10
MCT275	70	10	10	0.4	16	2	4.5*/3.5*	2		5	80	1.5	20

* t_{on}, t_{off}

Triac Driver Output

Pinout: 1-Anode, 2-Cathode, 3-N.C., 4-Main Terminal, 5-Substrate, 6-Main Terminal

Device	Peak Blocking Voltage Min	LED Trigger Current-I_{FT} (V_{TM} = 3 V) mA Max	Zero Crossing Inhibit Voltage (at rated I_{FT}) Volts Max	V_{ISO} Vac Pk	dv/dt V/μs Typ
MOC3009	250	30	—	7500	10
MOC3010	250	15	—	7500	10
MOC3011	250	10	—	7500	10
MOC3012	250	5	—	7500	10
MOC3020	400	30	—	7500	10
MOC3021	400	15	—	7500	10
MOC3022	400	10	—	7500	10
MOC3023	400	5	—	7500	10
MOC3031	250	15	20	7500	2000
MOC3032	250	10	20	7500	2000
MOC3033	250	5	20	7500	2000
MOC3041	400	15	20	7500	2000
MOC3042	400	10	20	7500	2000
MOC3043	400	5	20	7500	2000
MOC3061	600	15	20	7500	1500
MOC3062	600	10	20	7500	1500
MOC3063	600	5	20	7500	1500
MOC3081	800	15	20	7500	1500
MOC3082	800	10	20	7500	1500
MOC3083	800	5	20	7500	1500

SCR Output

Device	Peak Blocking Voltage Min	LED Trigger Current-I_{FT} (V_{AK} = 50 V) mA Max	V_{ISO} Vac Pk	dv/dt V/μs Typ
4N39	200	30	1500	500
4N40	400	30	1500	500
H11C1	200	20	3535	500 Min
H11C2	200	20	2500	500 Min
H11C3	200	30	2500	500 Min
MCS2	200	14(V_{AK} = 100 V)	3000 RMS	
MCS2400	400	14(V_{AK} = 100 V)	3000 RMS	
MOC3000	400	20	7500	500
MOC3001	400	30	7500	500
MOC3002	250	30	7500	500
MOC3003	250	20	7500	500
MOC3007	200	40	7500	500
H11C4	400	20	3535	500
H11C5	400	20	2500	500
H11C6	400	30	2500	500

Schmitt Trigger Output

Device	Threshold Current On mA Max	Threshold Current Off mA Min	$I_{F(off)}/I_{F(on)}$		V_{CC}		t_r, t_f μs Typ	V_{ISO} Vac Pk
			Min	Max	Min	Max		
H11L1	1.6	0.3	0.5	0.9	3	15	0.1	3535
H11L2	10	0.3	0.5	0.9	3	15	0.1	3535
MOC5007	1.6	0.3	0.5	0.9	3	15	0.1	
MOC5008	4	0.3	0.5	0.9	3	15	0.1	
MOC5009	10	0.3	0.5	0.9	3	15	0.1	

OPTOELECTRONIC DEVICES (continued)

VDE Approved Optoisolators

VDE has approved Motorola's entire portfolio of DOME 6-pin DIP OPTOISOLATORS against their Component Standard VDE0883 and has granted Motorola compliance with many VDE and IEC Equipment Standards per approval No. 41853 Nov. 26, 1985.

VDE approval is based on mechanical and electrical performance of the new "DOME" package shown in Figure 1. This 6-pin DIP package incorporates specially developed materials and assembly processes optimizing thermal and moisture stability while maintaining the high level of IRED life and isolation voltage. Most 6-pin DIP optoisolators are now made in this package, but in the near future, all will use the "DOME" construction.

VDE0833 Component Standard

Electrical ratings in this standard are:

Isolation withstand voltages:

3750 V_{RMS}, 1 min, T_A = 100°C

5300 Vdc, 1 min, T_A = 100°C

Isolation surge withstand voltage:

10 kV per IEC 65, 50 discharges

Isolation resistance:

10^{11} Ω, 500 Vdc, T_A = 100°C

Mechanical ratings are shown in the table below.

Equipment Standards Compliance

With the approval of the "DOME" package to the Component Standard VDE0883 combined with their VDE approval ratings, a wide range of Equipment Standards are covered. The following table summarizes the optocouplers approved for many of the equipment standards and insulation levels.

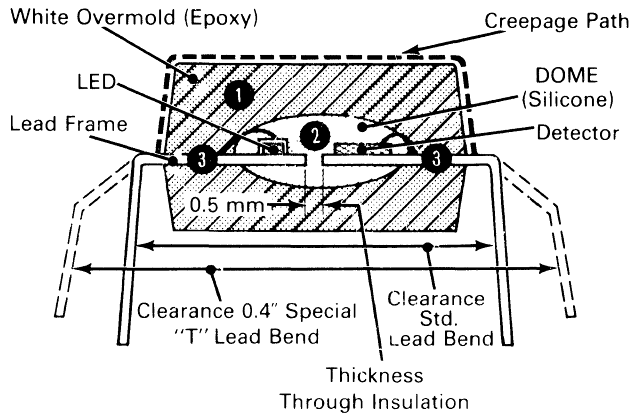


Figure 1. "DOME" Package

Two levels of electrical interface, or insulation, are used: 1. Reinforced, or safe, insulation; 2. Basic insulation.

Reinforced Insulation (sometimes referred to as "safe electrical isolation") is required in an optoisolator interfacing between a hazardous voltage circuit, like an ac line, and a **touchable s**afe **e**xtra **l**ow **v**oltage (SELV) circuit.

Basic Insulation is required in an optoisolator which interfaces between a hazardous voltage circuit and a **non-touchable, e**xtra **l**ow **v**oltage (ELV) circuit.

Examples for Safety Applications for Motorola VDE Approved DOME Optoisolators

Standard (2)			Requirements for reinforced (double) or save insulation for equipment with an operating voltage up to 250 V rms (line voltage to ELV or SELV interfaces)				
VDE	DIN IEC	Equipment	Creepage	Clearance (1)	Isolation Barrier	Dielectric Strength	Isolation Resistance
			[mm]	[mm]	[mm]	[kV RMS]	[Ω]
0806	380	Office Machines	8	8	0.5	3.75	7×10^6
0805	435	Data Processing	8	8	—	3.75	7×10^6
0804	—	Telecommunication	8	8	—	2.50	2×10^6
0860	65	Electrical Household	6	6	0.4	3.0 (10)*	4×10^6
0113	204	Industrial Controls	8	8	—	2.5	1×10^6
0160	—	Power Installations with Electronic Equipment	8	8	—	2.70	1×10^6
0832	—	Traffic Light Controls	8	8	—	2.50	4×10^6
0883	—	Alarm Systems	8	8	—	2.50	2×10^6
0831	—	Electrical Signal System for Railroads	8	8	—	2.0	2×10^6
0110	—	General Std. for Electrical Equipment	8	8	—	2.0	—
0883	—	Optoisolator Comp. Std.	8.5	8.3 (10.0) (1)	0.5	3.75 (10)*	10×10^{11}
			VDE Rating for Motorola Optoisolators				

All Motorola VDE Approved DOME Optoisolators meet or exceed the requirements of above listed VDE and DIN IEC Standards.

* Impulse discharge withstand voltage.

(1) To satisfy 8 mm creepage path on a PC board Motorola offers a special lead bend of 0.4 inch on all 6-pin dual-in-line optoisolators. Order by attaching "T" to the end of the Motorola part number.

(2) VDE standards (translated into English language) and IEC standards can be ordered from the American National Standard Institute ANSI 1430 Broadway, N.Y., N.Y. 10018, Sales Department, Phone 212-354-3300.

Optointerrupters

An Optointerrupter consists of an infrared emitting diode facing a photodetector in a molded plastic housing. A slot in the housing between the emitter and detector provides a means for interrupting the signal.

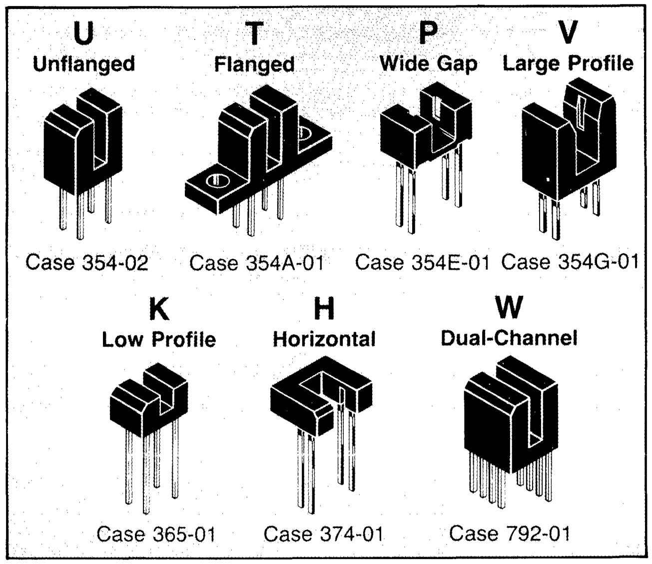
Motorola Optointerrupters are available in a wide selection of detector functions and housings to meet the specific needs of the system designer. The available variables are:

Detector Output;
Package Outline;
Performance Level.

The various options are listed in the table below.

The generic number for Motorola Optointerrupters is **MOC7.** To construct the final device number for a specific unit, the generic number is followed by:

- a single Digit representing the desired output function;
- a single Letter representing the desired package;
- another single Digit indicating the desired performance level, as given in the table.



These standard Interrupter packages can be supplemented with custom packages. For details consult your Motorola Sales Representative.

In accordance with this code, the sample Part Number at the bottom of the table (MOC75T2) represents a logic output interrupter in a flanged package with an LED trigger current of 15 mA. Parts that can be constructed within the above guidelines are readily available.

Output Function	Available Package Outlines	Performance Level	CTR Min	@ I_F (mA)	V_{CE} (V)	$V_{CE(S)}$ Max V	@ I_F (mA)	I_C (mA)	LED Trigger Current (mA)	V_F Max V	@ I_F (mA)	Output Voltage Range V Max
0 Transistor	H, P, K, T, U, V	1	5%	20	5	0.4	30	1.8	N/A	1.8	50	30
		2	10%	20	5	0.4	20	1.8	N/A	1.8	50	30
		3	20%	20	5	0.4	20	1.8	N/A	1.8	50	30
	W	1	0.5%	20	10	0.4	20	.05	N/A	1.8	50	30
		2	1.25%	20	10	0.4	20	.125	N/A	1.8	50	30
1 Darlington	H, P, T, U, V	1	50%	5	1.5	1	10	1.8	N/A	1.8	60	30
		3	200%	10	1.5	1	10	1.8	N/A	1.8	60	30
	W	1	50%	5	5	1	10	1.8	N/A	1.8	60	30
			750%	10	5							
5 Logic	T, U	1	N/A			N/A			30	1.6	20	3–15
		2							15	1.6	20	

Example of part number construction

MOC 7	5	T	2

MOC75T2 is a flanged, logic output interrupter with LED trigger current of 15 mA.

Custom package outlines are available also. Consult your sales representative for information.

Fixed-Specification Optointerrupters ($V_{(BR)CEO}$ = 30 V)

Device Case 354A-01	Device Case 354-02	Current Transfer Ratio % Min	@ I_F mA	@ V_{CE} Volts	$V_{CE(sat)}$ Volts Max	@ I_F mA	& I_C mA	t_{on}/t_{off} μs Typ(1)	V_F Volts Max	@ I_F mA
TRANSISTOR OUTPUT										
H21A1	H22A1	5	20	5	0.4	30	1.8	12/60	1.7	60
H21A2	H22A2	10	20	5	0.4	20	1.8	12/60	1.7	60
H21A3	H22A3	20	20	5	0.4	20	1.8	12/60	1.7	60
DARLINGTON OUTPUT										
H21B1	H22B1	75	10	1.5	1	10	1.8	125/150	1.7	60
H21B2	H22B2	140	10	1.5	1	10	1.8	125/150	1.7	60
H21B3	H22B3	250	10	1.5	1	10	1.8	125/150	1.7	60

Fiber Optic Components

Emitters

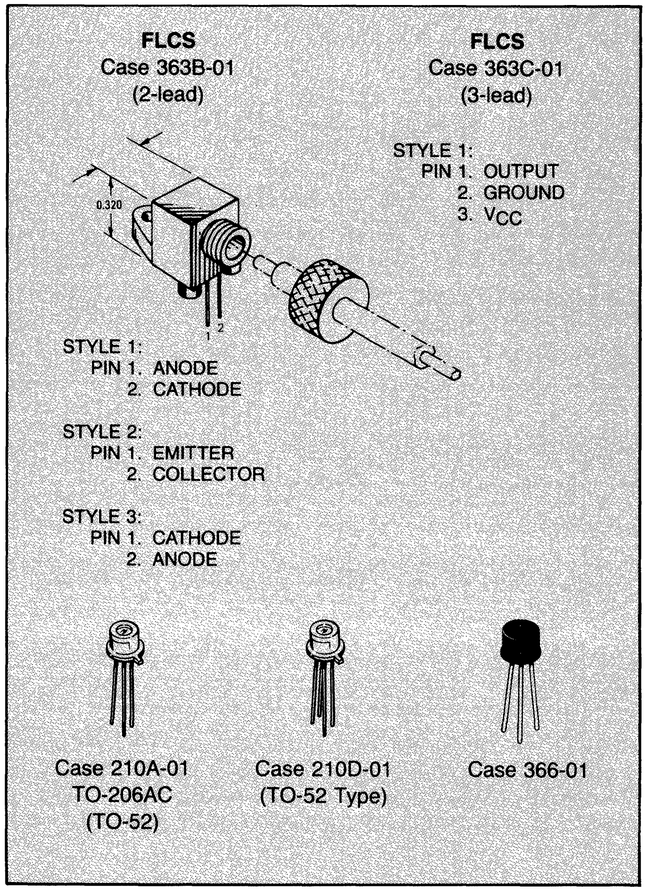
Motorola offers three families of emitters for fiber optic systems.

- **"High Performance"** family in hermetic Case 210 for systems requiring greater than 100 MHz analog bandwidth over several kilometers.
- **"MOD-LINE"** family in plastic Case 366 provides moderate performance (60 MHz) over moderate distances (500 meters).
- **"FLCS"** family in unique FLCS package is designed for applications requiring low cost, speeds up to 10 MHz and distances under 200 meters. (The FLCS package serves as its own connector.) It is used with inexpensive 1000 micron core fiber (Eska SH4001).

Detectors

Detectors are available with a variety of output configurations that greatly affect Bandwidth and Responsivity.

All Motorola fiber optic components, except the FLCS family, are designed for use with 100 micron (or larger) core glass fiber and fit directly into the following industry standard connector systems. AMP #228756-1, AMPHENOL #905-138-5001, OFTI #PCR001.



Emitters

Device	Total Power Output mW Typ	@ I_F mA	Response Time t_r ns Typ	t_f ns Typ	λ nm Typ	Case/Style
MFOE71	3.5	100	25	25	850	363B-01/1
MFOE76	3.5	100	250	250	660	
MFOE200	3	100			940	209-02/1
MFOE1100	2.6	100	15	16	850	210A-01/1
MFOE1101	4	100	15	16	850	
MFOE1102	5	100	15	16	850	
MFOE1200	0.9	100	5	5	850	210A-01/1
MFOE1201	1.5	100	2.8	3.5	850	
MFOE1202	2.4	100	2.8	3.5	850	
MFOE1203	2.8	100	2.8	3.5	850	
MFOE3100	0.85	50	19	14	850	366-01/1
MFOE3101	1.65	50	19	14	850	
MFOE3102	2.2	50	19	14	850	
MFOE3200	1	50	2.8	3.5	850	366-01/1
MFOE3201	1.8	50	2.8	3.5	850	
MFOE3202	2.5	50	2.8	3.5	850	

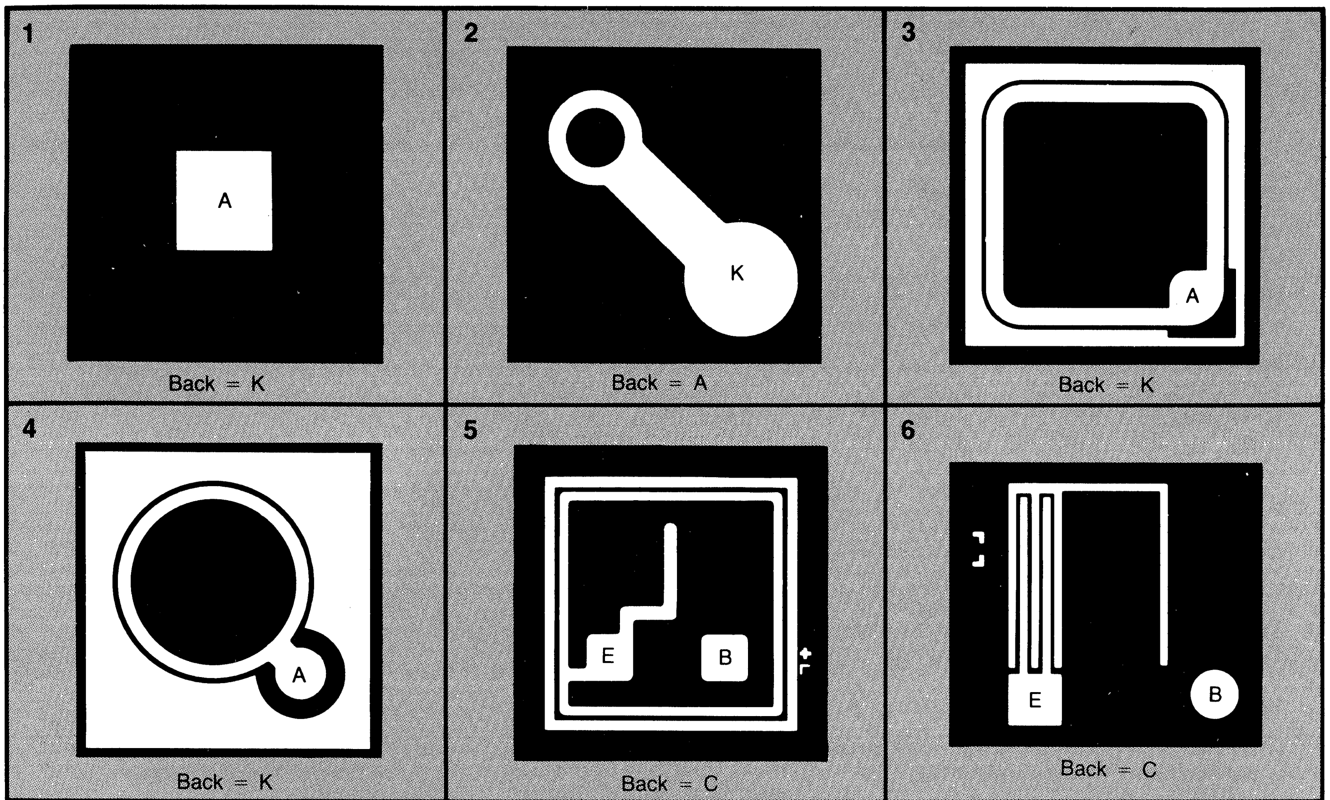
Photodetectors

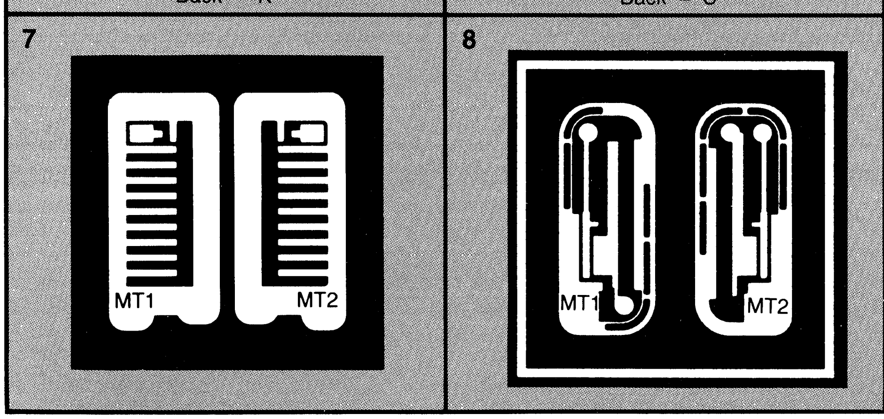
Device	BWE MHz	Responsivity $\mu A/\mu W$ Typ	Response Time μs Typ t_{on}* t_r	t_{off}* t_f	$V_{(BR)}$ Volts Min	Case/Style
Photo PIN Diodes						
MFOD1100	350	0.35	0.5 ns	0.5 ns	50	210A-01/1
MFOD3100	70	0.3	2 ns	2 ns	50	366-01/2
MFOD71	70	0.2	1* ns	1* ns	100	363B-01/3
Phototransistors						
MFOD72	6 kHz	125	10*	60*	30	363B-01/2
Photodarlingtons						
MFOD73	2 kHz	1500	125*	150*	60	363B-01/2
Detector Preamps		**$mV/\mu W$**			**V_{CC} Range**	
MFOD2404	10	35	0.035	0.035	4–6	210D-01/1
MFOD2405	35	6.0	0.010	0.010	4–6	

Logic Level Output

Device	Light Required to Trigger $-H(on)$ (V_{CC} = 5 V) μW Typ	Response Time t_{on} μs Typ	t_{off} μs Typ	Hysteresis Ratio H(on)/H(off) Typ	Case/Style
MFOD75	6	0.4	0.8	0.75	363C-01/1
MFOD3510	4	0.4	0.8	0.75	366-01/3

Opto Chips Die Geometries





A = Anode
B = Base
C = Collector
E = Emitter
G = Gate
K = Cathode

MECHANICAL SPECIFICATIONS

Front Metallization Thickness — a minimum of 10,000 Å
Back Metallization Thickness — a minimum of 15,000 Å

Type	Chip Part #	Die Geometry Reference #	Die Size Mils	Die Thickness Mils	Active Area Mils^2	Bond Pad Size Mils	Bond Pad Size Mils	Metallization Front	Metallization Back	Packaging Multi (none)	Packaging Wafer (WP)	Packaging Circle (CP)
						Anode	**Cathode**					
Pin Diode	MRDC100	3	30x30	8–10	350	4.5x4.5	30x30	Al	Au	*	*	*
						Emitter	**Base**					
Transistor	MRDC200	5	25x25	8–10	270	3.5x3.5	3.5x3.5	Al	Au	*	*	*
Darlington	MRDC400	6	27x27	8–10	357	4.0x4.0	4.0 dia.	Al	Au	*	*	*
						MT1	**MT2**					
Zero Cross Triac Driver	MRDC600	8	45x45	8–10	1400	4.6 dia.	4.6 dia.	Al	Au	*	*	*
Triac Driver	MRDC800	7	40x40	8–10	1400	4.0x5.0	4.0x5.0	Al	Au	*	*	*
						Anode	**Cathode**					
LED (940 nm)	MLEDC1000	1	16x16	8–10	240	4x4	16x16	Al	Au	*	*	*
LED (850 nm)	MFOEC1200	2	24x24	8–10	7	24x24	3.5 dia.	Al	Au	*	*	*
F.O. Pin Diode	MFODC1100	4	30x30	8–10	154	4.0 dia.	30x30	Al	Au	*	*	*

Samples available upon request, contact the Motorola Sales Office.

*Available Packaging

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit
MRDC100					
Responsitivity (V_R = 20 V, λ = 850 nm)	R	0.3	0.4	—	μA/μW
Dark Current (V_R = 20 V, H = 0)	I_D	—	—	10	nA
MRDC200					
Light Current (V_{CE} = 5 V, H = 5 mW/cm^2)	I_L	0.8	—	22	mA
Collector-Emitter Breakdown Voltage (I_{CE} = 100 μA)	$V_{(BR)CEO}$	40	—	—	Volts
MRDC400					
Light Current (V_{CE} = 5 V, H = 1 mW/cm^2)	I_L	0.8	—	20	mA
Collector-Emitter Breakdown Voltage (I_C = 1 mA)	$V_{(BR)CEO}$	45	—	—	Volts
MRDC600					
Light Required to Trigger (λ = 940 nm, V_{TM} = 3 V, R_L = 150 Ω)	H_{FT}	—	5	10	mW/cm^2
Peak Repetitive Current (PW = 100 μs, 120 pps)	I_T	—	—	300	mA
Off-State Output Terminal Voltage	V_{DRM}	—	—	600	Volts
Peak Blocking Current (V_{DRM} = 600 V)	I_{DRM}	—	60	500	nA

Parameter	Symbol	Min	Typ	Max	Unit
MRDC600 (continued)					
Inhibit Voltage (H = 20 mW/cm^2, MT1–MT2; voltage above which device will not trigger)	V_{IH}	—	10	20	Volts
MRDC800					
Light Required to Trigger (λ = 940 nm, V_{TM} = 3 V, R_L = 150 Ω)	H_{FT}	—	5	10	mW/cm^2
On-State RMS Current (Full Cycle 50–60 Hz)	$I_{T(RMS)}$	—	—	100	mA
Off-State Output Terminal Voltage	V_{DRM}	—	—	400	Volts
Peak Blocking Current (V_{DRM} = 400 V)	I_{DRM}	—	10	100	nA
MFOEC1200					
Peak Wavelength (I_F = 100 mAdc)	λ_p	—	850	—	nm
Total Power Out (I_F = 100 mA)	P_O	1.5	—	—	mW
Forward Voltage (I_F = 100 mA)	V_F	1	—	2.5	Volts
MLEDC1000					
Peak Wavelength (I_F = 50 mA)	λ_p	—	940	—	nm
Total Power Out (I_F = 50 mA)	P_O	2	—	—	mW
Forward Voltage (I_F = 50 mA)	V_F	—	—	1.5	Volts

Sensors

In Brief . . .

Pressure Sensors

The marriage of integrated circuit technology with the most advanced pressure sensor architecture now offers an unrivaled combination of performance, reliability and design adaptability in a single monolithic pressure sensing element – the Motorola MPX series of pressure transducers. Available in three versions:

Uncompensated for unlimited adaptability;
Compensated and calibrated, for simplified circuit design;
Signal compensation, for high-level output.

This series of components provides both electrical and mechanical design-in options that uniquely fit the varying requirement of the system designer.

Temperature Sensors

The sensitivity of semiconductor junctions to variations in temperature is utilized in a series of temperature-calibrated transistors that provide high temperature accuracy (±2% over a temperature range from –40° to +150°C at low cost).

Page

Pressure Sensors

Motorola pressure sensors combine advanced piezoresistive sensor architecture with integrated circuit technology to offer a wide range of pressure sensing devices for automotive, biomedical, consumer and industrial applications. Selection versatility includes choice of:

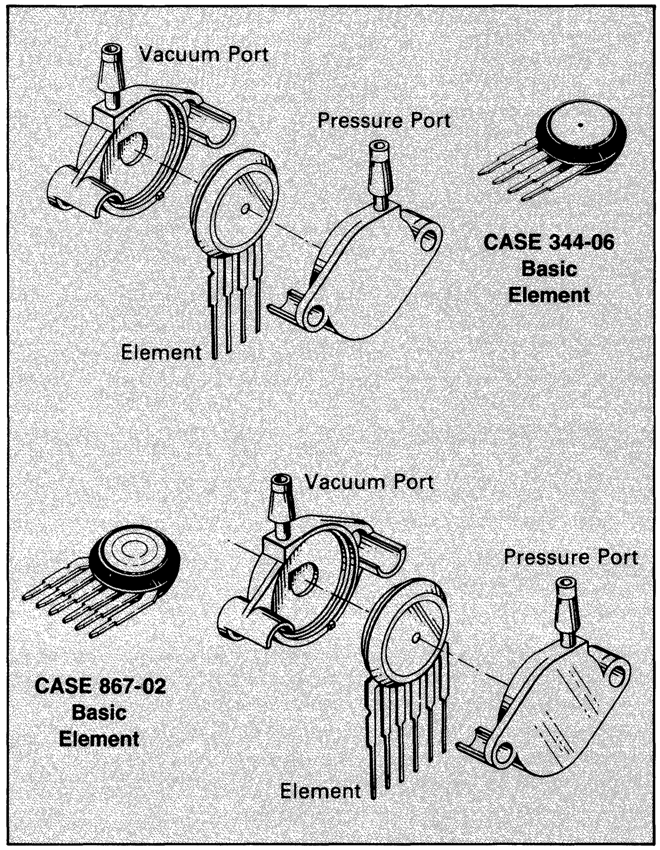
Pressure Ranges in PSI:
0 to 1.5, 0 to 7.5, 0 to 15, 0 to 30, 0 to 100

Application Measurements:
Absolute, Differential, Gage

Sensing Options:
Uncompensated, Temperature Compensated/Calibrated, Signal Conditioned (with on-chip amplifier)

Package Options:
Basic Element, Ported Elements for specific measurements

Direct to the Factory, Technical Assistance
Sensor Hotline 1-800-752-3621



Electrical Characteristics

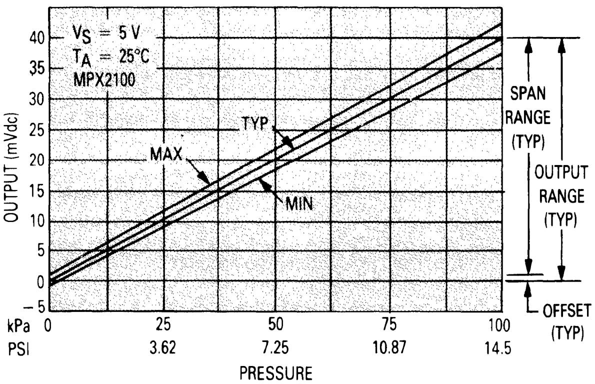
Device Series	Pressure Range kPa/psi	Over Pressure (kPa)	Offset mV (Typ)	Full Scale Span mV (Typ)	Sensitivity (mV/kPa)	Linearity % of FSS(1) (Typ)	Temperature Coefficient of Span %/°C (Typ)
Basic: V_S = 3 Vdc, T_A = 25°C							
MPX10D	10/1.5	100	20	35	3.5	±1 (max)	−0.19
MPX11D	10/1.5	100	20	50	5	−0.5, +3 (max)	−0.19
MPX12D	10/1.5	100	20	55	5.5	0, +5 (max)	−0.19
MPX50D	50/7	200	20	60	1.2	±0.05	−0.19
MPX51D	50/7	200	20	45	0.9	±0.05	−0.19
MPX52D	50/7	200	20	60	1.2	±0.3	−0.19
MPX100D,A	100/15	200	20	60	0.6	±0.05	−0.19
MPX200D,A	200/30	400	20	60	0.3	±0.05	−0.19
MPX201D,A	200/30	400	20	60	0.3	±0.1	−0.19
MPX700D	700/100	2100	20	60	0.086	0.5	−0.18
Compensated and Calibrated (On-Chip): V_S = 10 Vdc, T_A = 25°C							
MPX2010D	10/1.5	75	±0.05	25	2.5	±0.15	±0.5
MPX2040D	40/6	125	5 (mmHg)	—	5 (μV/V/mmHg)	±0.15	±0.02
MPX2050D	50/7	200	±0.05	40	0.8	±0.1	±0.5
MPX2051D	50/7	200	±0.1	40	0.8	±0.1	±0.5
MPX2100D,A	100/15	400	±0.05	40	0.4	±0.1	±0.5
MPX2101D,A	100/15	400	±0.1	40	0.4	±0.1	±0.5
MPX2200D,A	200/30	400	±0.05	40	0.2	±0.1	±0.5
MPX2201D,A	200/30	400	±0.1	40	0.2	±0.1	±0.5
MPX2700D	700/100	2100	±0.1	40	0.057	0.5	−0.18
Signal Conditioned (On-Chip): V_S = 5 Vdc, T_A = 25°C							
MPX3100D	100/15	200	0.5 V	2.5 V	25	±0.2	±2
MPX5100D,A	100/15	700	0.5 V	4 V	40	±0.2	±1

(1) Based on end point straight line fit method. Best fit straight line linearity error is approximately 1/2 of listed value.

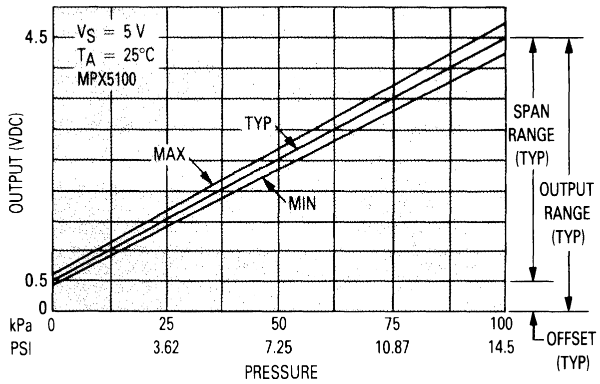
Typical Electrical Characteristic Curves

Output Voltage versus Pressure

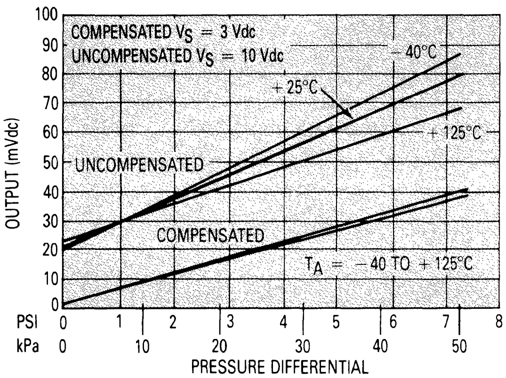
Compensated MPX2100



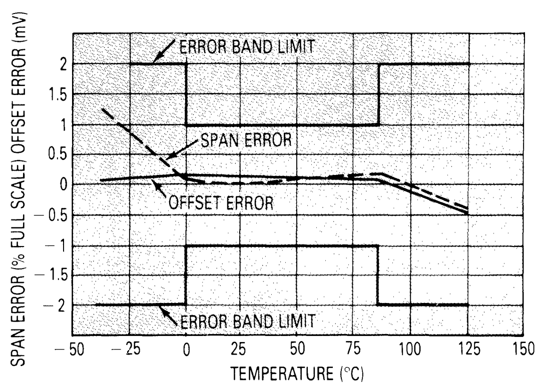
Signal Conditioned MPX5100



Typical-Output Voltage versus Pressure and Temperature for Compensated and Uncompensated Devices



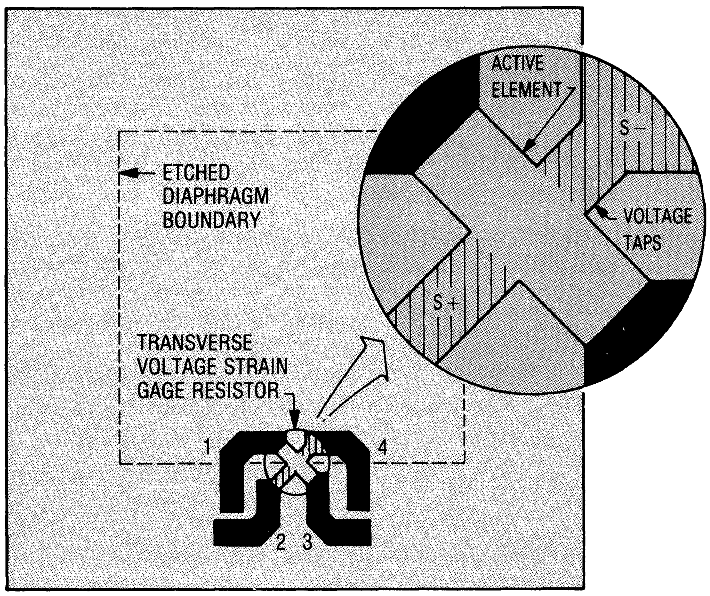
Temperature Error Band Limit and Typical Span and Offset Errors — Compensated Devices



MOTOROLA'S PATENTED X-DUCER

Excitation current is passed longitudinally through the resistor (taps and 3), and the pressure that stresses the diaphragm is applied at a right angle to the current flow. The stress establishes a transverse electric field in the resistor that is sensed as voltage at taps 2 and 4, which are located at the midpoint of the resistor. The single-element transverse voltage strain gauge can be viewed as the mechanical analog of a Hall effect device.

Using a single element eliminates the need to closely match the four stress and temperature sensitive resistors that form a Wheatstone bridge design. At the same time, it greatly simplifies the additional circuitry necessary to accomplish calibration and temperature compensation. The offset does not depend on matched resistors but instead on how well the transverse voltage taps are aligned. This alignment is accomplished in a single photolithographic step, making it easy to control, and is only a positive voltage, simplifying schemes to zero the offset.



Pressure/Vacuum Side Identification Table

Motorola designates the two sides of the pressure sensor as the Positive Pressure (top) side and the Vacuum (back) side. The Positive Pressure side is the side containing silicon gel which protects the die from harsh media. The Motorola MPX pressure sensor is designed to operate with positive differential pressure applied (i.e., top side pressure is greater than or equal to back side pressure).

The Positive Pressure side may be identified by using the example table below:

Part Number	Case Type	Positive Pressure Side Identifier
MPX____D	344-06	Stainless Steel Cap
MPX____DP	352-01	Side with Part Marking
MPX____GP	350-01	Side with Port Attached
MPX____GVP	350-02	Stainless Steel Cap
MPX____GS	371-04	Side with Port Attached
MPX____GVS	371-03	Stainless Steel Cap
MPX____GSX	371C-01	Side with Port Attached
MPX____GVSX	371D-01	Stainless Steel Cap

Ordering Information . . .

MPX10/50/100/200/700 Series (Uncompensated)

Device Type	Measurement Options	Package Options	Pressure Range				
			0–1.5 PSI	0–7.5 PSI	0–15 PSI	0–30 PSI	0–100 PSI
4-Pin Basic Element	Absolute	Case 344-06	—	—	MPX100A	MPX200A	—
	Differential	Case 344-06	MPX10D	MPX50D	MPX100D	MPX200D	MPX700D
Ported Element	Absolute Port	Case 350-01	—	—	MPX100AP	MPX200AP	—
	Absolute Stovepipe	Case 371-03	—	—	MPX100AS	MPX200AS	—
	Absolute Axial	Case 371-C01	—	—	MPX100ASX	MPX200ASX	—
	Differential Port	Case 352-01	MPX10DP	MPX50DP	MPX100DP	MPX200DP	MPX700DP
	Gage	Case 350-01	MPX10GP	MPX50GP	MPX100GP	MPX200GP	MPX700GP
	Gage Vacuum	Case 350-02	MPX10GVP	MPX50GVP	MPX100GVP	MPX200GVP	MPX700GVP
	Gage Stovepipe	Case 371-03	MPX10GS	MPX50GS	MPX100GS	MPX200GS	MPX700GS
	Gage Vacuum Stovepipe	Case 371-04	MPX10GVS	MPX50GVS	MPX100GVS	MPX200GVS	MPX700GVS
	Gage Axial	Case 371-C01	MPX10GSX	MPX50GSX	MPX100GSX	MPX200GSX	MPX700GSX
	Gage Vacuum Axial	Case 371-D01	MPX10GVSX	MPX50GVSX	MPX100GVSX	MPX200GVSX	MPX700GVSX

MPX2000 Series (Temperature Compensated and Calibrated On-chip)

Device Type	Measurement Options	Package Options	Pressure Range				
			0–1.5 PSI	0–7.5 PSI	0–15 PSI	0–30 PSI	0–100 PSI
4-Pin Basic Element	Absolute	Case 344-06	—	—	MPX2100A	MPX2200A	—
	Differential	Case 344-06	MPX2010D	MPX2050D	MPX2100D	MPX2200D	MPX2700D
Ported Element	Absolute Port	Case 350-01	—	—	MPX2100AP	MPX2200AP	—
	Absolute Stovepipe	Case 371-03	—	—	MPX2100AS	MPX2200AS	—
	Absolute Axial	Case 371-C01	—	—	MPX2100ASX	MPX2200ASX	—
	Differential Port	Case 352-01	MPX2010DP	MPX2050DP	MPX2100DP	MPX2200DP	MPX2700DP
	Gage	Case 350-01	MPX2010GP	MPX2050GP	MPX2100GP	MPX2200GP	MPX2700GP
	Gage Vacuum	Case 350-02	MPX2010GVP	MPX2050GVP	MPX2100GVP	MPX2200GVP	MPX2700GVP
	Gage Stovepipe	Case 371-03	MPX2010GS	MPX2050GS	MPX2100GS	MPX2200GS	MPX2700GS
	Gage Vacuum Stovepipe	Case 371-04	MPX2010GVS	MPX2050GVS	MPX2100GVS	MPX2200GVS	MPX2700GVS
	Gage Axial	Case 371-C01	MPX2010GSX	MPX2050GSX	MPX2100GSX	MPX2200GSX	MPX2700GSX
	Gage Vacuum Axial	Case 371-D01	MPX2010GVSX	MPX2050GVSX	MPX2100GVSX	MPX2200GVSX	MPX2700GVSX

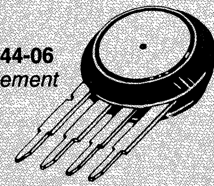
MPX3100 (Signal conditioned On-chip)

Device Type	Measurement Options	Package Options	Pressure Range
4-Pin			0–15 PSI
Basic Element	Differential	Case 344-06	MPX3100D
Ported Element	Differential Port	Case 352-01	MPX3100DP
	Gage	Case 350-01	MPX3100GP
	Gage Vacuum	Case 350-02	MPX3100GVP
	Gage Stovepipe	Case 371-03	MPX3100GS
	Gage Vacuum Stovepipe	Case 371-04	MPX3100GVS
	Gage Axial	Case 371-C01	MPX3100GSX
	Gage Vacuum Axial	Case 371-D01	MPX3100GVSX

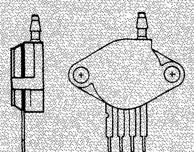
MPX5100 Series (Signal conditioned On-chip)

Device Type	Measurement Options	Package Options	Pressure Range
			0–15 PSI
6-Pin Basic Element	Absolute	Case 867-02	MPX5100A
	Differential	Case 867-02	MPX5100D
Ported Element	Absolute Port	Case 867B-02	MPX5100AP
	Absolute Stovepipe	Case 867E-01	MPX5100AS
	Absolute Axial	Case 867F-01	MPX5100ASX
	Differential Port	Case 867C-02	MPX5100DP
	Gage	Case 867B-02	MPX5100GP
	Gage Vacuum	Case 867D-02	MPX5100GVP
	Gage Stovepipe	Case 867E-01	MPX5100GS
	Gage Vacuum Stovepipe	Case 867A-02	MPX5100GVS
	Gage Axial	Case 867F-01	MPX5100GSX
	Gage Vacuum Axial	Case 867G-01	MPX5100GVSX

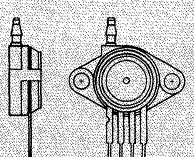
4-PIN



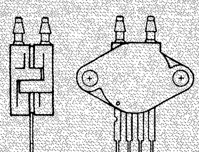
CASE 344-06
Basic element



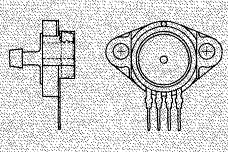
CASE 350-01
Sensing element with positive pressure side ported — for absolute and gage measurements



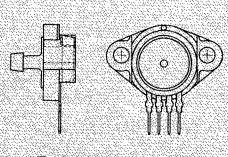
CASE 350-02
Sensing element with vacuum side ported — for vacuum measurement



CASE 352-01
Sensing element with both sides ported — for differential measurement

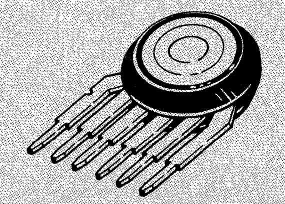


CASE 371C-01
Sensing element with Axial port on positive pressure side — for positive pressure measurement

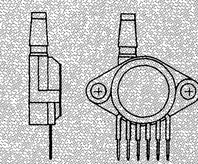


CASE 371D-01
Sensing element with Axial port on vacuum side — for vacuum measurement

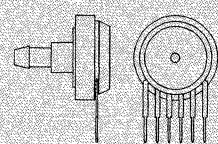
6-PIN



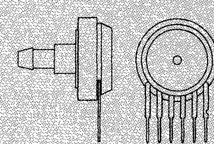
CASE 867-02
Basic element



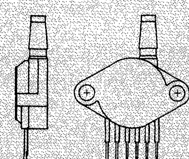
CASE 867D-02
Sensing element with vacuum side ported — for vacuum measurement



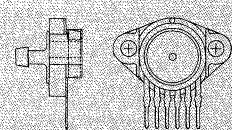
CASE 867A-02
Sensing element with stovepipe port on vacuum side — for vacuum measurement



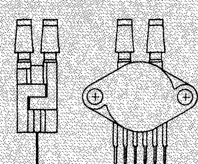
CASE 867E-01
Sensing element with stovepipe port on positive pressure side — for gage/ absolute pressure measurement



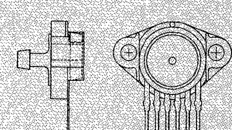
CASE 867B-02
Sensing element with positive pressure side ported — for absolute and gage measurements



CASE 867F-01
Sensing element with Axial port on positive pressure side — for positive pressure measurement



CASE 867C-02
Sensing element with both sides ported — for differential measurement



CASE 867G-01
Sensing element with Axial port on vacuum side — for vacuum measurement

NEW PRODUCTS

Device	Description	Intro	Production	Case*
MPX2700D Series	100psi Differential/Gage	2Q91	2Q91	344-06
MPX5050D	7psi Differential/Gage	2Q91	3Q91	867-02
MPX7100D,A	High Impedance 15psi	3Q91	3Q91	344-06
MPX7200D,A	High Impedance 30psi	2Q91	3Q91	344-06
MPX700A	100psi, Absolute	4Q91	4Q91	344-06

*Standard Port Options Also Available

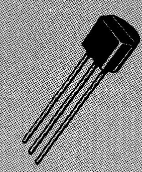
SAMPLE/EVALUATION KITS*

Device	Pressure Range kPa/psi	Available	Description	Cost
MPX2010DP	10/1.5	Now	Device w/Literature	Free
MPX700DP	700/100	Now	Device w/Literature	Free
MPX5100DP	100/15	Now	Device w/Literature	$25.00
MPX5100AP	100/15	Now	Device w/Literature	$25.00
MPX2700DP	700/100	2Q91	Device w/Literature	Free
KITSEK-1/D	100/15	Now	Evaluation Board for MPX2000 Series	$10.00
KITDEVB104/D	100/15	2Q91	Pressure Regulator Board	$35.00
KITDEVB114/D	100/15	2Q91	Pressure Sensor w/Microprocessor	$51.00
KITDEVB126/D	100/15	2Q91	4-20 mAmp Demo Board	$30.00

*To order Sample Kits or Evaluation Kits contact the Literature Distribution Center, 602-994-6561.

Silicon Temperature Sensors

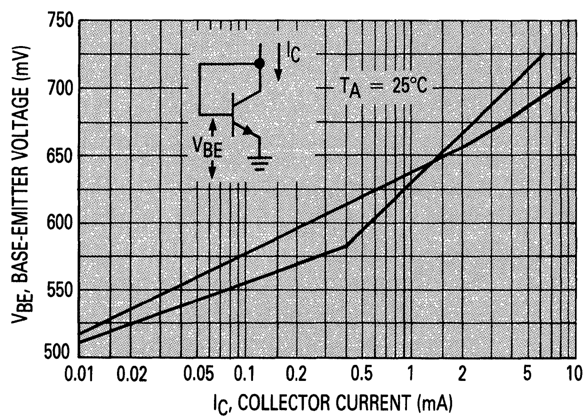
Available in a standard (TO-92) plastic package, these temperature sensing transistor elements are suitable for applications in automotive, consumer and industrial products requiring low cost and high accuracy.



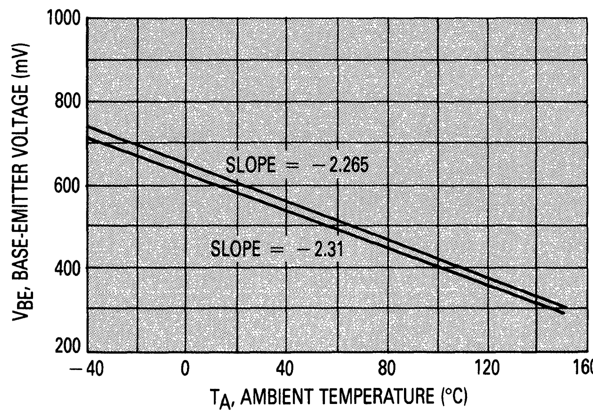
CASE 29-04
(TO-92)

Device	V_{BE} @ I_C = 0.1 mA, T_A = 25°C Typ	Temperature Over −40°C to 150°C	Thermal Time Constant Liquid-to-Liquid	Thermal Time Constant Flowing Air	Case
MTS102	595 mV	±2°C	3 s	8 s	29-04
MTS103		±3°C			
MTS105		±5°C			

Typical V_{BE} versus Collector Current



Typical V_{BE} versus Ambient Temperature



Winner 1988 Malcolm Baldrige National Quality Award

Military Integrated Circuits & Discrete Products

In Brief . . .

Motorola, Inc. is one of the world's leading manufacturers of electronic equipment, systems and components. Motorola products include two-way radios, pagers, cellular and mobile telephones, defense and aerospace electronics, automotive and industrial equipment, data communications, information processing equipment and semiconductor products. Motorola is one of the few end-equipment manufacturers that can draw on a complement of government electronics and semiconductor technology.

Motorola has been an industry leader and consistent manufacturer of semiconductors since the advent of the technology, and has since emerged as a world-wide leader of leading-edge technology. Motorola's leadership position applies to products such as the 68000 series microprocessor including the 68040, the newest and most powerful member of the family, our DSP family including the DSP56001 and the new DSP96000, logic, linear, discretes, memory components, ASIC and our state-of-the-art 88000 RISC microprocessor.

Motorola supplies high reliability semiconductors through two major groups: the Military Products Operation (MPO) and the Discrete Military Operation (DMO). Motorola's Military Products operation produces and markets bipolar and MOS integrated circuits that perform both digital and analog functions. Motorola's Discrete Military Operation produces a wide range of discrete components for standard military applications.

MPO's charter is to provide a broad and balanced portfolio of defect-free, low cost products screened to MIL-M-38510 and MIL-STS-883C specifications, delivered on time, with superior service to the customer. Similarly, DMO's portfolio covers a broad range of 1N— and 2N— products tested to JAN, JTX, JTXV and JANS specifications.

The Military Products Operation and Discrete Military Operation are 100% dedicated to the manufacture and supply of standard military products, with controlled engineering, manufacturing and administrative resources. Products are manufactured, screened and tested world-wide, on lines certified to the requirements of the pertinent military specifications.

Page

REWARRANTY POLICY

MILITARY PRODUCTS OPERATION

PARAGRAPH 4.2 OF MIL-M-38510H AMENDMENT 5

Section 4.2 of the above specification has been amended as follows:

"Procedures for microcircuits held by manufacturers. The requirements for microcircuits held by manufactures or distributors for more than 36 months has been deleted. However, it is recommended that the users with inspection lot identification codes in excess of 36 months verify that the devices remain solderable and functional prior to the next level assembly (i.e., that the devices have not been damaged or degraded by storage or handling)."

As a result of the above statement, effective January 01, 1991, **Motorola MPO will no longer automatically rewarranty distribution inventory every three (3) years.** Current distribution inventories will therefore be shippable to OEM's regardless of date codes.

In an effort to address some of our customers' recent concerns over solderability shelf-life, we are implementing an Internal Procedure to Resolder and Functionaly test any factory inventory which exceeds 24 months, prior to shipment, per the following:

Motorola Internal Procedures		
Requirement	**Old Process**	**New Process**
Rewarranty Required	Yes	No
6 month warranty remaining prior to shipping to distributor	Yes	No
Group "A" Sample DC/AC-All Temps.	Yes	No
Solderability (B3) Sample	Yes	No
Visual and Mechanical Sample	Yes	Yes
100% Resolder DIP	No	Yes
100% DC room Temp.	No	Yes
Fine and Gross Leak Sample	No	Yes
100% Visual and Mechanical	No	Yes

Existing distribution inventory is not to be returned for the New Process Flow.

Concerning the MIL spec recommendation that users with product having date codes older than 36 months be verified for solderability and functionality, it is our position that the end customers perform this verification on their aged inventories themselves, at their discretion.

We hope this clarifies our position. Please contact MPO Customer Service if you have any questions.

Military Semiconductor
Integrated Circuits & Discrete Products

Process Flows

The process flows for our integrated circuit and discrete products are as follows:

JAN S	All discrete product assembled, screened and inspected per the applicable requirements of MIL-S-19500. Electrical parameters and marking requirements shall be as specified in the applicable detail specification. Product shall be manufactured in the U.S. on DESC certified lines. These products are most commonly produced for space applications.
Motorola S	All I/C product assembled, screened and inspected per the requirements of Motorola Processing Document 12MRM51815A. Electrical parameters and marking requirements shall be as specified in Motorola's Class S Master List: 48ARM51950A. Product shall be manufactured in the U.S.. These products are most commonly produced for space applications, where fully compliant JANS is not required.
JAN	All discrete product assembled, screened and inspected per the applicable requirements of MIL-S-19500. Electrical parameters, test conditions, and marking requirements shall be as specified in the applicable detail specification. Product may be assembled in DESC approved off-shore facilities. Testing shall be done in the USA using DESC qualified facilities. These products are presently being removed from the QPL as the detail specifications are being revised. Recommended replacement is the JANTX level.
JAN B	All product assembled, screened and inspected per the applicable requirement of MIL- M-38510. Electrical parameters and marking requirements shall be as specified in the applicable detail specification. Product shall be manufactured in the U.S. on a DESC certified line. These products are produced for military applications.
JAN TX	All discrete product assembled, screened and inspected per the applicable requirements of MIL-S-19500. Electrical parameters, test conditions and marking requirements shall be as specified in the applicable specification. Product assembly and high temperature storage life may be done in DESC approved off-shore facilities. Screening and testing must be done in the USA on DESC certified lines. These products are produced for general military applications.
JAN TXV	All discrete product assembled, screened and inspected per the applicable requirements of MIL-S-19500. Electrical parameters, test conditions and marking requirements shall be as specified in the applicable detail specifications. Product must be assembled in DESC approved USA facilities. Testing shall be performed in the USA using DESC qualified facilities. These products are recommended when higher level of reliability than JTX is required.
SMD	All product assembled, screened, inspected and certitfied to the requirements of paragraph 1.2.1. of MIL-STD-883C. Electrical parameters and marking requirements shall be as specified in the SMD. These products are produced for military applications.

* Generic and Lot Traceability Data are provided at a nominal Fee. Please contact your local sales office or the Military Service Center for more information.

Process Flows (Continued)

DESC Drawings	All product assembled, screened and inspected per the applicable requirements of MIL- S-19500. Electrical parameters and test conditions are specified in the detail specification. Fabrication, assembly, screening and testing are not limited to USA facilities. These products are produced for all levels of military applications where no MIL-S-19500 detail specification exists. DESC drawings are similar to SMD devices for integrated circuits.
883C	All I/C product assembled, screened and inspected per the requirements of Paragraph 1.2.1 of MIL-STD-883C. Electrical parameters shall be as specified in the applicable detail specification. Marking shall be in accordance with JEDEC Publication 101. Fabrication, assembly, screening and inspection are not restricted to domestic facilities. However, the facilities must be certified per the requirements of Paragraph 1.2.1.. These products are produced for military applications.
MEP1	Integrated circuits which are assembled per the standard commercial flow , except for the addition of PIND, pre burn-in electrical tests, burn-in, final electrical tests and Group A & B inspections which shall be per M5004 and M5005 of MIL-STD-883C. Electrical parameters shall be as specified in the applicable detail specification. Marking requirements are in accordance with those specified in JEDEC Publication 101, except the class designator "EP1" which replaces class designator "B" and the JEDEC designator "JC" and the "C" are omitted. Fabrication, assembly, screening and inspection are not restricted to domestic or certified facilities. These products are produced for military applications which do not require JAN, SMD or 883C compliant product.
MEP2	Same as MEP 1 flow with the following exceptions: PIND is not performed and the part number class designator shall be "EP2."
MEP3	Same as MEP 1 flow with the following exceptions: PIND testing, pre burn-in electrical tests and burn-in is omitted and the part number class designator shall be "EP3."
MIL-Processed	All discrete product assembled, screened and inspected per the applicable requirements of MIL-S-19500. Electrical parameters and test conditions are specified in the Motorola military data sheet. Assembly, screening and testing are not limited to USA facilities. These products are produced for all levels of military applications where no MIL-S-19500 detail specification exists.

* Generic and Lot Traceability Data are provided at a nominal Fee. Please contact your local sales office or the Military Service Center for more information.

MILITARY PRODUCTS OPERATION
MEP PRODUCT FLOW

SCREENING AND QUALITY CONFORMANCE TESTING REQUIREMENTS
MOTOROLA ENHANCED PRODUCT

Operation	Methods	MEP 1	MEP 2	MEP 3
Assembly	Per appropriate commercial flow for each package type.	Each wafer visually sampled and sawn. The die are die bonded, wire bonded and sealed.		
Seal Fine and Gross	Method 1014 Conditions B and C	100%	100%	100%
Interim Electrical	Optional	Per The Applicable Military Electrical Specification		
Burn-in Test	1015 160 hours @ 125°C or equivalent	100%	100%	—
PIND	2020 Condition A	100%	—	—
Final Electrical Test	Jan Slash Sheet or SMD/DESC Dwg or Motorola Spec	Per The Applicable Military Electrical Specification		
(A) Static Test (1) 25°C (96 hr Req't and PDA Apply)	Subgroup 1, Table 1, 5005	100%	100%	100%
(2) Max and Min rated oper. temperatures	Subgroup 2 and 3 Table 1, 5005	100%	100%	100%
(B) Dynamic Test or Switching Test 25°C	Subgroup 4 or 9, Table 1, 5005	100%	100%	100%
(C) Functional Test 25°C	Subgroup 7, Table 1, 5005	100%	100%	100%
Quality Conformance Inspection:	QCI per 5005 Class B Table 1	The sample size/rejects allowed is 116/0 per 5005 for each subgroup or predefined set of subgroup (tests defined in appropriate Military device specification).		
Group A (A) Static Tests (1) 25°C (2) Max and Min rated oper. temperatures	Subgroup 1 Subgroup 2 and 3			
(B) Dynamic or Switching Tests (1) 25°C (2) Max and Min rated oper. temperatures	Subgroup 4 or 9 Subgroup 5 and 6 or 10 and 11			
(C) Functional Tests (1) 25°C	Subgroup 7			
Group B (B02, B03, B05)	5005 Class B	Each Inspection Lot (Except no B05 MEP 3)		
External Visual	2009	100%	100%	100%
Assembly/Test Location		Malaysia	Malaysia	Malaysia
Data		C of C	C of C	C of C

Motorola's MEP flow is designed specifically to meet shorter lead times associated with the design-in of new products in Military programs. The MEP flow is also ideal for Military and Industrial applications that do not require MIL-STD-883 product.
*MEP product processing is covered by general specification 12MRY01742.

MEP NUMBERING SYSTEM

Package	Device	Speed	Class	Process	Case	Lead Finish
1) Dual-In-Line (DIL)	Part Number	-XX	/EP	1, 2 or 3	(See Table)	(See Table)
2) Leadless Ceramic Chip Carrier (LCCC)	Part Number	-XXM**	/EP	1, 2 or 3	(See Table)	(See Table)
3) Ceramic Leaded Chip Carrier (CLCC)	Part Number	-XX	/EP	1, 2 or 3	(See Table)	(See Table)
4) Cerflat (FP)	Part Number	-XX	/EP	1, 2 or 3	(See Table)	(See Table)
5) Metal Can (CAN)	Part Number	-XX	/EP	1, 2 or 3	(See Table)	(See Table)
6) Pin Grid Array (PGA)	Part Number	-XX	/EP	1, 2 or 3	(See Table)	(See Table)

XX Applicable only on microprocessors and memories.

Case Outline Table

Letter	MIL-M-38510 Appendix C Designation	Description
A	F-1	14-lead FP (1/4" X 1/4")
B	F-3	14-lead FP (3/16" x 1/4")
C	D-1	14-lead DIL (1/4" x 3/4")
D	F-2	14-lead FP (1/4" x 3/8")
E	D-2	16-lead DIL (1/4" x 7/8")
F	F-5	16-lead FP (1/4" x 3/8")
G	A-1	8-lead CAN
H	F-4	10-lead FP (1/4" x 1/4")
I	A-2	10-lead CAN
J	D-3	24-lead DIL (1/2" x 1-1/4")
K	F-6	24-lead FP (3/8" x 5/8")
L	D-9	24-lead DIL (1/4" x 1-1/4")
M	A-3	12-lead CAN
*N		Unassigned by Motorola
P	D-4	8-lead DIL (1/4" x 3/8")
Q	D-5	40-lead DIL (9/16" x 2-1/16")
R	D-8	20-lead DIL (1/4" x 1-1/16")
S	F-9	20-lead FP (1/4" x 1/2")
*T		Unassigned by Motorola
*T		SMD/JAN — See detail dwg.
*U		LCCC for Motorola 883C
*U		SMD/JAN — See detail dwg.
V	D-6	18-lead DIL (1/4" x 15/16")
W	D-7	22-lead DIL (3/8" x 1-1/8")
*X		DIL for Motorola 883C
*X		SMD/JAN — See detail dwg.
*Y		FP for Motorola 883C
*Z		All other Motorola 883C configurations
*Z		SMD/JAN — See detail dwg.
2	C-2**	20-Terminal SQ. LCCC (.350" x 350")
3	C-4	28-Terminal SQ. LCCC (.450" x 450")

*Undesignated in MIL-M-38510 Appendix C.

****Motorola Case Outline Table**

M = Motorola designation for the 751 MIL Multi-Layer Leadless Chip Carrier, (Meets C2a Designation Criteria).

Maximum height dimension 0.075 inches.

Lead Finish

A-Kovar or Alloy 42, with hot solder dip
B-Kovar or Alloy 42, with fused matte tin plate
C-Kovar, Alloy 42, or Co-Fired, with gold plate
X-Any of above, for ordering purposes only.

Check with your local Motorola representative for price and delivery.

100% Processing Requirements for JANTX, JANTXV and JANS Products

Inspections and tests must be performed in the order specified.

Subgroup Screen	MIL-STD-750 Test Method	JANTX	JANTXV	JANS
Internal Visual	2072/3/4	N/A	100%	100%
High Temperature Storage	1032	100%	100%	100%
Thermal Shock	1051	100%	100%	100%
Constant Acceleration	2006	100%	100%	100%
P.I.N.D.	2052	N/A	N/A	100%
Instability Shock (Diodes only)				
FIST	2081	N/A	N/A	100%
BIST	2082	N/A	N/A	100%
Hermetically	1071	100%	100%	100%
Serialization	—	N/A	N/A	100%
Electricals, Read & Record		Go/No-Go	Go/No-Go	100%
H.T.R.B.				
Transistors	1039	100%	100%	100%
Diodes	1038	100%	100%	100%
Electricals, Read & Record		100%	100%	100%
Power Burn-In				
Transistors	1039	160 Hrs	160 Hrs	240 Hrs
Diodes	1038	96 Hrs	96 Hrs	240 Hrs
Thyristors	1040	96 Hrs	96 Hrs	140 Hrs
Electricals, Detail Spec		100%	100%	100%
Deltas, within 96 Hrs		100%	100%	100%
Hermetically	1071	Optional	Optional	100%
X-Ray	2076	N/A	N/A	100%
External Visual	2071	N/A	N/A	100%

The above tests shall be followed by Group A, B, and C tests on a sample basis.
N/A = Not Applicable

Military Semiconductor
Integrated Circuits

Process Flows: Certificate of Compliance

"The following policy change refers to the Military Integrated Circuit Products only"

We have recently designed and implemented a new and improved data information packet to be shipped with each lot. It is much more concise, easier to understand, and clearer in format than the bulky, complicated report we previously provided. The reverse side of this notice is more generic in nature, but provides the "essentials" in terms of lot identification, military methods utilized for processing, and a clear summarization of the different steps the product goes through prior to shipment. Also on the same form is the required certificate of compliance.

We understand that for a very small percentage of customers who have specific attribute data requirements imposed on them by contract, this lot data may be insufficient. In those limited cases, we will be happy to research the records and provide "supplementary" data which consists of more specific lot history on Groups A, B, C and D and any extra processing which may have been completed. We will charge only $300.00 per shipment for this additional information effective January 1, 1990 and will require a separate line item entry.

Preliminary inputs that we have received from our customers and the sales field have been very positive. Our cycle time, administrative quality and overall customer responsiveness will be improved as a result. For further information please contact your local sales office or the Military Service Center at 1-800-521-6274.

Process Flows: Certificate of Compliance

LOT DATA
&
CERTIFICATE OF COMPLIANCE

MOTOROLA P/N:	***JM38510/30402BCA***	CUSTOMER P/N:	***990-3525-064***
CUSTOMER NAME:	***T.C.S. CORP.***	FACTORY ORDER #:	***441019***
		PO. NUMBER:	***INLE-2789-707***
		TOTAL QTY:	***10000***

T.C.S. CORP.
PRODUCTION AVENUE
TEMPE, AZ 85284

LOT NO	SEAL D/C	WARRANTY D/C	REWARRANTY D/C	QUANTITY
R98084A	***KK8917***	***9030***	***9330***	***10000***

IT IS HEREBY CERTIFIED THAT ALL ARTICLES LISTED ABOVE ARE IN THE QUANTITIES SHOWN AND ARE IN COMPLIANCE WITH ALL OF THE SCREENING AND QUALITY CONFORMANCE INSPECTION REQUIREMENTS OF MIL-M-38510, MIL-STD-883 (PARA 1.2.1 FOR SMD AND JEDEC PRODUCTS) AND THE APPLICABLE DETAIL SPECIFICATIONS. RECORDS OF TRACEABILITY, INSPECTION, AND TEST PROVIDING OBJECTIVE EVIDENCE OF THE FOREGOING ARE ON FILE AT MOTOROLA AND ARE AVAILABLE UPON REQUEST.

____
QUALITY ASSURANCE INSPECTOR

DATE: ______________________________

Military Semiconductor
Integrated Circuits

Process Flows: Certificate of Compliance

SCREENING AND INSPECTION REQUIREMENTS
FOR MOTOROLA'S JAN/SMD/JEDEC PROGRAMS

OPERATION	**100% SCREENING PER METHOD 5004, MIL-STD-883C, LEVEL B:**
INTERNAL VISUAL	METHOD 2010 CONDITION B AND PARA. 3.3.1 OF M5004, SEE NOTE 1
TEMPERATURE CYCLING	METHOD 1010, CONDITION C: 10 OR 50 CYCLES (–65°C TO 150°C), SEE NOTE 1
CONSTANT ACCELERATION	METHOD 2001, Y1 AXIS ONLY: SEE NOTE 2 FOR TEST CONDITIONS
FINE LEAK	METHOD 1014 CONDITION B
GROSS LEAK	METHOD 1014, CONDITION C
BURN-IN	METHOD 1015, CONDITION A, C OR D; 160 HRS @ +125°C (OR EQUIVALENT)
FINAL ELECTRICAL	THE FOLLOWING ELECTRICAL SUBGROUPS ARE TESTED PER THE APPLICABLE SPECIFICATION: • SUBGROUPS 1, 4, 7 AND/OR 9 (+25°C SCREENING PER NOTE 3). • SUBGROUPS 2, 5, 8 AND/OR 10 (+125°C SCREENING PER NOTE 3). • SUBGROUPS 3, 6, 6 AND/OR 11 (–55°C SCREENING PER NOTE 3).

	QUALITY CONFORMANCE INSPECTION
QCI OPERATION	**PER METHOD 5005, MIL-STD-883C, LEVEL B: NOTE 4**
GROUP A	**PERFORMED ON EACH LOT (& BURN-IN PARTIAL) PER PARA. 3.5.1:** • SAMPLE SIZE ≥116/0
GROUP B	**PERFORMED ON EACH LOT (& BURN-IN PARTIAL) PER TABLE iib:** • RESISTANCE TO SOLVENTS, METHOD 2015: SAMPLE SIZE = 4/0. • SOLDERABILITY, METHOD 2003 (@ 245 ± 5°C): LTPD/ACC# = 10/0. • BOND STRENGTH, METHOD 2011, CONDITION D: LTPD/ACC# = 15/0.
GROUP C	**PERFORMED PERIODICALLY (SEE NOTE 5) PER TABLE III, ON THE MOST COMPLEX DEVICE TYPE FROM EACH MICROCIRCUIT GROUP:** • STEADY-STATE LIFE TEST PER METHOD 1005, COND. A, C OR D FOR 1000 HRS. @ +125°C (OR EQUIVALENT) WITH LTPD/ACC# = 5/2
GROUP D	**PERFORMED PERIODICALLY (SEE NOTE 6), PER TABLE IV, ON EACH PACKAGE TYPE:** • SUBR. 1: PHYSICAL DIMENSIONS (M2016) WITH LTPD/ACC# = 15/0. • SUBR. 2: LEAD INTEGRITY (M2004, CONDITION B2) WITH SEAL ENDPOINTS (M1014, COND. B & C) WITH LTPD/ACC# = 15/0 • SUBR. 3: THERMAL SHOCK (M1011, COND B, 15 CYCLES), TEMP. CYCLE (M1014, COND. B & C(, VISUAL (CRITERIA PER M1004), AND ELECTRICAL (PER THE SAME APPLICABLE DETAIL SPEC.) ENDPOINTS. OTPD/ACC# = 15/0. • SUBR. 4: MECH. SHOCK (M2002, COND. B), VAR. FREQ. VIBRATION (M2007, COND. A), CONSTANT ACCELERATION M2001, SEE NOTE 2 FOR TEST COND.) WITH SEAL (M1014, CON D. B & C), VISUAL (CRITERIA PER M1004), AND ELECTRICAL (PER THE APPLICABLE DETAIL SPEC.) ENDPOINTS. LTPD/AC# =15/0. • SALT ATMOSPHERE 9M1009, COND. C) WITH SEAL (M1014, COND. B & C), VISUAL (CRITERIA PER M1009) ENDPOINTS. SAMPLE SIZE = 15/0. • INTERNAL WATER-VAPOR CONTENT (M1018, 5K PPM MAX @ 100°C), SAMPLE SIZE = 3/0 OR 5/1. • ADHESION OF LEAD FINISH (M2025) WITH SAMPLE SIZE = 15/0. • LID TORQUE (M2024) WITH SAMPLE SIZE = 5/0.

NOTES:

1. • ALL BIPOLAR LOGIC PRODUCT RECEIVES 100% VISUAL INSPECTION PER M2010, CONDITION B AND THE ALTERNATE CRITERIA SPECIFIED IN PARA. 3.3.1 OF M5004, WHICH SPECIFIES THE FOLLOWING ADDITIONAL REQUIREMENTS: 50 TEMPERATURE CYCLES (IN LIEU OF THE SPECIFIED 10 CYCLES) AND SPECIAL ELECTRICAL SCREENING TESTS AS DEFINED BY PARA. 3.3.2 (SCREENING SHALL BE PERFORMED DURING THE 100% ELECTRICAL PROBE TEST AT THE WAFER LEVEL).
   • ALL OTHER PRODUCT RECEIVE THE NORMAL M2010 VISUAL INSPECTION AND 10 TEMPERATURE CYCLES.
2. STANDARD TEST CONDITION IS E (30KG's); HOWEVER, IF THE PACKAGE HAS AN INNER SEAL OR CAVITY PERIMETER OF 2 INCHES OR MORE IN TOTAL LENGTH, OR WHICH HAVE A PACKAGE MASS OF 5 OR MORE GRAMS, THE PRODUCT WILL BE SCREENED (OR TESTED) AT 20KG's, EXCEPT FOR THE T03 PACKAGE, WHICH IS SCREENED (OR TESTED) AT 10KG's (PER THE JAN SLASH SHEET).
3. THE ELECTRICAL SUBGROUPS TESTED SHALL BE SPECIFIED IN THE APPLICABLE DETAIL SPECIFICATION.
4. THE SAMPLE SIZE INCLUDES THE ACCEPTANCE CRITERIA AS FOLLOWS: "SAMPLE SIZE = 4/0" INDICATES THAT THE SAMPLE SIZE IS 4 UNITS AND THAT THE ACCEPTANCE LEVEL IS ZERO REJECTS.
5. GROUP C PERIODICAL TESTING: JAN: ONCE EVERY QUARTER; SMD/JEDEC: ONCE EVERY FOURTH QUARTER.
6. GROUP D PERIODICAL TESTING: JAN: ONCE EVERY 26 WEEKS; SMD/JEDEC: ONCE EVERY 52 WEEKS.
7. ALL TESTING IS PERFORMED ON A "GO/NO GO" BASIS.

Military Semiconductor
Integrated Circuits

Manufacturing, Quality & Test

Certified Facilities

Our broad MIL-STD-883C and MIL-M-38510 certified resource base, domestic and off-shore, guarantees our customers product support from a variety of manufacturing, assembly and test facilities. Our 883C facilities are audited and certified to MIL-STD-38510 specification (qualification excluded). The Foundation of Standard Military Product is the basis for program administration (JAN and/or 883C). The following tables expand on our production capabilities.

MIL-M-38510 CERTIFIED FACILITIES					
Technology	Wafer Fab	Assembly	Burn-In	Test	QCI
Linear	Bipolar-1/Mesa, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ
LS/MECL10K	Bipolar-2/Mesa, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ
FAST/Memory	Bipolar-3/Meas, AZ	MPO/Temp, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ
HCMOS Logic	MOS-2/Austin, TX	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ	MPO/Tempe, AZ

MIL-STD-883C CERTIFIED FACILITIES					
Technology	Wafer Fab	Assembly	Burn-In	Test	QCI
Linear	Bipolar-1/Mesa, AZ	Malaysia, Korea	Malaysia, Korea, Tempe, AZ	Malaysia, Korea, Tempe, AZ	Malaysia, Korea, Tempe, AZ
LS/MECL 10K	Bipolar-2/Mesa, AZ	Malaysia	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ
FAST/DRAM	Bipolar-3/Mesa, AZ	Malaysia	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ
ALS	Bipolar-3/Mesa, AZ	Malaysia	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ
CMOS Logic	MOS-1/Scotland	Malaysia	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ
HCMOS Logic	MOS-2/Mesa, AZ	Malaysia	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ	Malaysia, Tempe, AZ
MPU-6800	MOS-3/Austin, TX	Malaysia	Tempe, AZ	Tempe, AZ	Tempe, AZ
MPU-88000	MOS-5/Mesa, AZ	Malaysia	Tempe, AZ	Tempe, AZ	Tempe, AZ
68020/68030	MOS-8/Austin, TX	Malaysia	Tempe, AZ	Tempe, AZ	Tempe, AZ
SRAM	MOS-8/Austin, TX	Malaysia	Tempe, AZ	Tempe, AZ	Tempe, AZ

Process Flow Quality Ratings

Our wide range of certified manufacturing, assembly and test areas offer our customers several different levels of screening and qualification: JAN, SMD/DESC, 883C and MEP (Motorola Enhanced Product). The table below illustrates the variety of processes available to our customers.*

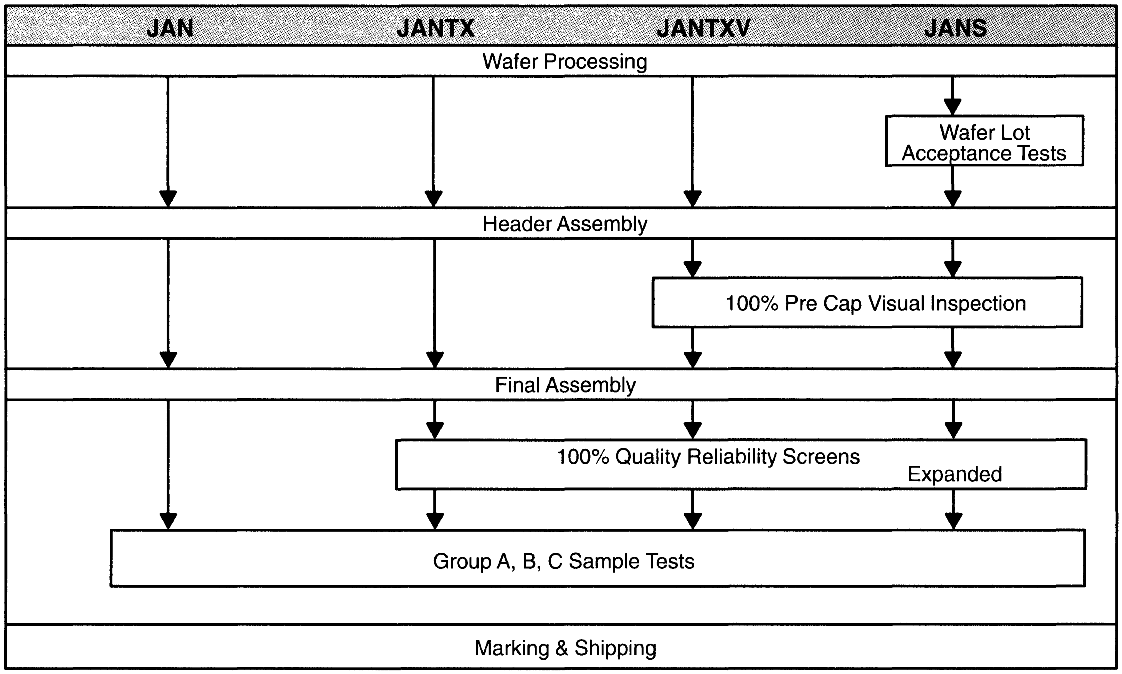
Motorola Process	Quality Level	Process Description	Quality Factor π Q
None	S	Procured in full accordance with MIL-M-38510 Class S requirements. Class S listing on QPL-38510.	0.25
None	S-1	Procured in full compliance with the requirements of MIL-STD-975 or MIL-STD-1547 and have procuring activity specification approval.	0.75
Motorola Quasi "S"	S-2	Procured in full compliance with Motorola Document 12MRM51815A.	0.8 (EST)
MIL-M-38510	B	Procured in full accordance with MIL-M-38510 Class B Requirements. Class B listing on QPL-38510.	1.0
SMD/DESC	B-1	Fully compliant with all requirements of Paragraph 1.2.1 of MIL-STD-883 and procured to a Military or DESC Drawing or other approved documentation.	2.0
MIL-STD-883C**	B-1	Fully compliant with requirements of Paragraph 1.2.1 MIL-STD-883C and procured to approved documentation including vendor's equivalent Class B requirements.	2.0
MEP, Quasi S	D	Hermetically sealed parts with normal reliability screening and manufacturer's quality assurance practices.	10.0
Commercial	D-1	Commercial (non-military) flow	20.0

Federal Supply Commission Manufacturing Number (FSCM#)

For reference purposes, Motorola's FSCM# is 04713

* Reference Table 5.1.2.7-1 MIl. HNBK217E

** Motorola's 883 flow is identical to the SMD/DESC requirements and is fully compliant to MIL-STD-883 but may be electrically tested to a JAN/SMD/DESC drawing or to a Motorola drawing as indicated in the test program column in the 883 section. For most standard device types, the 883C version is identical to the SMD/DESC version.



The MIL-S-19500 Semiconductor Process Flow

MIL-Qualified Semiconductors

MIL-type semiconductors are high reliability components that exhibit long product life under severe operating conditions. They are specified for use in most complex systems supplied to the military market and utilized extensively to provide the required accuracy for today's missile systems and the long operational life demanded by spacecraft. To insure optimum component reliability, the Department of Defense has established a complex system of Specifications and Standards involving all phases of manufacturing, including Facility Certification as well as Product Processing, Testing and Screening. A manufacturer of MIL-Qualified components must rigidly conform to these standards throughout all worldwide facilities.

THE MIL-S-19500 SPECIFICATION

To insure compliance with the requirements, the Department of Defense controls the procurement of semiconductor devices used in military equipment through a general specification, MIL-S-19500. (The latest revision of this specification is MIL-S-19500H, dated April 30, 1990.) This is maintained by the Department of the Navy but is approved for use by all departments and agencies of the Department of Defense and their military OEM subcontractors. It covers the basic requirements for the manufacture of MIL-Qualified semiconductor devices and through a series of associated "Methods documents" (MIL-STD-750) it prescribes the detailed procedures for satisfying these requirements.

The MIL-S-19500 "Methods" Compendium

MIL-S-19491	Packaging of Semiconductors
FED-STD-209	Clean Room, Work Stations, Controlled Environments
FED-STD-H28	Screw-Thread Standards
MIL-STD-105	Sampling Procedures
MIL-STD-129	Marking for Shipment Storage
MIL-STD-750	Test Methods for Semiconductors
MIL-STD-45662	Calibration Systems Requirements

THE JAN PROGRESSION

Test methods for semiconductor devices are detailed in MIL-STD-750 which covers qualification procedures for four successively higher levels of quality assurance: JAN, JANTX, JANTXV and JANS.

The term "JAN" is a U.S. Government Certification Mark, registered by the U.S. Patent Office as number 504860, and its assignment to a specific product signifies:

— Manufacturer has complied with all requirements for the manufacture of MIL-type components.

— Product has satisfied all the applicable test requirements.

— Test data will remain on file for at least three years.

— Data will be available for on-sight review by government representatives upon request.

— That JAN data is available and may be obtained from the supplier.

A simplified production flow chart for each of the four JAN levels, including the applicable tests and screens, is shown in the illustration.

JAN Products

JAN was the initial government classification for products requiring special reliability assurances. It signifies that the products so classified are taken from a controlled and isolated lot (or batch) of devices, and that samples from this lot have satisfactorily passed the ascribed electrical, thermal, mechanical, environmental, life and storage requirements in accordance with the associated Slash Sheet(1). If the sample lot has passed the specified statistical criteria, the entire lot is qualified as JAN, and all devices in the lot may be marked accordingly.

JANTX Products

With increasing system complexity came the need for a reduction in the number of defective devices per lot and for a longer "Mean Time Between Failures" (MTBF). This led to the JANTX (JTX) specification and to the concept of 100% screening. This involves subjecting all devices in the proposed qualification lot to a stringent program of stress tests that must precede the sample tests associated with conventional JAN processing. These tests seek to weed out potential failures, as well as those that might pass undetected in JAN lots where only samples of the lot are investigated.

JANTXV Products

JANTXV (JTXV) testing is essentially the same as JTX, except that the JTXV products undergo an additional 100% Precap Visual inspection. Visual screening procedures involve microscopic inspection of the semiconductor assembly, before capping the package, to uncover potential failures due to chip imperfection or imperfect die or wire bonds. While the U.S. government has qualified off-shore facilities for the assembly of JAN and JANTX devices, JANTXV products must be manufactured in the U.S. due to the visual precap inspection requirement. One exception to this is a clear-glass-encapsulated diode line which can be inspected after assembly.

JANS Products

In the early '70s, developments in the aerospace industry dictated the accommodation of more hostile operating environments as well as extended MTBF demands. This helped drive the concept of wafer lot acceptance(2) prior to encapsulation, and spurred additional and even tighter 100% test limits after encapsulation. The resulting JANS specification reflects the most critical test sequence in effect today.

The initial set of slash-sheet-prescribed sample tests associated with the JAN qualification consists of three separate groups. These were developed to:

1. Verify conformance to electrical specifications. (Group A)
2. Assure manufacturing integrity and reliability in tactical and ground support applications. (Group B)
3. Provide evidence of long-term reliability under harsh environmental conditions where severe mechanical and life/environmental stresses exist (Group C).

Group A Testing							
Type of Test	Vis/Mech	Electrical					
Test Subgroups	A1	A2	A3	A4	A5	A6	A7
		DC Tests	Hi/Lo Temp	AC Tests	SOA Tests	Current Surge	Selected
Test Parameters	Package: Dimensions Marking	$V_{(BR)CBO}$ $V_{(BR)CEO}$ $V_{(BR)EBO}$ I_{CBO} I_{EBO} $V_{BE(sat)}$* $V_{CE(sat)}$* h_{FE}	I_{CBO} @ 150°C h_{FE} @ −55°C	$\|h_{fe}\|$ h_{fe} C_{obo} C_{ibo} NF* t_{on} t_{off}	SOA @ 25°C* Power Transistors	Diodes Rectifiers	As Specified

* These parameters are tested under two or more operating conditions.

Notes:

(1) A slash sheet is a numbered document describing the detailed characteristics of each individual semiconductor product. It is so called because each specific document number is appended to MIL-S-19500 by a "/" (slash), e.g. MIL-S-19500/135

(2) Wafer lot acceptance involves detailed documentation and verification of the selection and processing of wafers destined for JANS qualification, including specification of sample size, control of wafer thickness, cleanliness, junction and surface preparation, metal deposition and thickness, etching, alloying and other processing steps.

Group A tests consist of visual, mechanical and electrical tests that verify "form, fit and function" of a particular group of devices. The procedure begins with the selection of a representative sample from a MIL-designated lot that has been fully processed. The sample is subjected to a test sequence that begins with a visual and mechanical inspection per MIL-STD-750 (subgroup A1), followed by a comprehensive series of electrical tests (subgroups A2 through Ax). The number of subgroups in the electrical test sequence may vary considerably, depending on the nature of the device and its potential applications. The test sequence shown depicts the procedure for a 2N3498 transistor.

The visual/mechanical inspection for the Group A tests are performed in accordance with MIL-STD-750, METHOD 2071. It consists of a sample (LTPD = 5) which are examined to determine that the devices meet the applicable materials, design, construction, marking and workmanship standards.

A typical electrical test sequence begins with the verification of the major DC parameters of the device operating under normal (25°C) temperature conditions, Subgroup A2. Usually this is followed by testing a sample of several parameters at either high and/or low temperature limits to verify satisfactory performance over the entire temperature range for which it is specified, Subgroup A3. Then the AC (dynamic) parameters are investigated (Subgroup A4). For power transistors, the Safe Operating Area (SOA) is verified (Subgroup A5). Surge current for diodes and rectifiers is tested in Subgroup A6. Finally, Subgroup A7 provides for tests that are unique to certain products but do not fit into a general classification.

Successful completion of this test sequence provides assurance that the devices are capable of operating in accordance with their design parameters.

Group B Testing

Test Subgroups	**B1**	**B2***	**B3***	**B4**	**B5**	**B6***
Type of Test	Solderability	Thermal Shock	Steady State Operating Life	Decap Visual	Thermal Resistance	High Temp Life (non-operating)
	Resistance to Solvents	Surge	Intermittent	SEM when specified		
		Hermetic Seal	Operation Life	Bond Strength		
		Fine	Blocking Life			
		Gross				

* The tests in this subgroup are preceded and followed by electrical tests of the most susceptible parameters — h_{FE}, I_{CBO}, $V_{CE(sat)}$ and $V_{BE(sat)}$.

This sequence includes screens that are intended to verify that the devices are mechanically sound and that they can be expected to continue to operate satisfactorily over time and under adverse operating conditions. Since a number of these screens involve stress factors that could result in ultimate performance degradation, the electrical parameters expected to be affected are tested before and after the applied screen to ascertain that the performance change remains within prescribed limits. Group B tests are run on a lot by lot basis.

Group C Testing

Test Subgroups	**C1**	**C2***	**C3***	**C4**	**C5**	**C6**
Type of Test	Physical	Thermal Shock	Mech. Shock	Salt	Not	Steady State or Intermittent or Blocking
	Dimensions	(Glass Strain)	Vibration (Variable Freq.)	Atmosphere.	Applicable	Operation Life
		Terminal	Constant Acceleration			
		Strength				
		Hermetic Seal				
		Moisture				
		Resistance				

* The tests in this subgroup are preceded and followed by electrical tests of the most susceptible parameters — h_{FE}, I_{CBO}, $V_{CE(sat)}$ and $V_{BE(sat)}$.

Group C tests must be performed on samples from the initial lot as well as on samples from subsequent lots formed at six-month periodic intervals. These tests consist of mechanical, environmental and life tests intended to provide assurance that the devices will continue to perform reliably in long term harsh environments where severe mechanical and life/environmental stresses exist.

JANTX, TXV, JANS QUALIFICATION — 100% PROCESSING

Higher levels of reliability assurance require more extensive and more elaborate reliability test procedures. For these, the sample tests for JAN devices have been supplemented with the processing screens described in the table on the following page. These screens are performed immediately after lot identification, prior to the Group A, B, and C sample tests. They are applied to 100% of the devices in the lot and include procedures developed to eliminate any marginal devices that would pass all normal operational tests but might fail under hostile environmental conditions. The most comprehensive screening procedure applies to the JANS classification which not only demands the greatest number of tests and screens after header assembly, but imposes Wafer Lot Acceptance criteria as well.

Military Semiconductor Integrated Circuits

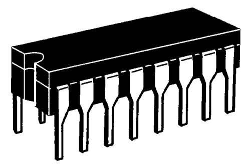
Packaging and Mechanical Data

Military Products Operation Integrated Circuits Packages

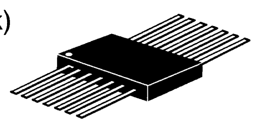
MPO products are offered in several application specific and cost effective hermetically sealed ceramic packages. Our packages conform to the mechanical requirements of Appendix C of MIL-M-38510. We offer our products in the following ceramic packages: Dual In-Line package (DIL), solder seal Dual In-Line (Side Brazed DIL), ceramic FlatPack (FP or CERFLAT), Leadless Ceramic Chip Carrier (LCCC), Ceramic Leaded Chip Carrier (CLCC), several metal can packages (CAN) and Pin Grid Array (PGA).

All MPO packages are offered in a variety of pin patterns and lead finishes. The following pages will help you determine the proper combination of package, pin count and lead finish for your specific application. For your convenience, we have also included a "Supplier Package Cross Reference" which will help you cross other suppliers packaging codes to Motorola package codes.

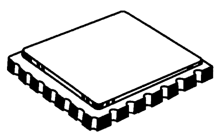
DIL (Dual In-Line)



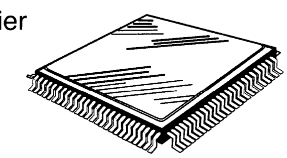
FP (Flat Pack)



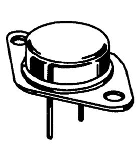
LCCC (Leadless Ceramic Chip Carrier)



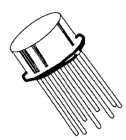
(CLCC) Ceramic Leaded Chip Carrier



CAN (All Can Packages)

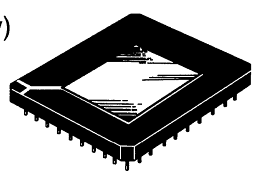


TO – 3



TO – 5

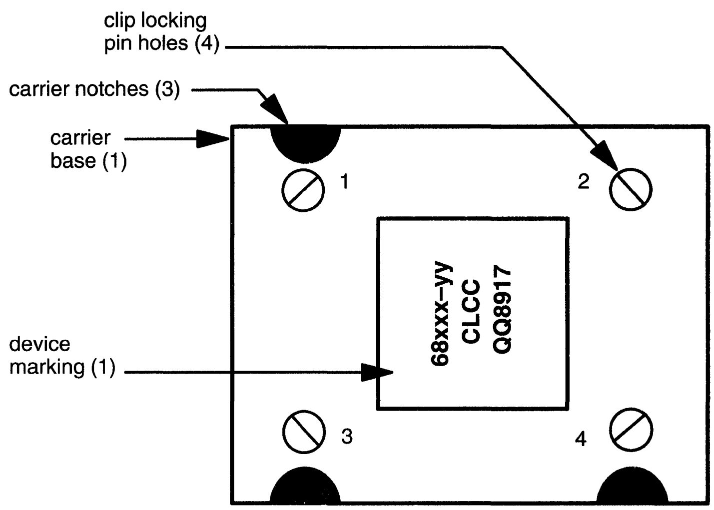
PGA (Pin Grid Array)

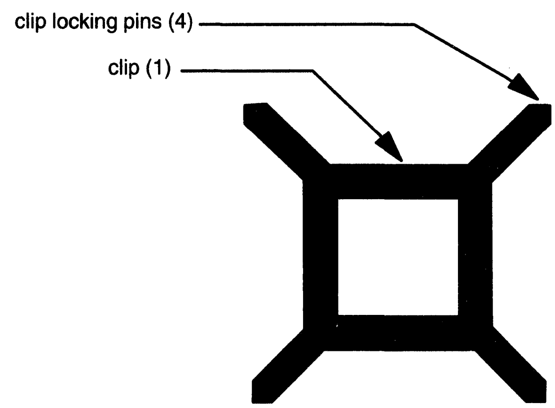


Military Semiconductor Integrated Circuits

Packaging and Mechanical Data

The following guidelines are providing for your assistance in manual handling and unloading CLCC carriers. Please read carefully before handling product.





Note: Numbers do not appear on the carrier; orient position of carrier to the diagram by using the outside notches on the carrier.

WARNING: Devices are sensitive to ESD damage. All work with the product must be done on a grounded work surface. Individuals handling the product must be grounded prior to handling the product. Careless handling of the package will result in damaged or unusable parts. If you have questions regarding these instructions, please contact the Military Products Operation at (602) 897-3770.

Unloading guidelines for Ceramic Leadless Chip Carriers (CLCC):

Note: If your CLCC's are shipped to you in a rail, remove the pin(s) at one end of the rail. To remove the devices, hold the rail at a 45° angle and gently slide the units out of the rail onto a flat surface, observing the above precautions.

[1] Orient the carrier with the device marking facing upwards, as shown in the above diagram.
[2] Using the tip of a ball-point pen (or similar object) carefully insert the tip into the clip locking hole 1 (refer to above diagram) to release clip locking pin 1 from the carrier base.
[3] Proceeding diagonally, move to hole 4, Use the same procedure in hole 4 to release the clip locking pin as in step [2].
[4] Proceed to hole 2. Use the same procedure in hole 2 to release the clip locking pin as in step [2].
[5] Proceed to the last hole; hole 3. Use the same procedure in hole 3 as used in step [2].

At this time, all clip locking pins should be unlocked and the clip should be separated from the carrier base. Lift carrier base off device and set aside. The device should be resting on top of the clip. Use a vacuum pick-up to place the device onto the printed circuit board. If the clip and base do not separate, repeat steps [1] through [5].

Note: If the package seems stuck in the carrier base, a gentle touch to the device lid may be necessary to free the base. Before touching the package lid, make absolutely sure that the clip is unlocked from the carrier's base or the device may become damaged.

Military Semiconductor Integrated Circuits

Supplier Package Index

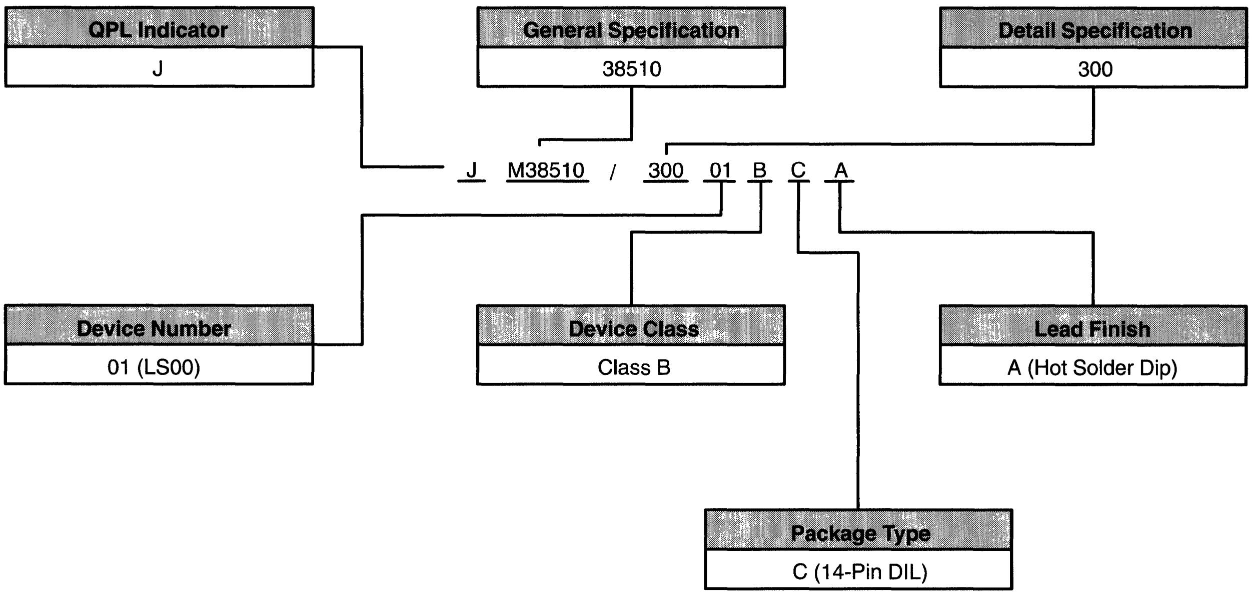
Motorola		JAN/SMD		National		TI		Harris		SGS		AMD		Signetics	
2	20-LCCC	2	20-LCCC	D	DIP	FD	LCCC	0	Chip Form	C	DIL	2	20-LCCC	C	DIL
3	28-LCCC	3	28-LCCC	E	LCCC	FE	LCCC	1	DIP	D	DIL	3	28-LCCC	EC	TO-46
5	20-FP	A	14-FP	F	Flat Pack	FG	LCCC	2	CAN	DG	DIL	A	14-FP	EE	TO-72
A	14-FP	B	14-FP	G	TO-8	FJ	CLCC	4	LCCC	E	LCCC	B	14-FP	F	CERDIL
B	14-FP	C	14-DIP	H	CAN	FK	LCCC	5	Substrate	F	FP	C	14-DIP	FA	DIL
C	14-DIL	D	14-FP	H-05	TO-5	FT	Flat Pack	7	Mini DIP	GC	LCCC	D	14-FP	FE	8-DIL
D	14-FP	E	16-DIP	H-46	TO-46	FV	LCCC	9	Flat Pack	H	CAN	E	16-DIP	G	LCCC
E	16-DIL	F	16-FP	J-14	14-DIP	GB	68-PGA	1B	Brazed Seal	J	883 DIL	F	16-FP	GA	LCCC
F	16-FP	G	8-CAN	J-8	8-DIP	HA	Quad FP	1B	SB DIP	K	TO-3	G	8-CAN	H	TO-5
G	8-CAN	H	10-FP	K	TO-3	HB	Quad FP	A	TO-237	R	PGA	H	10-FP	I	DIL
H	12-FP	I	10-CAN	K-Steel	TO-3 Stl	J	DIP	C	TO-220	T	PGA	I	10-CAN	K	TO-3
I	12-CAN	J	24-DIP	KC	TO-3 Al	JD	SB DIP	D	DIP	T	TO-220	J	24-DIP	L	CLCC
J	24-DIL	K	24-FP	L	LCCC	JG	DIP	E	TO-8	W	CLCC	K	24-FP	P	PGA
K	24-FP	L	24-DIP	P	TO-202	JT	DIP	F	FP	Y	DIL	L	24-DIP	Q	Flat Pack
L	24-DIL	M	12-CAN	Q	CerDIP UV	KC	TO-220	H	TO-66	Z	LCCC	M	12-CAN	R	Beryllia FP
M	12-CAN	P	8-DIP	U	PGA	KH	TO-220	I	16 Hybrid DIP			P	8-DIP	TA	TO-5
P	8-DIL	Q	40-DIP	W	FP	KV	TO-220	J	CERDIP			Q	40-DIP	W	Flat Pack
Q	42-DIL	R	20-DIP	Z	TO-92	L	Metal Can	K	TO-3			R	20-DIP	W	CERPAC
R	20-DIL	S	20-FP			LD	Metal Can	L	LCCC			S	20-DIP	Y	FP w/ Radial Lds
S	22-FP					LP	TO–226A	S	TO-52			U	LCCC		
T	SMD					RA	Flat Pack	T	TO-5			V	18-DIP		
U	CLCC	V	18-DIP			U	Flat Pack	U	TO-72			W	22-DIP		
V	18-DIL	W	22-DIP			W	Flat Pack	V	TO-39			X	DIP		
W	22-DIL					WA	Flat Pack	Z	TO-92			Y	Other		
X	DIL					WC	Flat Pack					Z	Other		
Y	FP														
Z	other							**RCA/GE**							
								1	Modified Class S						
								3	Modified Class B						
								3w	Modified Class B						

CAN	Any Metal Can Package
CLCC	Ceramic Leaded Chip Carrier
DIL	Dual In-Line Package
DIP	Dual In-Line Package
FP	Flat Pack
LCCC	Leadless Ceramic Chip Carrier
PGA	Pin Grid Array
SB	Sidebraze package
Stl	Steel package

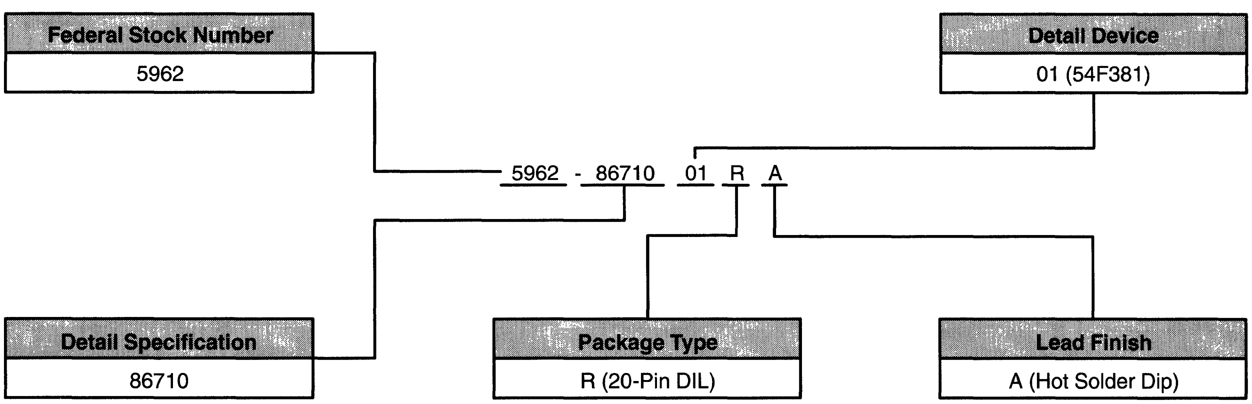
Military Semiconductor Integrated Circuits

Device Nomenclature

MIL-M-38510 (JAN)



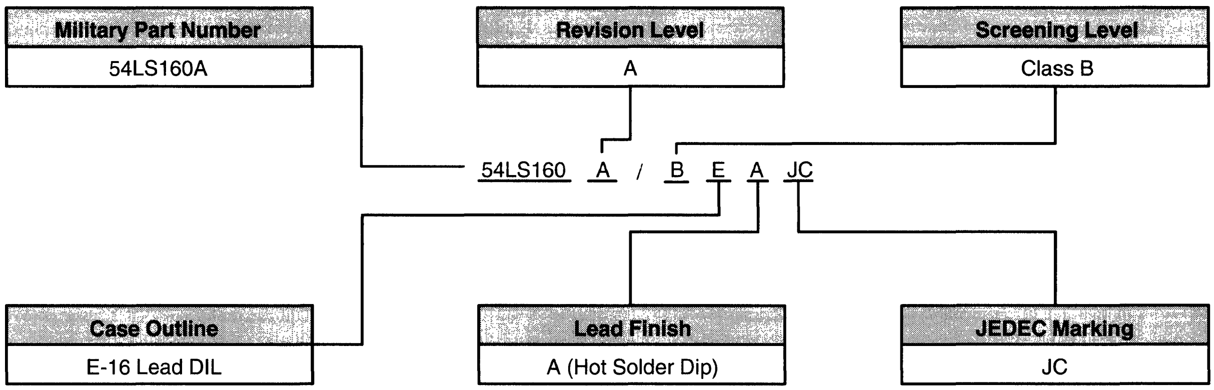
Standard Military Drawing SMD/DESC



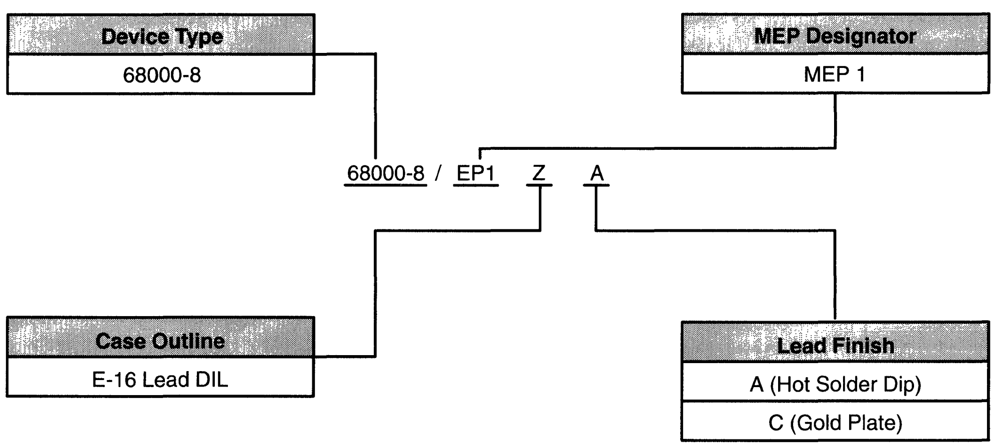
Military Semiconductor Integrated Circuits

Device Nomenclature

MIL-STD-883C*



Motorola Enhanced Process (MEP)*

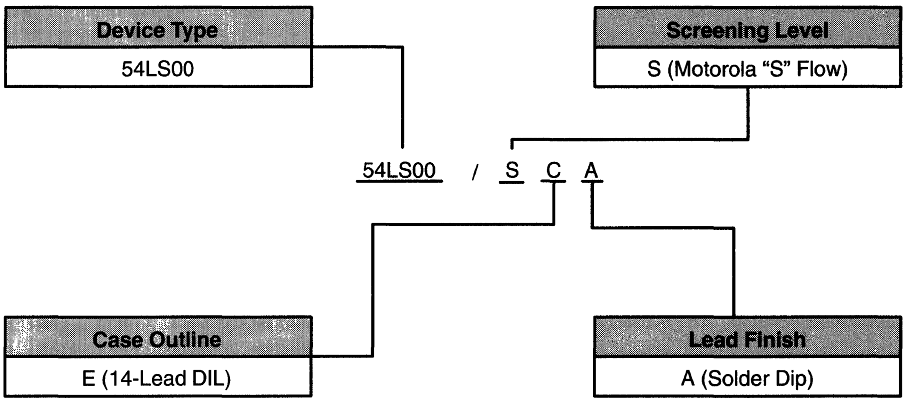


*Both 883C and MEP part number nomenclatures include an "M" after the device type to indicate the 75 mil LCCC package.

Military Semiconductor Integrated Circuits

Device Nomenclature

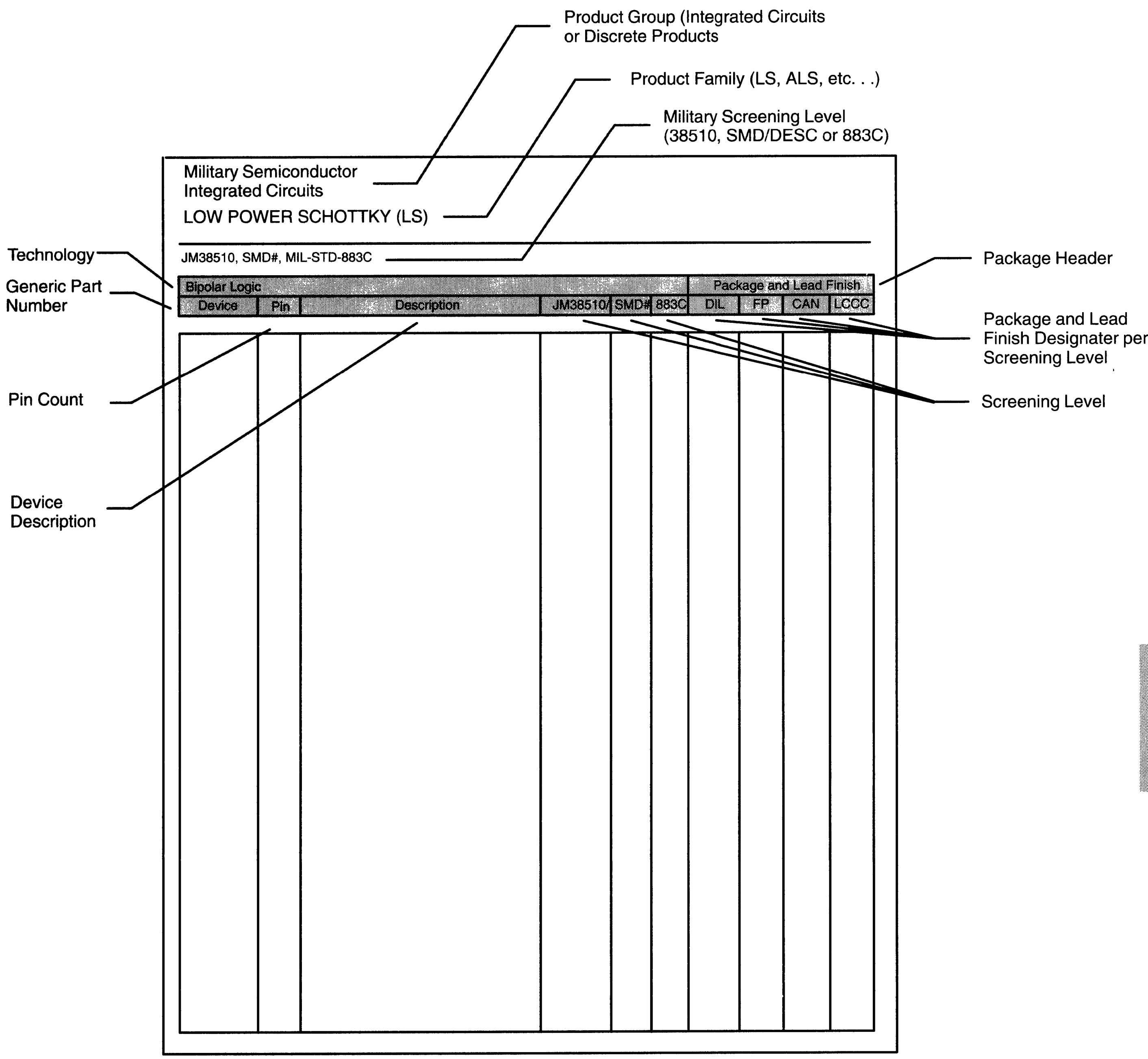
Motorola "S" Flow



Military Semiconductor Integrated Circuits

Product Portfolio

The following section contains our complete military integrated circuit product portfolio. For your reference, the description below identifies our page layout and the corresponding sections.



Military Semiconductor Integrated Circuits

Product Offering

Military Semiconductor Integrated Circuits

ANALOG/TELECOM & SPECIAL FUNCTION

JM38510/, SMD#, MIL-STD-883C

Analog						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
10319	24	High Speed 8-Bit A/D Flash Convertor			/B	JA			
108	14	Precision Operational Amplifier			/B	CA			
	8				/B	PA		GA	
108A	14	Precision Operational Amplifier			/B	CA			
	8		10104		/B	PA		GA	
111	8	High Performance Voltage Comparator	10304			PA			
117K	3	Adjustable Output Positive Voltage Regulator		77034	/B			2Q91	
124	14	Quad Low Power Operational Amplifier	11005		/B	CA			
137K	3	Negative Adjustable 1.5 A Voltage Regulator			/B			2Q91	
139	14	Quad Single Supply Comparator	11201		/B	CA			
139A	14	Quad Single Supply Comparator			/B	CA			
1488	14	Quad MDTL Line Driver [T_A = 0°C to +75°C]			LTR	CA			
1489	14	Quad MDTL Line Driver [T_A = 0°C to +75°C]			LTR	CA			
1489A	14	Quad MDTL Line Receiver [T_A = 0°C to +75°C]			LTR	CA			
1508	16	8-Bit Multiplying D/A Converter			/B	EA			
1525A	16	Pulse Width Modulator Control Circuit	12602	5962-8951101	/B	4Q91			
1526	18	Pulse Width Modulator Control Circuit	12603	8551501	/B	VA			
1527A	16	Pulse Width Modulator Control Circuit	12604	5962-8951102	/B	4Q91			
1536	8	High-Voltage Operational Amplifier			/B	PA		GA	
1537	14	Dual Operational Amplifier			/B	CA			
1539	14	High Slew-Rate Operational Amplifier			/B	CA			
	8				/B	PA		GA	
1545	14	Wideband Amplifier		5962-8671201	/B	CA			
	10			5962-8671201	/B			IA	
1550	10	RF/IF Amplifier			/B			IA	

Military Semiconductor Integrated Circuits

ANALOG/TELECOM & SPECIAL FUNCTION

JM38510/, SMD#, MIL-STD-883C

Analog						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
1554	10	1-Watt Power Amplifier			/B			IA	
1555	8	Timing Circuit			/B	PA		GA	
1556	14	High Performance Operational Amplifier			/B	CA			
	8				/B	PA		GA	
1558	14	Dual Operational Amplifier			/B	CA			
	8				/B	PA		GA	
1558S	14	High Slew-Rate Dual Operational Amplifier			/B	CA			
	8				/B	PA		GA	
1563	10	Adjustable Negative Voltage Regulator			/B			IA	
1568	14	Dual Positive 15 Volt Tracking Regulator			/B	CA			
	10				/B			IA	
1569	10	Adjustable Positive Voltage Regulator			/B			IA	
158	8	Dual Low Power Operational Amplifier		5962-8771001	/B	PA		GA	
1590	8	Wideband Amplifier with AGC		5962-8765701	/B			GA	
1594	16	Four-Quadrant Multiplier			/B	EA			
1595	14	Four-Quadrant Multiplier			/B	CA			
1596	14	Balanced Modulator-Demodulator		5962-8857101	/B	CA			
	10			5962-8857101	/B			IA	
1709	14	General Purpose Operational Amplifier			/B	CA			
	8				/B	PA		GA	
1723	14	Adjustable Positive or Negative Voltage Reg			/B	CA			
	10				/B			IA	
1733	14	Differential Video Amplifier		8418501	/B	CA			
	10			8418501	/B			IA	
1741	14	General Purpose Operational Amplifier			/B	CA			
	8	General Purpose Operational Amplifier			/B	PA		GA	
1741S	8	High Slew-Rate Operational Amplifier			/B	PA		GA	
1747	14	Dual 1741 Operational Amplifier			/B	CA			
	10				/B			IA	

Military Semiconductor Integrated Circuits

ANALOG/TELECOM & SPECIAL FUNCTION

JM38510/, SMD#, MIL-STD-883C

Analog						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
193	8	Dual Comparator			/B			GA	
193A	8	Dual Comparator			/B			GA	
2003A	16	Darlington Driver	14103		/B	EA			
26LS31	16	Quad RS-422 Line Driver with 3-State Outputs		7802301	/B	EA	FA		2A
26LS32	16	Quad RS-422/23 Line Receiver — 3-State Outputs		7802001	 /B	2Q91 1Q91	2Q91 1Q91		2Q91 1Q91
35035	24	DC Brushless Motor Controller			/B	1Q91			
35039	8	DC Brushless Motor Controller Adapter			*	2Q91			
35063	8	DC to DC Converter Control Circuit			/B	PA			
35074	14	Quad High-Performance Single-Supply Op Amp		5962-8996901	/B	CA			2A
35074A	14	Quad High-Performance Single-Supply Op Amp		5962-8996902	/B	CA			2A
35164	8	Undervoltage Lockout			/B	4Q90			
3517	16	Continuously Variable-Slope Delta Mod/Demod		5962-8764301	/B	EA			2A
35174	14	Low Power Single Supply Op Amp			/B	CA			
35179	14	Quad Low Noise OpAmp			/B	2Q91			
3523	8	Overvoltage Sensing Circuit		5962-8978001	/B	PA			
3556	14	Dual Timing Circuit			/B	CA			
431	8	Programmable Precision References	14801	8410901	/B	PA			
55107	14	Dual Line Receiver	10401		/B	CA			
6875A	16	6800 MPU Clock Generator/Driver			/B	EA			
7805	2	Positive Voltage Regulator (1.5 A, 5 V)			/B			2Q91	
7805A	2	Positive Voltage Regulator (1.5 A, 5 V)			/B			2Q91	
7806	2	Positive Voltage Regulator (1.5 A, 6 V)			/B			2Q91	
7806A	2	Positive Voltage Regulator (1.5 A, 6 V)			/B			2Q91	

*** Offshore Commercial Wafer Flow**

Military Semiconductor Integrated Circuits

ANALOG

JM38510/, SMD#, MIL-STD-883C

Analog						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
7808	2	Positive Voltage Regulator (1.5 A, 8 V)			/B			2Q91	
7808A	2	Positive Voltage Regulator (1.5 A, 8 V)			/B			2Q91	
7812	2	Positive Voltage Regulator (1.5 A, 12 V)			/B			2Q91	
7812A	2	Positive Voltage Regulator (1.5 A, 12 V)			/B			2Q91	
7815	2	Positive Voltage Regulator (1.5 A, 15 V)			/B			2Q91	
7815A	2	Positive Voltage Regulator (1.5 A, 15 V)			/B			2Q91	
7818	2	Positive Voltage Regulator (1.5 A, 18 V)			/B			2Q91	
7818A	2	Positive Voltage Regulator (1.5 A, 18 V)			/B			2Q91	
7908	2	Negative Voltage Regulator (1.5 A, 8 V)			/B			3Q91	
7908A	2	Negative Voltage Regulator (1.5 A, 8 V)			/B			3Q91	
7912	2	Negative Voltage Regulator (1.5 A, 12 V)			/B			3Q91	
7912A	2	Negative Voltage Regulator (1.5 A, 12 V)			/B			3Q91	
7915	2	Negative Voltage Regulator (1.5 A, 15 V)			/B			3Q91	
7915A	2	Negative Voltage Regulator (1.5 A, 15 V)			/B			3Q91	
7918	2	Negative Voltage Regulator (1.5 A, 18 V)			/B			3Q91	
7918A	2	Negative Voltage Regulator (1.5 A, 18 V)			/B			3Q91	

Military Semiconductor Integrated Circuits

ANALOG/TELECOM & SPECIAL FUNCTION

JM38510/, SMD#, MIL-STD-883C

Telecom & Special Functions						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
145406	16	RS232/V.28 Driver Receiver			/B	2Q91			
145152-2	28	PLL Parallel Programmable			/B	2Q91			
145151-2	28	PLL Parallel Programmable			/B	2Q91			
145146-2	20	PLL 4-Bit Data Bus Programmable			/B	2Q91			
145155-2	18	PLL Serial Input			/B	2Q91			
145157-2	16	PLL Serial Input			/B	2Q91			
145156-2	16	PLL Serial Input			/B	2Q91			
145158-2	16	PLL Serial Input			/B	3Q91			
145407	20	RS232/V.28 Driver Receiver (5.0 Volt only)			/B	4Q91			

Military Semiconductor Integrated Circuits

ADVANCED LOW POWER SCHOTTKY

JM38510/, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	LCCC	CLCC
54ALS00	14	Quad 2-Input NAND Gate			/B	CA	DA	2A	
	14	End Of Life 13 Nov. 1991		5962-8683301			DA	2A	
54ALS04	14	Hex Inverter			/B	CA	DA	2A	
	14	End Of Life 13 Nov. 1991		5962-8684301			DA	2A	
54ALS163	16	4-Bit Binary Counter, Synchronous Reset End Of Life 13 Nov. 1991			/B	EA	FA	2A	
54ALS573	20	Octal Transparent Latch, 3-State End Of Life 13 Nov. 1991		8401201	/B	RA	SA	2A	
54ALS574	20	Octal D Flip-Flop, 3-State End Of Life 13 Nov. 1991		8400101	/B	RA	SA	2A	

Military Semiconductor Integrated Circuits

EMITTER COUPLED LOGIC IN PICO SECONDS (ECLinPS)

JM38510/, SMD#, MIL-STD-883C

100K ECLinPS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	QFP	CAN	LCCC
10E416	28	8-Bit Synchronous Binary Up Counter			/B		TBD		
10E501	28	Quad 4-Input OR/NOR Gate			/B		TBD		
10E504	28	Quint 2-Input AND/NAND Gate			/B		TBD		
10E507	28	Quint 2-Input XOR/XNOR Gate			/B		TBD		
10E516	28	Quint Differential Line Receiver			/B		TBD		
10E541	28	8-Bit Shift Register			/B		TBD		
10E542	28	9-Bit Shift Register			/B		TBD		
10E543	28	9-Bit Hold Register			/B		TBD		
10E551	28	6-Bit D Register			/B		TBD		
10E558	28	5-Bit 2:1 Multiplexer			/B		TBD		
100E416	28	8-Bit Synchronous Binary Up Counter			/B		TBD		
100E501	28	Quad 4-Input OR/NOR Gate			/B		TBD		
100E504	28	Quint 2-Input AND/NAND Gate			/B		TBD		
100E507	28	Quint 2-Input XOR/XNOR Gate			/B		TBD		
100E511	28	1:9 Differential Clock Driver Low Skew, Enable, V_{BB}, Differential Output			/B		1Q91		
100E516	28	Quint Differential Line Receiver			/B		TBD		
100E541	28	8-Bit Shift Register			/B		TBD		
100E542	28	9-Bit Shift Register			/B		TBD		
100E543	28	9-Bit Hold Register			/B		TBD		
100E551	28	6-Bit D Register			/B		TBD		
100E558	28	5-Bit 2:1 Multiplexer			/B		TBD		
100E851	28	6-Bit D Register, Differential Data & Clk Inputs V_{BB}, Common Reset, Single Ended Output			/B		1Q91		

Military Semiconductor Integrated Circuits

MOTOROLA EMITTER COUPLED LOGIC (MECL)

JM38510/, SMD#, MIL-STD-883C

MECL 10K						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
10500	16	Quad 2-Input NOR Gate with Strobe			/B	EA	FA		
10501	16	Quad OR/NOR Gate	06001		/B	EA	FA		2A
10502	16	Quad 2-Input NOR Gate	06002		/B	EA	FA		2A
10503	16	Quad 2-Input OR Gate			/B	EA	FA		2A
10504	16	Quad 2-Input AND Gate	06201		/B	EA	FA		2A
10505	16	Triple 2-3-2-Input OR/NOR Gate	06003		/B	EA	FA		2A
10506	16	Triple 4-3-3-Input NOR Gate	06004		/B	EA	FA		2A
10507	16	Triple 2-Input Exclusive OR Exclusive NOR Gate	06005		/B	EA	FA		2A
10509	16	Dual 4-5-Input OR/NOR Gate	06006		/B	EA	FA		2A
10513	16	Quad Exclusive OR Gate			/B	EA	FA		2A
10514	16	Triple Line Receiver			/B	EA	FA		2A
10515	16	Quad Line Receiver			/B	EA	FA		2A
10516	16	Triple Line Receiver		5962-7800901	/B	EA	FA		2A
10517	16	Dual 2-Wide 2-3-Input OR-AND/OR-AND-INVERT Gate			/B	EA	FA		2A
10518	16	Dual 2-Wide 3-Input OR-AND Gate			/B	EA	FA		2A
10519	16	4-Wide 4-3-3-3-Input OR-AND Gate			/B	EA	FA		2A
10521	16	4-Wide OR-AND/OR-AND-INVERT Gate		5962-8857701	/B	EA	FA		2A
10523	16	Triple 4-3-3 Input Bus Driver			/B	EA	FA		2A
10524	16	Quad TTL-to-MECL Translator	06301		/B	EA	FA		2A
10525	16	Quad MECL-to-TTL Translator	06302		/B	EA	FA		2A
10530	16	Dual Latch			/B	EA	FA		2A
10531	16	Dual Type D Master-Slave Flip-Flop	06101		/B	EA	FA		2A
10533	16	Quad Latch			/B	EA	FA		2A

Military Semiconductor Integrated Circuits

MOTOROLA EMITTER COUPLED LOGIC (MECL)

JM38510/, SMD#, MIL-STD-883C

MECL 10K						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
10535	16	Dual J-K Master-Slave Flip-Flop	06104		/B	EA	FA		2A
10536	16	Universal Hexadecimal Counter		5962-87745	/B	EA	FA		2A
10537	16	Universal Decade Counter			/B	EA	FA		
10538	16	Bi-Quinary Counter			/B	EA	FA		2A
10539	16	32 x 8 Bit PROM			/B	EA	FA		2A
10541	16	4-Bit Universal Shift Register		5962-8855701	/B	EA	FA		2A
10545	16	64-Bit Register File (RAM)		5962-8856001	/B	EA	FA		2A
10549	16	256 x 4 Bit PROM			/B	EA	FA		2A
10552	16	256 x 1 Bit RAM			/B	EA	FA		2A
10553	16	Quad Latch (Negative Clock)			/B	EA	FA		2A
10558	16	Quad 2-Input Multiplexer (Noninverting)		5962–8779201	/B	EA	FA		2A
10560	16	12-Bit Parity Generator-Checker			/B	EA			
10561	16	Binary to 1-8 Line Decoder (Low)			/B	EA	FA		2A
10562	16	Binary to 1-8 Line Decoder (High)			/B	EA	FA		2A
10563	16	Error Detection and Correction Circuit (IBM Pattern)			/B	EA	FA		2A
10564	16	8-Line Multiplexer		5962-8852701	/B	EA	FA		2A
10565	16	8-Input Priority Encoder		5962-90561	/B	EA	FA		2A
10566	16	5-Bit Magnitude Comparator			/B	EA	FA		2A
10568	16	Quad Latch (Common Clock)			/B	EA	FA		
10570	16	9+2-Bit Parity Generator-Checker			/B	EA			

MOTOROLA EMITTER COUPLED LOGIC (MECL)

JM38510/, SMD#, MIL-STD-883C

MECL 10K						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
10571	16	Dual Binary to 1-4-Decoder (Low)			/B	EA			
10572	16	Dual Binary to 1-4-Decoder (High)			/B	EA	FA		2A
10573	16	Quad 2-Input Multiplexer/Latch			/B	EA	FA		2A
10574	16	Dual 4-to-1 Multiplexer			/B	EA	FA		2A
10575	16	Quint Latch			/B	EA	FA		2A
10576	16	Hex D Master-slave Flip-Flop	06103		/B	EA	FA		2A
10578	16	Binary Counter			/B	EA	FA		2A
10579	16	Look-ahead Carry Block		5962-87746	/B	EA			2A
10580	16	Dual 2-Bit High-Speed Adder/Subtracter			/B	EA	FA		
10581	24	4-Bit Arithmetic Logic Unit/Function Generator			/B	JA	KA		N/A
10582	16	2-Bit Arithmetic Logic Unit/Function Generator			/B	EA			
10586	16	Hex D Master-Slave Flip-Flop With Reset		5962-8779301	/B	EA	FA		2A
10590	16	Quad IBM (MST)-to-MECL Translator			/B	EA	FA		2A
10591	16	Hex MECL-to-IBM (MST) Translator			/B	EA			
10592	16	Quad Bus Driver			/B	EA			
10595	16	Hex Inverter/Buffer			/B	EA	FA		2A
10597	16	Hex AND Gate	06202		/B	EA	FA		2A
10598	16	Monostable Multivibrator		5962-8777301	/B	EA	FA		
10610	16	High Speed Dual 3-Input/3-Output OR Gate			/B	EA	FA		2A
10611	16	High Speed Dual 3-Input/3-Output NOR Gate			/B	EA	FA		2A
10612	16	High Speed Dual 3-Input/3-Output OR/NOR Gate		5962-8775001	/B	EA	FA		2A
10616	16	High Speed Triple Line Receiver			/B	EA	FA		2A
10631	16	High Speed Dual D Master-Slave Flip-Flop	06102		/B	EA	FA		2A
10687	16	High Speed 2-Bit Multiplier			/B	EA	FA		2A

Military Semiconductor Integrated Circuits

MOTOROLA EMITTER COUPLED LOGIC (MECL)

JM38510/, SMD#, MIL-STD-883C

MECL 10KH						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
10H416	16	Binary Counter		5962-8759001	/B	EA	FA		
10H500	16	Quad 2-Input NOR w/Strobe			/B	EA			
10H501	16	Quad OR/NOR Gate		5962-8750301	/B	EA	FA		2A
10H502	16	Quad 2-Input NOR Gate		5962-8755702	/B	EA	FA		2A
10H503	16	Quad 2-Input OR Gate		5962-8756501	/B	EA	FA		2A
10H504	16	Quad 2-Input AND Gate		5962-8750401	/B	EA	FA		2A
10H505	16	Triple 2-3-2 Input OR/NOR Gate		5962-8750701	/B	EA	FA		2A
10H506	16	Triple 4-3-3 Input NOR Gate		5962-8756401	/B	EA	FA		2A
10H507	16	Triple 2-Input/Exclusive NOR Gate		5962-8772701	/B	EA	FA		2A
10H509	16	Dual 4-5 Input OR/NOR Gate		5962-89856	/B	EA	FA		
10H513	16	Quad Exclusive OR Gate		5962-8755801	/B	EA	FA		2A
10H515	16	Quad Line Receiver		5962-8750101	/B	EA	FA		2A
10H516	16	Triple Line Receiver		5962-8750201	/B	EA	FA		2A
10H517	16	Dual 2-Wide 2-3 Input OR-AND/OR-AND-INVERT Gate			/B	1Q91	1Q91		1Q91
10H518	16	Dual 2-Wide 3-Input OR/AND Gate		5962-8755901	/B	EA	FA		2A
10H519	16	4-Wide 4-3-3-3 Input OR-AND Gate		5962-8772801	/B	EA	FA		2A
10H521	16	4-Wide OR-AND/OR-AND INVERT Gate		5962-8773001	/B	EA	FA		2A
10H524	16	Quad TTL-to-MECL Translator		5962-8756001	/B	EA	FA		2A
10H525	16	Quad MECL-to-TTL Translator		5962-8750801	/B	EA	FA		2A
10H531	16	Dual D Master Slave Flip-Flop		5962-8756101	/B	EA	FA		2A
10H535	16	Dual J-K Master Slave Flip-Flop		5962-8750501	/B	EA	FA		2A
10H536	16	Universal Hexadecimal Counter		5962-8700101	/B	EA	FA		2A
10H541	16	4-Bit Universal Shift Register		5962-8751101	/B	EA	FA		2A
10H558	16	Quad 2-Input Multiplexer (Noninverting)		5962-8756601	/B	EA	FA		2A
10H560	16	12-Bit Parity Generator-Checker		5962-8756201	/B	EA	FA		2A
10H561	16	Binary to 1-8 Line Decoder (Low)		5962-8756701	/B	EA	FA		2A
10H562	16	Binary 1-8 Line Decoder (High)			/B	EA	FA		2A

Military Semiconductor Integrated Circuits

MOTOROLA EMITTER COUPLED LOGIC (MECL)

JM38510/, SMD#, MIL-STD-883C

MECL 10KH						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
10H564	16	8-Line Multiplexer		5962-8772901	/B	EA	FA		2A
10H571	16	Dual Binary to 1-4 Line Decoder (Low)		5962-8756801	/B	EA	FA		2A
10H574	16	Dual 4-1 Multiplexer		5962-8750601	/B	EA	FA		2A
10H576	16	Hex D Master-Slave Flip-Flop		5962-8751201	/B	EA	FA		2A
10H581	16	4-Bit Arithmetic Logic Unit/Function Generator			/B	1Q91	1Q91		1Q91
10H586	16	Hex D Master-Slave Flip-Flop w/Common Reset		5962-8756301	/B	EA	FA		2A
10H588	16	Hex Buffer w/Enable		5962-8750901	/B	EA	FA		2A
10H589	16	Hex Inverter w/Enable		5962-8751001	/B	EA	FA		2A
10H609	16	Dual 4-5-Input OR/NOR Gate		5962-8756901	/B	EA	FA		2A
10H610	16	High Speed Dual 3 Input/3 Output OR Gate		5962-8754101	/B	EA	FA		2A
10H750	16	ECL-to-TTL Translator (Quad), Single Power Supply (–5.2 V or +5.0 V)			/B	EA	FA		2A
10H751	16	Quad TTL/NMOS to MECL Translator			/B	2Q91	2Q91		2Q91
10H1000	28	9-Bit TTL to ECL Translator			/B				TBD
10H1001	28	9-Bit ECL to TTL Translator			/B				TBD
10H1002	28	9-Bit Latch /TTL to ECL Translator			/B				TBD
10H1003	28	9-Bit Latch /ECL to TTL Translator			/B				TBD
10H1040	28	68030/040 ECL/TTL Clock Driver			/B				TBD
10H1041	28	Single Supply ECL/TTL 1:9 Clock Driver			/B				TBD
10H1042	28	68030/040 ECL/TTL Clock Driver			/B				TBD
10H1043	28	Dual Supply ECL/TTL 1:8 Clock Driver			/B				TBD

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MOTOROLA EMITTER COUPLED LOGIC (MECL) III

JM38510/, SMD#, MIL-STD-883C

MECL III						Package Type and Lead Finish			
Device	Pins	Description	JM35810/	SMD#	883C	DIL	FP	CAN	LCCC
1648M	14	Voltage Controlled Oscillator, [T_A = –55°C to +125°C]			/B	CA	DA		2A
1650	16	Dual A/D Converter [T_A = –30°C to +85°C]			LTR	EA	FA		
1651	16	Dual A/D Converter [T_A = –30°C to +85°C]			LTR	EA	FA		
1654	16	Binary Counter [T_A = –30°C to +85°C]			LTR	EA			
1660	16	Dual 4-Input Gate [T_A = –30°C to +85°C]			LTR	EA	FA		
1662	16	Quad 2-Input NOR Gate [T_A = –30°C to +85°C]			LTR	EA	FA		
1664	16	Quad 2-Input OR Gate [T_A = –30°C to +85°C]			LTR	EA	FA		
1668	16	Dual Clocked Latch [T_A = –30°C to +85°C]			LTR	EA	FA		
1670	16	Master-Slave Flip-Flop [T_A = –30°C to +85°C]			LTR	EA	FA		
1672	16	Triple 2-Input Exclusive OR Gate [T_A = –30°C to +85°C]			LTR	EA	FA		
1674	16	Triple 2-Input Exclusive-NOR Gate [T_A = –30°C to +85°C]			LTR	EA	FA		
1678	16	Bi-Quinary Counter [T_A = –30°C to +85°C]			LTR	EA			
1690	16	UHF Prescaler D Flip-Flop [T_A = –30°C to +85°C]			LTR	EA	FA		
1692	16	Quad Line Receiver [T_A = –30°C to +85°C]			LTR	EA	FA		

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MOTOROLA EMITTER COUPLED LOGIC (MECL)

JM38510/, SMD#, MIL-STD-883C

MECL Phase-Locked-Loop (PLL)						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
12502	14	Analog Mixer Double Balanced			/B	CA			
12509	16	Two-Modulus ÷5/÷6, 600 MHz Typical		5962-8774801	/B	EA			
12511	16	Two-Modulus ÷8/÷9, 600 MHz Typical			/B	EA			
12513	16	Two-Modulus ÷10/÷2, 600 MHz Typical			/B	EA			
12514	16	Counter-Control Logic			/B	PA			
12515	8	Low Power Two-Modulus Prescaler			/B	EA			
12540	14	Phase-Frequency Detector		5962-8775201	/B	CA			
12561	16	Crystal Oscillator (2–20 MHz)			/B	EA			

Military Semiconductor Integrated Circuits

ADVANCED CMOS TECHNOLOGY (FACT)

JM38510/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD	883C	DIL	FP	CAN	LCCC
54AC00	14	Quad 2-Input NAND Gate		5962-87549	/B	1Q91			2Q91
54ACT00	14	Quad 2-Input NAND Gate, with TTL Inputs		5962-87699	/B	1Q91			2Q91
54AC02	14	Quad 2-Input NOR Gate		5962-87612	/B	1Q91			2Q91
54ACT02	14	Quad 2-Input NOR Gate, with TTL Inputs		TBD	/B	1Q91			2Q91
54AC138	16	1-of-8 Decoder/Demultiplexer		5962-87622	/B	1Q91			2Q91
54ACT138	16	1-of-8 Decoder/Demultiplexer with TTL Inputs		5962-87554	/B	1Q91			2Q91
54ACT151	16	8-Input Multiplexer, with TTL Inputs		5962-88756	/B	1Q91			2Q91
54AC153	16	Dual 4-Input Multiplexer		5962-87625	/B	2Q91			3Q91
54AC163	16	4-Bit Binary Counter, Synchronous Reset		5962-89592	/B	2Q91			3Q91
54AC174	16	Hex D Flip-Flop with Master Reset			/B	2Q91			3Q91
54AC240	20	Octal Buffer/Line Driver		5962-87550	/B	1Q91			2Q91
54AC244	20	Octal Buffer/Line Driver		5962-87552	/B	1Q91			2Q91
54ACT244	20	Octal Buffer/Line Driver with TTL Inputs		5962-87760	/B	1Q91			2Q91
54AC245	20	Octal Bidirectional Transceiver		5962-87758	/B	1Q91			2Q91
54AC273	20	Octal D-Type Flip-Flop			/B	2Q91			3Q91
54AC299	20	8-Bit Shift/Store Register			/B	1Q91			2Q91
54ACT299	20	8-Bit Shift/Store Register with TTL Inputs		5962-88771	/B	2Q91			3Q91
54AC32	14	Quad 2-Input OR Gate		5962-87614	/B	2Q91			3Q91
54AC373	20	Octal Transparent Latch, 3-State		5962-87555	/B	1Q91			2Q91
54ACT373	20	Octal Transparent Latch, 3-State, TTL		5962-87555	/B	1Q91			2Q91
54AC374	20	Octal D Flip-Flop, TTL Compatible Inputs			/B	1Q91			2Q91
54ACT374	20	Octal D Flip-Flop, TTL Compatible Inputs		5962-87631	/B	1Q91			2Q91
54AC540	20	Octal Buffer/Line Driver with 3-State Outputs		5962-87695	/B	3Q91			4Q91
54AC541	20	Octal Buffer/Line Driver with 3-State Outputs		5962-88706	/B	3Q91			4Q91

ADVANCED CMOS TECHNOLOGY (FACT)

JM38510/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD	883C	DIL	FP	CAN	LCCC
54ACT74	14	Dual D Flip-Flop, with TTL Inputs		5962-87525	/B	1Q91			2Q91
54AC86	14	Quad 2-Input EX-OR Gate		5962-89550	/B	2Q91			4Q91
5488913	14	Hex Divide by two Flip-Flop with matching Propagation Delays		Planned	/B	1Q91			2Q91
5488914	14	Hex Divide by two Flip-Flop with Synchronized Power and Reset		Planned	/B	1Q91			2Q91

Military Semiconductor Integrated Circuits

ADVANCED SCHOTTKY TTL (FAST)

JM38510/, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54F00	14	Quad 2-Input NAND Gate	33001		/B	CA	DA		2A
54F02	14	Quad 2-Input NOR Gate	33301		/B	CA	DA		2A
54F04	14	Hex Inverter	33002		/B	CA	DA		2A
54F08	14	Quad 2-Input AND Gate	34001		/B	CA	DA		2A
54F10	14	Triple 3-Input NAND Gate	33003		/B	CA	DA		
54F109	16	Dual JK Flip-Flop with Preset	34102		/B	EA	FA		2A
54F11	14	Triple 3-Input AND Gate	34002		/B	CA	DA		2A
54F112	16	Dual JK Edge Triggered Flip-Flop			/B	TBD	TBD		TBD
54F125	14	Quad Buffer, 3-State, Enable-LO			/B	CA	DA		2A
54F126	14	Quad Buffer, 3-State, Enable-HI			/B	CA	DA		2A
54F13	14	Dual 4-Input NAND Schmitt Trigger			/B	CA	DA		2A
54F132	14	Quad 2-Input NAND Schmitt Trigger			/B	CA	DA		2A
54F138	16	1-of-8 Decoder/Demultiplexer	33701		/B	EA	FA		2A
54F139	16	Dual 1-of-4 Decoder/Demultiplexer	33702		/B	EA	FA		2A
54F14	14	Hex Inverter Schmitt Trigger		5962-8875201	/B	CA	DA		2A
54F151	16	8-Input Multiplexer	33901		/B	EA	FA		2A
54F153	16	Dual 4-Input Multiplexer	33902		/B	EA	FA		2A
54F157A	16	Quad 2-Input Multiplexer	33903		/B	EA	FA		2A
54F158A	16	Quad 2-Input Multiplexer, Inverting	33904		/B	EA	FA		2A
54F161A	16	4-Bit Binary Counter, Asynchronous Reset	34301		/B	2Q91	2Q91		2Q91
54F163A	16	4-Bit Binary Counter, Synchronous Reset	34302		/B	1Q91	1Q91		1Q91
54F174	16	Hex D Flip-Flop	34107		/B	EA	FA		2A
54F175	16	Quad D Flip-Flop	34104		/B	EA	FA		2A

Military Semiconductor Integrated Circuits

ADVANCED SCHOTTKY TTL (FAST)

JM38510/, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54F181	24	4-Bit ALU	33801			2Q91	2Q91		N/A
					/B	JA	KA		N/A
54F182	16	Look-Ahead Carry Generator	33802			3Q91	3Q91		3Q91
					/B	EA	FA		2A
54F194	16	Universal Shift Register	33601			3Q91	3Q91		3Q91
					/B	2Q91	2Q91		2Q91
54F20	14	Dual 4-Input NAND Gate	33004		/B	CA	DA		2A
54F240	20	Octal Buffer/Line Driver/Inverting/3-State	33201		/B	RA	SA		2A
54F241	20	Octal Buffer/Line Driver, 3-State	33202	5962-8687401	/B	RA	SA		2A
54F242	14	Quad Bus Transceiver/Inverting/3-State	34801		/B	1Q91	1Q91		1Q91
54F243	14	Quad Bus Transceiver/Non-Inverting/3-State	34802		/B	1Q91	1Q91		1Q91
54F244	20	Quad Buffer Driver/Non-Inverting/3-State	33203		/B	RA	SA		2A
54F245	20	Octal Bus Transceiver	34803	8551101	/B	RA	SA		2A
54F251	16	8-Input Multiplexer/3-State	33905		/B	EA	FA		2A
54F253	16	Dual 4-Input Multiplexer/3-State	33908		/B	EA	FA		2A
54F257	16	Quad 2-Input Multiplexer/3-State			/B	EA	FA		2A
54F258	16	Quad 2-Input Multiplexer/Inverting/3-State			/B	EA	FA		2A
54F280	14	9-Bit Odd/Even Parity Generator/Checker	34901		/B	CA	DA		2A
54F283	16	4-Bit Full Adder	34201		/B	EA	FA		2A
54F32	14	Quad 2-Input OR Gate	33501		/B	CA	DA		2A
54F352	16	Dual 4-Input Multiplexer	33909		/B	EA	FA		2A
54F353	16	Dual 4-Input Multiplexer/3-State	33910		/B	EA	FA		2A
54F373	20	Octal Transparent Latch/3-State	34601		/B	RA	SA		2A
54F374	20	Octal D Flip-Flop/3-State	34105		/B	RA	SA		2A
54F378	16	Hex Parallel D Register with Enable	34108	5962-8855501	/B	EA	FA		2A

Military Semiconductor Integrated Circuits

ADVANCED SCHOTTKY TTL (FAST)

JM38510/, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54F379	16	Quad Parallel Register with Enable	34109		/B	EA	FA		2A
54F381	20	4-Bit ALU	33803	8671001	/B	RA	SA		2A
54F382	20	4-Bit ALU	33804		/B	RA	SA		2A
54F398	20	Quad 2-Port Register	35001		/B	RA	SA		2A
54F399	16	4-Bit Register with Non-Inverting Outputs	35002		/B	EA	FA		2A
54F521	20	Octal Comparator			/B	RA	SA		2A
54F533	20	Octal Transparent Latch/3-State	34602		/B	RA	SA		2A
54F534	20	Octal D-Type Flip-Flop/3-State	34106		/B	RA	SA		2A
54F64	14	4-2-3-2 Input AND-OR-INVERT Gate	33401		/B	CA	DA		2A
54F74	14	Dual D Flip-Flop	34101		/B	CA	DA		2A
54F803	14	Clock Driver with Matched Propagation Delays			/B	1Q91	1Q91		1Q91
54F86	14	Quad 2-Input Exclusive OR Gate	34501		/B	CA	DA		2A

Military Semiconductor Integrated Circuits

HIGH SPEED CMOS (HCMOS) LOGIC

JM38510/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54HC00	14	Quad 2-Input NAND Gate		8403701	/B	CA			2A
54HC02	14	Quad 2-Input NOR Gate		8404101	/B	CA			2A
54HC03	14	Quad 2-Input NAND, Open Drains		5962-8764701	/B	CA			2A
54HC04	14	Hex Inverter		8409801	/B	CA			2A
54HCU04	14	Hex Unbuffered Inverter		8601001	/B	CA			2A
54HCT04	14	Hex Unbuffered Inverter, with TTL Inputs		5962-89747	/B	1Q91			1Q91
54HC08	14	Quad 2-Input AND Gate		8404701	/B	CA			2A
54HC10	14	Triple 3-Input NAND Gate		8403801	/B	CA			2A
54HC109	16	Dual JK Flip-Flop with Set/Reset, Positive Edge Triggered		8415001	/B	EA			2A
54HC11	14	Triple 3-Input AND Gate		8404801	/B	CA			2A
54HC112	16	Dual JK Flip-Flop with Set/Reset, Negative Edge Triggered		8408801	/B	EA			2A
54HC113	14	Dual JK Flip-Flop with Set, Negative Edge Triggered			/B	CA			2A
54HC132	14	Quad 2-Input Schmitt-Trigger NAND			/B	CA			2A
54HC138	16	1-of-8 Decoder/Demultiplexer		8406201	/B	EA			2A
54HC139	16	Dual 1-of-4 Decoder (Active Low Out)		8409201	/B	EA			2A
54HC14	14	Hex Schmitt-Trigger Inverter		8409101	/B	CA			2A
54HC151	16	8-Channel Digital Multiplexer		8412801	/B	EA			2A
54HC153	16	Dual 4-Channel Digital Multiplexer		8409301	/B	EA			2A
54HC154	24	1-to-16 Decoder/Demultiplexer		5962-8682201	/B	LA			N/A
54HC157	16	Quad 2-Input Data Selector/Multiplexer		5962-8606101	/B	EA			2A
54HC158	16	Quad 2-Input Data Selector/Multiplexer, Inverted	66204			1Q91			1Q91
				5962-8682301	/B	EA			2A

Military Semiconductor Integrated Circuits

HIGH SPEED CMOS (HCMOS) LOGIC

JM38510/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
54HC160	16	Programmable Decade Counter w/Asynchronous Clear		5962-8682401	/B	EA			2A
54HC161	16	Programmable 4-Bit Binary Counter, Asynchronous Clear		8407501	/B	EA			2A
54HC163	16	Programmable 4-Bit Binary Counter, Synchronous Clear		8607601	/B	EA			2A
54HC164	14	8-Bit Serial-In/Parallel-Out Shift Register	66501	 8416201	 /B	1Q91 CA			1Q91 2A
54HC165	16	8-Bit Serial-In or Parallel-In/Serial-Out Shift Register	66502	 8409501	 /B	1Q91 EA			2Q91 2A
54HC173	16	4-Bit D Register, 3-State		5962-8682501	/B	EA			2A
54HC174	16	Hex D Flip-Flop with Common Clock and Reset		8407301	/B	EA			2A
54HC175	16	Quad D Flip-Flop		8408901	/B	EA			2A
54HC194	16	4-Bit Bidirectional Universal Shift Register		5962-8682601	/B	EA			2A
54HC20	14	Dual 4-Input NAND Gate		8403901	/B	CA			2A
54HC240	20	Octal Buffer/Line Driver/Line Receiver, 3-State	65705			3Q91			4Q91
		Inverting Output		8407401	/B	RA			2A
54HCT240	20	Octal Buffer/Line Driver/Line Receiver, 3-State Inverting Output, TTL Compatible Inputs		8550501	/B	RA			2A
54HCT241	20	Octal Buffer/Line Driver/Line Receiver, 3-State TTL Compatible Inputs		85130	/B	RA			2A
54HC244	20	Octal Buffer/Line Driver/Line Receiver, 3-State	65705	8409601	/B	RA			2A
54HCT244	20	Octal Buffer/Line Driver/Line Receiver, 3-State TTL Compatible Inputs	65755	 8513001	 /B	3Q91 2Q91 RA			4Q91 3Q91 1Q91
54HC245	20	Octal 3-State Noninverting BusTransceiver, TTL Compatible Inputs	65503			3Q91			4Q91
54HCT245	20	Octal 3-State Noninverting BusTransceiver, TTL Compatible Inputs	65553	 85506	 /B	3Q91 1Q91 RA			4Q91 2Q91 1Q91

HIGH SPEED CMOS (HCMOS) LOGIC

JM38510/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54HC251	16	8-Input Multiplexer, 3-State		8512501	/B	EA			2A
54HC257	16	Quad 2-Input Data Selector/Multiplexer, 3-State		8512401	/B	EA			2A
54HC27	14	Triple 3-Input NOR Gate		8404201	/B	CA			2A
54HC273	20	Octal D-type Flip-Flop with Common Clock/Reset	65601			4Q91			4Q91
				8409901	/B	RA			2A
54HC30	14	8-Input NAND Gate		8404001	/B	CA			2A
54HC32	14	Quad 2-Input OR Gate		8404501	/B	CA			2A
54HC365	16	Hex 3-State Buffer with Common 2-Input NOR Enable		8500101	/B	EA			2A
54HC366	16	Hex 3-State Buffer w/Common 2-Input NOR Enable, Inverting Output		5962-8682801	/B	EA			2A
54HC367	16	Hex 3-State Buffer w/2 Separate 2-Bit and 4-Bit Sections		8500201	/B	EA			2A
54HC368	16	Hex 3-State Buffer with Separate 2-Bit and 4-Bit Sections, Inverting Output		5962-8681201	/B	EA			2A
54HC373	20	Octal D Transparent Latch	65403			4Q91			4Q91
				8407201	/B	RA			2A
54HCT373	20	Octal D Transparent Latch, 3-State, TTL Compatible Inputs		86867		1Q91			2Q91
					/B	RA			1Q91
54HC374	20	Octal D Flip-Flop, 3-State	65602			1Q91			4Q91
				8407101	/B	RA			2A
54HCT374	20	Octal D Flip-Flop, 3-State, TTL Compatible Inputs		85507		1Q91			2Q91
					/B	RA			1Q91
54HC390	16	Dual Decade Counter		8600901	/B	EA			2A
54HC393	14	Dual 4-Bit Binary Counter		8410001	/B	CA			2A
54HC4017	16	Decade Counter/Divider		8601101	/B	EA			2A
54HC4020	16	14-Stage Binary Ripple Counter		8500301	/B	EA			2A
54HC4024	14	7-Stage Binary Ripple Counter		8601201	/B	CA			2A

Military Semiconductor Integrated Circuits

HIGH SPEED CMOS (HCMOS) LOGIC

JM38510/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
54HC4040	16	12-Stage Binary Ripple Counter		8500401	/B	EA			2A
54HC4060	16	14-Stage Binary Ripple Counter with Oscillator		5962-8768001	/B	EA			2A
54HC4075	14	Triple 3-Input OR Gate		5962-8772201	/B	CA			2A
54HC4078	14	8-Input NOR/OR Gate		5962-8857401	/B	CA			2A
54HC42	16	BCD to 1-of-10 Decoder		5962-8682101	/B	EA			2A
54HC4511	16	BCD-to-7 Segment Latch/Decoder/Display Driver		5962-8773301	/B	EA			2A
54HC4514	24	4-Bit Latch/4-to-16 Line Decoder			/B	LA			N/A
54HC4538	16	Dual Precision Retriggerable/Resettable Monostable Multivibrator		5962-8688601	/B	EA			2A
54HC4543	16	BCD-to-7 Segment Latch/Decoder/Driver for Liquid Crystal Display			/B	EA			2A
54HC51	14	2-Wide 2-Input/2-Wide 3-Input AOI			/B	CA			2A
54HC595	16	8-Bit Serial-to-Parallel Shift Register, 3-State		5962-8681601	/B	EA			2A
54HC646	24	Octal 3-State Noninverting Bus Transceiver w/TTL Compatible Inputs		5962-8688501	/B	LA			
54HC73	14	Dual JK Flip-Flop with Reset		5962-8515301	 /B	CA CA			 2A
54HC74	14	Dual D Flip-Flop with Set/Reset Positive Edge Triggered		8405601	/B	CA			2A
54HC85	16	4-Bit Magnitude Comparator		8601301	/B	EA			2A
54HC86	14	Quad 2-Input EX-OR Gate		8404601	/B	CA			2A

Military Semiconductor Integrated Circuits

LOW POWER SCHOTTKY (LS)

JM38510, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54LS00	14	Quad 2-Input NAND Gate			/B	CA	DA		2A
54LS02	14	Quad 2-Input NOR Gate			/B	CA	DA		2A
54LS03	14	Quad 2-Input NAND Gate, Open-Collector	30301		/B	CA	DA		2A
54LS04	14	Hex Inverter	30003		/B	CA	DA		2A
54LS05	14	Hex Inverter, Open-Collector	30004		/B	CA	DA		2A
54LS08	14	Quad 2-Input AND Gate	31004		/B	CA	DA		2A
54LS09	14	Quad 2-Input AND Gate, Open-Collector	31005	8001901	/B	CA	DA		2A
54LS10	14	Triple 3-Input NAND Gate			/B	CA	DA		2A
54LS107A	14	Dual JK Flip-Flop with Clear	30108		/B	CA	DA		2A
54LS109A	16	Dual JK Flip-Flop with Preset	30109		/B	EA	FA		2A
54LS11	14	Triple 3-Input AND Gate	31001		/B	CA	DA		2A
54LS112A	16	Dual JK Edge-Triggered Flip-Flop	30103		/B	EA	FA		2A
54LS113A	14	Dual JK Edge-Triggered Flip-Flop	30103		/B	CA	DA		2A
54LS114A	14	Dual JK Edge-Triggered Flip-Flop	30105		/B	CA	DA		2A
54LS12	14	Triple 3-Input NAND Gate, Open-Collector	30006		/B	CA	DA		2A
54LS122	14	Retriggerable Monostable Multivibrator	31403	7600301	/B	CA	DA		2A
54LS123	16	Dual Retriggerable Monostable Multivibrator	31401	7603901	/B	EA	FA		2A
54LS125A	14	Quad Buffer, Low Enable, 3-State	32301		/B	CA	DA		2A
54LS126A	14	Quad Buffer, High Enable, 3-State	32302		/B	CA	DA		2A
54LS13	14	Dual 4-Input Schmitt Trigger	31301		/B	CA	DA		2A
54LS132	14	Quad 2-Input Schmitt Trigger	31303		/B	CA	DA		2A
				7600401		CA			
54LS133	16	13-Input NAND Gate			/B	EA	FA		2A
54LS138	16	1-of-8 Decoder/Multiplexer	30701	7600501	/B	EA	FA		2A

Military Semiconductor Integrated Circuits

LOW POWER SCHOTTKY (LS)

JM38510, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
54LS139	16	Dual 1-of-4 Decoder/Multiplexer	30702	7600701	/B	EA	FA		2A
54LS14	14	Hex Schmitt Trigger	31302		/B	CA	DA		2A
54LS15	14	Triple 3-Input AND Gate	31002		/B	CA	DA		2A
54LS151	16	8-Input Multiplexer	30901		/B	EA	FA		2A
				7601001		EA	FA		
54LS153	16	Dual Input Multiplexer	30902	7601101	/B	EA	FA		2A
54LS155	16	Dual 1-to-4 Decoder	32601		/B	EA	FA		2A
54LS156	16	Dual 1-to-4 Decoder, Open-Collector	32602		/B	EA	FA		2A
54LS157	16	Quad 2-Input Multiplexer, Non-Inverting	30903	7600201	/B	EA	FA		2A
54LS158	16	Quad 2-Input Multiplexer, Inverting	30904	7603301	/B	EA	FA		2A
54LS160A	16	BCD Decade Counter, Asynchronous Reset	31503	7700901	/B	EA	FA		2A
54LS161A	16	4-Bit Binary Counter, Asynchronous Reset	31504	7600801	/B	EA	FA		2A
54LS162A	16	BCD Decade Counter, Synchronous Reset	31511		/B	EA	FA		2A
54LS163A	16	4-Bit Binary Counter, Synchronous Reset	31512	7603401	/B	EA	FA		2A
54LS164	14	8-Bit Serial-In/Parallel-Out Shift Register	30605		/B	CA	DA		2A
54LS165	16	8-Bit Parallel-In/Serial-Out Shift Register	30608	7700601	/B	EA	FA		2A
54LS166	16	8-Bit Parallel-In/Serial-Out Shift Register	30609	8001701	/B	EA	FA		2A
54LS169	16	Up/Down Binary Counter			/B	EA	FA		2A
54LS173	16	4-Bit D Register, 3-State			/B	EA			
54LS174	16	Hex D Flip-Flop with Clear	30106		/B	EA	FA		2A
54LS175	16	Quad D Flip-Flop with Clear	30107		/B	EA	FA		2A
54LS181	24	4-Bit ALU	30801		/B	JA	KA		N/A
54LS190	16	Up/Down Decade Counter	31513	7603501	/B	EA	FA		2A
54LS191	16	Up/Down Binary Counter	31509	7600901	/B	EA	FA		2A

Military Semiconductor Integrated Circuits

LOW POWER SCHOTTKY (LS)

JM38510, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54LS192	16	Up/Down Decade Counter with Clear	31507	7603601	/B	EA	FA		2A
54LS193	16	Up/Down Binary Counter with Clear	31508	7600601	/B	EA	FA		2A
54LS194A	16	4-Bit Right/Left Shift Register	30601		/B	EA	FA		2A
54LS195A	16	4-Bit Shift Register (9300 Type)	30602		/B	EA	FA		2A
54LS20	14	Dual 4-Input NAND Gate	30007		/B	CA	DA		2A
54LS21	14	Dual 4-Input AND Gate	31003		/B	CA	DA		2A
54LS22	14	Dual 4-Input NAND Gate, Open Collector	30008		/B	CA	DA		2A
54LS221	16	Dual One-Shot (Very Stable)	31402		/B	EA	FA		2A
				7604201		EA	FA		
54LS240	20	Octal Bus/Line Driver, Inverting 3-State	32401	7801201	/B	RA	SA		2A
54LS241	20	Octal Bus/Line Driver, 3-State	32402		/B	RA	SA		2A
54LS242	14	Quad Bus Transceiver, Inverting, 3-State	32801	8002001	/B	CA	DA		2A
54LS243	14	Quad Bus Transceiver, Non-Inverting, 3-State	32802	8002002	/B	CA	DA		2A
54LS244	20	Octal Driver, Non-Inverting, 3-State	32403	7705701	/B	RA	SA		2A
54LS245	20	Octal Bus Transceiver, Non-Inverting, 3-State	32803	8002101	/B	RA	SA		2A
54LS251	16	8-Input Multiplexer, 3-State	30905		/B	EA	FA		2A
				7601601		EA	FA		
54LS253	16	Dual 4-Input Multiplexer, 3-State	30908		/B	EA	FA		2A
				7601701		EA	FA		
54LS257A	16	Quad 2-Input Multiplexer, Non-Inverting,	30906		/B	EA	FA		2A
				7603701		EA	FA		
54LS258A	16	Quad 2-Input Multiplexer, Inverting, 3-State	30907		/B	EA	FA		2A
				7603801		EA	FA		
54LS259	16	8-Bit Addressable Latch (9334)	31603		/B	EA	FA		2A
54LS26	14	Quad 2-Input NAND, High Voltage	32102		/B	CA	DA		2A
				7602001		CA	DA		
54LS266	14	Quad Exclusive NOR Gate, Open-Collector	30303		/B	CA	DA		

Military Semiconductor Integrated Circuits

LOW POWER SCHOTTKY (LS)

JM38510, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54LS27	14	Triple 3-Input NOR Gate	30302		/B	CA	DA		2A
54LS273	20	Octal D Flip-Flop with Clear	32501	7801001	/B	RA	SA		2A
54LS279	16	Quad Set/Reset Latch	31602	7601801	/B	EA	FA		2A
54LS28	14	Quad 2-Input NOR Buffer	30204		/B	CA	DA		2A
54LS280	14	9-Bit Odd/Even Parity Generator/Checker	32901		/B	CA	DA		2A
54LS283	16	4-Bit Full Adder (Rotated LS83A)	31202	7604301	/B	EA	FA		2A
54LS298	16	Quad 2-Multiplexer, with Output Register	30909		/B	EA	FA		2A
				7601901		EA	FA		
54LS30	14	8-Input NAND Gate	30009		/B	CA	DA		2A
54LS32	14	Quad 2-Input OR Gate	30501		/B	CA	DA		2A
54LS365A	16	Hex Buffer, Common Enable, 3-State	32201		/B	EA	FA		2A
54LS366A	16	Hex Inverter, Common Enable, 3-State	32202		/B	EA	FA		2A
54LS367A	16	Hex Buffer, 4-Bit and 2-Bit, 3-State	32203		/B	EA	FA		2A
54LS368A	16	Hex Inverter, 4-Bit and 2-Bit, 3-State	32204		/B	EA	FA		2A
54LS37	14	Quad 2-Input NAND Buffer	30202		/B	CA	DA		2A
54LS373	20	Octal Transparent Latch, 3-State	32502		/B	RA	SA		2A
54LS374	20	Octal D Flip-Flop	32503	7801101	/B	RA	SA		2A
54LS375	16	Quad Latch	31604		/B	EA	FA		2A
54LS377	20	Octal D Flip-Flop with Enable	32504		/B	RA	SA		2A
54LS38	14	Dual 4-Input NAND Buffer	30203		/B	CA	DA		2A
54LS390	16	Dual Decade Counter	32701		/B	EA	FA		2A
				7802601		EA	FA		
54LS393	14	Dual 4-Bit Binary Counter	32702		/B	CA	DA		2A
54LS399	16	Quad 2-Input Multiplexer with Output Register			/B	EA	FA		2A
54LS40	14	Dual 4-Input NAND Buffer	30201		/B	CA	DA		2A

Military Semiconductor Integrated Circuits

LOW POWER SCHOTTKY (LS)

JM38510, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
54LS42A	16	1-of-10 Decoder	30703	7603101	/B	EA	FA		2A
54LS47	16	BCD to 7-Segment Decoder/Driver	30704		/B	EA	FA		2A
				7604501		EA	FA		
54LS51	14	Dual AND-OR-INVERT Gate	30401		/B	CA	DA		2A
54LS569	20	4-Bit Up/Down Counter, 3-State			/B	RA	SA		2A
54LS645	20	Octal Bus Transceiver, Non-Inverting, 3-State			/B	RA	SA		2A
54LS670	16	4 x 4 Register File, 3-State			/B	EA	FA		2A
54LS716	16	Programmable Modulo-N Counter			/B	EA	FA		
54LS718	16	Programmable Modulo-N Counter			/B	EA	FA		2A
54LS719	16	Programmable Modulo-N Counter			/B	EA			
54LS73A	14	Dual JK Flip-Flop	30101		/B	CA	DA		
54LS74A	14	Dual D Flip-Flop	30102		/B	CA	DA		2A
54LS75	16	4-Bit Bi-Stable Latch with Q and $\overline{Q}$	31601	7601201	/B	EA	FA		
54LS76A	16	Dual JK Flip-Flop	30110	7601301	/B	EA	FA		
54LS83A	16	4-Bit Full Adder	31201	7601401	/B	EA	FA		
54LS85	16	4-Bit Magnitude Comparator	31101		/B	EA	FA		2A
54LS86	14	Quad Exclusive OR Gate	30502		/B	CA	DA		2A
54LS95B	14	4-Bit Shift Register	30603		/B	CA	DA		2A

Military Semiconductor Integrated Circuits

METAL GATE CMOS

JM385610/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
14001A	14	Quad 2-Input NOR Gate			/B	CA			
14001B	14	Quad 2-Input NOR Gate			/B	CA			
14002A	14	Dual 4-Input NOR Gate			/B	CA			
14002B	14	Dual 4-Input NOR Gate			/B	CA			
14006B	14	18-Bit Static Shift Register			/B	CA			
14007A	14	Dual Complementary Pair plus Inverter			/B	CA			
14008B	16	4-Bit Full Adder			/B	EA			
14011A	14	Quad 2-Input NAND Gate			/B	CA			
14011B	14	Quad 2-Input NAND Gate			/B	CA			
14012B	14	Dual 4-Input NAND Gate			/B	CA			
14013B	14	Dual D Flip-Flop			/B	CA			
14014B	16	8-Bit Static Shift Register			/B	EA			
14015B	16	Dual 4-Bit Static Shift Register			/B	EA			
14016B	14	Quad Analog Switch/Quad Multiplexer			/B	CA			
14017B	16	Decade Counter/Divider			/B	EA			
14018B	16	Presettable Divide-by-N Counter			/B	EA			
14020B	16	14-Bit Binary Counter			/B	EA			
14021B	16	8-Bit Static Shift Register			/B	EA			
14022B	16	Octal Counter/Divider			/B	EA			
14023A	14	Triple 3-Input NAND Gate			/B	CA			
14023B	14	Triple 3-Input NAND Gate			/B	CA			
14024B	14	7-Stage Ripple Counter			/B	CA			
14025A	14	Triple 3-Input NOR Gate			/B	CA			
14025B	14	Triple 3-Input NOR Gate			/B	CA			

Military Semiconductor Integrated Circuits

METAL GATE CMOS

JM385610/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
14027B	16	Dual JK Flip-Flop			/B	EA			
14028B	16	BCD-to-Decimal Decoder			/B	EA			
14029B	16	4-Bit Presettable Up/Down Counter			/B	EA			
14034B	24	8-Bit Universal Bus Register			/B	JA			
14035B	16	4-Bit Shift Register			/B	EA			
14040B	16	12-Bit Binary Counter			/B	EA			
14042B	16	Quad Latch			/B	EA			
14043B	16	Quad NOR R-S Latch			/B	EA			
14044B	16	Quad NOR R-S Latch			/B	EA			
14046B	16	Phased-Locked Loop			/B	EA			
14049A	16	Hex Inverter/Buffer			/B	EA			
14050B	16	Hex Buffer			/B	EA			
14051B	16	8-Channel Analog Multiplexer			/B	EA			
14052B	16	Analog Multiplexer, Dual 4-Channel			/B	EA			
14053B	16	Triple 2-Channel Analog Multiplexer			/B	EA			
14066B	14	Quad Analog Switch			/B	CA			
14068B	14	8-Input NAND Gate			/B	CA			
14069A	14	Hex Inverter			/B	CA			
14070B	14	Quad Exclusive OR Gate			/B	CA			
14071B	14	Quad 2-Input OR Gate			/B	CA			
14072B	14	Dual 4-Input OR Gate		7706001	/B	CA			
14073B	14	Triple 3-Input AND Gate		7705101	/B	CA			
14075B	14	Triple 3-Input OR Gate			/B	CA			
14076B	16	Quad D Register			/B	EA			

Military Semiconductor Integrated Circuits

METAL GATE CMOS

JM385610/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
14078B	14	8-Input NOR Gate			/B	CA			
14081B	14	Quad 2-Input AND Gate		7702401	/B	CA			
14082B	14	Dual 4-Input AND Gate		7705901	/B	CA			
14093B	14	Quad 2-Input NAND Schmitt Trigger			/B	CA			
14094B	16	8-Bit Bus Compatible Shift/Store/Latch			/B	EA			
14099B	16	8-Bit Addressable Latch			/B	EA			
14161B	16	Binary Counter, Asynchronous Clear			/B	EA			
14162B	16	Decade Counter, Synchronous Clear			/B	EA			
14163B	16	Binary Counter, Synchronous Clear			/B	EA			
14174B	16	Hex D Flip-Flop			/B	EA			
14175B	16	Quad D Flip-Flop			/B	EA			
14194B	16	4-Bit Universal Shift Register			/B	EA			
14490A	16	Hex Contact Bounce Eliminator		5962-8764601	/B	EA			
14502B	16	Strobe Hex Inverter/Buffer		7702001	/B	EA			
14503B	16	Hex 3-State Buffer			/B	EA			
14504B	16	Triple TTL or CMOS-to-CMOS Level Shifter			/B	EA			
14506A	16	Dual Expandable AOI Gate			/B	EA			
14508B	24	Dual 4-Bit Latch			/B	JA			
14510B	16	BCD Up/Down Counter			/B	EA			
14511B	16	BCD-to-7 Segment Latch/Decoder/Driver			/B	EA			
14512B	16	8-Channel Data Selector			/B	EA			
14514B	24	4-Bit Latch/4-to-16 Line Decoder (High)		7703501	/B	JA			
14515B	24	4-Bit Latch/4-to-16 Line Decoder (Low)			/B	JA			
14516B	16	Binary Up/Down Counter			/B	EA			

Military Semiconductor Integrated Circuits

METAL GATE CMOS

JM385610/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
14517B	16	Dual 64-Bit Static Shift Register			/B	EA			
14518B	16	Dual BCD Up Counter			/B	EA			
14519B	16	4-Bit AND/OR Selector			/B	EA			
14520B	16	Dual Binary Up Counter			/B	EA			
14521B	16	24 Stage Frequency Divider			/B	EA			
14522B	16	Programmable BCD Divide-by-N Counter			/B	EA			
14526B	16	Programmable Binary Divide-by-N Counter			/B	EA			
14529B	16	Dual 4-Channel Analog Data Selector			/B	EA			
14531B	16	12-Bit Parity Tree			/B	EA			
14532B	16	8-Bit Priority Encoder			/B	EA			
14536B	16	Programmable Timer			/B	EA			
14538B	16	Dual Precision Monostable Multivibrator			/B	EA			
14539B	16	Dual 4-Channel Data Selector/Multiplexer			/B	EA			
14541B	14	Programmable Oscillator-Timer			/B	CA			
14543B	16	BCD-to-7 Segment Latch/Decoder/Driver			/B	EA			
14549B	16	Successive Approximation Register			/B	EA			
14551B	16	Quad 2-Channel Analog Multiplexer			/B	EA			
14553B	16	3-Digit BCD Counter			/B	EA			
14555B	16	Dual Binary to 1-to-4 Decoder			/B	EA			
14556B	16	Dual Binary to 1-to-4 Decoder, Inverting			/B	EA			
14557B	16	1-to-64-Bit Variable Length Shift Register		7901601	/B	EA			
14559B	16	Successive Approximation Register			/B	EA			
14560B	16	NBCD Adder			/B	EA			
14561B	14	9's Complementer			/B	CA			

Military Semiconductor Integrated Circuits

METAL GATE CMOS

JM385610/, SMD#, MIL-STD-883C

CMOS Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
14562B	14	128-Bit Static Shift Register			/B	CA			
14568B	16	Phase Comparator and Programmable Counter			/B	EA			
14572A	16	Hex Gate			/B	EA			
14584B	14	Hex Schmitt Trigger		5962-8550102	/B	CA			
14585B	16	4-Bit Magnitude Comparator			/B	EA			

TRANSISTOR TO TRANSISTOR (TTL) LOGIC

JM385610/, SMD#, MIL-STD-883C

Bipolar Logic						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
4324	14	Dual Voltage-Controlled Multivibrator				CA	DA		
4344	14	Phase-Frequency Detector		5962-8780301		CA	DA		

Military Semiconductor Integrated Circuits

NOTICE: ***Military products are not necessarily pin for pin substitutable with their commercial product counterparts. If there are any questions as to the compatibility please contact Product Marketing (602) 897-3768 for detail information.***

MEMORIES

JM38510/, SMD#, MIL-STD-883C

Bipolar Memories						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**CAN**	**LCCC**
10539	16	32 x 8-Bit ECL PROM, 17 ns			/B	EA	FA		2A
10545	16	64-Bit ECL Register File, RAM, 18 ns		5962-8856001	/B	EA	FA		2A
10549	16	256 x 4-Bit ECL PROM, 30 ns			/B	EA	FA		2A
10552	16	256 x 1-Bit ECL RAM, 15 ns			/B	EA	FA		2A
93415	16	1024 x 1-Bit RAM, Open-Collector			/B	EA	FA		
93422	22	256 x 4-Bit RAM, 3-State Output, 60 ns	23110		/B	WA			
93L422A	22	256 x 4-Bit RAM, 3-State Output, 55 ns, Low Power			/B	WA			
93L422	22	256 x 4-Bit RAM, 3-State Output, 75 ns, Low Power	23112		/B	WA			
93425	16	1024 x 1-Bit RAM, 3-State Output			/B	EA	FA		

High Speed CMOS III Cache Tag Memories						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**SB DIL**	**FP**	**CAN**	**LCCC**
4180-30	22	4K x 4 Cache Tag RAM Comparators, 30 ns			/B	3Q90			
4180-35	22	4K x 4 Cache Tag RAM Comparators, 35 ns			/B	3Q90			
4180-40	22	4K x 4 Cache Tag RAM Comparators, 40 ns			/B	3Q90			

CMOS DRAMs						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**SB DIL**	**FP**	**CAN**	**LCCC**
511000-80	18	1M x 1 High Speed DRAM, Fast Page Mode, 80 ns			/B	2Q91			
511000-80	20	1M x 1 High Speed DRAM, Fast Page Mode, 80 ns			/B				2Q91
511000-90	18	1M x 1 High Speed DRAM, Fast Page Mode, 90 ns			/B	2Q91			
511000-90	20	1M x 1 High Speed DRAM, Fast Page Mode, 90 ns			/B				2Q91
511000-110	18	1M x 1 High Speed DRAM, Fast Page Mode, 110 ns			/B	2Q91			

Military Semiconductor Integrated Circuits

MEMORIES

JM38510/, SMD#, MIL-STD-883C

CMOS DRAMs						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	SB DIL	FP	CAN	LCCC
511000-110	20	1M x 1 High Speed DRAM, Fast Page Mode, 110 ns			/B				2Q91
511000-120	18	1M x 1 High Speed DRAM, Fast Page Mode, 120 ns			/B	2Q91			
511000-120	20	1M x 1 High Speed DRAM, Fast Page Mode, 120 ns			/B				2Q91

DSP RAMs						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	CLCC
56824-35	52	8K x 24 DSP RAM, 35 ns			/B				TBD
56824-40	52	8K x 24 DSP RAM, 40 ns			/B				TBD
56824-45	52	8K x 24 DSP RAM, 45 ns			/B				TBD

Military Semiconductor Integrated Circuits

MEMORIES

JM38510/, SMD#, MIL-STD-883C

High Speed CMOS III Static Memories						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
6164-55	28	8K x 8 Fast Static RAM, 55 ns		5962-8552505	/B	XA			
6164-55	32	8K x 8 Fast Static RAM, 55 ns		5962-8552505	 /B				YA UA
6164-70	28	8K x 8 Fast Static RAM, 70 ns		5962-8552504	/B	XA			
6164-70	32	8K x 8 Fast Static RAM, 70 ns		5962-8552504	 /B				YA UA
6168-55	20	4K x 4 Fast Static RAM, 55 ns		5962-8670507	 /B	RA RA			XA UA
6168-70	20	4K x 4 Fast Static RAM, 70 ns		5962-8670509	 /B	RA RA			XA UA
6206-35	28	32K x 8 Fast Static RAM, 35 ns			/B	3Q90			
6206-35	32	32K x 8 Fast Static RAM, 35 ns			/B				4Q90
6206-45	28	32K x 8 Fast Static RAM, 45 ns		5962-8866204	 /B	4Q90 3Q90			
6206-45	32	32K x 8 Fast Static RAM, 45 ns		5962-8866204	/B				4Q90
6206-55	28	32K x 8 Fast Static RAM, 55 ns		5962-8866203	 /B	4Q90 3Q90			
6206-55	32	32K x 8 Fast Static RAM, 55 ns		5962-8866203	/B				4Q90
6206-70	28	32K x 8 Fast Static RAM, 70 ns		5962-8866202	 /B	4Q90 3Q90			
6206-70	32	32K x 8 Fast Static RAM, 70 ns		5962-8866202	/B				4Q90
6206-100	28	32K x 8 Fast Static RAM, 100 ns		5962-8866201	 /B	4Q90 3Q90			
6206-100	32	32K x 8 Fast Static RAM, 100 ns		5962-8866201	/B				4Q90
6264-35	28	8K x 8 Fast Static RAM, 35 ns		5962-8552507	/B	XA			
6264-35	32	8K x 8 Fast Static RAM, 35 ns			/B				4Q90
6264-45	28	8K x 8 Fast Static RAM, 45 ns		5962-8552506	/B	XA			
6264-45	32	8K x 8 Fast Static RAM, 45 ns			/B				4Q90

Military Semiconductor Integrated Circuits

MEMORIES

JM38510/, SMD#, MIL-STD-883C

High Speed CMOS III Static Memories						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
62L64-35	28	8K x 8 Fast Static RAM, 35 ns, Low Power		5962-8552508	/B	XA			
62L64-35	32	8K x 8 Fast Static RAM, 35 ns, Low Power			/B				4Q90
62L64-45	28	8K x 8 Fast Static RAM, 45 ns, Low Power		5962-8552509	/B	XA			
62L64-45	32	8K x 8 Fast Static RAM, 45 ns, Low Power			/B				4Q90
6268-35	20	4K x 4 Fast Static RAM, 35 ns		5962-8670503		RA	4Q90		XA
					/B	RA	4Q90		UA
6268-45	20	4K x 4 Fast Static RAM, 45 ns		5962-8670505		RA	4Q90		XA
					/B	RA	4Q90		UA
6287-35	22	64K x 1 Fast Static RAM, 35 ns, Low Power		5962-8601501		XA			ZA
					/B	XA			UA
6287-45	22	64K x 1 Fast Static RAM, 45 ns, Low Power		5962-8601503		XA			ZA
					/B	XA			UA
62L87-35	22	64K x 1 Fast Static RAM, 35 ns, Low Power		5962-8601502		XA			ZA
					/B	XA			UA
62L87-45	22	64K x 1 Fast Static RAM, 45 ns, Low Power		5962-8601504		XA			ZA
					/B	XA			UA
6288-35	22	16K x 4 Fast Static RAM, 35 ns		5962-8685924		TA			UA
					/B	XA			UA
6288-45	22	16K x 4 Fast Static RAM, 45 ns		5962-8685922	/B	XA			UA
					/B	XA			UA
62L88-35	22	16K x 4 Fast Static RAM, 35 ns, Low Power		5962-8685923		TA			ZA
					/B	XA			UA
62L88-45	22	16K x 4 Fast Static RAM, 45 ns, Low Power		5962-8685921		TA			ZA
					/B	XA			UA
6290-35	24	16K x 4 FSRAM, Chip Enable/Out Enable, 35 ns		5962-8685918	/B	LA			
6290-35	28	16K x 4 FSRAM, Chip Enable/Out Enable, 35 ns		5962-8685918	/B				4Q90
6290-45	24	16K x 4 FSRAM, Chip Enable/Out Enable, 45 ns		5962-8685916	/B	LA			
6290-45	28	16K x 4 FSRAM, Chip Enable/Out Enable, 45 ns		5962-8685916	/B				4Q90

Military Semiconductor Integrated Circuits

MEMORIES

JM38510/, SMD#, MIL-STD-883C

High Speed CMOS III Static Memories							Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
62L90-35	24	16K x 4 FSRAM, Chip Enable/Out Enable, 35 ns, Low Power		5962-8685917	/B	LA			
62L90-35	28	16K x 4 FSRAM, Chip Enable/Out Enable, 35 ns, Low Power		5962-8685917	/B				4Q90
62L90-45	24	16K x 4 FSRAM, Chip Enable/Out Enable, 45 ns, Low Power		5962-8685915	/B	LA			
62L90-45	28	16K x 4 FSRAM, Chip Enable/Out Enable, 45 ns, Low Power		5962-8685915	/B				4Q90 3Q90
6293-30	28	16K x 4 Synch SRAM, Synch Output, 30 ns			/B	4Q90			
6293-30	32	16K x 4 Synch SRAM, Synch Output, 30 ns			/B				4Q90
6293-35	28	16K x 4 Synch SRAM, Synch Output, 35 ns			/B	4Q90			
6293-35	32	16K x 4 Synch SRAM, Synch Output, 35 ns			/B				4Q90
6293-40	28	16K x 4 Synch SRAM, Synch Output, 40 ns			/B	4Q90			
6293-40	32	16K x 4 Synch SRAM, Synch Output, 40 ns			/B				4Q90
6294-30	28	16K x 4 Synch SRAM, Out Reg/Out Enable, 30 ns			/B	XA			
6294-30	32	16K x 4 Synch SRAM, Out Reg/Out Enable, 30 ns			/B				4Q90
6294-35	28	16K x 4 Synch SRAM, Out Reg/Out Enable, 35 ns			/B	XA			
6294-35	32	16K x 4 Synch SRAM, Out Reg/Out Enable, 35 ns			/B				4Q90
6294-40	28	16K x 4 Synch SRAM, Out Reg/Out Enable, 40 ns			/B	XA			
6294-40	32	16K x 4 Synch SRAM, Out Reg/Out Enable, 40 ns			/B				4Q90
6295-30	28	16K x 4 Synch SRAM, Transparent Output, Out Enable, 30 ns			/B	4Q90			
6295-30	32	16K x 4 Synch SRAM, Transparent Output, Out Enable, 30 ns			/B				4Q90

Military Semiconductor Integrated Circuits

MEMORIES

MIL-STD-883C

High Speed CMOS III Static Memories						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	CAN	LCCC
6295-35	28	16K x 4 Synch SRAM, Transparent Output, Out Enable, 35 ns			/B	4Q90			
6295-35	32	16K x 4 Synch SRAM, Transparent Output, Out Enable, 35 ns			/B				4Q90
6295-40	28	16K x 4 Synch SRAM, Transparent Output, Out Enable, 40 ns			/B	4Q90			
6295-40	32	16K x 4 Synch SRAM, Transparent Output, Out Enable, 40 ns			/B				4Q90

Military Semiconductor Integrated Circuits

8-BIT MICROPROCESSORS & MICROCONTROLLERS 32-BIT CONTROLLERS AND PERIPHERALS

JM38510/, SMD#, MIL-STD-883C

8-Bit Microprocessors, 32-Bit Controllers & Microcontrollers						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	FP	LCCC	CLCC
6800	40	8-Bit Microprocessor			/B	QA			
6802	40	8-Bit Microprocessor with Clock and Optional RAM			/B	QA			
6809	40	8-Bit Microprocessor with Clock			/B	QA			
68A09	40	1.5 MHz 8-Bit Microprocessor with Clock			/B	QA			
68B09	40	2.0 MHz 8-Bit Microprocessor with Clock			/B	QA			
6821	40	8-Bit Peripheral Interface Adapter			/B	QA			
68A21	40	1.5 MHz 8-Bit Peripheral Interface Adapter			/B	QA			
68B21	40	12 MHz 8-Bit Peripheral Interface Adapter			/B	QA			
6840	28	Programmable Timer Module			/B	XA			
6845	40	CRT Controller			/B	QA			
68488	40	GPIA Support Module			/B	QA			
68A488	40	1.5 MHz GPIA Support Module			/B	QA			
68B488	40	2.0 MHz GPIA Support Module			/B	QA			
6850	24	Asynchronous Communications Interface Adapter			/B	JA			
68A50	24	1.5 MHz Asynchronous Communications Interface Adapter			/B	JA			
68B50	24	1.5 MHz Asynchronous Communications Interface Adapter			/B	JA			
6852	24	Synchronous Serial Data Adapter			/B	JA			
6854	28	Advanced Data-Link Controller			/B	XA			
6875A	16	6800 Clock Generator/Driver			/B	EA			
68HC11A0	48	8-Bit Micontroller with 256 Bytes RAM		5962-90510	 /B	1Q91 XA			
	52	8-Bit Micontroller with 256 Bytes RAM		5962-90510	 /B				1Q91 YC

Military Semiconductor Integrated Circuits

8-BIT MICROPROCESSORS & MICROCONTROLLERS 32-BIT CONTROLLERS AND PERIPHERALS

JM38510/, SMD#, MIL-STD-883C

8-Bit Microprocessors, 32-Bit Controllers & Microcontrollers						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**FP**	**LCCC**	**CLCC**
68HC11A1	48	8-Bit Microcontroller, 256 Bytes RAM & 512 Bytes EEPROM		5962-90510	/B	1Q91 XA			
	52	8-Bit Microcontroller, 256 Bytes RAM & 512 Bytes EEPROM		5962-90510	/B				1Q91 YC
68HC811E2	48	8-Bit Microcontroller with 2K EEPROM		5962-89527	/B	1Q91 XA			
	52	8-Bit Microcontroller with 2K EEPROM		5962-89527	/B				1Q91 YC
68HC705C8	40	8-Bit Microtontroller with 8K EPROM		TBD	/B	2Q91 1Q91			

32-Bit Controllers & Microcontrollers						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**PGA**	**LCCC**	**CLCC**
68332	132	32-Bit Microcontroller		5962-91501	/B		3Q91		3Q91

Data Communications & Memory Management						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**PGA**	**LCCC**	**CLCC**
68302	132	Integrated Mulit-Protocol Processor		Planned	/B		2Q91		
68442-8	68	Expanded DDMA Controller [T_C = −55°C to +110°C]		5962-86811	/B		1Q91 ZA		4Q90 YC
68605-10	84	X.25 Protocol Controller		Planned	/B		1Q91		TBD
68824-10	84	Token Bus Controller		Planned	/B		1Q91		TBD
68851-12	132	Page Memory Management Unit		5962-89461	/B		1Q91 4Q90		
68851-16	132	Page Memory Management Unit		5962-89461	/B		1Q91 4Q90		

Military Semiconductor Integrated Circuits

16 AND 32-BIT MICROPROCESSORS

JM38510/, SMD#, MIL-STD-883C

16 and 32-Bit Microprocessors						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	PGA	LCCC	CLCC
68000-8*	64	16-Bit external/32-Bit internal MPU		8202102		YA			
	68						TA	ZA	UC
	64				/B	XA			
	68				/B		ZA	UA	YC
68000-8T*	68	16-Bit external/32-Bit internal MPU		8202102				XA**	
					/B			UA**	
68000-10*	64	16-Bit external/32-Bit internal MPU		8202103		YA			
	68						TA	ZA	UC
	64				/B	XA			
	68				/B		ZA	UA	YC
68000-10T*	68	16-Bit external/32-Bit internal MPU		8202103				XA**	
					/B			UA**	
68020-16	114	32-Bit external and internal		5962-8603202			XA		
	132	32-Bit external and internal							YC
	114				/B		ZA		
	132				/B				YC
68020-20	114	32-Bit external and internal		5962-8603203			XA		
	132	32-Bit external and internal							YC
	114				/B		ZA		
	132				/B				YC
68030-16	128	32-Bit external and internal w/built-in PMMU		5962-8946401			XA		
	132	32-Bit external and internal w/built-in PMMU							YC**
	128				/B		ZA		
	132				/B				YC**
68030-20	128	32-Bit external and internal w/built-in PMMU		5962-8946402			XA		
	132	32-Bit external and internal w/built-in PMMU							YC**
	128				/B		ZA		
	132				/B				YC**
68030-25	128	32-Bit external and internal w/built-in PMMU		5962-8946403			XA		
	132	32-Bit external and internal w/built-in PMMU							YC**
	128				/B		ZA		
	132				/B				YC**
68030-33	128	32-Bit external and internal w/built-in PMMU		5962-8946404			XA		
	132	32-Bit external and internal w/built-in PMMU							YC**
	128				/B		ZA		
	132				/B				YC**

* [$T_C = -55^{\circ}$ to $+110^{\circ}$C]
** This device includes thermal pad(s).

Military Semiconductor Integrated Circuits

16 AND 32-BIT MICROPROCESSORS

JM38510/, SMD#, MIL-STD-883C

16 and 32-Bit Microprocessors						Package Type and Lead Finish			
Device	**Pins**	**Description**	**JM38510/**	**SMD#**	**883C**	**DIL**	**PGA**	**LCCC**	**CLCC**
68040	179	32-Bit external and internal w/built-in PMMU and FPU		TBD	/B		2Q91		
	196	32-Bit external and internal w/built-in PMMU and FPU		TBD	/B				2Q91
68881-16	68	32-Bit Floating Point Coprocessor		5962-8602102			XA		YC
					/B		ZA		YC
68881-20	68	32-Bit Floating Point Coprocessor		5962-8602103			XA		YC
					/B		ZA		YC
68882-16	68	Enhanced 16 MHz 32-Bit Floating Point Coprocessor		5962-89463			1Q91		1Q91
					/B		ZA		YC
68882-20	68	Enhanced 20 MHz 32-Bit Floating Point Coprocessor		5962-89463			1Q91		1Q91
					/B		ZA		YC
68882-25	68	Enhanced 25 MHz 32-Bit Floating Point Coprocessor		5962-89463			1Q91		1Q91
					/B		ZA		YC
68882-33	68	Enhanced 33 MHz 32-Bit Floating Point Coprocessor		5962-89463			1Q91		1Q91
					/B		ZA		YC
68HC000-8	64	16-Bit external/32-Bit internal HCMOS MPU		5962-89462		1Q91			
	68	16-Bit external/32-Bit internal HCMOS MPU		5962-89462			1Q91	1Q91	1Q91
	64				/B	XA			
	68				/B		ZA	UA	YC
68HC000-10	64	16-Bit external/32-Bit internal HCMOS MPU		5962-89462		1Q91			
	68	16-Bit external/32-Bit internal HCMOS MPU		5962-89462			1Q91	1Q91	1Q91
	64				/B	XA			
	68				/B		ZA	UA	YC
68HC000-12	64	16-Bit external/32-Bit internal HCMOS MPU		5962-89462		1Q91			
	68	16-Bit external/32-Bit internal HCMOS MPU		5962-89462			1Q91	1Q91	1Q91
	64				/B	XA			
	68				/B		ZA	UA	YC
68HC001-8	68	Configurable 16-Bit or 8-Bit MPU		TBD	/B		2Q91		TBD
68HC001-10	68	Configurable 16 or 8-Bit MPU		TBD	/B		2Q91		TBD
68HC001-12	68	Configurable 16 or 8-Bit MPU		TBD	/B		2Q91		TBD

* [$T_C = -55^{o}$ to $+110^{o}C$]
** This device includes thermal pad(s).

Military Semiconductor Integrated Circuits

REDUCED INSTRUCTION SET COMPUTERS (RISC) DIGITAL SIGNAL PROCESSORS (DSP)

JM38510/, SMD#, MIL-STD-883C

RISC						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	PGA	LCCC	CLCC
88100-20	180	32-Bit RISC		TBD	/B		1Q91		
	200	32-Bit RISC		TBD	/B				2Q91
88100-25	180	32-Bit RISC		TBD	/B		1Q91		
	200	32-Bit RISC		TBD	/B				2Q91
88200-20	180	16K Cache/Memory Management Unit		TBD	/B		1Q91		
	200	16K Cache/Memory Management Unit		TBD	/B				2Q91
88200-25	180	16K Cache/Memory Management Unit		TBD	/B		1Q91		
	200	16K Cache/Memory Management Unit		TBD	/B				2Q91

DSP						Package Type and Lead Finish			
Device	Pins	Description	JM38510/	SMD#	883C	DIL	PGA	LCCC	CLCC
56001-20	88	56-Bit Digital Signal Processor		5962-8951201XA	/B		ZA		
	100	56-Bit Digital Signal Processor		5962-8951201YC	/B				YC
96002-27	223	96-Bit Floating Point Digial Signal Processor		TBD	/B		4Q91		
	TBD	96-Bit Floating Point Digital Signal Processor		TBD	/B				4Q91

Military Semiconductor Discrete Products

Page

PRODUCT LISTING

MIL-QUALIFIED PRODUCTS

The following table lists Motorola-supplied devices which appear on the QPL-19500 list as JAN, JANTX, JANTXV and JANS qualified products. (Although Motorola will continue to supply components to JAN specifications where desired, this classification has been declared "inactive for new designs," per MIL-S-19500. The higher level JANTX classification is a recommended replacement.). As the detail specifications are being revised, JAN level is being removed. Consult your local sales office for specific JAN availability.

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
Zener Diodes					
1N746A through 1N759A	/127		X	X	
1N746A-1 through 1N759A-1	/127		X	X	
1N821	/159	X	X	X	
1N821-1	/159	X	X	X	
1N823	/159	X	X	X	
1N823-1	/159	X	X	X	
1N825	/159	X	X	X	
1N825-1	/159	X	X	X	
1N827	/159	X	X		
1N827-1	/159	X	X	X	
1N829	/159	X	X	X	
1N829-1	/159	X	X	X	
1N962B through 1N992B	/117		X	X	
1N962B-1 through 1N984B-1	/117		X	X	
1N3821A through 1N3828A	/115	X	X		
Rectifiers					
1N3890,R	/304	X	X		
1N3891,R	/304	X	X		
1N3893,R	/304	X	X		
1N3910 through 1N3913	/308	X	X		
Zener Diodes					
1N4099 through 1N4135	/435	X	X	X	

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
Zener Diodes					
1N4099-1 through 1N4135-1	/435	X	X	X	
1N4370A	/127	X	X	X	
1N4370A-1	/127	X	X	X	
1N4371A	/127	X	X	X	
1N4371A-1	/127	X	X	X	
1N4372A	/127	X	X	X	
1N4372A-1	/127	X	X	X	
Reference Diodes					
1N4565A,-1 through 1N4574A,-1	/452	X	X	X	
Zener Diodes					
1N4614,-1 through 1N4627,-1	/435	X	X	X	
Current Regulators					
1N5283 through 1N5314	/463	X	X	X	
Zener Diodes					
1N5518B,-1 through 1N5546B,-1	/437	X	X	X	
Diode Arrays					
1N5772	/474		X	X	
1N5774	/474		X	X	
Zener Diodes					
1N6309 through 1N6324	/533	X			
Diode Arrays					
1N6508	/474		X	X	
1N6509	/474		X	X	

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
TRANSISTORS					
Small Signal					
2N708	/312		X		
2N718A	/181		X	X	
2N869A	/283		X		
2N914	/373		X		
2N918	/301	X	X	X	X
2N930	/253	X	X		
2N1613	/181		X	X	
2N2060	/270		X	X	X
2N2218	/251		X	X	
2N2218A	/251		X	X	
2N2219	/251		X	X	
2N2219A	/251	X	X	X	X
2N2221, A	/255		X	X	
2N2222	/255	X	X	X	
2N2222A	/255	X	X	X	X
2N2369A	/317	X	X	X	X
2N2481	/268		X		
2N2484	/376	X	X	X	
2N2605	/354		X	X	X
* 2N2608	/295	X			
2N2609	/296	X			
* 2N2857	/343	X	X	X	X
2N2904, A	/290		X	X	
2N2905	/290		X	X	
2N2905A	/290	X	X	X	X
2N2906, A	/291		X	X	
2N2907	/291	X	X	X	
2N2907A	/291	X	X	X	X
2N2919	/355		X	X	X
2N2920	/355	X	X	X	X
2N3013	/287		X		
2N3019S	/391	X	X	X	X
2N3057A	/391		X	X	X
2N3227	/317		X	X	
2N3250A	/323		X	X	
2N3251A	/323	X	X	X	
2N3253S	/347		X		
JFETs					
2N3330	/378		X		
2N3331	/378		X		
Small-Signal					
2N3439	/368	X	X	X	
2N3440	/368		X	X	
2N3444S	/347		X		
2N3467	/348		X	X	
2N3468	/348		X	X	
2N3485A	/392		X		
2N3486A	/392	X	X		
2N3498	/366		X	X	X
2N3499	/366		X	X	X
2N3500	/366		X	X	X
2N3501	/366	X	X	X	X
2N3506	/349	X	X	X	
2N3507	/349	X	X	X	

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
TRANSISTORS					
RF					
* 2N3553	/341	X	X	X	
Small-Signal					
2N3634 through 2N3637	/357	X	X	X	X
2N3700	/391	X	X	X	X
Power					
2N3715	/408	X	X	X	
2N3716	/408	X	X	X	
Small-Signal					
2N3735	/395		X	X	X
2N3737	/395		X	X	X
Power					
2N3739	/402		X	X	
2N3740	/441	X	X	X	
2N3741	/441	X	X	X	
Small-Signal					
2N3743	/397		X	X	
2N3762	/396		X	X	
2N3763	/396		X	X	
2N3764	/396		X	X	
2N3765	/396		X	X	
Power					
2N3766	/518		X	X	
2N3767	/518	X	X	X	
2N3791	/379	X	X	X	
2N3792	/379	X	X	X	
Small-Signal					
2N3810	/336	X	X	X	X
2N3811	/336		X	X	X
2N3821	/375		X	X	
2N3822	/375		X	X	
2N3823	/375		X	X	
RF					
* 2N3866,A	/398	X	X	X	X
Power					
2N3867S	/350		X	X	
2N3868S	/350	X	X	X	
Small-Signal					
2N4033	/512	X	X	X	
THYRISTORS					
2N4199 through 2N4204	/372	X			

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
TRANSISTORS					
Small-Signal					
2N4261	/511		X	X	
Power					
2N4399	/433	X	X	X	
Small-Signal					
2N4405	/448	X	X	X	
2N4416A	/428		X	X	
2N4449	/317		X	X	
2N4453	/283		X		
2N4854	/421		X	X	
2N4856 through 2N4858	/385	X	X	X	
2N4930	/397		X	X	
2N4931	/397		X	X	
THYRISTORS					
2N4948	/388	X	X		
2N4949	/388	X	X		
TRANSISTORS					
RF					
* 2N4957	/426	X	X	X	
Power					
2N5038	/439	X	X	X	
2N5039	/439		X	X	
RF					
* 2N5109	/453	X	X	X	
Power					
2N5302	/456	X	X	X	
2N5303	/456	X	X	X	
2N5339	/560	X	X	X	
Small-Signal					
2N5415S	/485		X	X	
2N5416S	/485	X	X	X	
THYRISTORS					
2N5431	/425	X	X		
TRANSISTORS					
Small-Signal					
2N5581	/423		X		
2N5582	/423	X	X		
Power					
2N5683	/466	X	X	X	
2N5684	/466	X	X	X	
2N5685	/464	X	X	X	
2N5686	/464	X	X	X	
2N5745	/433	X	X	X	

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
TRANSISTORS					
Small-Signal					
2N5793,94	/495		X	X	
2N5795,96	/496		X	X	
Power					
2N6051	/501		X	X	
2N6052	/501	X	X	X	
2N6058	/502		X	X	
2N6059	/502	X	X	X	
THYRISTORS					
2N6116	/493	X	X	X	
2N6117	/493	X	X	X	
2N6118	/493	X	X	X	
TRANSISTORS					
Power					
2N6193	/561	X	X	X	
2N6274	/514	X	X	X	
2N6277	/514	X	X	X	
2N6283	/504		X	X	
2N6284	/504	X	X	X	
2N6286	/505		X	X	
2N6287	/505	X	X	X	
2N6298	/540	X	X	X	
2N6299	/540	X	X	X	
2N6300	/539		X	X	
2N6301	/539	X	X	X	
2N6306	/498	X	X		
2N6308	/498		X		
2N6378	/515		X	X	
2N6379	/515		X	X	
2N6383	/523		X	X	
2N6384	/523		X	X	
2N6385	/523	X	X	X	
2N6437	/508	X	X	X	
2N6438	/508	X	X	X	
2N6546	/525	X	X	X	
2N6547	/525	X	X	X	
RF					
* 2N6603	/522	X	X	X	
Power					
2N6648	/527	X	X	X	
2N6649	/527		X	X	
2N6650	/527	X	X	X	
2N6671	/536		X	X	
2N6673	/536		X	X	
2N6756	/542		X	X	
2N6758	/542		X	X	
2N6760	/542		X	X	
2N6762	/542		X	X	
2N6764	/543	X	X	X	
2N6766	/543	X	X	X	
2N6768	/543	X	X	X	
2N6770	/543	X	X	X	

Type Number	Detailed Spec	Specification Levels			
		JAN	JTX	JTXV	JANS
Multiples					
2N6987	/558		X	X	
2N6988	/558		X	X	
2N6989	/559		X	X	
2N6990	/559		X	X	

* Device on Product Discontinuance Notice.

Product Listing (Continued)

MIL-PROCESSED PACKAGED PRODUCTS

The following type numbers represent standard part numbers that have been built and tested to MIL-S-19500 reliability specifications. For details, see page 6-13.

Type Number	Motorola Std Part Number	Specification Levels		
		JAN	JTX	JTXV
RECTIFIERS				
Schottky				
MBR030A			HX	HXV
MBR040A			HX	HXV
MBR5825	1N5825		HX	HXV
MBR6391	1N6391		HX	HXV
MBR6392	1N6392		HX	HXV
THYRISTOR				
MCR2323, A	2N2323, A	H		
MCR2324, A	2N2324, A	H		
MCR2326, A	2N2326, A	H		
MCR2328, A	2N2328, A	H		
TRANSISTORS				
Duals				
MD2219AF	2N2219A			HXV
MD2369A,AF	2N2369A		HX	HXV
MD2605, F	2N2605			HXV
MD2905AF	2N2905A			HXV
MD3251A	2N3251A		HX	HXV
MD3251AF	2N3251A			HXV
MD3468	2N3468		HX	HXV
MD3468F	2N3468			HXV
MD3799	2N3799		HX	HXV
MD4261	2N4261		HX	HXV
MD4261F	2N4261			HXV
MD6002	MD6002		HX	HXV
MD6002F	MD6002			HXV
MD918, F	2N918		HX	HXV
TMOS				
MHM5N100			HX	HXV
MHM12N50			HX	HXV
MHM25N20			HX	HXV
MHM25N10			HX	HXV
MHM8P20			HX	HXV
MHR30N20			HX	HXV
MHR35N10			HX	HXV
Quads				
MHQ2369	2N2369A		HX	HXV
MHQ2484	2N2484		HX	HXV
MHQ3251A	2N3251A		HX	HXV
MHQ3468	2N3468		HX	HXV
MHQ3799	2N3799		HX	HXV
MHQ4261	2N4261		HX	HXV
MHQ6002	2N2222/2907		HX	HXV
MHQ918	2N918		HX	HXV
Bipolar Power				
MJ6316	2N6316		HX	HXV
MJ6318	2N6318		HX	HXV
MJ10016	MJ10016		HX	HXV
MJ11021	MJ11021		HX	HXV

Type Number	Motorola Std Part Number	Specification Levels		
		JAN	JTX	JTXV
Bipolar Power				
MJ11022	MJ11022		HX	HXV
MJ11032	MJ11032		HX	HXV
MJ11033	MJ11033		HX	HXV
MJ12005	MJ12005		HX	HXV
MJM3716	2N3716		HX	HXV
MJM3792	2N3792		HX	HXV
MJM5339	2N5339		HX	HXV
MJM6036	2N6036		HX	HXV
MJM6052	2N6052		HX	HXV
MJM6059	2N6059		HX	HXV
MJM6193	2N6193		HX	HXV
MJM6341	2N6341		HX	HXV
MJT5339	2N5339		HX	HXV
MJT6193	2N6193		HX	HXV
Small-Signal				
MM2896	2N2896		HX	HXV
MM3227	2N3223	H	HX	
MM3497	2N3497		HX	HXV
MM4236	2N4236		HX	HXV
MM4239	2N4239		HX	HXV
MM5680	2N5680		HX	HXV
MM5681	2N5681		HX	HXV
MM5682	2N5682		HX	HXV
Quads, Flat Packs				
MQ2369A	2N2369A			HXV
MQ2484	2N2484			HXV
MQ2605	2N2605			HXV
MQ3251A	2N3251A			HXV
MQ3468	2N3468			HXV
MQ4261	2N4261			HXV
MQ6002	MQ6002			HXV
MQ918	2N918			HXV
RECTIFIERS				
MR836	MR836		HX	HXV
MR3910	1N3910		HX	HXV
MR3911	1N3911		HX	HXV
MR3913	1N3913		HX	HXV
TRANSISTORS				
RF				
MRF522	MRF522			HXV
MRF544, A	MRF544		HX	HXV
MRF545, A	MRF545		HX	HXV
MRF3960	2N3960		HX	HXV
MRF4957	2N4957		HX	HXV
MRF5031	2N5031		HX	HXV
MRF5160	2N5160		HX	HXV
MRF5583	2N5583		HX	HXV
MRF5836	2N5836		HX	HXV
MRF6603	2N6603			HXV

Product Listing (Continued)

MIL-PROCESSED PACKAGED PRODUCTS

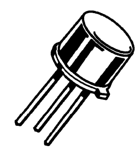
The following type numbers represent standard part numbers that have been built and tested to MIL-S-19500 reliability specifications. For details, see page 19.

Type Number	Motorola Std Part Number	Specification Levels JAN	JTX	JTXV
TRANSISTORS				
RF				
MRF6604	2N6604			HXV
MRF6985	2N6985		HX	HXV
MRF6986	2N6986		HX	HXV
MRF904	MRF904		HX	HXV

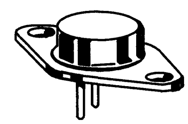
Type Number	Motorola Std Part Number	Specification Levels JAN	JTX	JTXV
RECTIFIERS				
Ultrafast				
MUR2515	MUR2515		HX	HXV
MUR5010	MUR5010		HX	HXV
MUR5020	MUR5020		HX	HXV

MIL-QUALIFIED PRODUCTS

Motorola MIL qualified components are ordered by adding suffix JAN, JTX, JTXV or JANS to the part numbers indicated in the following tables. Although Motorola will continue to supply components to the JAN specification where desired, this classification has been declared “inactive for new designs” per MIL-STD-19500. The higher level, JTX, is the recommended replacement.



CASE 79-04
TO-205AD (TO-39)



CASE 80
TO-213AA (TO-66)

Power Transistors

All listed power transistors are available with JAN, JTX and JTXV classifications except * = JAN and JTX only.

Bipolar

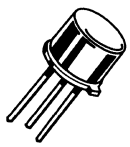
I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} @ Min/Max	I_C Amp	t_{on}/t_{off} µs Max	$V_{CE(sat)}$ @ Max Vdc	I_C/I_B Amp	P_D(Case) Watts @ 25°C
TO-204AA/AE (Formerly TO-3)									
8	250	2N6306*		15/75	3	0.6/3	0.8	3/0.6	125
	300	2N6671		29–Sep	5	0.5*/0.4*	1	5/1	150
	350	2N6308*		Oct–52	3	0.6/3	1.5	3/0.6	125
	400	2N6673		Aug–32	5	0.5*/0.4*	1	5/1	150
10	40	2N6383#	2N6648	1k/20k	5	2.5/10	2	5/0.01	100**
	60	2N3715	2N3791	50/150	1	—/2	1	5/0.5	150
		2N6384#	2N6649	1k/20k	5	2.5/10	2	5/0.01	100**
	80	2N3716	2N3792	50/150	1	—/2	1	5/0.5	150
		2N6385#	2N6650	1k/20k	5	2.5/10	2	5/0.01	100**
12	80	2N6058#	2N6051#	1k/18k	6	2/10	2	6/0.024	150
	100	2N6059#	2N6052#	1k/18k	6	2/10	2	6/0.024	150
15	300	2N6546		6/—	10	1/4.7	5	15/3	175
	400	2N6547		6/—	10	1/4.7	5	15/3	175
20	75	2N5039		20/—	10	0.5/2	1	10/1	140
	80	2N5303		15/60	10	0.9*/1*	1	10/1	200
			2N5745	15/60	10	1.5*/1*	1	10/1	200
		2N6283#	2N6286#	1250/18k	10	2/10	2	10/0.04	175
	90	2N5038		20/—	12	0.5/2	1	12/1.2	140
	100	2N6284#	2N6287#	1250/18k	10	2/10	2	10/0.04	175
25	100		2N6437	30/120	10	0.5/1.25	1	10/1	200
	120		2N6438	30/120	10	0.5/1.25	1	10/1	200
30	60	2N5302		15/60	15	2*/1*	1	15/1.5	200
			2N4399	15/60	15	—/2.1	1	15/1.5	200
50	60	2N5685	2N5683●	15/60	25	1.5/3	1	25/2.5	300
	80	2N5686●	2N5684●	15/60	25	1.5/3	1	25/2.5	300
	100		2N6378●	30/120	20	0.5/1.05	1	20/2	250
	100	2N6274●		30/120	20	0.5/1.05	1	20/2	250
	120		2N6379●	30/120	20	0.5/1.05	1	20/2	250
	150	2N6277●		30/120	20	0.5/1.05	1	20/2	250

Darlington, ● TO-204AE; all others TO-204AA

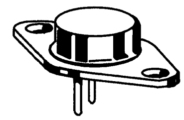
t_r^*/t_f^*

** P_D = 85 for devices 2N6648, 2N6649 and 2N6650.

Power Transistors, Bipolar (Continued)



CASE 79-04
TO-205AD (TO-39)



CASE 80
TO-213AA (TO-66)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	Resistive Switching h_{FE} Min/Max	@ I_C Amp	t_{on}/t_{off} µs Max	$V_{CE(sat)}$ Max Vdc	@ I_C/I_B A/mA	P_D(Case) Watts @ 25°C
TO-205AA (Formerly TO-5)									
3	40		2N3867S	40/200	1.5	65*/100*	0.75	1.5/150	10
	60		2N3868S	30/150	1.5	65*/100*	0.75	1.5/150	10
TO-205AD (Formerly TO-39)									
5	100	2N5339	2N6193	60/240	2	100*/200*	0.7	2/200	1
TO-213AA (Formerly TO-66)									
1	300	2N3739		40/200	0.1	1.5/3.5	0.75	0.1/10	20
4	60		2N3740	30/120	0.25	0.4/1	0.4	0.25/25	25
		2N3766		40/160	0.5	0.25/2.5	1	0.5/50	25
	80		2N3741	30/120	0.25	0.4/1	0.4	0.25/250	25
		2N3767		40/160	0.5	0.25/2.5	1	0.5/50	25
8	60	2N6300#	2N6298#	750/18k	4	2/8	4	4/16	75+
	80	2N6301#	2N6299#	750/18k	4	2/8	4	4/16	75+

Darlington; + $T_C = 0°C$ for devices 2N6300, 2N6301 t_r*/t_r*

MOSFETs (TMOS)

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	C_{iss} pF Max	P_D* (Watts) Max
N-Channel — Case 1-06 TO-204AA (TO-3)						
500	1.5	3	2N6762	4.5	800	75
	0.4	7.75	2N6770	12	3000	150
400	1	3.5	2N6760	5.5	800	75
	0.3	9	2N6768	14	3000	150
200	0.4	6	2N6758	9	800	75
	0.085	19	2N6766	30	3000	150
100	0.18	9	2N6756	14	800	75
	0.055	24	2N6764	38	3000	150

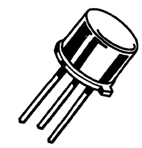
* @ 25°C

MIL-Qualified Products (Continued)

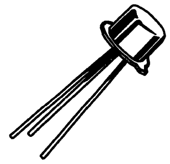
Small-Signal Transistors, Bipolar

All devices in the following tables are qualified to JAN, JTX and JTXV levels, except:

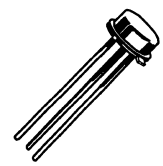
• = JAN only
* = JAN/JTX only
** = JAN/JTX/JTXV/JANS



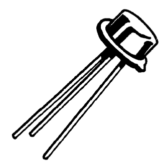
CASE 79-04
TO-205AD (TO-39)



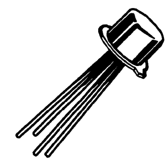
CASE 22-03
TO-206AA (TO-18)



CASE 26-03
TO-206AB (TO-46)



CASE 27-02
TO-206AC (TO-52)

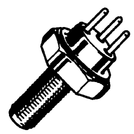
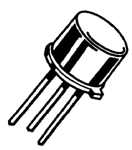
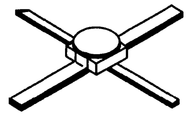
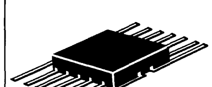
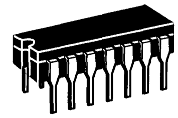
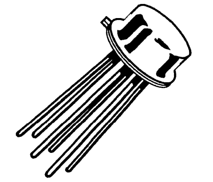


CASE 20-03
TO-206AF (TO-72)

General Purpose

Package	Device Number	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C/I_B mA
NPN								
TO-206AA (TO-18)	2N3700**	80	1000	50	200	500	0.5	500/50
	2N2484	60	50	200	500	0.01	0.3	1.0/0.1
	2N2221A	50	800	35	150	1	1.2	150/15
	2N2222A	50	800	75	325	1	1.2	150/15
	2N930*	45	30	100	300	0.01	1	10/0.5
	2N718A	30	500	40	120	150	1.5	150/15
	2N2221	30	800	25	150	1	1.3	150/15
	2N2222	30	800	50	325	1	1.3	150/15
	2N916•	25	50	50	200	10	0.5	10/1.0
TO-205AD (TO-39)	2N3019S**	80	1000	100	300	150	0.2	150/15
	2N2219A**	50	800	100	300	150	0.3	150/15
	2N2218A	50	800	40	120	150	0.3	150/15
	2N1613	30	500	40	120	150	1.5	150/15
	2N2218	30	800	40	120	150	0.4	150/15
	2N2219	30	800	100	300	150	0.4	150/15
TO-206AB (TO-46)	2N5581*	50	800	40	120	150	0.3	150/15
	2N5582*	50	800	100	300	150	0.3	150/15
PNP								
TO-206AA (TO-18)	2N2906A	60	600	40	120	150	0.4	150/15
	2N2907A**	60	600	100	300	150	0.4	150/15
	2N3250A	60	200	50	150	10	0.25	10/1.0
	2N3251A	60	200	100	300	10	0.25	10/1.0
	2N2906	40	600	40	120	150	0.4	150/15
	2N2907	40	600	100	300	150	0.4	150/15
T0-205AD (TO-39)	2N3057A	80	1000	50	200	500	0.5	500/50
	2N4033	80	1000	100	300	100	0.15	150/15
	2N4405*	80	500	100	300	150	0.2	150/15
	2N2905A**	60	600	100	300	1	0.4	150/15
	2N2904A	60	600	40	120	1	0.4	150/15
	2N2904	40	600	40	120	1	0.4	150/15
	2N2905	40	600	100	300	1	0.4	150/15
	2N1132•	40	600	30	90	150	1.5	150/15
TO-206AB (TO-46)	2N3485A*	60	600	40	120	150	0.4	150/15
	2N3486A*	60	600	100	300	150	0.4	150/15
	2N2605**	60	30	100	400	10	0.3	10/0.5

Small-Signal Transistors, Bipolar (Continued)

 CASE 36	 CASE 79-04	 CASE 303-01	 CASE 607-04	 CASE 632-08	 CASE 654-07

High-Frequency Amplifiers/Oscillators

The transistors shown are designed for use as both oscillators and amplifiers at UHF and VHF frequencies.

Package	Device Number	$V_{(BR)CEO}$ Volts Min	h_{FE} Min	@ I_C mA	G_{pe} dB Min	NF dB Max	@ f MHz	$\lvert h_{fe} \rvert$ Min	@ f MHz	C_{obo} pF Max
NPN										
TO-206AF	2N918**	15	20	3	15	6	60	6	100	1.7
PNP										
TO-206AF	2N4261	15	30	10	—	—	—	15	100	2.5

Switching Transistors

The following devices are intended primarily for use in general-purpose switching, but can be used in amplifier and driver applications. Within each package group shown, the devices are listed in order of decreasing turn-on time (t_{on}).

Package	Device Number	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA
NPN												
TO-206AA	2N914*	40	40	200	15	150	30	120	10	0.3	10	1
	2N708	40	75	10	15	—	40	120	10	0.4	10	1
	2N2481	40	55	100	15	—	40	120	10	0.25	10	1
	2N2369A**	12	18	10	15	200	40	120	10	0.2	10	1
	2N3227	12	18	10	20	200	100	300	10	0.2	10	1
TO-205AD	2N3444S*	35•	30•	500	50	1000	20	60	500	0.6	500	50
	2N3253S*	35•	30•	500	40	1000	25	75	500	0.6	500	50
	2N3735**	—	60	1000	50	1500	20	80	1000	0.9	1000	100
	2N3506	30•	35•	1500	40	3000	40	200	1500	1	1500	150
	2N3507	30•	35•	1500	50	3000	30	150	1500	1	1500	150
	2N3737**	—	60	1000	50	1500	20	80	1000	0.9	1000	100
TO-206AC	2N3013	15	25	300	20	300	35	120	30	0.18	30	3
	2N4449	12	18	10	15	200	40	120	10	0.2	10	1
PNP												
TO-206AA	2N869A*	50	80	30	18	200	40	120	10	0.15	10	1
TO-205AD	2N3634**	400	600	50	140	1000	50	150	50	0.6	50	5
	2N3635**	400	600	50	140	1000	100	300	50	0.6	50	5
	2N3636**	400	600	50	175	1000	50	150	50	0.6	50	5
	2N3637	400	600	50	175	1000	100	300	50	0.6	50	5
	2N4033	25•	35•	500	80	1000	100	300	100	0.15	150	15
	2N3467	30•	30•	500	40	1000	40	120	500	0.6	500	50
	2N3468	30•	30•	500	50	1000	25	75	500	0.6	500	50
	2N3762	35•	35•	1000	40	1500	30	120	1000	0.9	1000	100
	2N3763	35•	35•	1000	60	1500	20	80	1000	0.9	1000	100
	2N4405	25•	50•	500	80	500	100	300	150	0.2	150	15
TO-206AC	2N4453	50	80		18	200	40	120	30	0.15	10	1
TO-206AB	2N3764	35•	35•	1	40	1500	30	120	1000	0.9	1000	100
	2N3765	35•	35•	1	60	1500	20	80	1000	0.9	1000	100

* = JAN/JTX t_r•/t_f•

** = JAN/JTX/JTXV/JANS. All others, JAN/JTX/JTXV.

High-Voltage/High-Current Transistors

This following table lists Motorola standard devices that have high Collector-Emitter Breakdown Voltage. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package type.

Package	Device Number	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min/Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA
NPN								
TO-205AD	2N3439	350	1000	40/160	20	0.5	50	4
	2N3440	250	1000	40/160	20	0.5	50	4
	2N3500**	150	300	40/120	150	0.4	150	15
	2N3501**	150	300	100/300	150	0.4	150	15
	2N3498**	100	500	40/120	150	0.6	300	30
	2N3499**	100	500	100/300	150	0.6	300	30
PNP								
TO-205AD	2N5416S	350	1000	30/120	50	2	50	5
	2N3743	300	50	50/200	30	1.2	30	3
	2N4931	250	50	50/200	30	1.2	30	3
	2N5415S	200	1000	30/120	50	2	50	5
	2N4930	200	50	50/200	30	1.2	30	3
	2N3637**	175	1000	100/300	50	0.6	50	5
	2N3636**	175	1000	50/150	50	0.6	50	5
	2N3635**	140	1000	100/300	50	0.6	50	5
	2N3634**	140	1000	50/150	50	0.6	50	5

Multiple Transistors

These multiple small-signal transistors include devices intended for amplifier and switching applications.

Device Number	Maximum Ratings			Electrical Characteristics					
	V_{CEO} V	I_C mA	P_D(Total) W	I_{CBO} µA Max	h_{FE} Min/Max	@ I_C mA	$V_{CE(sat)}$ Volts Min	@ I_C mA	& I_B mA
QUAD — NPN Case 632-02									
2N6989	50	800	1.5	0.01	100/300	150	0.3	150	15
Case 607-04									
2N6990	50	800	0.4	0.01	100/300	150	0.3	150	15
QUAD — PNP Case 632-02									
2N6987	60	600	1.5	0.01	100/300	150	0.4	150	15
Case 607-04									
2N6988	60	600	0.4	0.01	100/300	150	0.4	150	15
DUAL — NPN Case 654-07									
2N2060**	60	500	0.5	0.002	30/90	0.1	0.3	0.5	5
2N3819**	60	30	0.5	0.002	300/1000	0.1	0.3	1	0.1
2N3820**	60	30	0.5	0.002	150/600	0.1	0.3	1	0.1
2N3810**	60	50	0.6	0.01	150/450	0.1	0.2	0.1	0.1
2N3811**	60	50	0.6	0.01	300/900	0.1	0.2	0.1	0.1
2N4854	40	600	0.6	0.01	100/300	150	0.4	150	15
2N5793	40	600	0.6	0.01	40/120	150	0.6	150	15
2N5794	40	600	0.6	0.01	100/300	150	0.6	150	15
2N5795	60	600	0.6	0.02	40/150	150	0.4	150	15
2N5796	60	600	0.6	0.02	100/300	150	0.4	150	15

** = JAN/JTX/JTXV/JANS. All others, JAN/JTX/JTXV.

Small-Signal Transistors, JFETs

Amplifiers, TO-206AF

All are low-frequency amplifiers except 2N3823 and 2N4416A which are suitable for VHF/UHF amplification.

Device	$\lvert Y_{fs} \rvert$ (µmho) Min	@ f (kHz)	$\lvert Y_{os} \rvert$ (µmho) Min	@ f (kHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	@ R_G=1 MΩ f (kHz)	$V_{(BR)}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
P-Channel													
2N3330*	1500	1	40	1	20	—	3	1	20	—	6	2	6
2N3331*	2000	1	100	1	20	—	4	1	20	—	8	5	15
N-Channel													
2N3821	1500	1	10	1	6	3	2.5	0.01	50	—	4	0.5	2.5
2N3822	3000	1	20	1	6	3	2.5	0.01	50	—	6	2	10
2N3823	3500	1	35	1	6	2	2.5	1	30	—	8	4	20
2N4416A	4500	1	50	1	4	0.8	4	400	35	2.5	6	5	15

Switches and Choppers, TO-206AA — N-Channel

Device	$r_{ds(on)}$ (Ω) Max	@ I_D mA	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	$V_{(BR)}$ (V) Min	C_{iss} (pF) Max	C_{rss} (pF) Max	t_{on} (ns) Max	t_{off} (ns) Max
2N4856*	25	0	4	10	50	—	40	18	8	6	25
2N4857	40	0	2	6	20	100	40	18	8	6	50
2N4858	60	0	0.8	4	8	80	40	18	8	10	100

RF Transistors, Bipolar NPN

Power, V_{CC} = 28 Vdc

Device Number	Frequency MHz, Max	P_{out} W	@ P_{in} W (Max)	η G_{pe} dB (min)	Package
2N3553 (note 1)	175	2.5	0.25	65	79-04 (TO-39)
2N3375 (note 1)	400	3	1	65	36-03 (TO-60)
2N3866,A** (note 1)	400	1	0.15	45	79-034 (TO-39)

Small-Signal

Device Number	Maximum Ratings			Electrical Characteristics					
	V_{CEO} V	I_C mA	P_T mW	h_{FE} Min/Max	@ I_C mA	nF dB Min/Max	@ f GHz	G_{pe} dB Min/Max	@ f GHz
Case 303-1									
2N6603 (note 1)	15	30	300	30/200	15	1.0/2.5	1	15/21	1
Case TO-206AF									
2N2857** (note 1)	15	40	300	30/150	3	—/4.5	0.45	12.5/21	0.45
2N4957 (note 1)	30	30	200	30/165	5	—/3.0	0.45	17/25	0.45
Case TO-205AD									
2N5109 (note 1)	20	400	1000	40/150	50	—/3.5	0.2	11/—	0.2

* = JAN/JTX, ** = JAN/JTX/JTXV/JANS. All others, JAN/JTX/JTXV

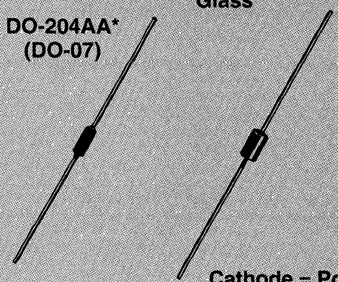
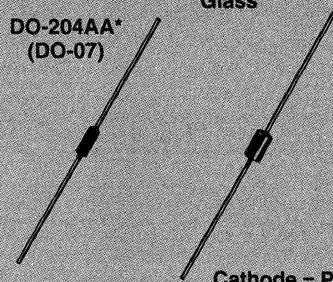
Note 1: Device on Product Discontinuation Notice.

MIL-Qualified Products (Continued)

Zener Diodes

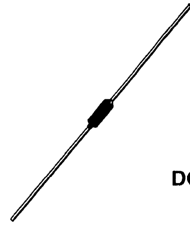
General-Purpose Regulator Diodes

All devices are qualified to JAN, JTX and JTXV levels except: ☐ = JAN and JTX only.

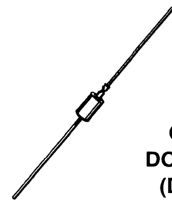
Nominal Zener Voltage V_Z ±5%	250 mW	400 mW	500 mW	Nominal Zener Voltage V_Z ±5%	250 mW	400 mW	500 mW
	Glass DO-204AA* (DO-07)  DO-204AH* (DO-35) Cathode = Polarity Mark				Glass DO-204AA* (DO-07)  DO-204AH* (DO-35) Cathode = Polarity Mark		
1.8	1N4614,-1			27	1N4118,-1		1N971B,-1
2	1N4615,-1			28	1N4119,-1		
2.2	1N4616,-1			30	1N4120,-1		1N972B,-1
2.4	1N4617,-1		1N4370A,-1	33	1N4121,-1		1N973B,-1
2.7	1N4618,-1		1N4371A,-1	36	1N4122,-1		1N974B,-1
3	1N4619,-1		1N4372A,-1	39	1N4123,-1		1N975B,-1
3.3	1N4620,-1	1N5518B	1N746A,-1	43	1N4124,-1	—	1N976B,-1
3.6	1N4621,-1	1N5519B	1N747A,-1	47	1N4125,-1		1N977B,-1
3.9	1N4622,-1	1N5520B	1N748A,-1	50			1N978B,-1
4.3	1N4623,-1	1N5521B	1N749A,-1	51	1N4126,-1		
4.7	1N4624,-1	1N5522B	1N750A,-1	56	1N4127,-1	—	1N979B,-1
5.1	1N4625,-1	1N5523B	1N751A,-1	60	1N4128,-1		
5.6	1N4626,-1	1N5524B	1N752A,-1	62	1N4129,-1		1N980B,-1
6.2	1N4627,-1	1N5525B	1N753A,-1	68	1N4130,-1		1N981B,-1
6.8	1N4099,-1	1N5526B	1N754A,-1	75	1N4131,-1		1N982B,-1
7.5	1N4100,-1	1N5527B	1N755A,-1	82	1N4132,-1	—	1N983B,-1
8.2	1N4101,-1	1N5228B	1N756A,-1	87	1N4133,-1		
8.7	1N4102,-1			91	1N4134,-1		1N984B,-1
9.1	1N4103,-1	1N5529B	1N757A,-1	100	1N4135,-1		1N985B
10	1N4104,-1	1N5530B	1N758A,-1	110			1N986B
11	1N4105,-1	1N5531B	1N962B,-1	120		—	1N987B
12	1N4106,-1	1N5532B	1N759A,-1	130			1N988B
13	1N4107,-1	1N5533B	1N964B,-1	150			1N989B
14	1N4108,-1	1N5534B		160			1N990B
15	1N4109,-1	1N5535B	1N965B,-1	180			1N991B
16	1N4110,-1	1N5536B	1N966B,-1	200			1N992B
17	1N4111,-1	1N5537B					
18	1N4112,-1	1N5538B	1N967B,-1				
19	1N4113,-1	1N5539B					
20	1N4114,-1	1N5540B	1N968B,-1				
22	1N4115,-1	1N5541B	1N969B,-1				
24	1N4116,-1	1N5542B	1N970B,-1				
25	1N4117,-1	1N5543B					

* Basic part number supplied in DO-204AA (DO-7) package. For preferred DO-204AH (DO-35) package, add "-1" to basic part numbers.

Voltage Reference Diodes



Glass
DO-204AA
(DO-7)



Glass
DO-204AH
(DO-35)

Temperature Compensated Reference Devices

For applications where output voltage must remain within narrow limits during changes in input voltage, load resistance and temperature. Motorola guarantees all reference devices to fall within the specified maximum voltage variations, ΔV_Z, at the specifically indicated test temperatures and test current. Indicated temperature coefficient should be considered as a reference only — not a maximum rating. Devices in this table are available as JAN, JTX and JTXV versions. Part numbers apply to DO-204AA package. For preferred DO-204AH package, add a -1 between part number and the JAN, JTX or JTXV suffix, i.e. 1N821-1JAN.

			AVERAGE TEMPERATURE COEFFICIENT OVER THE OPERATING RANGE									
			0.01%/°C		0.005%/°C		0.002%/°C		0.001%/°C		0.0005%/°C	
V_Z Volts	Z_{ZT} Ohms	I_{ZT} mA	Device	ΔV_Z Max Volts	Device	ΔV_Z Max Volts	Device	ΔV_Z Max Volts	Device	ΔV_Z Max Volts	Device	ΔV_Z Max Volts
6.2	15	7.5	1N821	0.1	1N823	0	1N825	0	1N827	0	1N829	0
6.4	10	0.5	1N4565A	0.1	1N4566A	0.1	1N4567A	0	1N4568A	0	1N4569A	0
6.4	10	1	1N4570A	0.1	1N4571A	0.1	1N4572A	0	1N4573A	0	1N4574A	0

Test Temperature points are –55, 0, +25, +75 and 100°C

Special Purpose Regulators

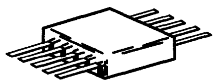
Glass
DO-204AA
(DO-7)

Field-Effect Current Regulator Diodes

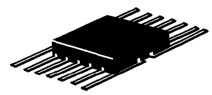
High impedance diodes whose "constant current source" characteristic complements the "constant voltage" of the zenerline. Regulated current values range from 0.22 to 4.7 mA, with usable voltage range from a minimum limit indicated, up to a voltage compliance of 100 V. All are available with JAN, JTX and JTXV classification.

Reg. Current I_P @ V_T = 25 V mA Nom	Device Number	Knee Imp Z_K @ V_K = 6.0 V MΩ Min	Limiting Voltage @ I_L = 0.8 I_P Volts Max
0.22	1N5283	2.75	1
0.24	1N5284	2.35	1
0.27	1N5285	1.95	1
0.3	1N5286	1.6	1
0.33	1N5287	1.35	1
0.39	1N5288	1	1.05
0.43	1N5289	0.87	1.05
0.47	1N5290	0.75	1.05
0.56	1N5291	0.56	1.1
0.62	1N5292	0.47	1.13
0.68	1N5293	0.4	1.15
0.75	1N5294	0.335	1.2
0.82	1N5295	0.29	1.25
0.91	1N5296	0.24	1.29
1	1N5297	0.205	1.35
1.1	1N5298	0.18	1.4

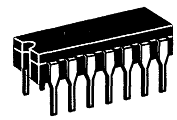
Reg. Current I_P @ V_T = 25 V mA Nom	Device Number	Knee Imp Z_K @ V_K = 6.0 V MΩ Min	Limiting Voltage @ I_L = 0.8 I_P Volts Max
1.2	1N5299	0.155	1.45
1.3	1N5300	0.135	1.5
1.4	1N5301	0.115	1.55
1.5	1N5302	0.105	1.6
1.6	1N5303	0.092	1.65
1.8	1N5304	0.074	1.75
2	1N5305	0.061	1.85
2.2	1N5306	0.052	1.95
2.4	1N5307	0.044	2
2.7	1N5308	0.035	2.15
3	1N5309	0.029	2.25
3.3	1N5310	0.024	2.35
3.6	1N5311	0.02	2.5
3.9	1N5312	0.017	2.6
4.3	1N5313	0.014	2.75
4.7	1N5314	0.012	2.9



Case 606-04



Case 607-04

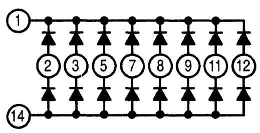


Case 632-08

DIODE ARRAYS — Available in HX or HXV classification.

Schematic Diagrams

1



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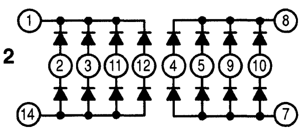


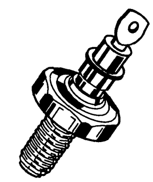
NC Pin 6, 13

Device Number	$V_{(BR)R}$ Vdc	I_R μAdc	V_F Vdc	t_{fr} ns	t_{rr} ns	P_D mW	Figure	Package	Description
1N5772	60	0.1	1	40	20	500		606-0	16 DIODES, C.A./C.C.
1N5774	60	0.1	1	40	20	500	6	607-0	16 DIODES, DUAL C.A./C.C.
1N6508	60	0.1	1	40	20	500	1	632-0	16 DIODES, C.A./C.C.
1N6509	60	0.1	1	40	20	500	6	632-0	16 DIODES, DUAL C.A./C.C.

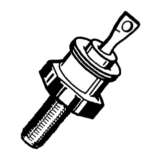
MIL-Qualified Products (Continued)
Rectifiers

Fast recovery power rectifiers providing high efficiency at frequencies up to 250 kHz. R–suffix indicates reverse polarity. All are available with JAN and JTX classification.

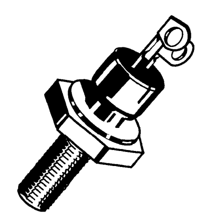
Device Number	V_{RRM} V Max	I_O A Max	I_{FSM} A Max	V_F V Max	I_R µA Max	t_{rr} ns Max	Package
1N3890, R	100	12	200	1.4	25	200	DO-203AA
1N3891, R	200						
1N3893, R	400						
1N3910	100	30	300	1.4	25	200	DO-203AB
1N3911	200						
1N3913	400						



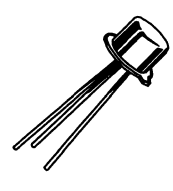
DO-203AA (DO-4)



DO-203AB (DO-5)



TO-64



TO-206AA (TO-18)

Thyristors — SCRs
Radar (Pulse) Modulators

Fast switching high-voltage SCRs with maximum turn-on times specified at 300 to 400 ns. Especially designed for pulse modulator applications. Available with JAN classification only.

Device Number	V_{DRM} V Max	I_{TRM} A Max	I_{GT} mA Max	V_{GT} V Max	I_H mA Min	Package
2N4199	300	100	50	1.5	5	TO-64
2N4200	400					
2N4201	500					
2N4202	600					
2N4203	700					
2N4204	800					

Thyristor Triggers
Unijunction Transistors — UJT

Highly stable devices for general-purpose trigger applications and as pulse generators (oscillators) and timing circuits. Useful at frequencies ranging (generally) from 1 Hz to 1 MHz. Available with JAN and JTX classification.

Device Number	η		I_P µA Max	I_{EB20} µA Max	I_V mA Min	Package
	Min	Max				
2N4948	0.55	0.82	2	0.05	2	TO-206AA
2N4949	0.74	0.86	1	0.05	2	
2N5431	0.72	0.8	0.4	0.01	2	

η = Intrinsic Standoff Ratio

Programmable
Unijunction Transistors — PUT

Similar to UJTs, except that I_V, I_P and intrinsic standoff voltage are programmable (adjustable) by means of external voltage divider. This stabilizes circuit performance for variations in device parameters. General operating frequency range is from 0.01 Hz to 10 kHz, making them suitable for long-duration timer circuits. Available with JAN, JTX and JTXV classifications.

Device Number	I_P		I_{GAO} @ 40 V nA Max	I_V		Package
	R_G = 10 kΩ	R_G = 1 MΩ		R_G = 10 kΩ	R_G = 1 MΩ	
	µA Max			µA Max	µA Max	
2N6116	5	2	5	70	50	TO-206AA
2N6117	2	0.3	5	50	50	
2N6118	1	0.15	5	50	25	

MIL-PROCESSED DISCRETE SEMICONDUCTORS

The wide range of component requirements for today's high-technology military and space applications often go beyond the available MIL-S-19500-specified component complement. Normally, these needs are met with devices manufactured and tested to a customer's high-reliability specifications developed specifically for these custom parts. The result — high initial cost and long delivery time.

To reduce both of these detriments, Motorola now offers a standard, inventoried line of popular discrete products for which no military specifications exist, but which have been processed to rigid MIL-S-19500 and MIL-STD-750 specifications, just as if they were built for JAN registration. Since no military slash sheets exist for these components, the electrical parameters are those applied to equivalent Motorola commercial products. Delta calculations, however, and Group B and C test limits, are selected with the same considerations as for MIL-S-19500 specifications

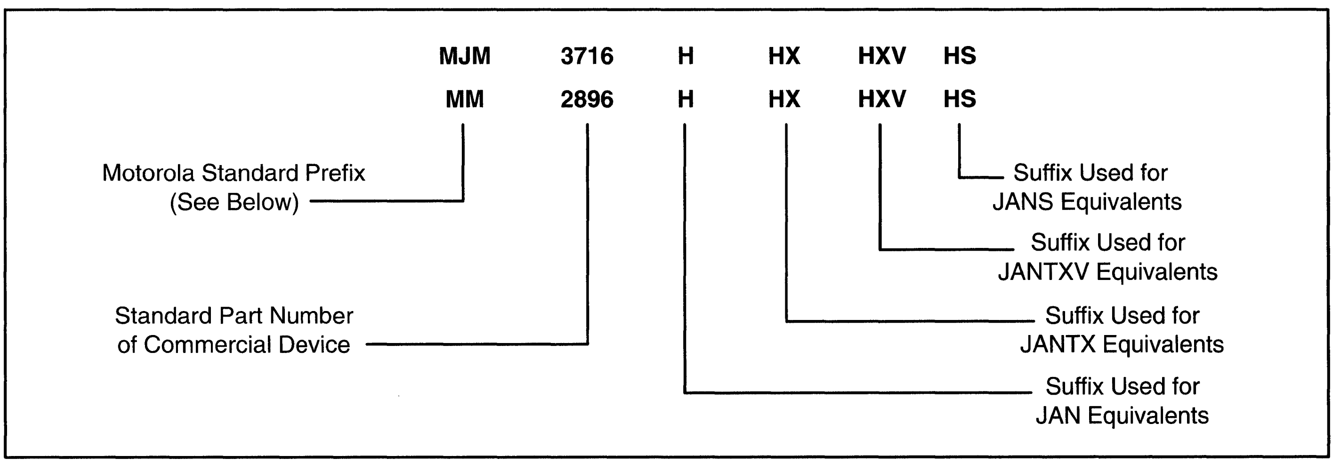
Compared with custom equivalents, customers able to utilize these components will find significant savings in both cost and delivery time. Moreover, the life span of such devices will be considerably longer than that of custom-built "specials", so that replacements will be available for the foreseeable future.

Parts Identification and Marking

For its packaged Military Processed Components, Motorola will use only hermetically sealed commercial products capable of being processed to MIL-S-19500 requirements. For identification, the products will have a prefix similar to those presently used for internal (non-EIA-registered) devices, e.g. MM, MHM, MRF, MCR etc., followed by the standard EIA or internal part number, and special JAN equivalent suffixes. The suffixes, HX, HXV and HS signify testing to JANTX, JANTXV and JANS respectively.

MIL-Processed devices will be marked with the Motorola Logo, the in-house part number and a four digit date code. Should a DESC Drawing become available, the DESC Drawing part number will also be marked. (Presently, no DESC Drawing specifications exist for any of these devices.) Re-marking is not available, due to permanency of the marking.

Should fully qualified JAN equivalents become available, Motorola will discontinue the MIL-Processed Devices unless there is a technical problem with supplying the JAN qualified device. In such cases the MIL-Processed devices will be retained and a detailed list of variations from the JAN equivalent will be provided.



Motorola Standard Prefixes

MAD — Diode Arrays
MBR — Rectifiers
MCR — Thyristors
MD — Dual Transistors (Bipolar)
MFE — Transistors, Field Effect
MHM, MHT — Transistors, TMOS
MHQ — Quad Transistors (Bipolar)

MJ — Transistors, Bipolar Power
MJM — Transistors, Bipolar Power, TO-254
MM — Transistors, Small-Signal
MR — Rectifiers
MRF — Transistors, RF
MUR — Rectifiers
MWA — Circuit, RF

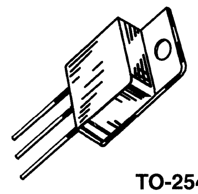
JAN-Type Processing for Commercial Products

MIL-Processed devices will receive the following screens, tests and inspections

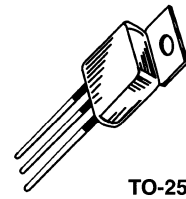
Processing	Specification	Lot
HX Level, (JAN TX Equivalent) —		
High Temperature Non-operating Life	MIL-STD-750, Method 1032	Optional
Temperature Cycle	MIL-STD-750, Method 1051	100%
Surge (Rectifiers) when specified	MIL-STD-750, Method 4066	100%
Thermal Response when specified	MIL-STD-750, Method 3101-61	100%
Constant Acceleration*	MIL-STD-750, Method 2006	Optional
Instability Shock (axial lead diodes only) when specified	MIL-STD-750, Method 2081/82	100%
Hermetic Seal Fine Leak, Condition G or H Gross Leak, Condition A, C, D ,E or F	MIL-STD-750, Method 1071	100%
Interim Electrical Measurements	As Specified, when required	100%
High Temperature Reverse Bias Condition A	MIL-STD-750, Method 1039/9/42	
Interim Electrical Measurements	As specified, parameters as required	100%
Power Burn-in	MIL-STD-750, Method 1038/9/40/2	100%
Electrical Measurements, Delta Calculations	Parameters as Required	100%
Electrical Measurements	Subgroup A2 only	100%
Group A Inspection (QA)	MIL-S-19500	Sample
Group B Inspection	MIL-S-19500	Sample
Group C Inspection*	MIL-S-19500	Sample
HXV Level, (JAN TXV Equivalent) — Devices will receive all Level HX tests, plus Precap Visual Inspection	MIL-STD-750, Method 2069-74	100%
HS Level, (JAN S Equivalent) —	Contact your Motorola Sales representative for processing details	

*MIL-S-19500 Rev. H will delete this screen, and move the test to Subgroup B7.
* Group C inspection will be run on the initial lot only. Data will be retained for seven years.

SELECTOR GUIDE
POWER TRANSISTORS



TO-254AA



TO-257AA

TMOS FETs

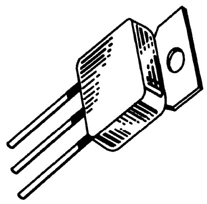
These TMOS Power FETs are designed for high speed power switching applications such as switching regulators, converters, solenoid and relay drivers, and PWM motor controls.

Device Number	Maximum Ratings			Electrical Characteristics					
	V_{DSS} Vdc	I_D A	P_D W	I_{DSS} mA Max	$r_{DS(On)}$ Ohms Max	@ I_D Adc	$V_{GS(th)}$ Vdc Min/Max	$t_{d(on)}$ ns Max	$t_{d(off)}$ ns Max
TO-254AA Package N-Channel									
MHM5N100HX, HXV	1000	5	125	0.2	3	2.5	2/4.5	40	160
MHM12N50HX, HXV	500	12	125	0.2	0.4	7	2/4.5	40	150
MHM25N20HX, HXV	200	25	125	0.2	0.1	12.5	2–Feb	40	150
MHM25N10HX, HXV	100	25	125	0.2	0.065	20	2–Feb	40	150
P-Channel									
MHM8P20HX, HXV	200	8	125	0.2	0.75	4	2/4.5	40	100
TO-258AA Package N-Channel									
MHR30N20HX, HXV	200	30	125	0.2	0.1	16	2–Feb	40	150
MHR35N10HX, HXV	100	35	125	0.2	0.065	20	2–Feb	40	150

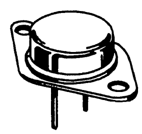
* has current sensing-capability

NOTE: All TMOS devices are presently on engineering hold pending requalification of the new die. Check with your local sales office for delivery.

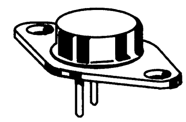
Power Transistors (Continued)



TO-258AA



TO-204AA
(TO-3)



TO-213AA
(TO-66)

Bipolar, Low Frequency

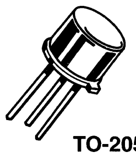
Device Number	Maximum Ratings: V_{CEO} Adc	I_C Adc	P_D W	Electrical Characteristics: h_{FE} Min/Max	@ I_C mA	t_r/t_f µs Max	@ I_C Adc	$V_{CE(sat)}$ Vdc Max	f_T MHz Min
TO-204AA/AE Package NPN									
MJ10016HX, HXV	120	30	200	200/—	30	—	—	4	—
MJ11022HX, HXV	250	15	175	400/15000	10000	1.2/10	10	2	3
MJ11032HX, HXV	120	50	300	400/—	50	—	—	3.5	—
MJ12005HX, HXV	750	8	100	Not Specified		—/1	5	5	—
PNP									
MJ11021HX, HXV	250	15	175	400/15000	10000	1.2/10	10	2	3
MJ11033HX, HXV	120	50	300	400/—	50	—	—	3.5	—
TO-213AA Package NPN									
MJ6316HX, HXV	80	7	90	20/100	2.5	0.7/0.8	2.5	1	4
PNP									
MJ6318HX, HXV	80	7	90	20/100	2.5	0.7/0.8	2.5	1	4
TO-254AA Package NPN						**t_{on}/t_{off}**			
MJM3716H, HX, HXV	80	10	150	50/150	1000	—/2	—	1	—
MJM5339H, HX, HXV	100	5	40	60/240	2000	0.1/0.2	0.5	0.7	30
MJM6059H, HX, HXV	100	12	150	1000/18000	6000	2/10	5	2	—
MJM6341H, HX, HXV	150	25	200	30/120	10000	—/—	—	1	40

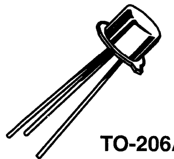
Bipolar, RF

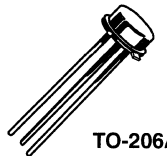
Device Number	Maximum Ratings: V_{CEO} Vdc	I_C mA	P_D W	Electrical Characteristics: h_{FE} Min/Max	P_{out} W Min	& G_{PE} dB Min	@ f MHz	Coll. Eff. % Min	@ f MHz
TO-257AA Package NPN									
MJT5339H, HX, HXV	100	5	40	60/240	2000	0.1/0.2	0.5	0.7	30
PNP									
MJT6193H, HX, HXV	100	5	40	60/120	2000	0.1/0.2	0.5	0.7	30

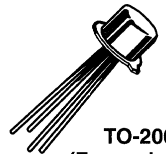
MIL-Processed Semiconductors (Continued)

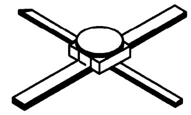
SMALL-SIGNAL TRANSISTORS


TO-205AD (Formerly TO-39)


TO-206AA (Formerly TO-18)


TO-206AB (Formerly TO-46)


TO-206AF (Formerly TO-72)


Case 303-01

Bipolar, General Purpose

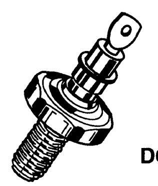
Device Number	Max Ratings		Electrical Characteristics							
	V_{CEO} Volts	I_C mA	h_{FE} Min/Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C/I_B mA	t_r*/t_f* t_{on}/t_{off} ns Max	@ I_C/I_B mA	h_{fe} Min/Max	@ f kHz
TO-206AA Package NPN										
MM2896HX, HXV	90	1000	60/200	150	0.6	150/15	—	—	50/275	1
MM3227H, HX	20	200	100/300	10	0.2	10/1	23–Dec	10/3	—	—
PNP										
MM3497HX, HXV	120	100	40/—	10	0.35	29–Sep	300/1000	10/1	40/300	1
TO-205AD Package NPN										
MM5682HX, HXV	120	1000	40/150	250	0.6	250/25	—	40/—	1	
MM5681HX, HXV	100	1000	40/150	250	0.6	250/25	—	—	40/—	1
MM4239HX, HXV	80	3000	30/150	250	0.3	500/50	—	—	30/—	1
PNP										
MM5680HX, HXV	120	1000	40/150	250	0.6	250/25	—	—	40/—	1
MM4236HX, HXV	80	1000	30/150	250	0.6	1k/125	—	—	25/—	1

Bipolar, RF

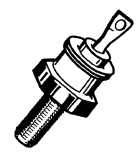
Device Number	Maximum Ratings			Electrical Characteristics								Package
	V_{CEO} Vdc	I_C mA	P_D W	I_{CBO} μAdc Max	h_{FE} Min/Max	f_T GHz Min	@ I_C mA	NF dB Max	@ f MHz	G_{PE} dB Min	@ f MHz	
NPN												
MRF6604HXV	15	50	0.5	0.05	30/200	—	—	3	1000	15	1000	CASE 303-01
MRF904HX,HXV	15	30	0.2	0.05	30/200	—	—	2	450	—	—	TO-206AF
MRF5031HX,HXV	10	20	0.2	0.01	25/300	1	5	2.5	450	14	450	TO-206AF
MRF5836HX,HXV	10	200	—	10	25/—	2	50	—	—	—	—	TO-206AB

Bipolar, RF (Continued)

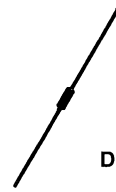
Device Number	Maximum Ratings V_{CEO} Vdc	I_C mA	P_D W	Electrical Characteristics I_{CBO} µAdc Max	h_{FE} Min/Max	f_T GHz Min	@ I_C mA	NF dB Max	@ f MHz	G_{PE} dB Min	@ f MHz	Package
PNP												
MRF522HXV	10	50	—	10	25/125	—	0	3.5	1000	10	1000	CASE 303-01
MRF4957HX,HXV	30	30	0.2	0.1	30/165	1.2	2(I_E)	3.5	450	17	450	TO-206AF
MRF5160HX,HXV	40	400	5	1	10/—	0.5	50	—	—	8	400	TO-205AD
MRF5583HX,HXV	30	500	5	0.05	25/100	1	40	—	—	—	—	TO-205AD
MRF6985HX,HXV	30	16	270	1500	20/100	—	—	—	—	8	400	—
MRF6986HX,HXV	30	16	270	1500	20/100	—	—	—	—	7.5	500	—



DO-203AA
(DO-4)



DO-203AB
(DO-5)

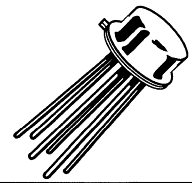


Glass
DO-204AA
(DO-7)

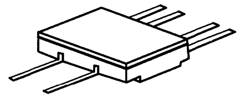
RECTIFIERS — All are available with HX and HXV classifications.

Device Number	Maximum Rating I_O Amps	V_{RRM} Volts	I_{FSM} Amps	Electrical Characteristics V_F Volts Max	@ I_F Amps	I_R µA Max	@ V_R Volts	t_{rr} µs Max	@ I_F Amps	Package
Fast Recovery										
MR836HX,HXV	3	600	100	1.1	3	500	600	0.2	1	CASE 60-01
MR3910HX,HXV	30	100	300	1.4	30	25	100	0.2	1	DO-203AB
MR3911HX,HXV		200	300	1.4	30	25	200	0.2	1	
MR3913HX,HXV		400	300	1.4	30	25	400	0.2	1	
Ultrafast Recovery										
MUR2515HX,HXV	25	150	500	0.95*	25*	10	150	0.05	1	DO-203AA
MUR5010HX,HXV	50	100	600	1.15	50	10	100	0.05	1	DO-203AB
MUR5020HX,HXV	50	200	600	1.15	50	10	200	0.05	1	DO-203AB
Schottky										
MBR030AHX,HXV	0.5	30	15	0.5*	0.1*	10.0	30*	—	—	DO-204AA
MBR040AHXHXV	0.5	40	15	0.5*	0.1*	10.0	40*	—	—	DO-204AA
MBR5825HX,HXV	15	40	500	0.38	5	10000	40	—	—	CASE 60-01
MBR6391HX,HXV	35	45	600	0.68*	50*	1500*	45*	—	—	DO-203AA
MBR6392HX,HXV	60	45	800	0.78*	65*	70*	45*	—	—	DO-203AB

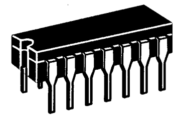
* = Instantaneous Values, e.g. vF(pk) @ iF(pk) and iR(pk) @ vR(pk)



Case 654
(TO-76)



Case 610A



Case 632-08

MULTIPLE TRANSISTORS

Bipolar

Multiple transistors are multi-chip devices with two (duals) or four (quads) chips in a single package. The transistors are signal devices intended for switching and amplifier applications.

Device Number	Maximum Ratings			Electrical Characteristics						Package
	V_{CEO} Vdc	I_C mA	P_D* W	I_{CBO} µAdc Max	h_{FE} Min/Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	
DUALs — NPN										
MD2219AFHXV	50	800	0.0046	0.01	100/300	150	0.3	150	15	610A
MD2369AHX, HXV	15	200	0.36	0.02	40/120	10	0.02	10	1	654
MD2369AFHXV	15	200	0.36	0.02	40/120	10	0.02	10	1	610A
MD918HX, HXV	15	50	0.2	0.01	20/200	3	0.4	10	1	654
MD918FHXV	15	50	0.2	0.01	20/200	3	0.4	10	1	610A
DUALS — PNP										
MD2905AFHXV	60	600	0.6	0.01	100/300	150	0.4	150	15	610A
MD3251AHX, HXV	60	50	0.625	0.02	100/300	10	0.25	10	1	654
MD3251AFHXV	60	50	0.4	0.02	100/300	10	0.25	10	1	610A
MD3468HX,HXV	50	1000	0.65	0.1	25/75	500	0.3	150	15	654
MD3468FHXV	50	1000	0.4	0.1	25/75	500	0.3	150	15	610
MD4261HX,HXV	15	30	0.3	—	30/150	10	0.35	10	1	654
MD4261FHXV	15	30	0.3	—	30/150	10	0.35	10	1	610
DUALS — NPN/PNP										
MD6002HX, HXV	30	500	0.625	0.02	100/300	150	0.4	150	15	654
MD6002FHXV	30	500	0.625	0.02	100/300	150	0.4	150	15	610
QUADs — NPN										
MHQ2484HX, HXV	60	50	2	0.005	200/500	0.01	0.3	1	0.1	632
MQ2484HXV	60	50	0.6	0.005	200/500	0.01	0.3	1	0.1	607
MHQ2369HX, HXV	15	500	1.5	0.2	40/120	10	0.2	10	1	632
MQ2369AHXV	15	500	0.6	0.2	40/120	10	0.2	10	1	607
MHQ918HX, HXV	15	50	1.6	0.01	20/200	3	0.4	10	1	632
MQ918HXV	15	50	0.4	0.01	20/200	3	0.4	10	1	607

* All die, equal power

(continued)

Bipolar (Continued)

Device Number	Maximum Ratings V_{CEO} Vdc	I_C mA	P_D* W	Electrical Characteristics I_{CBO} µAdc Max	h_{FE} Min/Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	Package
QUADS–PNP										
MHQ3251AHX, HXV	60	200	1.5	0.02	100/300	10	0.25	10	1	632
MQ3251AHXV	60	200	0.6	0.02	100/300	10	0.25	10	1	607
MHQ3799HX, HXV	60	50	1.5	0.01	300/900	0.5	0.25	1	0.1	632
MHQ3468HX, HXV	50	1000	2	0.1	25/75	500	0.35	150	15	632
MQ3468HXV	50	1000	0.6	0.1	25/75	500	0.35	150	15	607
MHQ4261HX, HXV	15	30	0.8	—	30/150	10	0.15	1	0.1	632
MQ4261HXV	15	30	0.4		30/150	10	0.15	1	0.1	607
QUADS–NPN/PNP										
MHQ6002HX, HXV	30	500	1.9	0.02	100/300	150	0.4	150	15	632
MQ6002HXV	30	500	0.6	0.02	100/300	150	0.4	150	15	607

* All die, equal power

THYRISTORS — SCRs

Device Number	V_{DRM} V Max	$I_{T(RMS)}$ A Max	I_{DRM} µA	V_{TM} V Max	I_{GT} µA Max	V_{GT} V Max	I_H mA Max	T_J °C Min/Max	Package
MCR2323H/AH	50								
MCR2324H/AH	100	1.6	10	1.5	200	0.8	2	–0.52	TO-205AD
MCR2326H/AH	200								(TO-39)
MCR2328H/AH	300								

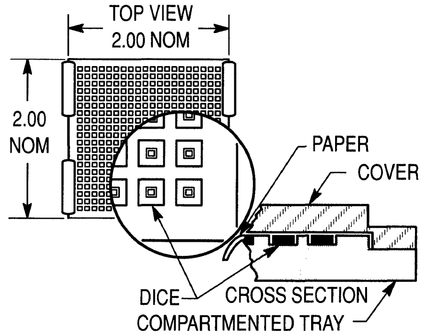


Figure 1. MIL-tested discrete semiconductor chips are now available off the shelf for high reliability hybrid (multi-chip) circuits.

DISCRETE MILITARY OPERATION CHIPS

Motorola's inventory of discrete military products qualified to JAN, JANTX, JANTXV and JANS specifications currently covers many devices listed on the QPL. From these, and from key internal product lines Motorola has designated a comprehensive selection of components in unencapsulated (chip) form to undergo stringent military type testing in order to serve the needs of customers manufacturing hybrid circuits for military and other high reliability applications. The chips are carried in stock by Motorola and by a number of authorized chip resellers, thereby avoiding much of the delay and some of the cost associated with the development of custom products for special applications. The chip line encompasses some of the most popular part numbers from various product categories and is expected to satisfy a substantial portion of a hybrid manufacturer's discrete chip requirements.

Presently the proposed Revision H of MIL-S-19500 includes Appendix H, which identifies a new level of military device, the JAN C chip. The Motorola DMO high reliability chips are identical with the new JAN C chip. As soon as the new Rev. H is dated Motorola will begin qualification to this new level of military semiconductor. Since the JAN C device will be a standard, it will become the preferred chip for all military programs.

Chip Identification

For identification, all Motorola MIL-tested chips will carry the part numbers of their encapsulated counterpart, except for the prefix. For EIA-registered devices, instead of the 1N or 2N prefixes the MIL-tested chips will be labelled 1C and 2C. For Motorola internal part numbers, the letter "C" will be added to the standard internal part number prefix.

Chips processed to JAN, JANTX and JANTXV specifications are further identified by the suffix "HV" added to the chip part number. Additional processing to JANS specifications (suffix "HS") can be initiated routinely through advance communications with any Motorola sales office. Examples:

Standard Part Numbers	Equiv. MIL-Tested Part Numbers
2N2222A	2C2222AHV (or HS)
MZ2.4A	MZC2.4AHV (or HS)

Chip Qualification

Chips to be used in military and other high-reliability applications are tested to conform to the following military specifications where applicable:

MIL-C-45662 Calibration System Requirements
MIL-L-45208 Inspection System Requirements
MIL-STD-750 Test Methods for Semiconductors

To qualify, individual chips are probe tested to guarantee conformance with the dc parameters corresponding to those on the military slash sheets. Parts not covered by military specifications will be tested to Motorola data sheet electricals and MIL-S-19500 will be used as a guide.

Table 1 describes the test capabilities for discrete chip probing.

Parameters which cannot be tested in probe will be tested on encapsulated devices on a sample basis for quality conformance. Table 2 details the tests performed on the chips, as well as those performed on encapsulated Lot Acceptance Test Samples (LATS).

Table 1. Probe Test Capabilities

Parameter	Test Conditions	Limits
Breakdown Voltages	10 µA to150 mA	0 to 2000 V
Leakage Currents	0 to 2000 V	10 nA to 175 mA
Current Gain (hFE)	100 µA to 30 A	0 to 20 V
Saturation and "On" Voltages	100 µA to 30 A	0 to 10V
Forward Voltages	0 to 30 A	0 to 10 V

Table 2. JANTXV Process Flow for Motorola Discrete Military Products Chips

Processing	Chips	LATS*
Electrical Probe, +25°C DC Only	100%	100%
Wafer Saw-Through	100%	100%
Visual Inspection MIL-STD-750, Method 2072 or 2073	100%	100%
Assemble in Applicable Package	—	See Table 3
In-Package Tests High Temperature Storage	—	100%
MIL-STD-750, Method 1032	—	100%
Hermetic Seal Fine and Gross Leaks MIL-STD-750, Method 1071	—	100%
Serialization	—	100%
Electrical Parameters Read and Record, Group A Only	—	100%
High Temperature Reverse Bias (HTRB) MIL-STD-750, Method 1039, Cond. A Transistors Only	—	100%
Delta Calculations for HTRB Read and Record	—	100%
Burn-In, High Power MIL-STD-750, Method 1039, Cond. B, Transistors Method 1038, Cond. B, Diodes	—	100%
Delta Calculations for Burn-In Read and Record	—	100%
Final Electrical Parameters Read and Record	—	100%
Bond Pull & Die Shear MIL-STD-750, Method 2017 & 2037	—	5 Devices

* LATS = Lot Acceptance Test Samples.

Lot Acceptance Criteria

For lot acceptance tests, transistor die will be mounted in applicable TO-18, TO-205AD (TO-39), TO-204AA/AE (TO-3) packages and zener diode chips will be mounted in TO-18 packages.

In cases where there are more than 2500 chips on a wafer, a lot will consist of only one wafer and sample chips to be used for packaged devices will be selected randomly and uniformly from across the wafer. For larger die, with less than 2500 chips per wafer, samples will be selected from more than one wafer and traceability will be to the wafer lot.

Table 3 lists the lot acceptance criteria for various size chips.

Table 3. Lot Acceptance Criteria

Average Number of Electrically Good Die Per Wafer	Minimum Sample Size	Limits
Over 2500	77	LTPD = 5 Acceptance No. C = 1
1000 to 2499	55	LTPD = 7 C = 1
2 to 999	38	LTPD = 10 C = 1

For devices with more than 2500 die per wafer, QCI will be performed on each wafer.

Packaging

Motorola supplies all discrete semiconductor chips in the industry standard multi-pak. This is a 2" x 2" waffle type carrier with separate compartments for each die, Figure 1. The dice are covered with filter papers aligned with the top edge of the tray. The multi-pak itself is conductive, or covered with conductive material, to reduce the danger of damage to the die from electro-static discharge. For die 30 mil square or smaller, there will be 400 chips in each waffle pack. For a progressively larger die, waffle packs with 100, 49 and 25 chip compartments will be used. The waffle pack will be enclosed in a dry nitrogen filled or vacuum packed conductive bag and each waffle pack will contain chips from only one wafer. All will contain the following information:

Motorola Logo
Device Part Number
Inspection Lot Number (Wafer Number)
Date Code (Assembly Date of the LATS)
ESD Symbol as applicable, per MIL-STD-1285

Handling and Storage

When removing the cover from the waffle pack, the die may have a tendency to stick to the paper insert between the top cover and the tray. To resolve this problem, Figure 2, place the cover upside-down on the tray and apply light finger pressure to the cover. Then using tweezers. slide the paper from between the tray and the cover.

Chips should be stored at room temperature in an inert environment. Special electrostatic discharge (ESD) precautions should be taken to avoid chip damage. Storage in the original shipping package is recommended.

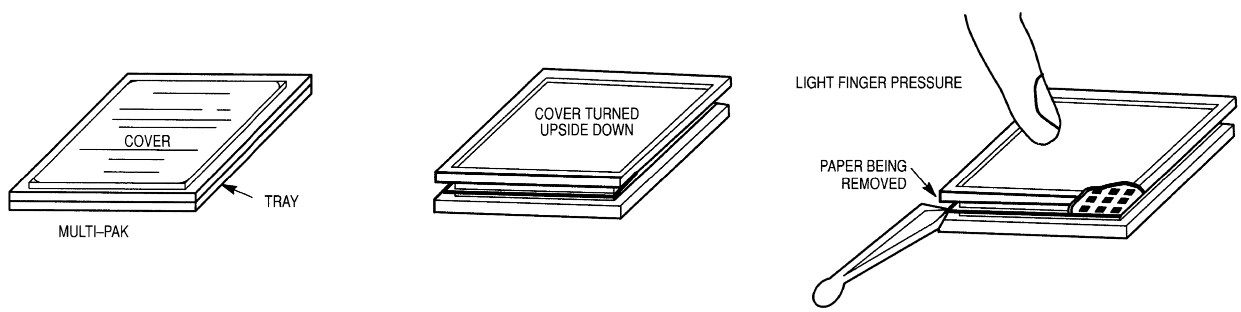


Figure 2. Care in removing the filter paper from the multi-pak will prevent loss of chips adhering to the paper.

SELECTOR GUIDE

The following tables list the various Motorola DMO chips first by specific product categories and then in a logical fashion that permits rapid comparison of the more important design specifications.

TRANSISTORS

Power, Bipolar — Listed in order of increasing Collector Current, I_C (continued)

Device Number NPN	Device Number PNP	I_C Adc Max	$V_{CEO(sus)}$ Vdc Min	h_{FE} Min/Max	@ I_C Adc	t_{on}/t_{off} µs Max	t_r/t_f µs Max	@ I_C A	h_{fe} Min/Max	@ f MHz
2C3767HV		4	80	40/60	0.5	0.25/2.5	—	0.5	1/8	10
	2C3741HV	4	80	30/120	0.25	0.4/1	—	1	25/250	0.001
2C5339HV	2C6193HV	5	100	60/240	2	—	0.1/0.2	2	3/15	10
2C3716HV	2C3792HV	10	80	30/120	3	—	1.3*	5	30/300	0.001
2C6059HV	2C6052HV	12	100	75/18k	6	2/10	—	5	1000/—	0.001

*t_f = 1.2 µs for 2C3716; 1.0 µs for 2C3792

Small-Signal — Listed in order of decreasing Breakdown Voltage, $V_{(BR)CEO}$

Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min/Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C/I_B mA	t_{on}/t_{off} ns Max	@ I_C mA	h_{fe} Min/Max	@ f MHz
NPN										
2C3439HV	350	1000	40/60	20	0.5	50/4	1/10**	20	3/15	5
2C3501HV	150	300	100/300	150	0.4	150/15	115/1150	15	1.5/8	100
2C3019HV	80	1000	100/300	150	0.2	150/15	30/30	—	5/20	20
2C2484HV	60	50	200/500	0.01	0.3	1/0.1	—	—	2/7	30
2C2222AHV	50	800	100/300	150	1	500/50	35/300	150	2.5/—	100
2C2369AHV	40	200	40/120	10	0.2	10/1	16–Dec	10	5/10	100
2C918HV	15	50	20/200	3	0.4	10/1	—	—	6/18	100
PNP										
2C3251AHV	60	200	100/300	10	0.25	10/1	35/50*	10	3/9	0.1
2C2907AHV	60	50	100/300	150	0.4	150/15	45/300	—	2/—	100
2C2605HV	60	30	100/300	0.01	0.3	10/0.5	—	—	1/8	30
2C3468HV	50	1000	25/75	500	0.35	150/15	30/30*	500	150/500***	100

* = t_r/t_f ** = µs *** = f_T

RF, Power

Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	P_{out} W Min/Max	@ P_{in} W	& f MHz	h_{FE} Min/Max	@ I_C mA	h_{fe} Min/Max	@ f MHz
NPN									
2C3553HV	40	1000	2.5/5.0	0.25	175	15/150	150	3.5/—	100
2C3866AHV	30	400	1.0/2.0	0.15	400	25/200	50	4/7.5	200

RF, Small Signal

Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	G_{pe} dB Min/Max	@ f MHz	Noise Figure dB Max	@ f MHz	h_{FE} Min/Max	@ I_C mA	h_{fe} Min/Max	@ f MHz
NPN										
2C5109HV	20	400	11/—	200	3.5	200	40/150	50	5/10	200
2C2857HV	15	40	12.5/21	450	4.5	450	30/150	3	19–Oct	100

ZENER DIODES

Device Type		V_Z Vdc ±5%
Registered	Internal	
1C4370AHV	MZC2.4A5HV	2.4
	MZC2.5A5HV	2.5
1C4371AHV	MZC2.7A5HV	2.7
	MZC2.8A5HV	2.8
1C4372AHV	MZC3.0A5HV	3
1C746AHV	MZC3.3A5HV	3.3
1C747AHV	MZC36A5HV	3.6
1C748AHV	MZC3.9A5HV	3.9
1C749AHV	MZC4.3A5HV	4.3
1C750AHV	MZC4.7A5HV	4.7
1C751AHV	MZC5.1A5HCV	5.1
1C752AHV	MZC5.6A5HV	5.6
	MZC6.0A5HV	6
1C753AHV	MZC6.2A5HV	6.2
1C754AHV	MZC6.8A5HV	6.8
1C755AHV	MZC7.5A5HV	7.5
1C756AHV	MZC8.2A5HV	8.2
	MZC8.7AHV	8.7
1C757AHV	MZC9.1A5HV	9.1
1C758AHV	MZC10A5HV	10
1C962BHV	MZC11A5HV	11
1C759AHV	MZC12A5HV	12
1C964BHV	MZC13A5HV	13
	MZC14A5HV	14
1C965BHV	MZC15A5HV	15
1C966BHV	MZC16A5HV	16
	MZC17A5HV	17
1C967BHV	MZC18A5HV	18
	MZC19A5HV	19
1C968BHV	MZC20A5HV	20

Device Type		V_Z Vdc ±5%
Registered	Internal	
1C969BHV	MZC22A5HV	22
1C970BHV	MZC24A5HV	24
	MZC25A5HV	25
1C971BHV	MZC27A5HV	27
	MZC28A5HV	28
1C972BHV	MZC30A5HV	30
1C973BHV	MZC33A5HV	33
1C974BHV	MZC36A5HV	36
1C975BHV	MZC39A5HV	39
1C976BHV	MZC43A5HV	43
1C977BHV	MZC47A5HV	47
1C978BHV	MZC51A5HV	51
1C979BHV	MZC56A5HV	56
	MZC60A5HV	60
1C980BHV	MZC62A5HV	62
1C981BHV	MZC68A5HV	68
1C982BHV	MZC75A5H	75
1C983BHV	MZC82A5HV	82
	MZC87A5HV	87
1C984BHV	MZC91A5HV	91
1C985BHV	MZCl00A5HV	100
1C986BHV	MZC110A5HV	110
1C987BHV	MZC120A5HV	120
1C988BHV	MZC130A5HV	130
	MZC140A5HV	140
1C989BHV	MZC150A5HB	150
1C990BHV	MZC160A5HV	160
	MZC170A5HV	170
1C991BHV	MZC180A5HV	180
	MZC190A5HV	190
1C992BHV	MZC200A5HV	200

Military Semiconductor or Integrated Circuits

Chip and Wafer Products

The increasing complexity of today's military electronic systems is accompanied by paralleling demands for increased component density, improved subsystem reliability and reduced functional costs. This triple requirement is leading to widespread adoption of hybrid technologies and consequently, to a rapidly expanding demand for unencapsulated semiconductor components with traceability and operational guarantees.

Motorola is responding to this demand by making available high reliability, MIL-tested and commercial devices from both the military and commercial product groups in chip form. Our Discrete Military Operation markets chips and wafers from the military discrete product line. The Military Products Operation (integrated circuits) markets all other military and commercial products which are offered as chips and wafers.

While this section contains general information and data on our chip and wafer products, our customers are recommended to contact the local sales office or the Military Service Center at 1-800-521-6274 for further information.

Military Products Operation Integrated Circuit Chip and Wafer Products

MPO supplies both commercial and military temperature range devices from the following families:

Family	Technology	Base Part Number/Prefix	GEL-Pak	Waffle-Pack*
ALS	Bipolar	54ALS	YES	YES
CMOS	CMOS	14000	YES	YES
DSP	CMOS	56000	YES	YES
DSP	CMOS	96000	YES	YES
ECLinPS	ECL	10EK, 10EKH	YES	YES
FACT	CMOS	54ACT, 54AC	YES	YES
FAST	Bipolar	54F	YES	YES
Linear	CMOS	LM,	YES	YES
Linear	Bipolar	mA, LF, DA, TL	YES	YES
LS	Bipolar	54LS	YES	YES
MCU	NMOS	6800	**	**
	CMOS	68HC11	**	**
MPU	NMOS	68000	**	**
	CMOS	68HC000	**	**
MECL	ECL	10K, 10KH	YES	YES
RISC	CMOS	88000	**	**

* MPO will convert from waffle-Pack to GEL-Pack in 1990. Please contact your local sales office or the Military Service Center at 1-800-521-6274 for further information.
** Please contact the Military Products Operation for further information at: (602) 897-3769.

Military Semiconductor or Integrated Circuits

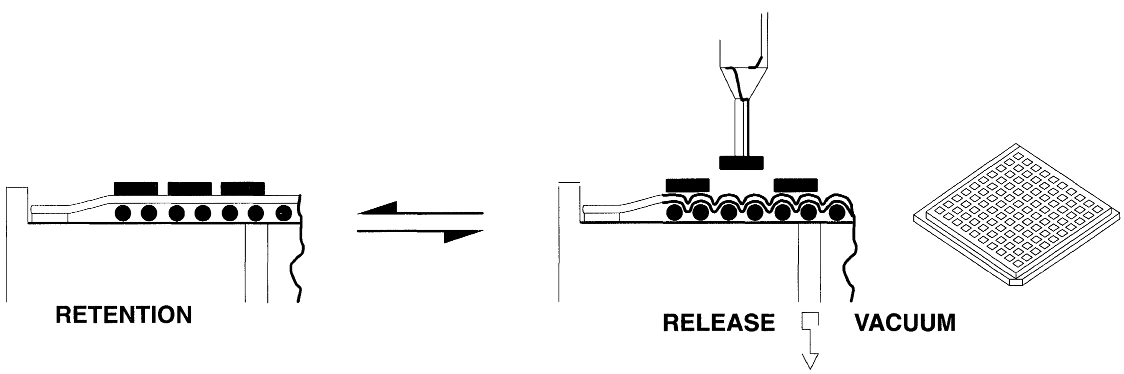
Chip and Wafer Products (Continued)

Packaging

Currently Motorola offers two packaging options for chip and wafer products: GEL-PAK and Waffle-Pack. Motorola will migrate to GEL-PAK as our designated package in 1990.

GEL-PAK packaging cleans the bottom side of die, captures chip dust, eliminates chafing and sticking inside cavities and eliminates spillage during handling, while providing positive die orientation. This procedure also allows for easy access to die edge for manual operations. This carrier system utilizes Fluoroware ESD approved protective components.

Vacuum Release Chip Trays



Note: Die removal will require provisions for vacuum release. For technical support or questions contact:

Vichem Corp.
P.O. Box 9396
Stanford, CA 94309
Phone: (415) 969-1313
FAX: (415) 969-1947

Waffle-Pack is packaged in ESD conductive Fluoroware waffle packs per Motorola specifications 12MSY011656B and 12MRB05332A.

Both packaging options provide that all die are 100% visually inspected per MIL-STD-883, Method 2010, Condition B. Wafers are visually sampled at the center and four quadrants, then packaged in ESD approved bags and boxes and shipped per Motorola specifications 12MRY71206A, 12MSM59616A and 12MSY0656B

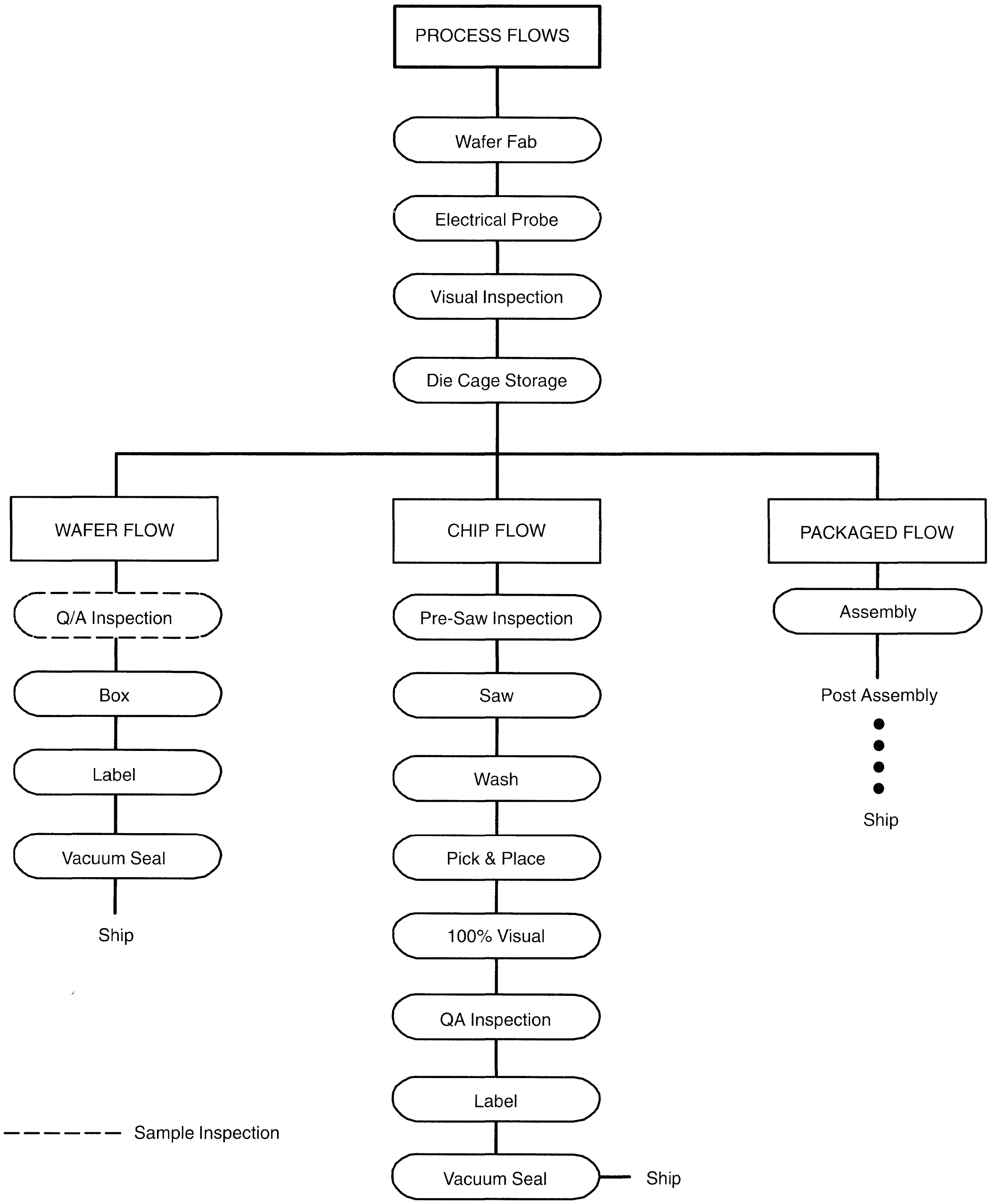
Lot acceptance testing can be performed per MIL-STD-883, Method 5008, by Motorola authorized die processors.

Source	Phone	Fax
Elmo Semiconductor Corp.	(818) 768-7400	(818) 767-7038
Minco Technology Labs, Inc.	(512) 834-2022	(512) 837-6285
Semi Dice	(213) 594-4631	(213) 430-5942

Military Semiconductor or Integrated Circuits

Chip and Wafer Products (Continued)

Process Flows



Winner 1988 Malcolm Baldrige National Quality Award

Product Literature and Technical Training

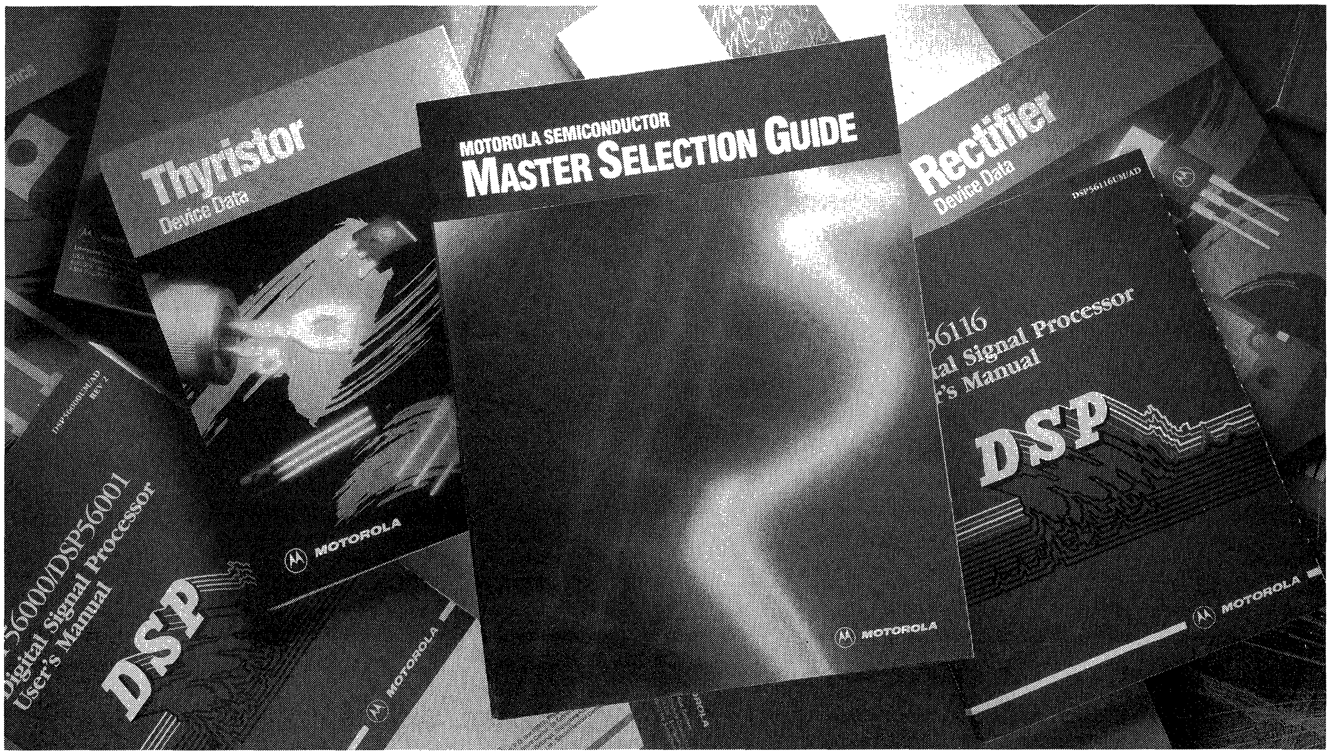
In Brief . . .

With the pace of new semiconductor product introductions, the task of providing an effective and up-to-date perspective of available components is beyond the means of any single document. Hence, a comprehensive Motorola Literature System has been put in place to keep semiconductor users totally informed of all aspects of the Motorola product lines – from new product introductions, to applications, to major changes in directions.

The Motorola technical literature library and associated services consist of the following:

- A unique and comprehensive Updating Subscription Service comprising both hard copy and microfiche updates.
- An extensive library of Data Books, each containing a complete selection of data sheets associated with a particular product line.
- A wide range of Application Notes and Article Reprints detailing the utilization of new and significant products.
- A series of User's Manuals and Design Manuals dealing with the application of highly complex products.
- A Video Training Series for the MC68000.
- Instructor-led Training for the M68000 Family, the DSP56000/1, and the MC88100/200 RISC.
- Audio Cassette Course programs covering the M68000 Family, the DSP56000/1, and the MC88100/200 RISC.

These products and services are described on the following pages. However, because of different conditions and standards, some of these may not be available outside the USA.

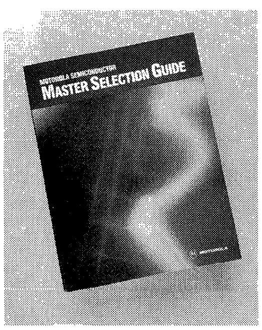


Technical Data Services

Literature and services designed to keep you fully informed of Motorola semiconductor devices and their applications

Motorola Semiconductor Master Selection Guide

For the identification and preliminary selection of components for circuit and system designs



For the design engineer, the Motorola Master Selection Guide is perhaps the most important single document for the identification and preliminary selection of components for circuit and system designs. Within its pages is a complete listing and description of Motorola semiconductor devices currently in general use, and those recommended for new designs. It serves two purposes:

1. It lists all standard products in the vast Motorola semiconductor inventory for rapid identification.
2. It divides this total product offering into a variety of major product categories, with sufficient technical information to permit an intelligent first-order evaluation as to the most suitable devices for a specific application.

Semiconductor Data Update

Innovative new developments from Motorola's Semiconductor Products Sector

This highly informative periodical is available to all semiconductor users on a free subscription basis. The magazine provides information on new semiconductor products and developments and provides a quick-scan insight into new-product offerings. Concise, informative articles discuss significant new product capabilities as well as newly introduced services and literature. In short, it represents an overview of the latest and most important events at Motorola that influence the efficient implementation and most cost-effective use of semiconductor devices.

We recently introduced an International edition of the periodical, which is now available throughout the European community. In addition to the informative news you've come to expect about Motorola's leading-edge products, this new broader coverage will enable us to highlight manufacturing, awards, special events, and trade shows from an international perspective.

For your free Update subscription in the USA, contact your Motorola Sales Representative or Authorized Distributor. The subscription service may not be available outside the USA. Please contact your local Motorola Semiconductor Sales Office.

Specs In Seconds – Motorola Data Disk

Selection of Motorola semiconductors is now as quick as your desk-top computer.

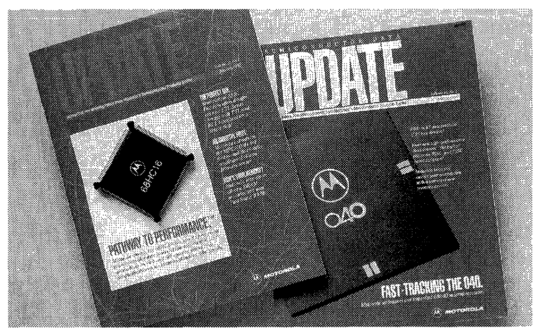
This resource is an engineering tool which speeds device selection. It provides you at-the-desk access to computerized device selection for over 13,000 Motorola devices in 124 product categories. It also contains cross references to over 25,000 competitive devices and is available in both IBM and Macintosh formats.The Motorola Data Disk is designed to assist in the selection of Motorola semiconductor devices by providing the following capabilities:

1. Perform a parametric search and display the most important parameters in rank order
2. Part number search
3. Partial part number search
4. The ability to limit searches to Surface Mount devices only
5. The ability to limit searches to Military devices only
6. Cross reference searches to similar and direct replacements
7. Phone number listing for Motorola's sales offices and distributors
8. Provides pricing information
9. The ability to print displayed screens
10. Automatic multilevel sorts
11. Footnotes support
12. The ability to print an Information Request Form to obtain specific technical literature or applications assistance
13. Complete literature support for all devices including application notes, article reprints, engineering bulletins, and data books

In the USA, you can obtain a free copy of the latest Motorola Data Disk from your nearest Motorola Semiconductor Sales Office or Distributor or Literature Distribution Center. Outside the USA, please ask your local Motorola Sales Office for the price in your country.

Technical Literature Update Program

A comprehensive automatic literature and information update service.



For anyone requiring an automatic and timely updating service of technical literature for all Motorola semiconductor products, we offer the Technical Literature Update Program. Subscribers to this service, automatically receive a copy of Semiconductor Data Update, all technical data sheets, application notes, data books, and product brochures soon after they are published. The program also includes the latest version of the Motorola Data Disk. All the literature is free. All we require is a $50.00 annual fee to cover the postage and handling cost. Therefore, if you require rapid updating of new-product data, plus a continually updated data-book series, you'll find this service the best literature bargain in the industry.

**The annual subscription rate of $50.00 applies to U.S. subscribers only. One-year subscription rates, in U.S. funds, outside the U.S. are as follows:

Canada and Mexico	$100.00
All countries other than the U.S., Mexico and Canada	$150.00

Microfiche Subscription Service

Hard copy in space-saving form

For the designer with access to a microfiche viewer, the Motorola Microfiche Subscription Service is a handy desk-top new-product data system. After publication of an Update issue, the data sheets and application notes of featured products will be made available on microfiche. It's a complete file of new-product data that is easily stored and retrieved.

Within the USA, please send your request to:

Motorola Semiconductor Products, Inc.
P.O. Box 20924
Phoenix, AZ 85036-0912

Because of different systems and standards, this may not be available in your country or region. Please contact your local Motorola Sales Office and inquire.

Motorola Data and Application Literature

Complete technical data for the world's most comprehensive inventory of semiconductor components

To complement the industry's broadest line of semiconductor products, Motorola offers a complete library of Data books which detail the electrical characteristics of its products. These documents are supplemented by User's Manuals describing the capabilities of the products in circuit and system design.

Motorola attempts to fill the need for applications information concerning today's highly complex electronic components. Each year dozens of authors from colleges and universities, and from the industry, add their individual contributions to the collective literature. From these, Motorola has selected a number of texts which add substantially to the comprehension and applications of some of the more complex products. By buying these in large quantities and providing them to customers at lower than retail cost, Motorola hopes to foster a more comprehensive acquaintance with these products at greatly reduced prices.

For complete summaries and prices, in the USA order BR101/D from the Literature Distribution Center and in Europe order BR464/D from the Literature Distribution Center.

Discrete Literature

Data Books and Handbooks

DL110/D	RF Device Data (Vol. 1 & 2)
DL111/D	Bipolar Power Transistor Data
DL118/D	Optoelectronics Device Data
DL126/D	Small-SignalTransistors/FETs/Diodes
DL135/D	Power MOSFET Transistor Data
DL137/D	Thyristor Device Data
DL148/D	Discrete Military Operations Data
HB213/D	Discrete Military Operations Handbook

Textbooks

TB321/D – Brown	Practical Switching Power Supply Design

IC Literature

Data Books and Handbooks

DL113/D	Memory Data
DL121/D	FAST and LS TTL Data
DL122/D	MECL Device Data
DL128/D	Linear and Interface ICs
DL129/D	High-Speed CMOS Logic Data
DL130/D	CMOS/NMOS Special Functions
DL131/D	CMOS Logic Data
DL136/D	Telecommunications Device Data
DL138/D	FACT Data
DL139/D	MPU/MCU/Peripheral Data (Vol 1 & 2)
DL140/D	ECLinPS Device Data
DL141/D	BiCMOS Logic Data
DL142/D	Military/ALS/FAST/LS/TTL Data
DL149/D	MDA20 CMOS Standard Cell Data
DL152/D	MDA15 CMOS Standard Cell Data
DL153/D	MDA12 CMOS Standard Cell Data
HB205/D	MECL System Design Handbook
HB206/D	Voltage Regulator Handbook
M68000FR/AD	M68000 Family Reference

Textbooks

TB312/D	Introduction to Integrated Circuit Layout – Spinks

Microprocessor Literature

User's Manuals and Designer's Handbooks

DSP56000UM/AD	DSP56000/56001 Digital Signal Processor User's Manual
DSP56116UM/AD	DSP56116 User's Manual
DSP96002UM/AD	DSP96002 IEEE Floating-Point Dual Port User's Manual
M68000PM/AD	Programmer's Reference to M68000 Family and CPU32
M68000UM/AD	MC68000/68008/68010/68HC000 8-/16-/32-Bit User's Manual
MC68020UM/AD	MC68020 32-Bit Microprocessor User's Manual
MC68030UM/AD	MC68030 Enhanced 32-Bit Microprocessor User's Manual
MC68E030UM/AD	EC030 32-Bit Embedded Controller User's Manual
MC68040DH/AD	MC68040 Designer's Handbook
MC68040UM/AD	MC68040 32-Bit User's Manual
MC68302UM/AD	MC68302 Integrated Multi-Protocol Processor User's Manual
MC68340UM/AD	MC68340 Integrated Processor User's Manual
MC68605UM/AD	MC68605 X.25 Protocol Controller User's Manual
MC68824UM/AD	MC68824 Token Bus Controller User's Manual
MC68851UM/AD	MC68851 Paged Memory Management Unit User's Manual
MC68881UM/AD	MC68881/68882 Floating-Point Coprocessor User's Manual
MC88100UM/AD	MC88100 RISC Microprocessor User's Manual
MC88200UM/AD	MC88200 Cache/Memory Management Unit User's Manual

Textbooks

TB301/D	Basic Microprocessors and the 6800 – Bishop
TB302/D	What Every Engineer Should Know about MCU's – Bennet & Evert Jr.

Microprocessor Textbooks (continued)

TB303/D	Using MPUs and MCUs: The 6800 Family – Greenfield &Wray
TB304/D	Pascal Programming Structures for Motorola MPUs – Cherry
TB305/D	Programming Microprocessor Interface for Control and Instrumentation – Andrews
TB309/D	Programming the 6809 – Zaks & Labiak
TB317/D	68000, 68010, 68020 Primer – Kelly-Bootle & Fowler
TB318/D	Microprocessor Systems Design, 68000 Hardware, Software and Interfacing – Clements
TB319/D	MC68000 Assembly Language and Systems Programming – Ford & Topp
TB320/D	The 68000 Family, Volume 1 – Hilf & Nausch
TB322/D	The 68000 Family, Volume 2 – Hilf & Nausch
TB323/D	The 68000 Book – Southern
TB324/D	Real Time Digital Signal Processing Applications with Motorola's DSP56000 Family – EL-Sharkawy

Microcontroller Literature

User's Manuals and Reference Manuals

CPU32RM/AD	CPU32 Central Processor Unit Reference Manual
MC6801RM/AD2	MC6801/6803/68701 8-Bit Single-Chip Reference Manual
M6805UM/AD2	M6805 HMOS/M146805 CMOS Family MCU/MPU User's Manual
M68HC05AG/AD	M68HC05 Applications Guide
MC68HC05CXRG/AD	MC68HC05CX HCMOS Single-Chip Microcontroller Programming Guide
M6809PM/AD	MC6809/6809E Microprocessor Programming Manual
M68HC11RM/AD	M68HC11 Reference Manual
MC68HC11A8RG/AD	MC68HC11A8 Programming Reference Guide
MC68HC11D3RG/AD	MC68HC11D3,711D3 Program. Reference Guide
MC68HC11E9RG/AD	MC68HC11E9 Programming Reference Guide
MC68HC11F1RG/AD	MC68HC11F1 Programming Reference Guide
MC68HC811E2RG/D	MC68HC811E2 Programming Reference Guide
MC68332UM/AD	MC68332 Sys. Integration Manual
MC68040UM/AD1	MC68040 Programmer Timer
MC68488UM/AD	MC68488 General Purpose Interface Adapter User's Manual
TPURM/AD	M68300 Family Time Processor Reference Manual

Textbooks

TB313/D	Efficient C – Plum and Brodie
TB316/D	Single and Multiple Chip Microcomputer Interface – Lipovski
TB316LM/D	Lab Manual – Lipovski

ASIC

Design Manuals

BR165/D	MCA800/MCA2500ECL, Macrocell Arrays
BR312/D	MCA2800RAM and MCA2800ALS Macrocell Arrays
HCA62A00DM/D	HCA62A00 Series HCMOS Macrocell Array Design Manual
HDCDM/D	High Density CMOS Arrays Design Manual
MCA3ECL/D	MCA3 Series ECL Array

Motorola Application Literature

Semiconductors in theory and practice

Application Notes, Engineering Bulletins and Article Reprints are part of a total information system to define the characteristics and applications of semiconductor devices. Motorola's library consists of more than 300 such documents dealing with the applications of all types of semiconductors from discrete power transistors to the most complex microprocessors. All are described in an Application Note Catalog available from our Literature Distribution Center.

Individual application notes, application reports, engineering bulletins and article reprints can also be ordered from our Literature Distribution Center.

For complete summaries and prices:

In the U.S.A. order BR135/D from the Literature Distribution Center. If you would like a complete compendium of these documents (ANSET/D), you can order this from our Literature Distribution Center for a cost of $30.00.

In Europe order SG410/D from the Literature Distribution Center. An Application Manual Series is also available which includes the following:

DL408/D	8-bit MCU Applications Manual
DL409/D	16/32-bit Applications Manual
DL410/D	Power Applications Manual
DL411/D	Communications Applications Manual
DL412/D	Industrial Control Applications Manual

Contact the Literature Distribution Center for prices and ordering information. In addition, there may be an alternative document available in some countries, contact your local Motorola Sales Office.

Expanding The Mind

Technical Training Instructor-led and Audio Courses

Motorola Training and Technical Operations offers a variety of training tools. We offer the best instructor-led training in the industry. Also offered are audio courses for those who need a general overview of semiconductor products. Whatever your needs, Motorola Training and Technical Operations can train you; we are prepared to teach at your facility, and we can specialize our courses to fit your specific needs. For more information on any of our training services, **call 1-800-521-6274 or (602) 897-3665.** If you are outside the USA, contact your local Motorola Sales Office or Technical Training Center listed on page 7-6.

Instructor-led Course Descriptions

M68000 16-/32-bit Microprocessor Family (MTT8)
An advanced microcomputer course based on the M68000 16-/32-bit microcomputer family (MC68008 and MC68010).
4 days.

M68020 32-bit Microprocessor (MTT20)
An advanced microcomputer course based on the MC68020 32-bit microprocessor family.
3 days.

MC68HC11 Microcontroller (MTT24)
An advanced course covering all phases of development with MC68HC11 microcomputer. Includes the HDS-300™ development system and the 'C' compiler.
3 days.

MC68030 Enhanced 32-bit Microprocessor (MTT30)
This course covers the major features of the MC68030; data cache, burst mode, synchronous bus and the Internal Memory Management Unit.
2 days.

DSP56000/1 Digital Signal Processing (MTT31)
This course covers the major features of the DSP56000 or DSP56001 including pins and buses, exception processing, DSP instructions and addressing modes.
4 days.

MC88100/200 RISC Microcomputer Family (MTT32)
This course is designed to introduce the student to the MC88100 32-bit Concurrent RISC Microprocessor and the MC88200 32-bit Cache /Memory Unit.
3 days.

MC68000 Microprocessor
Covers all features of the MC68000 16/32-bit microprocessor including: architecture, hardware interface, programming and exception processing. Class consists of lecture and labs.
3 days

MC68020 Microprocessor Update
Covers all features (except those already found in the MC68000) of the MC68020 32-bit microprocessor including: architecture, hardware interfacing, programming, exception processing and the co-processor interface.
3 days

MC68030 Microprocessor Update
Covers all features (except those already found in the MC68020) of the MC68030 32-bit microprocessor including: synchronous transfers, data cache and the memory management unit. Class consists of lecture and labs.
2 days.

MC68040 Microprocessor Update
Covers all features (except those already found in the MC68030) of the MC68040 32-bit microprocessor including: architecture, transfer bus, exception processing, bus arbitration and the memory management unit.
2 days

MC68000 Family Programming
Covers all software features of the MC68000 microprocessor family including: architecture, addressing modes, instruction set, exception processing, caches and memory management. Consists of lecture, in-class exercises and labs.
2 days

Advanced 32-bit Microprocessors
Covers all features (except those already found in the MC68000) of the MC68020 and MC68030 32-bit microprocessors including: architecture, hardware interfacing, programming, exception processing, synchronous transfers, data cache and the memory management unit.
4 days

MC68020/030 Hardware
Covers all hardware features of the MC68020 and MC68030 32-bit microprocessors including: asynchronous bus operation, system control and bus arbitration pins, synchronous bus operation, cache and exception processing. Prior knowledge of the MC68000 is not required.
1 day

MC68332 Embedded Controller
Covers all features (except those already found in the MC68000) of the MC68332 embedded controller including: CPU32, the System Integration Module (SIM), external bus interface, Time Processor Unit (TPU) and Queued Serial Module (QSM). Class consists of lecture, exercises and labs.
3 days

MC68302 Communications Controller
Covers all features (MC68000 features are only reviewed) of the MC68302 communications controller including: System Integration Block (SIB), communications processor and development systems. Class consists of lecture and a demonstration lab.
3 days

MC88100 RISC
Covers all features of the MC88100 and MC8820 RISC CHIP Set including: architecture, programming, processor bus, memory bus, cache, memory management, code scheduling and exception processing.
3 days

DSP5600/1 Microprocessor
Covers all features of the DSP56000/1 microprocessor including: architecture, programming, hardware interface, exceptions and on-chip peripherals. Class consists of lecture and demonstration labs.
4 days

DSP56116 Microprocessor
Covers all features of the DSP56116 microprocessor including: architecture, programming, hardware interface, exceptions, on-chip peripherals, and OnCE™. Class consists of lecture and labs.
3 days

DSP96002 Microprocessor
Covers all features of the DSP96002 microprocessor including: architecture, programming, hardware interface, exceptions and OnCE™.
3 days

MC68HC05 Microcontroller Family
Covers all features of the MC68HC05B and MC68HC05C series of microprocessors including: architecture, programming, hardware interface and I/O options.
2 days

MC68HC11 Microcontroller Family
Covers all features of the MC68HC11 microprocessors including: architecture, programming, hardware interface, timer and on-chip peripherals. Class consists of lecture and labs.
3 days

Call 1-800-521-6274
for a complete copy of our Technical Training Catalog
or call your local Technical Training Center if you are outside the USA

Technical Training Centers

Regional Training Centers

Austin
TBD

Chicago
2300 North Barrington Road, Suite 700
Hoffman Estates, IL 60195
(708) 490-9500

Phoenix
2100 E. Elliot Road - EL524
Tempe, AZ 85284
(602) 897-4172
(800) 521-6274

San Jose
1150 Kifer Road
Kifer Technical Center, Building 2
Sunnyvale, CA 94086
(408) 749-0510

Toronto
4000 Victoria Park Avenue
North York, Ontario M2H 3P4
(416) 497-8181

Washington, D.C.
8945 Gulford Road, Suite 145
Columbia, MD 21046-1409
(301) 577-2600

Worldwide Training Centers

Munich, Germany
Phone: (89) 92103-571

Solna, Sweden
Phone: (8) 7348800

Aylesbury, United Kingdom
Phone: (0296) 393312

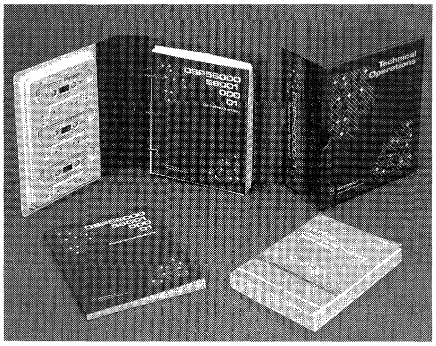
Kwai Chung, N.Y. Hong Kong
Phone: 0-223111

Vanves Cedex, France
Phone: (1) 40955900

Assago Milano, Italy
Phone: (39) 282201

Madrid, Spain
Phone: 457 82 04

Ramat, Israel
Phone: 972-3-7538222



An Introduction to the DSP56000/1
MTTA5 Audio Cassette Course

Course Description
The course is composed of three audio cassette tapes containing approximately four and one-half hours of material. For each topic, there will be stated objectives and self-evaluation exercises with answers. Upon completion the student will have a working, technical knowledge of the DSP56000/1.

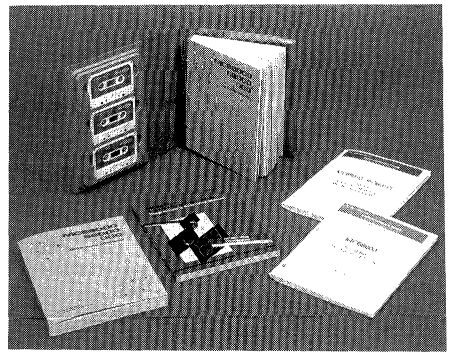
An Introduction to the MC88100/200 RISC
MTTA6 Audio Cassette Course

Course Description
The course is composed of three audio cassette tapes containing approximately four and one-half hours of material. Course notes for the tapes are supplied to aid the student. Each topic begins with clearly-stated objectives and continues with a comprehensive study of the subject including self-evaluation exercises (answers are provided). Upon successful completion, the student will have a working, technical knowledge of the MC88100/200.

To order an audio cassette course, or for a complete copy of the Technical Training Course Catalog describing all course offerings, **call 1-800-521-6274**. Outside the USA, contact your local Technical Training Center or Motorola Sales Office.

Audio Cassette Courses

An Introduction to the MC68000 16-bit Microprocessor
MTTA1 Audio Cassette Course

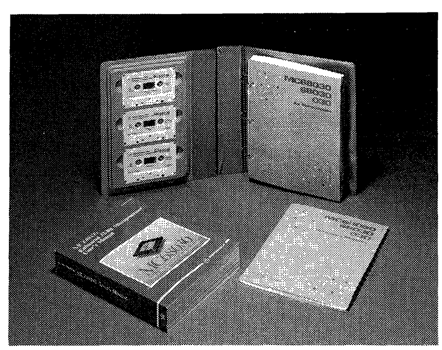


Course Description
The course is composed of three audio cassette tapes containing approximately four and one-half hours of material. Course notes for the tapes and an MC68000 User's Manual are supplied to aid the student. A set of application notes and other helpful technical materials are also included. Each topic begins with clearly stated objectives, continues with a comprehensive study of the subject, and concludes with a set of self-evaluation exercises (answers are provided). Upon successful completion, the student will have a working, technical knowledge of the MC68000.

An Introduction to the MC68020 32-bit Microprocessor
MTTA2 Audio Cassette Course

Course Description
The course is composed of three audio cassette tapes containing four and one-half hours of materials. Course notes for the tapes and an MC68020 User's Manual are supplied to aid the student. A set of article reprints and other helpful technical materials are also included. Each topic begins with a set of clearly stated objectives, continues with a comprehensive study of the subject and includes a set of self-evaluation exercises (answers are provided). Upon successful completion, the student will have a working, technical knowledge of the MC68020.

An Introduction to the MC68030 Enhanced 32-bit Microprocessor
MTTA3 Audio Cassette Course



Course Description
The course is composed of three audio cassette tapes containing approximately three and one-half hours of material. Course notes for the tapes are supplied to aid the student. Each topic begins with clearly stated objectives and continues with a comprehensive study of the subject including self-evaluation exercises (answers are provided). Upon successful completion, the student will have a working, technical knowledge of the MC68030.

Product Device Index
Subject Cross Reference

In Brief . . .

PRODUCT DEVICE INDEX

The following index lists all of the device numbers of the products contained in this selector guide and references the page number where each device is described in greater detail. The listing is in a numeric sequence organized in a "computer sort." The computer treats each "word" not as a complete number but as a sequential series of columns, and it organizes each column first in an ascending alpha sequence and then in an ascending numerical sequence. Thus, the number 1000 would precede the number 200, (first column — 1 precedes 2), the number 68000 would precede MC6800 (first column — numbers precede letters), and the number 14585 would precede 1N746 (second column — numbers before letters).

SUBJECT CROSS REFERENCE

This listing is intended to simplify the identification of products where specific device numbers are not known. The listing is preceded by definitions of acronyms and abbreviations commonly applied to specific product functions which are subsequently referenced in the succeeding table.

Product Index

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

DEVICE	PAGE	DEVICE	PAGE	DEVICE	PAGE	DEVICE	PAGE

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

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