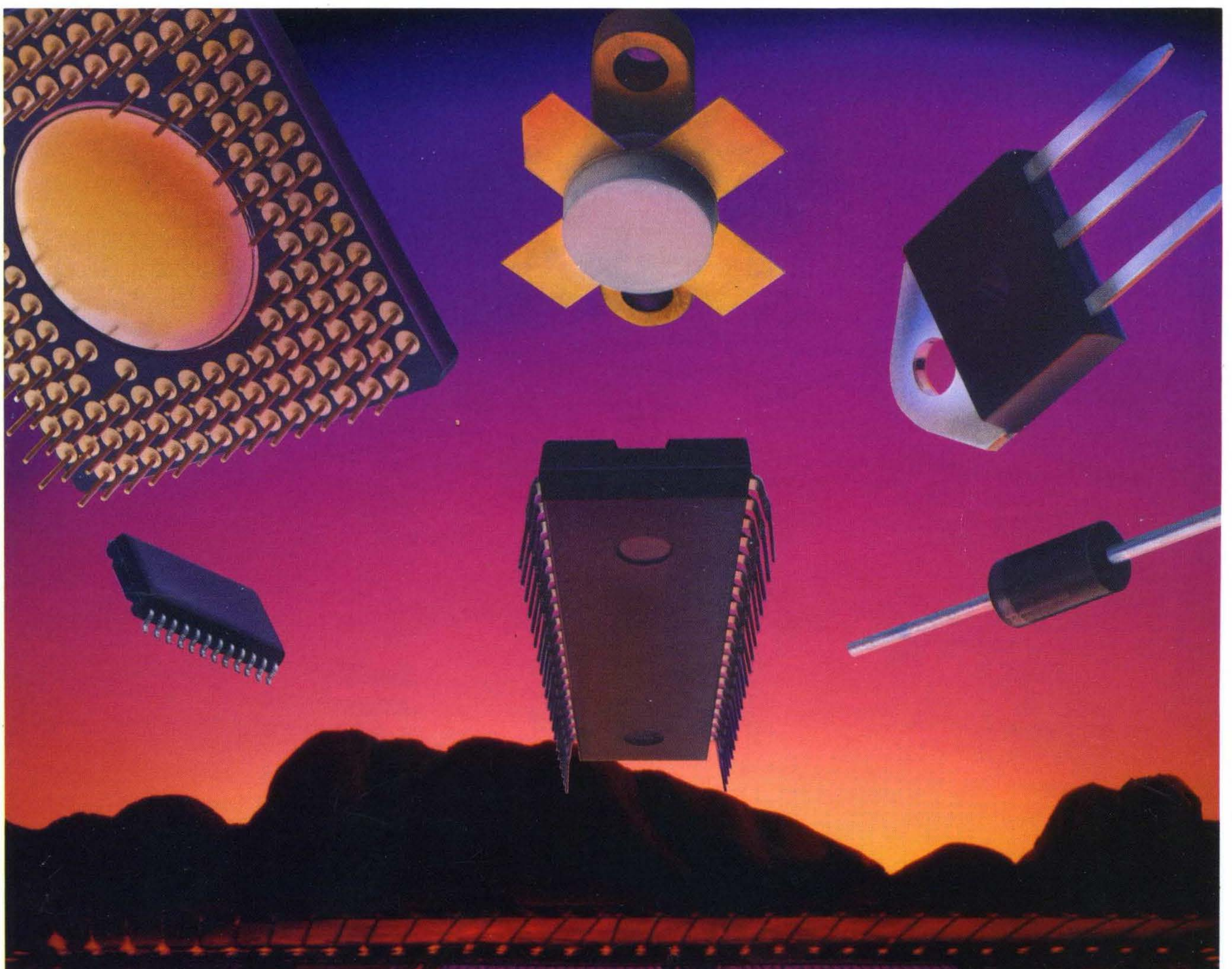
SG73/D
REV 3

MOTOROLA SEMICONDUCTOR
MASTER SELECTION GUIDE



MOTOROLA

MOTOROLA INC.

To Our Valued Customer:

Due to the importance of semiconductor devices in the design of high-technology equipment, it is Motorola's desire to make product selection as quick and easy as possible.

To meet this challenge, we have developed the Motorola Data Disk concept to provide you "at the desk" access to computerized device selection (via IBM PC or equivalent).

The introduction of the Power Transistor version of the Data Disk in 1987 met with immediate and positive reception on your part. Now, utilizing your feedback and suggestions we are introducing a new disk which covers our complete Discrete product line.

In the near future we will introduce a disk covering the complete Motorola Semiconductor product line. The selectivity will be enormous, ranging from the simplest device to the most complex integrated circuit family.

The Motorola Data Disk includes product identification as well as selection according to a variety of major electrical specifications and price. And, we believe its user-friendly menu will let you identify products that meet your needs in just a matter of minutes.

You can obtain a free copy of the latest Motorola Data Disk from your nearest Motorola Semiconductor Sales Office or Distributor.* We would like you to try this new communications medium and let us know your suggestions for improving its usefulness to you. Your ideas will help us better serve your needs.

Charles E. Thompson
V.P., Director of World Marketing

*You can obtain a copy of the disk by mail by sending your check or money order for $2.00 to Motorola Literature Distribution, P.O. Box 20912, Phoenix, AZ 85036. Please request the Motorola Data Disk, DK101/D, in your letter.

Semiconductor Products Sector
3102 North 56th Street, Phoenix, Arizona 85018-6606 (602) 952-3000
P.O. Box 52073, Phoenix, Arizona 85072-2073

MOTOROLA INC.

Dear Valued Customer:

We appreciate your interest in Motorola's semiconductor products. The Master Selection Guide you've received is currently under major revision due to new product introductions in several areas.

To fill the high demand until the revision is completed, we've reprinted a limited number of the current edition. To receive information on the products that are not included in this edition, we've supplied you with a list of Product Selector Guides and Data Disks.

Simply call the Literature Distribution Center at (602) 994-6561 to order those documents or contact your nearest Sales Office. Please refer to the Document Number when ordering.

We will have the new edition available as soon as possible and we apologize for any inconvenience.

Sincerely,

Kelly Rudd

Kelly Rudd
Manager, Sector Technical Publications

Data Disks

Document No.	
DK101/D	SPECS IN SECS - Electronic Selector Guide *(5 1/4" MS-DOS® Compatible)*
DK201/D	SPECS IN SECS - Electronic Selector Guide *(3 1/2" Macintosh® Compatible)*

Microcomputer Components

Document No.	
SG146/D	DSP
SG147/D	MPUs
SG148/D	MCUs
BR292/D	MCU Evaluation Products
SG103/D	MOS Memories

Discrete

Document No.	
BR121/D	Pressure Sensors
SG34/D	Thyristor
SG46/D	RF Products
SG48/D	Bipolar Power Transistor
SG56/D	TMOS Power MOSFET
SG79/D	Switchmode
SG87/D	Optoelectronics
SG114/D	EMS Modules/High Power Transistors
SG131/D	Full Pak Power Semiconductors
SG132/D	Small-Signal Transistors, FETs and Diodes
SG137/D	ICePAK
SG139/D	Surface Mount Discrete Products

Digital & Analog Integrated Circuits

Standard Logic Families

Document No.	
SG60/D	FAST and LS TTL
SG77/D	MECL
SG122/D	FACT, Advanced CMOS Logic
SG125/D	HIGH-SPEED and 1400 SERIES CMOS LOGIC

Linear

Document No.	
SG96/D	Linear and Interface Integrated Circuits

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MASTER SELECTION GUIDE

WHERE WE STAND . . .

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 manufactures 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.

TELEPHONE ASSISTANCE

1-800-521-6274

Call toll-free any weekday, 8:00 to 4:30 p.m., M.S.T. If the call can't cover your application requirement, we'll have an applications engineer contact you and help you to market faster.

Total Customer Satisfaction

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Application Specific Integrated Circuits (ASICs)

In Brief . . .

Semicustom Arrays

Customize Your Products — Cost-Effectively

Even as the demand for Standard (discrete) Logic forms continues to increase, the era of custom and semi-custom VLSI circuit implementation has arrived. Brought into focus by the economies of computer-aided design and manufacturing (CAD/CAM), Application-Specific Integrated Circuits (ASICs) have become cost effective even in applications with moderate volume requirements. ASIC technology has reduced both the time penalty and the cost premium for customized VLSI circuit implementation to virtually zero.

Motorola is in the forefront of this rapidly expanding field. Semicustom solutions are provided in gate arrays, customer defined arrays, foundry and application specific standard products. These products are offered in multiple technologies and are supported by a highly integrated set of CAD tools and design services.

THE ASIC PHILOSOPHY

"We're supplying a foundation that allows our customers to produce an end product which comes out competitive and *stays that way* through several generations. We get the design cycle working for them, so their products don't fizzle as soon as newer parts come out. It's the difference between a product that performs on paper and one that performs in the marketplace."

Macrocell Arrays

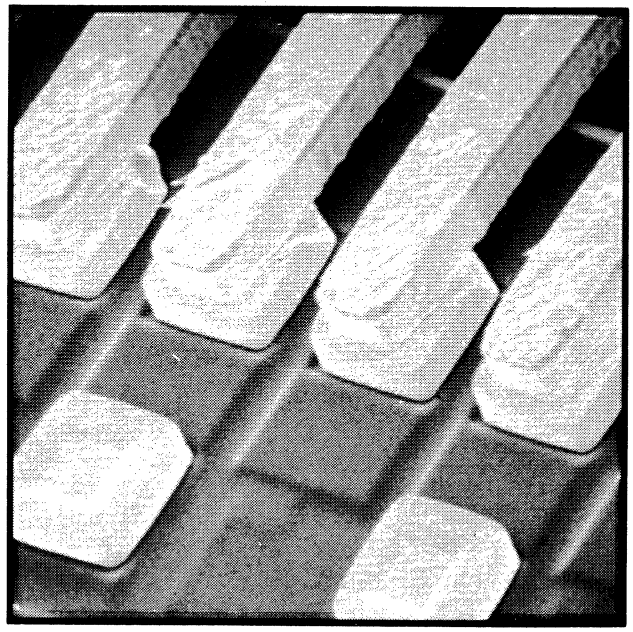
The Right Process for System Performance . . . The Right Size for Efficient Utilization and Minimum Cost

Motorola Macrocell Arrays offer the designer the same choice of process technologies that is available for discrete logic designs.

Selected arrays are offered for both commercial and military applications.

- For very high speeds — **State-of-the-art ECL Arrays** offer subnanosecond gate delays.
- For advanced TTL applications — **ALS-TTL Arrays** provide higher speed and lower power consumption at conventional TTL prices.
- For applications demanding very low power consumption, and low cost — **Advanced 2-micron silicon-gate CMOS Arrays.**
- For system level integration — **High Density 1.0 micron CMOS Arrays** can achieve over 75,000 usable gates on a channeless architecture of minimum dimensions.

To permit cost-effective implementation, Macrocell arrays are stocked in a variety of prediffused array sizes, that permit optimized utilization of die space for varying VLSI circuit complexities.



Motorola's tape automated bond (TAB) process provides a method of mounting die to a tape for use in multichip modules. In this case, no package is necessary, and die-on-tape is supplied in a carrier.

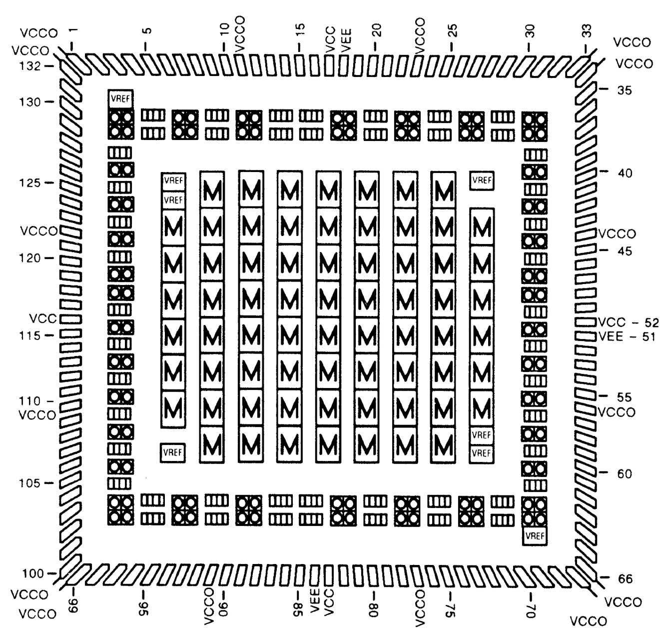
About Motorola Macrocell Arrays

Motorola's Macrocell technology is an extension of the gate-array concept. Each cell in the Macrocell array consists of a number of uncommitted components. Stored within a computer library are the specifications for creating interconnecting patterns that transform the unconnected components into SSI/MSI logic functions called macros. These macros yield standard logic elements such as flip-flops, adders, latches and numerous other high performance, space-efficient, predefined functions.

Generating a semicustom circuit design is simply a matter of selecting the required macrocells from the library and describing the interconnect network for implementing the desired results. Motorola's CAD interface provides automatic cell placement and interconnect routing as well as extensive design rule checks. It also performs ac delay simulation, generation of test tapes and customized metalization patterns required to perform the IC processing sequence.

Compared with the conventional approach to custom circuit design, the Macrocell approach offers a tremendous reduction in design and delivery time. Compared with equivalent systems constructed of discrete logic building blocks, the high packing density of array-based components can provide a reduction of system component count approaching several orders of magnitude.

TYPICAL MACROCELL ARRAY LAYOUT



BiMOS, MECL, MECL 10K, MECL 10KH, MOSAIC I, MOSAIC II and MOSAIC III are trademarks of Motorola.

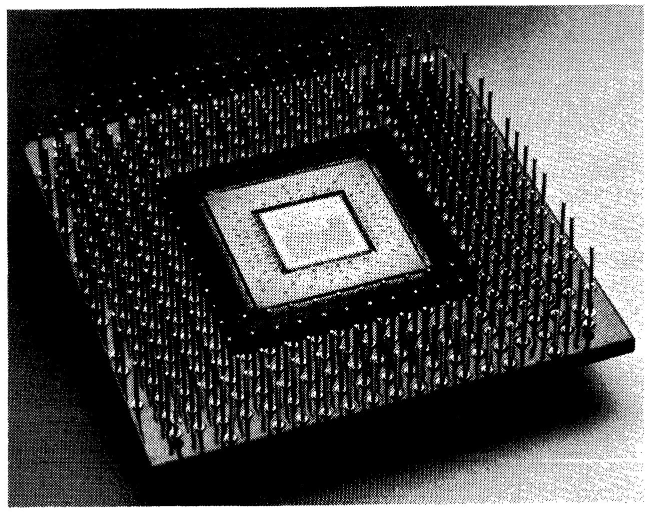
High-Speed ECL Arrays

MCA10000ECL Array Sets New Standards

- **Gate Delays As Low As 100 ps (TYP.)**
- **Power Dissipation As Low As 1 mW/gate**
- **10,000 Equivalent-Gate Density**
- **256 I/O Signal Ports**

These are the vital statistics of Motorola's third generation ECL Macrocell Array. Compared with second generation products, it represents four times the maximum available gate count and one third the gate delay time.

But the performance improvements don't stop with the statistics alone. With the new array, the designer can program speed-power system performance to match critical system requirements. By means of Motorola's CAD system you can select either a high or low power base array. The designer can then individually program logic switch currents and internal output drive levels. These options yield a performance range from 0.3 ns maximum gate delays with 1.0 mW dissipation to 0.15 ns maximum delay with 3.0 mW per gate.



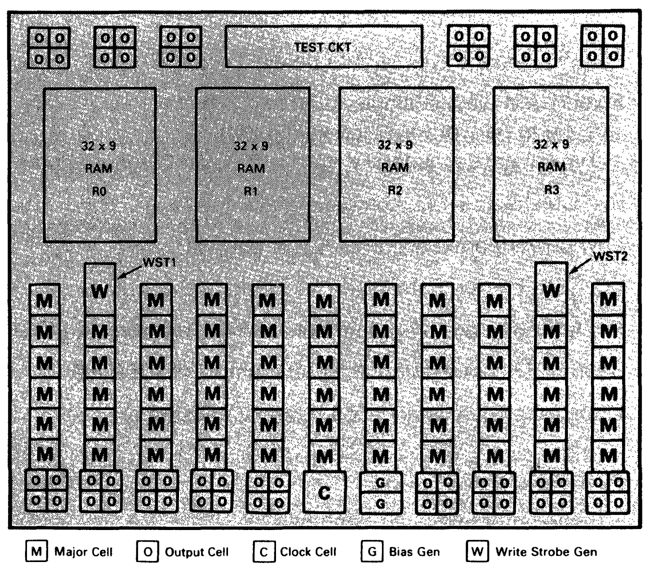
Typical Applications:
- **State of the art CPU/FPU designs**
- **>750 MHz Telecommunications**
- **High Speed VLSI testers**

On-Chip 1K RAM Enhances ECL Array Functions

With approximately 1500 equivalent logic gates this Motorola (MCA1500M) ECL Macrocell Array can satisfy a wide variety of design options while its four on-chip blocks of 32 x 9 user-configurable RAM simplify system implementation and reduce manufacturing costs.

Performancewise, this array is among the fastest and most versatile available. Internal gate delays of 0.3 ns and output gate delays of 0.75 ns offer state-of-the-art throughput, while its density packs the equivalent of up to 50 discrete SSI/MSI logic functions into a single package. With a power dissipation of 8 W (typical) per array, system power dissipation can be reduced by as much as 12 to 1 compared with an equivalent circuit board housing discrete circuits.

MCA1500M Macrocell Array Layout



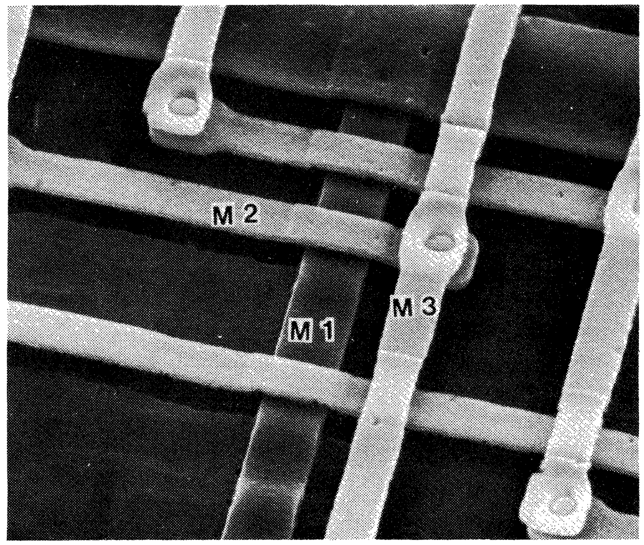
The Motorola ECL Array Series

The following table describes the range of capabilities for designs implemented with Motorola ECL arrays.

Features / Array	MCA 600ECL	MCA 1200ECL	MCA 800ECL	MCA 1500M	MCA 2500ECL	MCA 1500ECL	MCA 10000ECL
Technology	MOSAIC I		MOSAIC II			MOSAIC III	
Max Gate Equivalent	652	1192	902	1708 + RAM	2760	2208	10332
Internal (Major) Cells	24	48	36	64	110	68	414
I/O Ports	46	60	54	120	120	108	256
Input/Interface Cells	25	32	—	—	—	96	224
Output (O) Cells	18	26	22	60	68	96	200
Max Gate Delay (ns)	1.2	1.2	0.5	0.5	0.5	0.175	0.175
Max Toggle Frequency (MHz)	250	250	770	770	770	1200	1200
Typ Power Dissipation (W)	2.5	4.0	2.5	8.0	8.0	3–6	10–30

HDC Series High Density CMOS Arrays

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 75,000 usable gates on a channeless architecture having minimum chip dimensions. The result is very high performance (subnanosecond loaded gates) combined with unprecedented I/O flexibility and density.

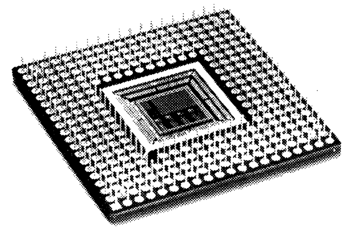


Features:

- 3,000 to 105,000 available gates
- Typically over 75% utilization
- Channeless Sea-Of-Gates architecture
- 1.0 micron drawn gate length (0.75 μ L_{eff})
- Triple layer metal routing and power distribution
- Eight transistor, fully utilizable, oxide isolated primary cell
- 250 picosecond typical gate delay (2-input NAND)
- Fixed RAM blocks (single, dual and 4 port)
  8 x 9 to 64 word x 72 bit configurations
  Typical access time (T_{AA}) = 3.0 ns on 8 x 9 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 programmable as I/O or power
- 3000 V ESD protection; latchup immunity to 300 mA
- Comprehensive workstation based CAD support

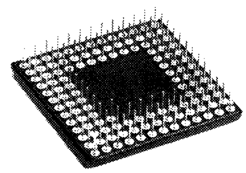
Technology:

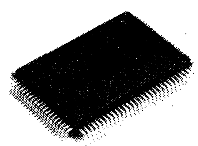
- 1.0 micron drawn Gate Lengths
- Three-layer Metallization
  3.6 micron M1 Pitch



PGA
84–299 Pins

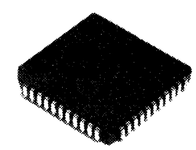
LPGA
68–144 Pins





QFP
64–160 Pins

PLCC
28–84 Pins

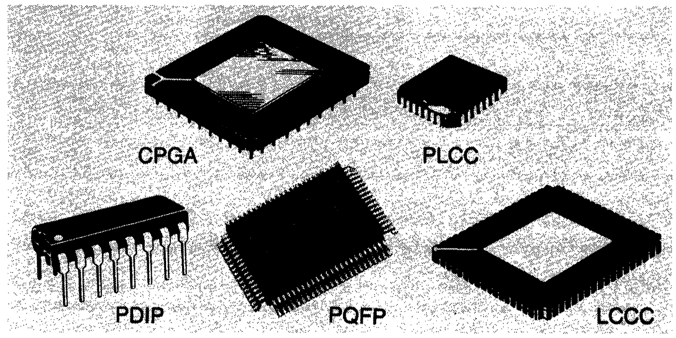


TYPICAL HDC SERIES PACKAGES

TABLE 1 – HDC SERIES ARRAY FEATURES

Array	# of Available Gates	# of Usable Gates @ 70% Utilization	# of 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	187
HDC011	11,208	8,000	120	168	204
HDC016	16,416	12,000	136	204	229
HDC031	31,290	23,000	180	280	291
HDC064	63,900	48,000	240	400	402
HDC105	104,832	75,000	300	512	486

HCA62A Series — CMOS Arrays



Sampling of available array packages. Range of packages includes everything from 16-pin DIP to 144-pin PGAs in plastic and ceramic.

The Motorola HCA62A series of macrocell arrays is implemented in silicon gate technology, with 2-micron drawn gate length, dual-layer metal interconnection and high-speed (HCMOS) processing. Equivalent gate counts from 600 to 8500 offer cost-effective arrays for a wide range of applications. The Series is available in an extensive line of plastic packages for commercial applications.

Functionally, the Series features full I/O flexibility and completely flexible power and ground inputs. The uncommitted I/O buffers contain N- and P-channel transistors which may be configured into any of 27 different input buffers, 16 different bidirectional buffers or three different output buffers which may be paralleled for up to 24 mA of driving current. Power and ground pads may be placed at any buffer location around the array.

HCA62A Series 2-Micron CMOS Macrocell Arrays

Features	HCA62A85	HCA62A67	HCA62A50	HCA62A36	HCA62A25	HCA62A17	HCA62A10	HCA62A06
Primary Cells	2856	2236	1658	1200	816	546	319	216
Equivalent Gates	8568	6708	4860	3600	2448	1638	957	648
Bidirectional Pads	168	146	124	102	84	68	54	44
V_{DD} Pads	Power and ground pins are programmable to any package pin.							
V_{SS} Pads	Number of pins varies with array utilization and output loading.							
Typical Gate Delay (ns)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Typical Frequency (MHz)	85	85	85	85	85	85	85	85
Package Range (Pins)	68–144	68–144	40–120	40–100	40–84	28–80	24–52	16–48

The ALS TTL Array Series

Schottky clamped TTL has become the most pervasive form of digital logic in current use. The popularity of these TTL families (LS, ALS and FAST) stems from their ease of use, low cost, medium-to-high speed operation and good output drive capability. For its macrocell array line, Motorola has selected the MOSAIC (oxide-isolated) process.

The ALSTTL array family differs from FAST in that it provides a 50% reduction in power dissipation and improved speed (frequency) characteristics. Yet, it is I/O compatible with its more pervasive (in discrete logic form) LSTTL building blocks. Thus, ALS macrocell arrays offer the performance advantages of this advanced family for the development of VLSI circuits while maximizing interface capability with the large assortment of discrete LS functions.

Motorola currently offers three array sizes ranging from 500 to 2800 equivalent gates per chip, plus an additional 2800-gate array featuring on-board 16 x 8 multiport memory (RAM). The characteristics of the available arrays are described in the following table:

Features	MCA 500ALS	MCA 1300ALS	MCA 2800ALS	MCA 2800RAM
Max Gate Equivalent	533	1280	2860	1800 + RAM
Internal (M) Cells	24	60	130	74
I/O Ports	57	75	120	120
Input Cells	26	40	120	120
Output Cells	27	40	120	120
Max Gate Delay (ns)	4.0	4.0	1.1	1.1
Max Toggle Freq. (MHz)	80	80	150	150
Power Diss. (W)	1.0	1.4	3.5	3.0

Design Software for Application Specific Circuits

Motorola's Open Architecture CAD System consists of ASIC design software tool sets for high performance engineering workstations.

The base OACS tool set provides engineers with software that will handle today's gate array designs and tomorrow's technologies as they become available. It allows design capture using the HDC Series symbol library to simulate design behavior over commercial, industrial, automotive and military temperature ranges, resimulate the actual performance of the design after physical layout, and perform rigorous timing checks prior to releasing a design.

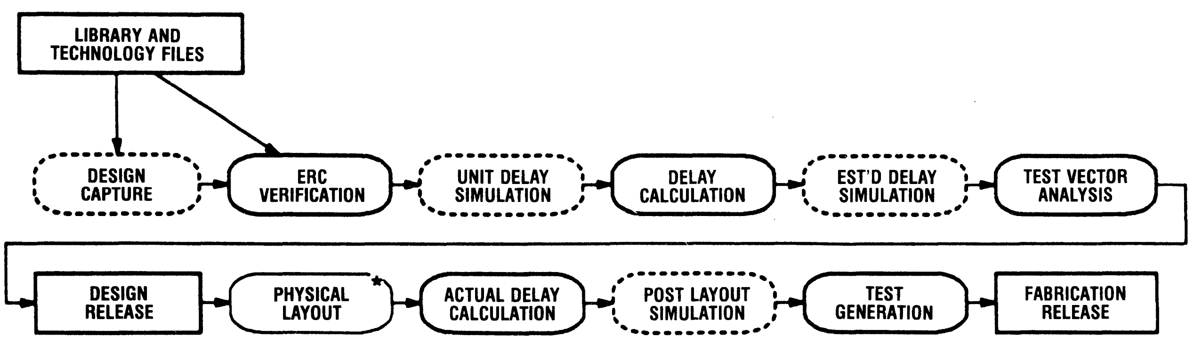
The traditional design tools addressing design capture, logic interconnection verification, and functional/delay simulation are fully supported by the base OACS system. In addition, Motorola is responding to the escalating complexity of the ASIC design process by offering optional productivity enhancement packages such as static timing analysis, ATPG, floorplanning and physical layout.

The **OACS System, Release 1.0,** (mid '89 introduction) promotes evolutionary progression of design automation based on existing tools. Built on an EDIF backplane, OACS software support is available for Sun and Apollo platforms.

OACS System Highlights:

- EDIF backplane approach to providing an open architecture
- Tools accessed through interactive menu system
- Supports the following design automation tools:
  - Mentor Graphics' NETED™ schematic capture (Apollo)
  - Valid Logic's GED™ schematic capture package (Sun)
  - Functional, pre and post layout delay simulations through
    - — Mentor Graphics' QuickSim™
    - — Gateway Design Automation's Verlog XL®
  - Motorola's TrailBlazer™ static timing analysis
  - Motorola's Mustang™ automatic test pattern generation
- Additional planned productivity enhancements:
  - Motorola Architect™ floorplanning package
  - Cadence physical layout (Tangate™) package
  - Synopsys logic synthesis package

Typical Mentor Based OACS System Design Flow



---- Supported Mentor Graphics' Tools (NETED and QuickSim)
*Motorola performs layout and transmits actual RC delays to customer.

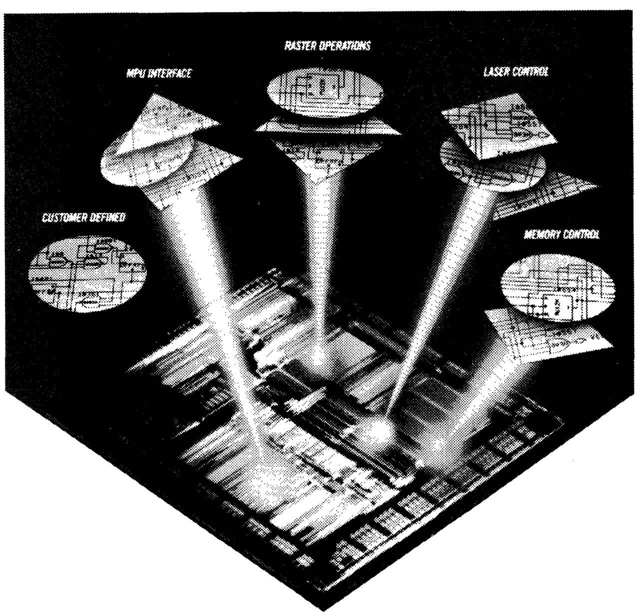
Mentor Based OACS System Features:

- Installation and Verification Utilities
- Produces Standard EDIF 2.0.0 Netlist
- Electrical Rules Checking
- Typical/Best/Worst Case Delay Calculations
- Sophisticated Node Delay Calculations
  - a. Continuous Temperature, Voltage, and Process Variation
  - b. Estimated and Actual Wirelength Capacitance
  - c. Delay = Intrinsic + Rise/Fall Effects + Output Load
  - d. User Specified Output Loading
- Post Layout Simulation Timing Analysis Tools with Back Annotation
- Test Vector Extraction and Design Transfer

A Look Ahead

Motorola is dedicated to servicing the application specific market with full semicustom solutions in CMOS, bipolar and BiCMOS technologies. The continuing evolution of processing improvements is clearly destined to yield rapidly expanding capabilities. The following products are already in the process of introduction or slated for 1989/1990 implementation:

- Extension of 1.0 micron High Density CMOS arrays — additional RAM blocks, mega functions for specialized applications, Tape Automated Bonding
- Expanded line of MOSAIC III ECL arrays providing mixed ECL, Pseudo-ECL, and TTL I/O configurations in 750, 3200 and 5800 gate densities.
- High performance ECL array surface mount packages with 2.4 GHz inputs and outputs
- Additional OACS™ system design automation productivity enhancement packages such as static timing analysis (TrailBlazer™), automatic test pattern generation (Mustang™), floorplanning (Architect™) and logic synthesis.
- Introduction of a fourth generation ECL array family based on a 1.0 micron 4-layer metal process.



ASIC solutions consolidate into a single integrated circuit an array of functions that previously required several chips.

Motorola MCA-4 Arrays

Motorola's MCA-4 Arrays are designed with Motorola's 1.0μ MOSAIC-4 Process Technology. The array is designed primarily to meet the high performance, high density needs of the Computer, Telecom and Military marketplace. In comparison with Motorola's MCA-3 family, the MCA-4 technology provides higher gate densities, improved gate delays, lower power/gate, higher gate interconnect performance, and super macro functionality.

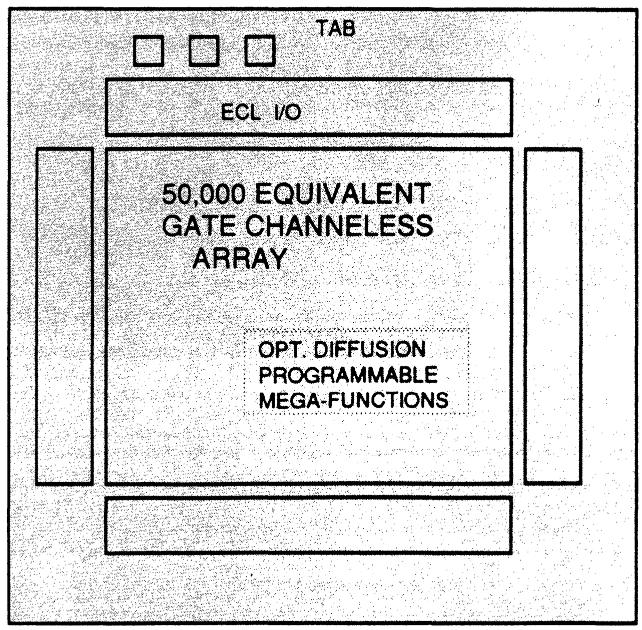
The first MCA-4 array is the MCA50000ECL. The key features of the array are:

- 51744 Equivalent gates (3.5 gates/cell) made up from 14784 Internal cells
- 4-layer metal to permit high degree of routing capability (in excess of 80%)
- 400 Signal pads, 400 I/O Cells, 136 Fixed Power Pads
- The array has three programmable speed power options. Typical gate delay options are:

2-Input OR

100 ps	(0.4 mA switch current)
140 ps	(0.2 mA switch current)
240 ps	(0.1 mA switch current)

- An internal cell can be used as a logic macro or transient driver.



The MCA-4 50K ECL array is a 'channeless' Sea-of-Macrocells™ architecture. Four layers of metal are available, three of which are used for personalization, the fourth layer being used solely for power and ground busses.

NEW

Service Center

Regional ASIC Design Support Locations

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▷ Design Center locations

NOTES

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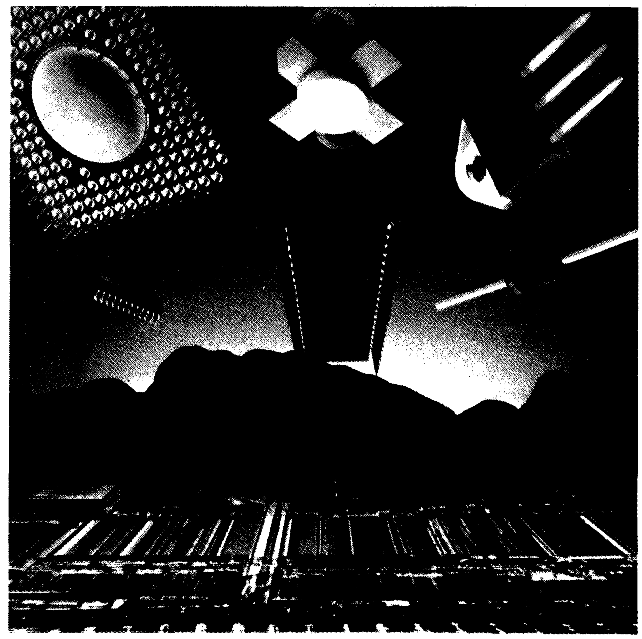


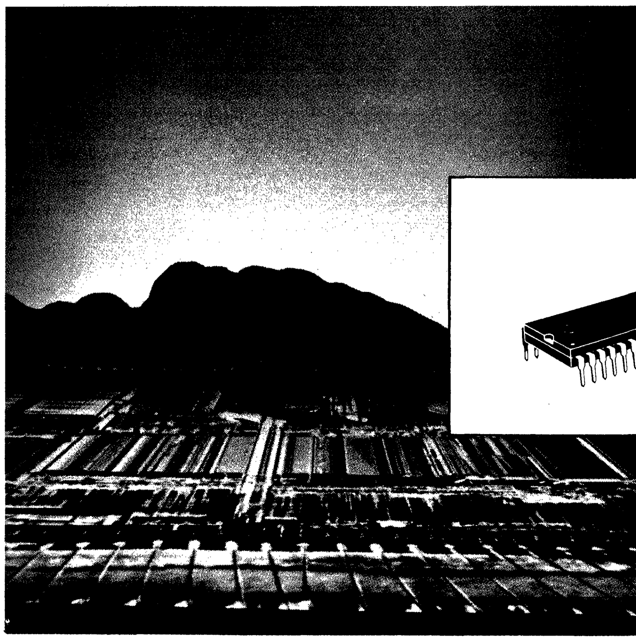
Microcomputer Components

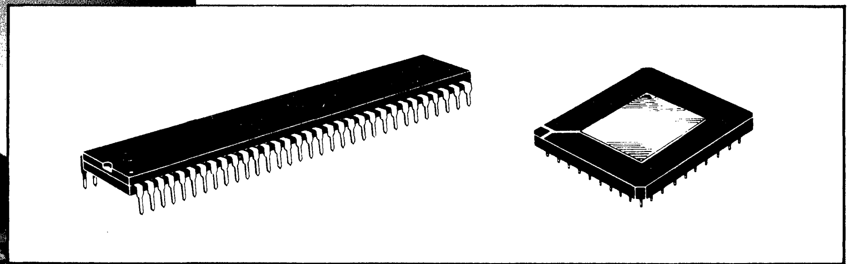
In Brief . . .

Chips and board-level products constitute a natural progression of microcomputer building blocks that the semiconductor manufacturer offers the equipment manufacturer. Each provides a different level of integration from which to begin system implementation.

Chips, of course, are the most cost effective, and offer the greatest latitude for system optimization. But they also demand the most intensive engineering effort and the longest design time. Board-level products require some sacrifice in ultimate design efficiency and in the area of contributed value. But they provide the significant compensating benefits of relatively simple implementation of the end product, quick entry into the marketplace and minimal investment in engineering effort. In each of these product categories, Motorola is an internationally recognized frontrunner in technology, product reliability and manufacturing capability.

To augment utilization of its products, Motorola supplies development instrumentation ranging from relatively simple evaluation modules to highly sophisticated MPU emulators, development systems and diagnostic instruments that support the entire spectrum of related products . . . support that is supplemented by a well-trained team of specialists to assist in solving customer design-in problems.





Microcomputer Chips

In Brief . . .

Since the beginning of the microprocessor era, Motorola has been in the forefront of this technology. Its initial MPU product line, the M6800 family, received widespread acceptance and still maintains a share of the 8-bit market.

But today's technology permits far more sophisticated products. Increased chip size and density has expanded chip content to include memory and peripheral circuitry, giving rise to microcomputer units (MCUs) that can replace the erstwhile CPU-limited microprocessor units (MPUs). And these same advances have expanded the single-chip repertoire to include Digital Signal Processing and up to 32-bit data manipulation.

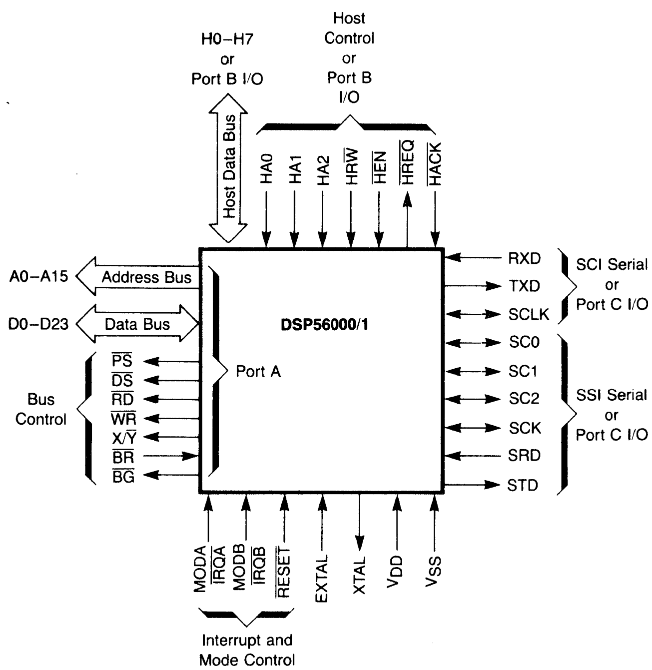
In the field of digital processing, Motorola's DSP56000 Processor is capable of running 10.25 million instructions per second to set the pace in throughput and performance. An associated VLSI CAFIR filter accompanies the processor and extensive development products facilitate system design and implementation.

In the most advanced area of microprocessors, Motorola's MC68030 is setting new standards for 32-bit performance. As the latest member of the upward-compatible 8-/16-/32-bit M68000 family it has already gained extensive industry support. It is accompanied by a VLSI co-processor and an array of peripherals from Motorola and other semiconductor suppliers to afford implementation of the most complex systems at decreasing costs.

In the pervasive 8-bit market, the inexorable swing to single-chip MCUs has been accelerated by the number and variety of products families which now include so many memory-I/O selections that it is possible to obtain virtual custom-tailored specifications at off-the-shelf pricing. And the M6805-family CPU has been adapted as a standard-cell element (see Section 1) to make even custom designs a truly affordable commodity.

Digital Signal Processing

The DSP56000 and DSP56001 Digital Signal Processors Set The Pace



With a run rate of 10.25 million instructions per second, coupled with significant advances in chip architecture, the HCMOS DSP56000 Family offers unmatched performance in digital signal processing. The chip architecture combines 24 x 24-bit multiplication and 56-bit accumulation with two parallel data moves in a single 97.5 ns instruction cycle. Four data buses and three address buses make this throughput-enhancing parallelism possible. In fact, many of the critical DSP benchmarks (see table above) run at their theoretical maximum on this processor.

The core of the DSP56000/1 consists of three single-cycle execution units — the Data ALU, the Address Arithmetic Unit, and the Program Controller — which operate in parallel at speeds up to 10 MHz. X data, Y data and Program data memories are provided on-chip, and each is expandable off-chip so that a total of 192K words of 24-bit data can be addressed. The I/O is flexible, with two serial ports and a parallel Host port being implemented on the chip.

An MPU-like instruction set, together with a user-friendly cross assembler and simulator which run on an IBM personal computer, Macintosh II system, VAX and Sun work station, simplify algorithm development and programming. The DSP56000CLASA software package permits immediate implementation of system design, including code generation and debugging, even prior to hardware availability. The DSP56KCC C Compiler offers high-level language support.

The DSP56000 has on-chip factory-programmable Data and Program ROMs. The DSP56001 is a RAM-based version of the DSP56000 that also includes preprogrammed Data ROM. The DSP56001, therefore, is user programmable for immediate implementation. In this version, the preprogrammed Data ROMs contain MU-Law and A-Law tables and sine-wave generation tables.

DSP56000/1 Benchmarks

Benchmark	Execution Time
Finite-Impulse Response Filter with Data Shift	0.1 μs per Tap
Infinite-Impulse Response Biquadratic Filter	0.4 μs
64-Point Complex Fast Fourier Transform	0.147 ms
256-Point Complex Fast Fourier Transform	0.713 ms
1024-Point Complex Fast Fourier Transform	5 ms

Core Features

- 10.25 Million Instructions Per Second (MIPS)
- Single Cycle Data ALU
  - 24 x 24 → 56-Bit Parallel Multiply/Accumulate
  - Two 56-Bit Accumulators
  - Ten Data Registers
  - Two Data Bus Shifter/Limiters
- DSP Oriented Address ALU
  - 24 Address Registers
  - Dual Modulo Arithmetic Units
  - Linear, Modulo, and Bit Reversed Address Generation
- Advanced Program Controller
  - 15 Level Hardware Stack
  - Nested Hardware DO Loops
  - No Overhead Auto-Return Fast Interrupts
- Highly Orthogonal Instruction Set
  - 62 MPU-Style Instruction Types
  - Makes Pipeline Invisible
  - Suitable for High Level Language (HLL) Compilers
- Multiple Buses
  - Four Data Buses
  - Three Address Buses

On-Chip MCU-Style Peripherals

- 24 Programmable I/O Port Pins or a Combination of I/O Port Pins and
  - 8-Bit Parallel Host MPU/DMA Interface
  - Serial Communication Interface with Baud Rate Generator/ Timer
  - Synchronous Serial (Codec) Interface with Clock Generator

On-Chip Memory

- Two Independent 256 x 24-Bit Data RAMs
- Two Independent 256 x 24-Bit Data ROMs (DSP56000)
- 2K x 24-Bit Program ROM (DSP56000)
- Two Independent Preprogrammed Data ROMs (DSP56001)
- 512 x 24-Bit Program RAM (DSP56001)

Off-Chip Memory Expansion

- 128K x 24-Bit Data Memory
- 64K x 24-Bit Program Memory
- Programmable Off-Chip Access Times (Wait States)

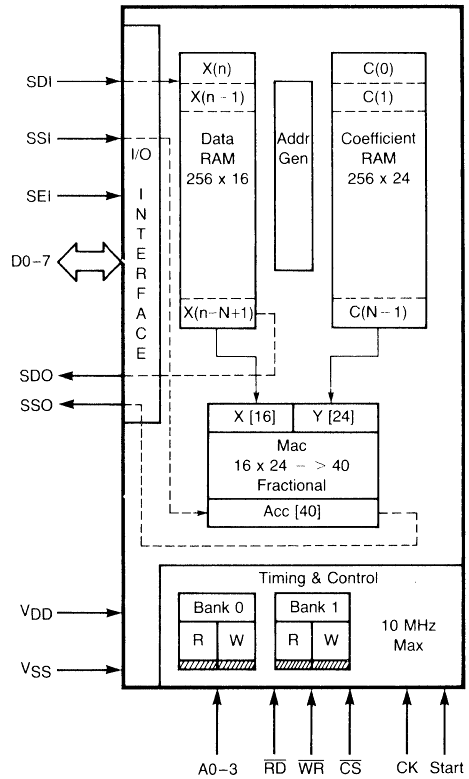
The CAFIR Filter, DSP56200

an Algorithm Specific DSP Peripheral

Features

- Low Power HCMOS
- 28 pins
- 100 ns per Tap Throughput
- 256 x 16-Bit Data RAM
- 256 x 24-Bit Coefficient RAM
- 16 x 24-Bit Multiplier, 40-Bit Accumulation
- Two FIR Modes:
  - — Single Channel
  - — Dual Channel
- Single Channel Adaptive FIR Mode
  - — Uses the Least-Mean-Squared (LMS) Coefficient Update Algorithm
- Programmable Tap Lengths Up to:
  - — 256 Taps in Single Channel Mode
  - — 128 Taps per Channel in Dual Mode
- Cascadable in Single Channel Mode
  - — Higher Sampling Frequencies
  - — Sharper Filters
  - — Longer Echoes Cancelled
- Programmable Leakage
  - — Adapting to Narrow Band Signals
- Programmable Gain
  - — Changing the Rate of Adaptation
- 8-Bit I/O Port with 7 Control Lines
- DC Tap Option
- Scratch Pad Memory
  - — Unused Data and Coefficient Memory is Available
- Power Down Mode

DSP56200



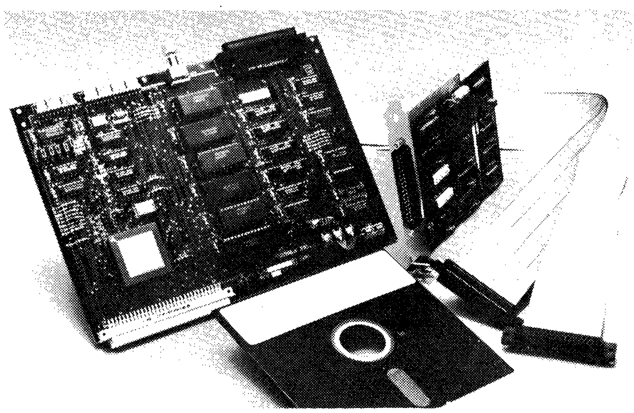
The DSP56200 Cascadable Adaptive Finite Impulse Response (CAFIR) Digital Filter is an algorithm-specific DSP peripheral chip capable of implementing two algorithms — the convolution sum and the least-mean-square (LMS) algorithm for updating coefficients — the CAFIR Filter is useful as a general-purpose linear phase filter and in applications requiring an adaptive filter, such as echo cancelling.

DSP56000ADS Development System

The DSP56000 family is Motorola's entry into the Digital Signal Processor arena. It represents one of the latest and certainly one of the most powerful signal processing capabilities, and to simplify its implementation Motorola now offers the DSP56000ADS Applications Development System.

The DSP56000ADS is a three-component development tool for designing, debugging, and evaluating DSP56000 and DSP56001 target systems. It simplifies evaluation of the user's prototype hardware/software product by making all of the essential DSP56000 timing and I/O circuitry easily accessible.

The three ADS components are an Application Development Module (ADM) board, an IBM PC bus interface board, and a MS-DOS based user interface program that runs on the IBM PC and interacts with the user, controlling as many as eight ADMs simultaneously. Using a low cost IBM PC or Macintosh II personal computer as a medium between the user and the DSP56000 hardware significantly decreases the overall hardware complexity and cost of development while increasing the capabilities of the system. With this system, DSP programs may be executed real-time, single instruction traced, or multiple instruction stepped with registers and/or memory block contents displayed.



Features:

- **Full speed operation at 20.48 MHz**
- **Single/multiple stepping through DSP56000 object programs**
- **Conditional or unconditional 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 that support multiple ADM development**
- **Hexadecimal/decimal/binary calculator**

DSP56000/1 Software

DSP56000CLASx Simulator Package

This Simulator/Macro-Assembler/Linker/Librarian software package is a development system support tool. The simulator program simulates the operation of the DSP56000 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 are simulated exactly.

The full-featured Macro Cross Assembler translates one or more source files containing instruction mnemonics, operands and assembler directives into an object file which is directly loadable by the Simulator. It supports the full instruction set, memory spaces and parallel transfer fields of the DSP56000.

The package is an upgrade of the earlier DSP56000SASM, adding the Linker/Librarian, a multiprocessor simulator, and a macro-assembler that produces relocatable code to the former package. Registered users of the preceding package may purchase the upgrade at a reduced price.

The DSP56000CLAS software is available for the following host stations:

Host	Operating System	Part Number
IBM-PC	DOS 2.X, 3.X	DSP56000CLASA
Macintosh II	MAC OS 4.1	DSP56000CLASB
Sun-3	UNIX BSD 4.2	DSP56000CLASC
VAX	VMS 4.X	DSP56000CLASD
VAX	UNIX BSD 4.2	DSP56000CLASE

The upgrade version may be ordered by adding a suffix "U" to the original part number (i.e., DSP56000SASMxU).

The DSP56KCCx C-Compiler Package

A full Kernighan and Ritchie C implementation, this compiler provides high efficiency, with compiler overhead as low as 20%. It has full in-line code capability and a C-language preprocessor supporting MACRO expansion, file inclusion and conditional compilation. It allows programmers to perform the entire compilation process in a single step. The package includes the C Compiler, a Macro Cross Assembler program and a Linker/Librarian, as well as all applicable user and reference manuals. For the various host computers, the software package is available as follows:

Host	Operating System	Part Number
IBM-PC	DOS 2.X, 3.X	DSP56KCCA
Macintosh II	MAC OS 4.1	DSP56KCCB
Sun-3	UNIX BSD 4.2	DSP56KCCC
VAX	VMS 4.X	DSP56KCCD
VAX	UNIX BSD 4.2	DSP56KCCE

DSP320to56001 Package Converts 32010 Code to DSP56000/1

This software package translates 32010 .lod modules to Motorola DSP56000/1 source code.

The converted code may be executed on the DSP56000ADS application development system, or may be executed with the SIM56000 simulator program on an IBM PC or equivalent.

The conversion program runs on an IBM PC under MS-DOS or PC-DOS. The C source code is provided on diskette which the user may modify for 32020 or 320C25 translation. The conversion programs are delivered on one double-sided, double-density 5¼-inch floppy disk and may be run from either a floppy disk drive or hard disk. They require only enough disk space to hold the converted source file.

Minimum hardware requirements for the conversion programs are:

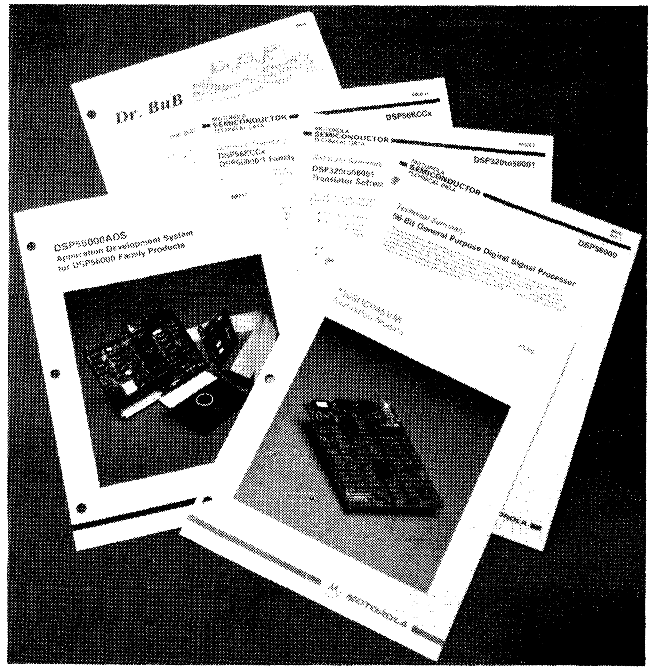
IBM-PC, XT, AT (or Compatible) with 256K bytes of RAM, and one floppy disk drive.

PC-DOS/MS-DOS, V2.0 or later.

Digital Signal Processor Documentation and Training

The following documents and training courses are currently available to support the DSP56000/1 Digital Signal Processor.

The documents can be obtained through your Motorola sales representative or authorized distributor. For additional information and schedules for the courses, please call the Motorola toll-free hotline any weekday, 8:00 a.m. to 4:30 p.m., M.S.T. **Telephone 1-800-521-6274.**



Documentation

DSP56000UM/AD	DSP56000 Digital Signal Processor User's Manual
BR526/D	DSP56000/1 Assembler/Simulator/ Linker Software Summary
BR282/D	DSP56000 Technical Sumrnary
DSP56001/D	DSP56001 Data Sheet
BR517/D	DSP56000ADS Brochure
BR522/D	DSP320to56001 Software Summary
BR283/D	DSP56200 Technical Summary
DSP56200/D	DSP56200 Data Sheet
BR297/D	DR. BuB, DSP Electronic Bulletin Board
BR541/D	C Compiler Software Summary

Digital Signal Processor Courses

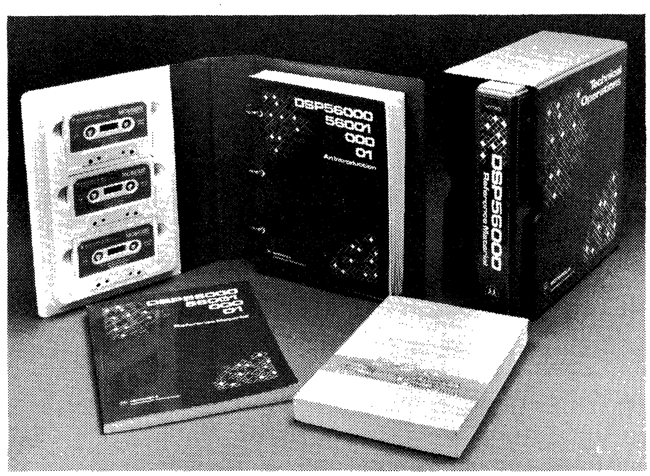
Home Study (Audio) Course

MTTA5 — An Introduction to the DSP56000/1

This course covers specifics appropriate for DSP56000 or DSP56001, including the following: internal architecture and programming model, pins and buses, general addressing modes, general instruction set, exception processing, on-chip I/O, plus the DSP instructions and addressing modes.

The course is composed of three audio cassette tapes containing approximately four and one-half hours of material. Each topic has stated objectives and self-evaluation exercises with answers. On completion, the user will have a working technical knowledge of the DSP56000/1.

As a prerequisite, the user should be familiar with memory concepts, binary numbers, hexadecimal number notation, binary arithmetic, standard logic operation and analog signal processing.



On-Location Courses

MTT31 — Digital Signal Processing (DSP56000/1) for Engineers and Technicians.

This 4-day, instructor-led course covers DSP concepts: internal architecture and programming model, pins and busses, general addressing modes and instruction set, exception processing, on-chip I/O, and DSP instructions and addressing modes. The architecture of the DSP56200 filter chip is also covered. Includes hands-on lab with selected applications. Knowledge of general DSP concepts is assumed.

MTT28 — Introduction to Digital Filtering and the DSP56200

A two-day instructor-led course that covers FIR and adaptive filters and Motorola's Adaptive Finite Impulse Response Digital Filter. Covers design concepts, including discrete time signals and sampling. Includes class exercises and hands-on lab with selected applications.

The M68000 MPU Family

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

An MPU For All Functions

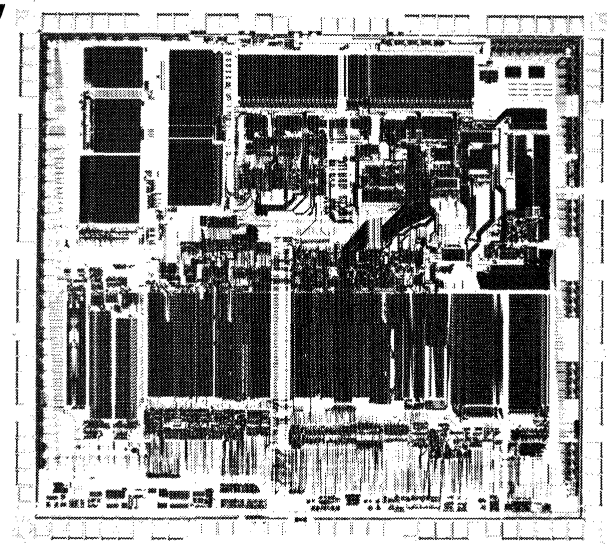
To designers of the most advanced microcomputer systems, the Motorola M68000 Family of microprocessors needs no introduction. Products based on its members have become the standard for systems utilizing the UNIX operating system and for CAD/CAM engineering workstations. They are invading the next generation 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. Then there is a comprehensive assortment of board-level products for modular integration, making Motorola the leading manufacturer of VMEmodules and VMEsystems based on the industry-standard VMEbus.



MC68030 — The Second-Generation 32-Bit MPU

The Compatible Processors

MC68030RC
The Second Generation 32-Bit MPU

The MC68030, oh thirty, sets the highest performance standards ever for 32-bit general-purpose microprocessors by providing up to twice the performance of the industry leading MC68020, oh twenty. The 030 takes 32-bit computing to the next logical step, while maintaining 100% upward software code compatibility with the entire M68000 product family.

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.

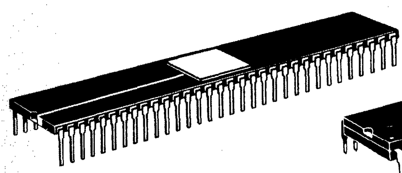
Two independent 32-bit address buses and two 32-bit data buses allow the CPU, caches, MMU, and the bus controller to operate in parallel, so the 030 can, for example, simultaneously access an instruction from the instruction cache, data from the data cache and instruction/data from external memory. These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

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.

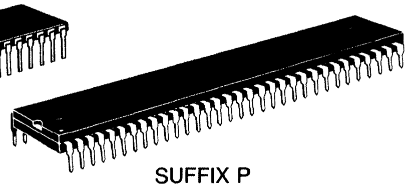
Overall bus requirements are reduced and multiple processors can run more efficiently thanks to increased bandwidth of the 030 bus, achieved by the enhanced bus controller allowing high speed fills of both data and instruction caches.

The on-chip paged memory management unit translates logical addresses 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.

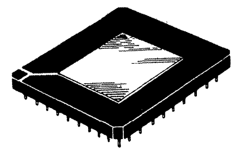
Packages shown
apply to MC68000



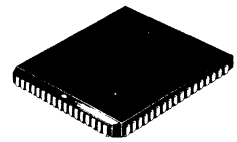
SUFFIX L, LC
L = Ceramic DIP
LC = Ceramic DIP, Gold Lead Finish



SUFFIX P
Plastic DIP



SUFFIX R, RC
R = Pin Grid Array
RC = Pin Grid Array, Gold Lead Finish



SUFFIX FN
Plastic Leaded Chip Carrier

MC68020RC
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 helps 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.

MC68010L,LC,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.

MC68HC000L,LC,P,R,RC,FN
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.

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 realtime 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.

MC682881RC
A Floating Point Coprocessor

Designed specifically for arithmetic expansion of the MC68020 MPU, 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
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.

M68000 Peripherals

Memory Management & DMA Control

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. An on-chip address translation cache minimizes translation delays and maximizes system performance.

MC68451L,LC,R,RC
Memory Management Unit, MMU

The MMU is the basic element of a memory management mechanism in an M68000 based system. The MMU provides address translation and protection for the entire 16 megabyte addressing range of the MC68000 microprocessor. It provides 32 segments of variable memory size and allows for multiple MMU capabilities to expand to any number of segments. Virtual memory support is also provided for the MC68010 MPU, as is full support for the UNIX System V/68 Operating System.

MC68450L,LC,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.

MC68442R,RC,FN
Expanded Dual DMA, EDDMA

32-bit DDMA for MC68020 based systems. The EDDMA supports up to 4 gigabytes of addressing range, and is pin compatible with the MC68440 and MC68450.

MC68440L,LC,P,R,RC,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
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.

MC68184L
Broadband Interface Controller, BIC

The BIC, coupled with rf circuitry, makes up a broadband modem needed in each node of a MAP broadband communications network. The MC68184 implements the digital portion of IEEE 802.4 broadband physical layer of the ISO/OSI (International Standards Organization/Open System Interconnect) communication model for standardized multivendor data communications networking. The digital portion implemented by the BIC manipulates data and provides control for the rf transmitter and receiver. The BIC supports high-speed data rates up to 10 Mbps using a duo-binary modulation technique. The IEEE 802.4 recommended standard serial interface is used to connect the BIC to the Token Bus Controller (TBC), MC68824, for implementing both layers one and two of the OSI communication model.

Data Communications

MC68652P
Multi-Protocol Communication Controller, MPCC

The MPCC is a single-channel, serial data communications device that recognizes byte control and bit oriented protocols. Also included within the device is CRC (programmable error detection) circuitry. The MPCC handles data transfers of 8- or 16-bit widths at a maximum 2-Mbit/second rate.

MC68681, MC2681L,P
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 M68000 bus interface is provided by the MC2681.

MC68605RC
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.

MC68661P
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
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
Multifunction Peripheral, MFP

The MFP provides basic microcomputer function requirements as a single companion chip to the M68000 Family of Microprocessors. 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.

System Interface

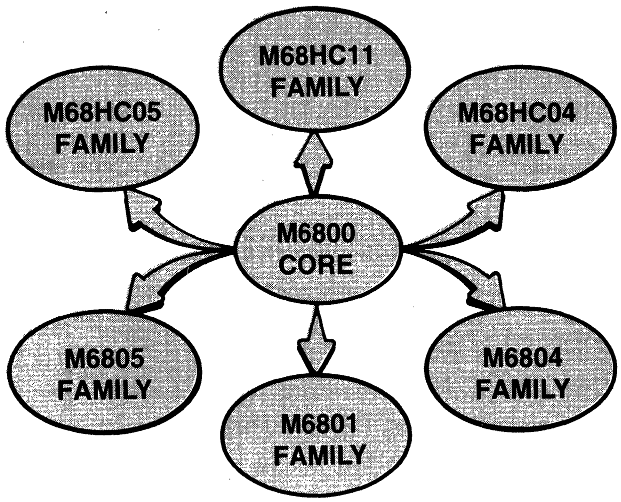
MC68153L,P
Bus Interrupt Module, BIM

The BIM interfaces an M68000 microcomputer system bus to multiple slave devices which require interrupt capabilities. It allows up to four independent sources of interrupt requests to be routed to any of the seven M68000 interrupt levels. The BIM is VMEbus and VERSAbus compatible and fully programmable.

MC68452L,P
Bus Arbitration Module, BAM

The BAM arbitrates the control of an M68000 system bus when multiple bus masters are involved. These bus masters can be processors, DMA controllers, and serial or parallel data communication controllers. Up to eight masters can be handled by each BAM device.

The 8-Bit M6800 Families



Single-Chip Microcontrollers (MCUs)

A Broad Spectrum of Design Solutions

Increased levels of peripheral integration gave rise to the single-chip microcontroller (MCU). Single-chip 8-bit MCUs essentially consist of a basic microprocessor, an on-chip clock oscillator, a timer, user programmable Read-Only Memory (ROM) to handle program routines for a dedicated application, Random Access Memory (RAM) capacity to handle the associated data manipulations, and sufficient input-output capability to interface with a number of parallel and serial oriented external peripherals. These single-chip systems reduce component cost, equipment manufacturing cost, and space requirements.

Motorola MCU families encompass both HCMOS and HMOS technologies. Each family, or core, fills a niche in the price/performance ranges demanded by the vast variety of applications in today's marketplace. Within each family there is the selection of on-chip peripheral functions that most closely fit the requirements of the eventual system.

HCMOS MCU Families

M68HC11, M68HC05, M68HC04

Two of the latest trends in MCU technology are HCMOS processing and on-chip EEPROM. HCMOS (high-speed complementary metal oxide silicon) processing offers several advantages over HMOS (high density NMOS) processing, including lower power consumption, higher throughputs, wider supply voltage ranges, and higher noise immunity.

The M68HC11 Family

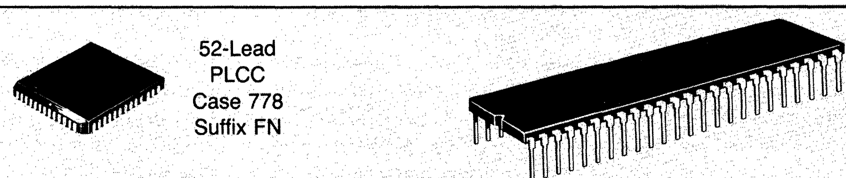
The M68HC11 with on-chip EEPROM is one of the most powerful and most versatile MCU families available in the market today. This family utilizes new high-density CMOS design techniques, and matches the highest nominal bus rate (2.1 MHz) of its fastest HMOS counterpart. Its basic M6800 core was expanded with eleven new instructions that add significant performance improvement without compromising compatibility with other M6800 MPU and peripheral family members.

Among the more significant additions to the instruction set is one that concatenates the two 8-bit accumulators into one double-byte accumulator, permitting 16-bit internal processing with a substantial improvement in throughput. A significant number of instruction enhancements result from the addition of a second 16-bit index register.

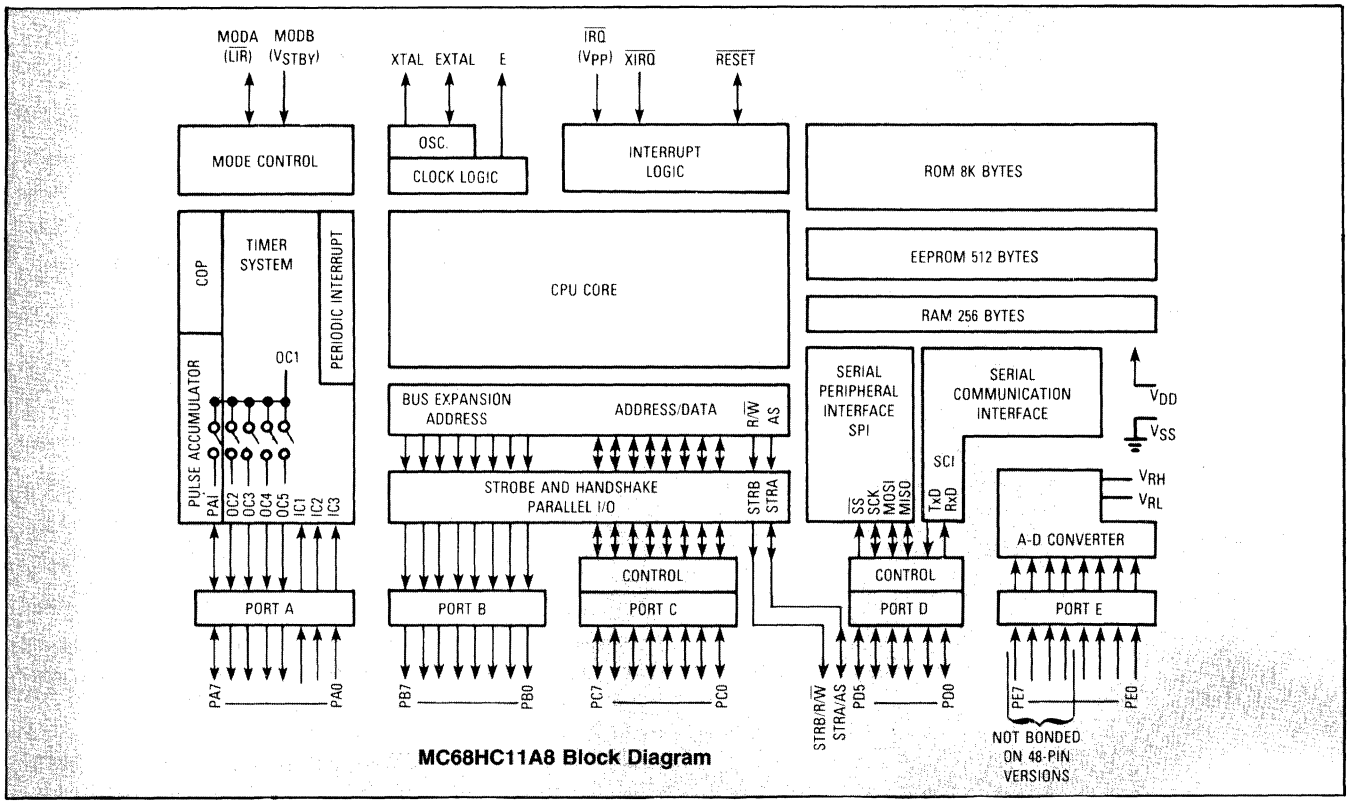
On-chip peripheral capabilities include a full duplex serial communications interface (SCI) with a variety of baud rates, an asynchronous communications interface, a 16-bit free running timer, and 38 I/O lines.

A selection of memory options meets a variety of needs combined with a mix of other functions. This yields cost-effective optimization for specific requirements.

With on-chip EEPROM for nonvolatile storage through power losses, the internal RAM is free for temporary data storage. Calibration tables, data acquisition, software corrections, custom routines, and look-up tables can be programmed into the EEPROM.



Packages shown apply to MC68HC11A8.



MC68HC11A8 Block Diagram

The M68HC11 Family

	HCMOS MC68HC							
	11A0 FN,P	11A1 FN,P	11A8 FN,P	11E1 FN	11E9 FN	811A2 FN,P	99 FN	11D3 FN,P
ROM (Bytes)	0	0	8192	0	12K	0	12K	4K
RAM (Bytes) — All saved during standby	256	256	256	512	512	256	256	128
EEPROM (Bytes)	—	512	512	512	512	2K	—	—
Timer	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit
Serial Peripheral Interface (SPI)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Serial Communications Interface (SCI)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Input Capture Functions	3	3	3	4	4	3	1	2
Output Compare Functions	5	5	5	4	4	5	1	3
A/D Converter	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Real-Time Interrupt	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Watchdog (COP)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

An M68HC11-Based Hard Disk Controller

The MC68HC99 hard disk controller is a single-chip microcontroller dedicated to disk control. It contains a high speed serial data controller, Reed-Solomon based error detection and correction, two 528 byte data buffers, and a host interface that is completely SCSI compatible. Also on the MC68HC99 are an MC68HC11 microprocessor core, 12K bytes of mask-programmable ROM, 256 bytes of scratchpad RAM, a 16-bit timer, and two 8-bit bidirectional parallel I/O ports (used to select the disk and position the read/write heads). The MC68HC99 replaces the multiple-chip set controller solutions used in current board level and drive embedded controller designs. It interfaces with ST-506, ESDI, and SMD disks and it supports SCSI as well as other popular host computer interfaces. Its command set and functions are user programmable.

The M68HC05 Family

The M68HC05 Family currently offers the widest variety of on-chip memory and I/O selections to provide users with a system that approximates their "ideal" requirements. This wide selection of functional options in standard, off-the-shelf components, adds the benefits of low cost to highly complex circuits that closely rival the applications-specific advantages of custom designs.

The M68HC05 core brings the high performance and greater chip density of HCMOS to the M6805 single-chip MCU Family. On-chip functions include 176 bytes of RAM, an oscillator with RC or crystal mask options, 24 bidirectional I/O lines, a 16-bit timer, five interrupt vectors, an enhanced UART (SCI), and a synchronous serial system (SPI). The fully static design allows operation down to dc. Stop and wait modes further enhance power savings for ultra low power/ battery applications.

Software capabilities like the 8 x 8 unsigned multiply instruction, true bit manipulation, memory-mapped I/O, and addressing modes with indexed addressing make the M68HC05 core a desirable option for applications between the low cost M68HC04 Family and the highly integrated M68HC11 Family.

The M68HC04 Family

Having somewhat lesser performance than the versatile M68HC05 Family, the M68HC04 Family represents a low-cost means of upgrading earlier 4-bit processor-based equipment to the more powerful world of 8-bit processing. It is ideal for dedicated high volume applications. The objective of minimizing cost led to the development of a self-test scheme in the form of a ROM-driven on-chip signature analysis technique. This attractive alternative to conventional testing utilizes polynomial division to compress lengthy output responses to much smaller results.

The HMOS Families

M6801/M6805/M6804

Today, given equivalent functionality, when low power consumption is not an issue and price is a major consideration, HMOS MCUs may be the best solution for an application. Motorola offers three HMOS MCU families: M6801, M6805, and the M6804.

The M6801 family is manufactured in HMOS providing a high degree of chip complexity with relatively small (low cost) dimensions. On the low end of the scale are the M6803 members intended for use with external ROM or EPROM, with a resultant saving in MPU cost. The 68701 series includes the substitution of EPROM for the more conventional factory-programmed ROM, thereby offering user-programmability.

Based on an M6800 8-bit core, the M6805 Family trims some of the lesser used MC6800 instructions, but includes bit-modify and test instructions as well as powerful indexing modes. The Family consists of a variety of members with various functions ranging from 1 to 3+ K of mask programmable ROM, 64 to 112 bytes of RAM, and on-chip peripherals such as an analog to digital converter and synchronous communication interface. Most part types also offer an EPROM version with the same functions.

The M6804 Family is a low cost line of single-chip microcontrollers designed to be cost competitive with 4-bit machines that are currently on the market, yet the M6804 Family offers more processing power and a streamlined instruction set that is easier to use. A very small die size and an extensive built-in self test written into each chip reduce the cost. A unique application for the M6804, because of its price structure, is to replace TTL logic. That is, the M6804 can perform as an intelligent PLA (programmable logic array). Any time an interface has to be built between some computer and the real world, an M6804 Family device can be a cost effective solution.

On-Chip I/O

Single-chip MCUs are available in packages ranging in pin configurations from 20 pins to 68 pins. As many as 12 pins are required to serve power and control functions; up to 40 pins in the largest packages may be used as I/O.

Although most digital I/O takes the form of general purpose input/output ports, several of the pins may be used in a number of designs for special serial communications interfaces.

A/D Converters — Members of the M68HC11 and M6805 Families include a multi-channel 8-bit A/D converter. The 6805R and S versions contain four analog input channels and the M68HC11 MCUs feature up to eight channels.

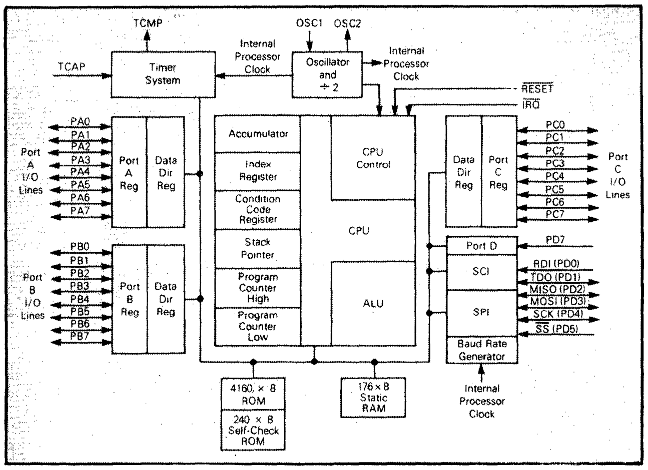
COP — "Computer Operating Properly" reset timer acts as a "watchdog" to automatically reset the CPU if not reset by a program sequence in a given amount of time. All M68HC11 Family members contain this feature.

Interrupts — Every Motorola MCU includes fully automatic interrupts (registers saved). The M68HC11, M6801 and M6805 Families contain programmable vectors for both external pins and internal timers.

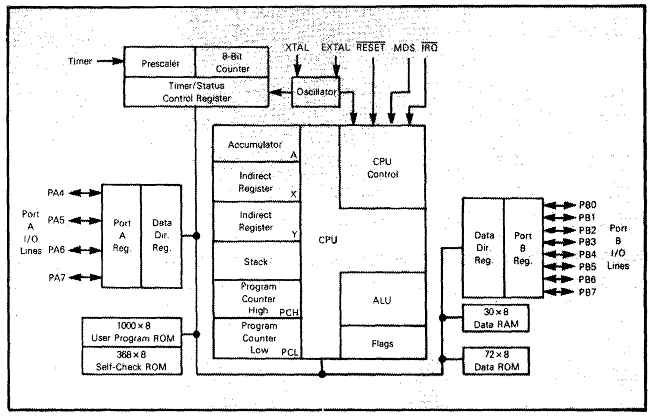
SCI (Serial Communications Interface) — The SCI is used for long-range communications, as in data transfer from an MCU to a terminal or modem. This two-line interface is also called a UART (Universal Asynchronous Receiver/Transmitter).

SPI (Serial Peripheral Interface) — The SPI is used primarily for serial communications between chips on the same printed circuit board.

Timers — Timers may generate interrupts to a program at a periodic rate, measure external values, count external events and generate measured output waveforms. The M68HC11, M68HC05, and M6801 Families include a 16-bit timer that may be used to perform three of the above functions simultaneously. The M6804 and M6805 timers consist of a programmable 8-bit counter and a selectable 7-bit prescaler.



MC68HC05C4 Block Diagram



MC68HC04J2 Block Diagram

The M68HC05 Family (HCMOS)

MC68HC05									
	C2	C3	C4	C8	A6	B4	B6	L6	M4
ROM	2K	2K	4K	8K	4160	4K	6K	6208	4K
RAM	176	176	176	176	176	176	176	176	128
EEPROM	0	0	0	0	2096	0	256	0	0
Timer	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	16-Bit	8-Bit 16-Bit
SPI	No	Yes	Yes	Yes	Yes	No	No	Yes	No
SCI	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No
A/D	No	No	No	No	No	Yes	Yes	No	Yes
I/O	24	24	24	24	24	32	32	24	32
PKG	40-DIP	40-DIP	40-DIP 44-PLCC	40-DIP 44-PLCC	40-DIP 44-PLCC	52-PLCC	52-PLCC	68-FPPLCC	
EPROM or EEPROM Version			MC68HC805C4	MC68HC705C8			MC68HC805B6		

The M68HC04 Family (HCMOS)

MC68HC04			
	J2	J3	P3
ROM	1008	1672	1688
RAM	32	124	124
Timer	8-Bit	8-Bit	8-Bit
I/O	12	12	20

The M6804 Family (HMOS)

MC6804			
	J1	J2	P2
ROM	512	1008	1024
RAM	32	32	32
Timer	8-Bit	8-Bit	8-Bit
I/O	12	12	20
EPROM Version			MC68704P2

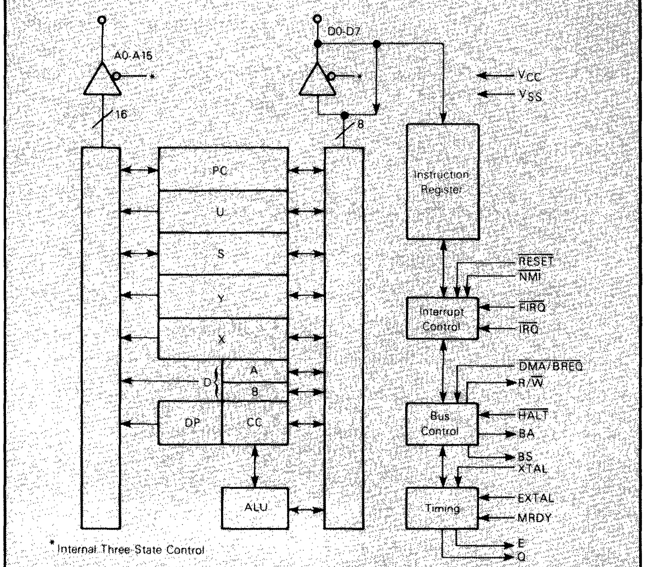
The M6805 Family (HMOS)

MC6805								
	R2	R3	S2	S3	U2	U3	P2	P6
ROM	2048	3776	1480	3720	2048	3776	1110	1804
RAM	64	112	64	104	64	112	64	64
SPI	—	—	Yes	Yes	—	—	—	—
A/D	Yes	Yes	Yes	Yes	—	—	—	—
I/O Bi-directional	24	24	21	14	24	24	20	20
I/O Uni-directional	8	8	7	7	8	8	—	—
PKG	40-DIP	40-DIP	28-DIP	28-DIP	40-DIP	40-DIP	28-DIP	28-DIP
EPROM Version	MC68705R3	MC68705R3	MC68705S3	MC68705S3	MC68705U3	MC68705U3	MC68705P3	MC68705P3

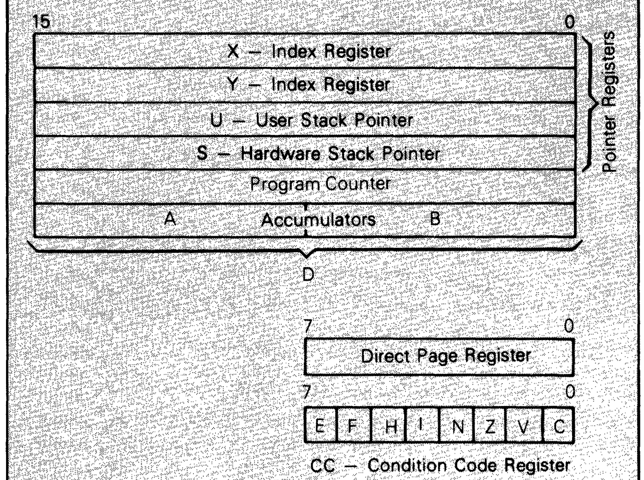
The M6801 Family (HMOS)

	MC 6801	MC 6803	MC 6801U4	MC 6803U4
RAM	128	128	192	192
Standby RAM	64	64	64	64
ROM	2048	—	4096	—
Timer	16-Bit	16-Bit	16-Bit	16-Bit
Input Capture Functions	1	1	1	1
Output Compare Functions	1	1	2	2
Serial Comm.	Yes	Yes	Yes	Yes
Parallel I/O	29	13	29	13
EPROM	MC 68701	—	MC 68701U4	—

8-Bit Microprocessors (MPUs)



Block Diagram of MC6809 — the most powerful Motorola 8-bit MPU



MC6809 Programming Model

Large-scale integration permits combining a basic microprocessor with a variety of peripheral functions on a single chip. This has led to a series of single-chip MCUs that can represent significant cost savings in many applications. Yet, in some instances, the basic MPU has some advantages:

- Being a non-dedicated device, it can be combined with a number of peripheral chips to provide a nearly ideal circuit configuration;
- Having reached a high degree of maturity, it is cost effective and easy to implement;
- With a long history of utilization, it is supported by a wide selection of peripheral chips that maximizes system flexibility.
- Motorola provides two proven NMOS MPUs and an unexcelled list of peripherals that still bears investigation for new designs where the more elaborate MCUs don't quite fill the bill.

The M6800 Families

M6800/6802

The M6800 Family has earned an enviable reputation as one of the easiest to use lines of microprocessors. The basic M6800 Family consists of:

MC6800 — Basic processor with external clock.

MC6802 — Adds on-chip clock and 128 x 8-bit RAM. Has 32-byte RAM retainability through V_{CC} standby function.

Seventy-two powerful instructions and six different addressing modes give these microprocessors unexcelled capabilities. These capabilities are enhanced by a single 5.0 V supply requirement that reduces system complexity and cost, a 16-bit address system that permits selective addressing of more than 65,000 memory locations, and inherent design that treats each peripheral as a memory location, thereby reducing programming complexity.

MC6809/6809E

Today, there is controversy about where a microcomputer turns into a "mini". While a number of benchmarks have been suggested, it is generally conceded that 16-bit processing capability constitutes a minimum "mini" requirement. From this standpoint alone, the M6809 Family at least borders on minicomputer capabilities.

The M6809 Family has two members:

MC6809 — Processor with on-chip clock.

MC6809E — Has external clock inputs for multi-processor operations.

Both units are available with operating frequencies of 1, 1.5, and 2 MHz; and at operating temperatures of 0 to 70°C and −40 to 85°C.

8-Bit Peripheral Support

The following list of 8-bit peripherals includes both NMOS and CMOS units that support both the MPU line and selected members of Motorola's MCU families.

Memory and Memory Control

M6800-Compatible Memory — 28 x 8-Bit Static RAM **MCM6810**

Dual-Port RAM Unit — permits two MPUs to exchange data via 256 bytes of RAM. Low-power HCMOS technology **MC68HC34**

Direct Memory Access Controller — bypasses MPU during data transfer between memory and peripherals. . **MC6844**

I/O Peripherals

Real-Time Clock Plus RAM — CMOS for low-power battery operation; includes 50 bytes of CMOS RAM **MC146818,A**

Real-Time Clock plus RAM — with serial interface **MC68HC68T1**

Peripheral Interface Adapter — two I/O ports, each controlling an independent 8-bit data bus **MC6821**

CMOS Parallel Interface — 24 independently programmable I/O lines. **MC146823**

Port Replacement Unit — replaces ports B and C of MC68HC11 MCU when these are unavailable because of expanded or test mode operation **MC68HC24**

Programmable Timer — three 16-bit binary counters **MC6840**

Interface Adapter — operates to IEEE-488 standards. **MC68488**

Asynchronous Communications Interface Adapter — formats serial data to interface with bus-organized systems. **MC6850**

Advanced Data Link Controller — provides serial-to-parallel and parallel-to-serial conversion of data . . . **MC6854**

Synchronous Serial Data Adapter — interfaces between M6800 MPU system and data terminals at speeds up to 600 kbps **MC6852**

Graphics/Display Peripherals

CRT Controller — interfaces between a terminal and an M6800 MPU to simplify the development of intelligent terminals, word processing and information display devices **MC6845**

Video Display Generator — interfaces the M6800 family (or similar product) to a standard color or black and white NTSC television receiver **MC6847**

System Enhancement

Data Security Device — MOS circuit protects data by employment of cryptographic measures. **MC6859**

Serial Peripheral Interface

MPUs and some MCUs can be used in expandable multichip 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 multimaster 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.

- **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

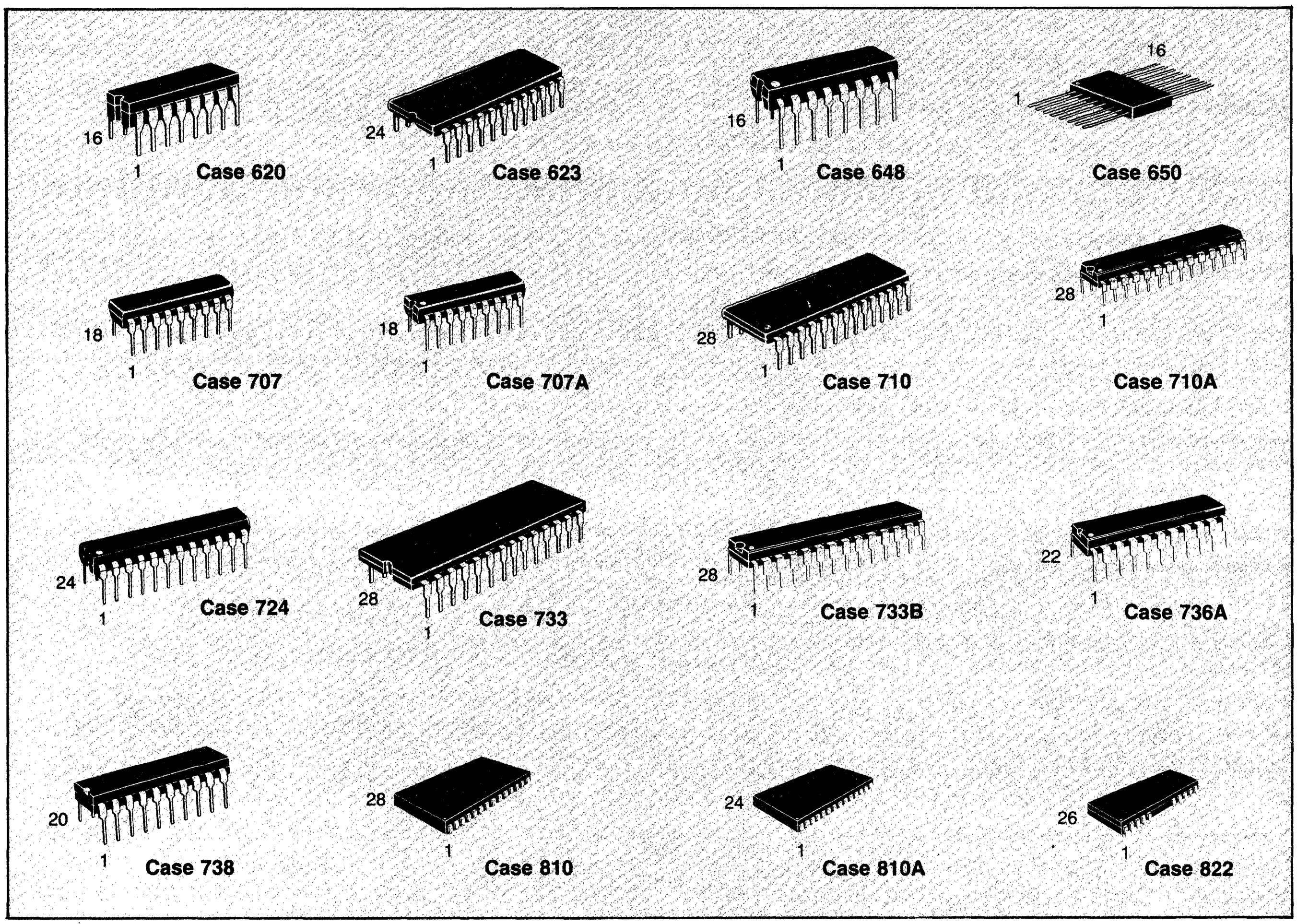
Data Converters — These parts may be applied to instrumentation, automotive uses, industrial controls and home electronics.

- **MC145040** — ADC; 11 inputs, SAR, external clock
- **MC145041** — ADC; 11 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.

- **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 4½-digit, 7-segment-plus-decimal display); may be paralleled for more digits.

Memories



MOS Memories

Static RAMs — NMOS — High Speed

Fast NMOS static RAMs combine ease of use with the reduced standby power dissipation associated with clocked memories. These devices are suitable for cache and sub-100 ns buffer memory systems.

+5 V, 0 to 70°C

Organization	Part Number	Suffix	Access Time ns Max	Power Diss. Active, Stdby mA Max	Case	Pins	Comments
2K x 8	MCM2016H	N45 N55 N70	45 55 70	135, 20	N-Case 724	24	300 mil plastic DIP. Replace TMM2018D.
	MCM2018A	N35 N45	35 45				

Static RAMs — CMOS — Fast

From 16K to 256K and with outputs organized x1, x4 or x8 the Motorola CMOS static RAM family offers design flexibility, high speed and low power, coupled with traditional Motorola reliability. Most CMOS static RAMs offer low power standby operation, with the capability of extremely low current drain when driven to standby with CMOS level (full rail) inputs. All are fully TTL compatible and require no external clocks or timing strobes.

+5 V, 0 to 70°C unless otherwise noted

Organization	Part Number	Suffix	Access Time ns Max	Power Diss. Active, Stdby mA Max	Case	Pins	Comments
4K x 4	MCM1423 IMS1423	P45 P-45	40	80, 20	P-Case 738	20	Improve system performance by replacing slower 45, 55, and 70 ns devices.
	MCM6168	P45 P55 P70	45 55 70	80, 20	P-Case 738	20	Only 2 mA of standby current with full rail inputs. t_{AA} = 50 ns for P55 and 60 ns for P70.
	MCM6268	P25 P35	25 35	110, 20 110, 20	P-Case 738	20	Innovative design and double layer metal provide the speed required for high performance.
	MCM6269	P25 P35	25 35	120, 15 110, 15	P-Case 738	20	Very fast select time, 12 or 15 ns.
8K x 8	MCM6164	C45,P45,J45 C55,P55,J55	45 55	90, 3 80, 3	C-Case 733 P-Case 710 J-Case 810	28	Two chip enable pins provide positive and negative logic for more system design flexibility.
	MCM61L64 (Low-power version)	C45,P45,J45 C55,P55,J55	45 55	90, 3 80, 3			Ideal for battery backup; 50 μA standby (CMOS levels).
	MCM6164C (−40 to 85°C)	C55 C70	55 70	80, 3 70, 3	C-Case 733	28	Full spec operation over the industrial temperature range.
	MCM6264	P35,J35 P45,J45	35 45	110, 20 100, 20	P-Case 710A J-Case 810	28	Space saving 300 mil plastic DIP and 400 mil plastic SOJ. Pinout is identical to MCM6164.
16K x 4	MCM6288	P25,J25 P30,J30 P35,J35	25 30 35	120, 20 120, 20 110, 20	P-Case 736A J-Case 810A	22 24	Innovative design and double layer metal provide the high speed required for high performance. Very popular for cache memory designs.
	MCM6290	P25,J25 P30,J30 P35,J35	25 30 35	120, 20 120, 20 110, 20	P-Case 724 J-Case 810A	24	Similar to the MCM6288 but with fast Output Enable function that allows access to data in only 12 or 15 ns.
64K x 1	MCM6287	P25,J25 P30,J30 P35,J35	25 30 35	120, 20 120, 20 110, 20	P-Case 736A J-Case 810A	22 24	Innovative design and double layer metal provide the speed required for high performance.
32K x 8	MCM6206*	P35,J35 P45,J45 P55,J55	35 45 55	120, 15 110, 15 100, 15	P-Case 710 J-Case 810	28	Two chip control functions: Chip Enable and Output Enable.
64K x 4	MCM6208*	P25,J25 P35,J35	25 35	120, TBD 110, TBD	P-Case 724 J-Case 810A	24	256K bits of memory in packages only 300 mils wide.
256K x 1	MCM6207*	P25,J25 P35,J35	25 35	120, TBD 110, TBD	P-Case 724 J-Case 810A	24	256K bits of memory in packages only 300 mils wide.

*To be introduced. TBD — To Be Determined.

Static RAMs — CMOS — Low Power

This series of CMOS Static RAMS features extremely low power dissipation in both active and standby modes. Each device type has an equivalent low-power (L) version which has battery backup capability.

+5 V, 0 to 70°C

Organization	Part Number	Suffix	Access Time ns Max	Power Diss. Active, Stdby mA Max	Case	Pins
8K x 8	MCM6064	P10 P12	100 120	45, 0.1 40, 0.1	P-Case 710	28
	MCM60L64	P10 P12	100 120	45, 0.03 40, 0.03		
32K x 8	MCM60256	P10 P12	100 120	70, 1.0		
	MCM60L256	P10 P12	100 120	70, 0.1		
	MCM60256A	P85 P10 P12	85 100 120	70, 0.1		
	MCM60L256A	P85 P10 P12	85 100 120	70, 0.03		

Static RAMs — CMOS — Cache Address Tag

The following devices are 16,384 bit cache address tag comparators organized as 4096 tags of 4 bits. Each device integrates a 4K x 4 SRAM core with an on-board comparator for efficient implementation of a cache memory. The MCM62350/351 have special pin functions for tag valid and system status bit applications. These allow easy interface to the MC68020 and MC68030 microprocessors or other environments requiring efficient external cache memory implementation. They also have a reset ($\overline{R}$) pin for flash clearing the RAM within two minimum cycles for system initialization.

The MCM4180 uses a clear ($\overline{CLR}$) pin to flash clear the RAM for system initialization.

All three devices are in 300 mil plastic DIP and 300 mil plastic SOJ packages.

+5 V, 0 to 70°C

Organization	Part Number	Suffix	Access Time ns Max	Case	Pins	Comments
4K x 4	MCM62350*	P22,J22 P25,J25 P30,J30	22 25 30	P-Case 724 J-Case 810A	24	Active pull-up match output
	MCM62351*	P22,J22 P25,J25 P30,J30	22 25 30	P-Case 736A J-Case 810A	22 24	Open drain match output
	MCM4180*	P22,J22 P25,J25 P30,J30	22 25 30	P-Case 724 J-Case 810A	24	Pin and function compatible with MK41H80.

*To be introduced

Static RAMs — CMOS — Synchronous

Motorola synchronous SRAMs integrate input registers, high-speed SRAM, and high drive capability output in a single monolithic circuit. They provide performance and parts count advantages in applications such as writeable control stores, memory mapping and cache memories. The on-board input registers eliminate the need for external latch chips in systems where addresses and data are not on the bus long enough to satisfy standard SRAM setup and hold times. A clock input controls both input and output operations and permits synchronizing the RAM to a system clock. Available in 300-mil plastic DIP and 400-mil plastic SOJ package.

+5 V, 0 to 70°C

Organization	Part Number	Suffix	Access Time ns Max	Power Diss. Active mA Max	Case	Pins
16K x 4	See Below	P25,J25 P30,J30 P35,J35	25 30 35	120	P-Case 710A J-Case 810	28

Part Numbers*:
MCM6292 — has transparent outputs for access within same cycle.
MCM6293 — has registered outputs for fully pipelined applications.
MCM6294 — has registered outputs, plus output enable for asynchronous bus control.
MCM6295 — has transparent outputs, plus output enable for asynchronous bus control.

*To be introduced

Dynamic RAMs (DRAMs)

DRAMs offer the lowest cost per bit of any memory. For that reason, they are very popular for a wide range of applications, particularly for high-density memories involving very high memory capacity. Motorola's dynamic RAMs include 256K- and 1M-bit devices with x1 and x4-bit organization and offer page mode, nibble mode and static column mode options that significantly decrease access time.

All devices are fabricated using silicon-gate MOS technology and designed for single 5-volt power supply operation. All have $\overline{CAS}$*-before-$\overline{RAS}$ and $\overline{RAS}$-only refresh modes. Multiplexed address inputs permit packing in standard 300-mil wide packages.

*$\overline{CS}$ for static column mode devices.

+5 V, 0 to 70°C

Organization	Part Number	Suffix	Access Time ns Max	Operating Mode	Case	Pins	Comments
64K x 4	MCM41464A	P10 P12	100 120	Page	P-Case 707	18	NMOS 256-cycle, 4 ms refresh
256K x 1	MCM6256B	P10 P12	100 120	Page	P-Case 648	16	
	MCM6257B	P10 P12	100 120	Nibble	P-Case 648	16	As above, plus fast nibble mode: 25 ns access, 50 ns cycle times.
256K x 4	MCM514256	P85,J85 P10,J10 P12,J12	85 100 120	Fast Page	P-Case 738A J-Case 822	20 20/26	CMOS 512-cycle, 8 ms refresh
	MCM514258	P85,J85 P10,J10 P12,J12	85 100 120	Static Column	P-Case 738A J-Case 822	20 20/26	
1M x 1	MCM511000	P85,J85 P10,J10 P12,J12	85 100 120	Fast Page	P-Case 707A J-Case 822	18 20/26	
	MCM511001	P85,J85 P10,J10 P12,J12	85 100 120	Nibble	P-Case 707A J-Case 822	18 20/26	
	MCM511002	P85,J85 P10,J10 P12,J12	85 100 120	Static Column	P-Case 707A J-Case 822	18 20/26	

ECL Memories

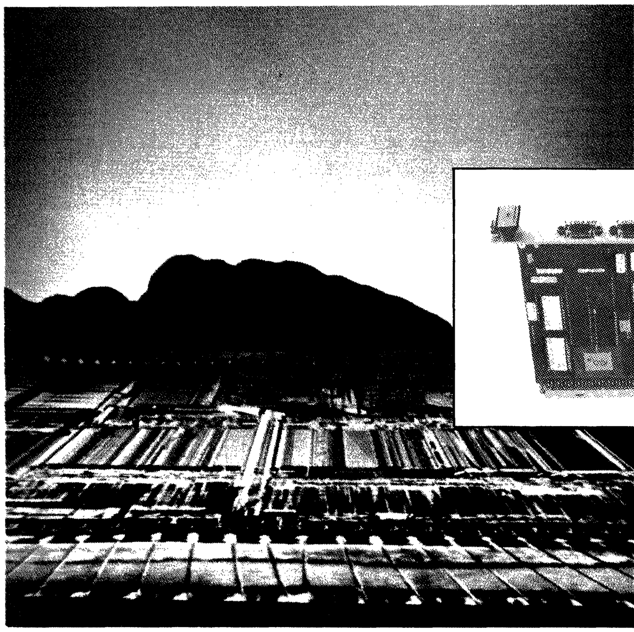
Emitter-coupled logic (ECL) represents today's fastest logic form; ECL memories complement this characteristic. Motorola ECL RAMs and ROMs are available to match the speed capabilities of the ECL10K and 10KH logic families, the two most pervasive ECL lines available.

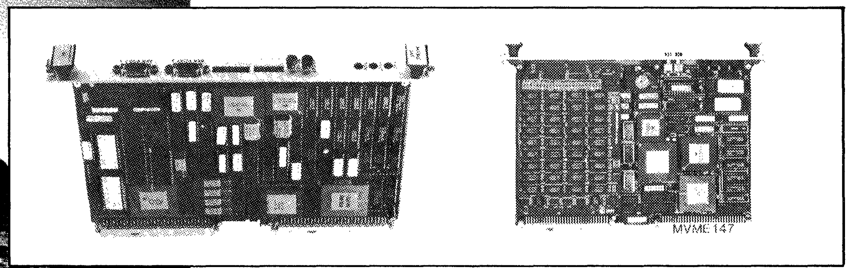
RAMs

Organization	Device Type	Suffix	Access Time ns Max	Power Dissipation mW Typ	Package	Comments
8 x 2	MCM10143	L	15	610	L-Case 623	Multiport Register File
16 x 4	MC10H145	P,L,FN	6	700	P-Case 648 L-Case 620 FN-Case 775	Register File
	MCM10145	L	15	468	L-Case 620	Register File
64 x 1	MCM10148	L	15	420	L-Case 620	
128 x 1	MCM10147	L	15	415		
256 x 1	MCM10144	L	26	468		
1K x 1	MCM10415	L15 L20	15 20	520		
	MCM10146	L	29	600		

ROMs

Organization	Device Type	Suffix	Access Time ns Max	Power Dissipation mW Typ	Package
32 x 8	MCM10139	L	20	520	L-Case 620
256 x 4	MCM10149	L10 L25	10 25	540	





Board Level Products

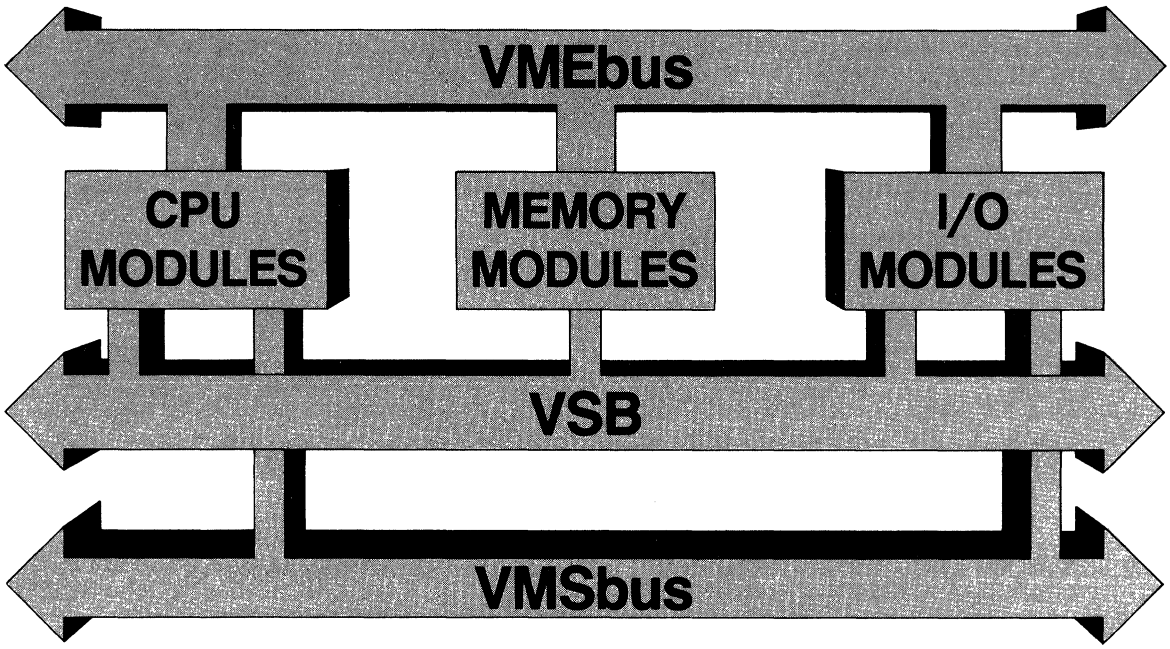
In Brief . . .

Today's system designer can mix and match three distinct integration levels to arrive at the most timely and cost-effective microcomputer system introduction — the component level, the board level, and the subsystem level. Of these, the components level is often the preferred choice if the number of end-system requirements is relatively large, and if adequate design talent is available to turn out the desired product in time to serve the market requirements. If only a very small number of end systems will be needed, or if the end product must be implemented very quickly, the selection of a proven, tested and immediately available subsystem may be the best solution.

Supplementing these two extremes is the multifaceted board level of integration. The designer can choose from a large selection of preassembled, tested and functionally compatible boards that can be interconnected by being plugged into the common backplane of a matching chassis or power supply. For end-use requirements of a few hundred units, this often proves to be the most appropriate approach.

With adequate advanced planning, the designer is not limited to any one of the above choices alone. A fundamental selection of a basic integration level can be supplemented with components from the other levels to form a homogeneous system with the most advantageous combination of characteristics. This hinges basically on defining a system with components that are compatibly related functionally, physically and philosophically. Toward that objective, Motorola offers one of the world's leading microprocessor components (chip) families and uses these in a pervasive array of microcomputer board-level modules and subsystems utilizing the widely accepted VME bus structure for system interconnect compatibility.

Board Level Products



Motorola and the VMEbus

In the relatively short period that microcomputers have existed, a variety of bus structures have been developed to match existing levels of technology and to mirror the philosophy of the manufacturer(s) involved. For modern high-performance processors, and for the emerging systems that can already be anticipated, the VMEbus system has emerged as a concept for the construction of forward-looking modular systems that has caught the imagination and adherence of the industry.

The VMEbus system was developed in Munich, Germany by Motorola in collaboration with several other leading semiconductor products manufacturers. It quickly established itself as a world standard, having been adopted by more than 300 major manufacturers who offer VME products to markets around the world.

Motorola has become the leading supplier of VME products as a result of the consistent introduction of new in-house-developed microprocessor technology, a broad spectrum of VME boards, complete software support and a world-wide sales and service network.

The VMEbus Features

VMEbus architecture offers the highest degree of system flexibility. Among its features are:

- **Support for 8-, 16-, and 32-bit microprocessors**
- **Unlimited use of processors in asynchronous, non-multiplexed relationship**
- **VME Subsystem Bus (VSB) adjunct for high-speed private access to processor-dedicated memory and parallel I/O**
- **VME serial sub-bus (VMS) for additional serial connections between VME modules**
- **I/O channel support to free the main bus from handling the requirements of low-speed system peripherals**

Motorola VMEmodule Features

And here are some of the features that have made Motorola VMEmodules the preferred board-level product line.

- **M68000 family state-of-the-art processing power for 8-, 16-, and 32-bit applications**
- **VMEbus versatilty**
- **Highly reliable Eurocard mechanical format with two industry-standard board sizes**
- **Powerful VERSAdos real-time support**
- **SYSTEM V/68 (UNIX) operating system for software development and multiple worldwide sourcing**
- **Rapid upgrading of performance as new and improved components become available**
- **A large and ever-expanding selection of functions for system implementation.**

Monoboard Microcomputers

The cornerstones of the VMEsystem components are the VMEmodule Monoboard Microcomputers. Motorola supplies a number of models utilizing various members of the M68000 microprocessor family in a variety of configurations to meet specific applications. In addition, all have built-in sockets for the addition of memory and other peripheral chips.

All Monoboard Microcomputer Modules utilize the double-high Eurocard format and are completely compatible with all VMEmodule peripheral assemblies.

Module (MVME)	Clock Freq. MHz	Memory Capacity SRAM Kb	DRAM Kb	EPROM Kb	I/O Interface Parallel	Serial	Float. Pt. Coprocessor	MMU

MC68000 Microprocessor

Module (MVME)	Clock Freq. MHz	SRAM Kb	DRAM Kb	EPROM Kb	Parallel	Serial	Float. Pt. Coprocessor	MMU
101	8.0	64		512	2x8 bit	2xRS232C		
110-1	8.0	64*		512	N/A	RS232C		

MC68010 Microprocessor

Module (MVME)	Clock Freq. MHz	SRAM Kb	DRAM Kb	EPROM Kb	Parallel	Serial	Float. Pt. Coprocessor	MMU
105	10.0		512	256	8-bit	RS232 RS485/422		
104	Same as 105, but has added I/O Channel Interface							
106	Same as 105, but has added Floppy Disk Interface							
107	Same as 105, but has added SCSI Interface							
117-3	10.0		512	256	2x8 bit	2xRS232C		
117-3FP	10.0		512	256	2x8 bit	2xRS232C	MC68881	
117-4	10.0		512	256	2x8 bit	2xRS232C		
117A	10.0		2000	256	2x8 bit	2xRS232C	MC68881	
121	10.0		512	256	N/A	RS232C		MC68451
123	10.0		512	256	N/A	RS232C		

MC68020 Microprocessor

Module (MVME)	Clock Freq. MHz	SRAM Kb	DRAM Kb	EPROM Kb	Parallel	Serial	Float. Pt. Coprocessor	MMU
133 -1 A-20	12.5 16.67 20.0		1000	256	N/A	2xRS232C RS485/422	MC68881	
133XT	25.0		4000	256	N/A	2xRS232C RS485/422	MC68882	
134 134FP-1	16.67 20.0		4000	256	N/A	2xRS232C RS485/42	 MC68882	MC68851
135 -1	16.67 20.0		1000	128	N/A	2xRS232C	MC68881	
135A	16.67		4000	128	N/A	2xRS232C	MC68881	
136	16.67		1000	128	N/A	2xRS232C	MC68881	MC68851
136A	16.67		4000	128	N/A	2xRS232C	MC68881	MC68851
141-1	25.0	32 (opt.)		2MB		2	MC68882	
141-2	33.3	32 (opt.)		2MB		2	MC68882	
143	16.67		4MB	256Kb		3	MC68882	
143-1	20.0		4MB	256Kb		3	MC68882	
143-2	25.0		4MB	256Kb		3	MC68882	
147	20.0		4MB	4MB	2x16	4	MC68882	
147-1	25.0		4MB	4MB	2x16	4	MC68882	
147A	20.0		8MB	4MB	2x16	4	MC68882	
147A-1	25.0		8MB	4MB	2x16	4	MC68882	

*Supplied with sockets only; User supplies memory devices.

System Expansion Modules

VMEbus System Controllers

MVME025
Provides arbitration, monitor and utility functions usually required for VMEbus systems.

- System reset and test
- Round-robin and priority-controlled bus management
- General bus management

MVME050
All the functions of the MVME025, above, plus

- General interrupt management
- Eight 28-pin sockets for ROM/RAM/EPROM
- Two serial RS232 interfaces. Real-time clock and calendar, bufferable by battery on the MVME701A Transition Module supplied with this module

System Controller Specifications

Module	MVME025	MVME050
Arbitration		
Round Robin	X	—
Priority	X	X
Single Level	X	X
Real Time Clock	—	X
System Clock	X	X
Power Monitor	X	—
JEDEC Sockets	—	8
Address Decoding	—	24,32
Data Transfer Size	—	8,26,32
Interrupts	—	1 of 7
Serial Ports	—	2
Parallel Ports	—	16-Bit
Transition Module	—	701A

VME Memory Modules

VMEbus DRAM

Module MVME	Capacity Organization	Byte Parity	Error Checking	Address Decoding (Bits)	Data Size (Bits)	Access Time Read (ns)	Access Time Write (ns)
202	512Kb 64Kx8	Yes	N/A	24	8,16	250	60
222-1	1Mb 256Kx8						
222-2	2Mb 256Kx8						
225-2	2Mb 256Kx8	Yes	N/A	24,32	8,16,32	280	90
226-1	4Mb 1Mx1	Yes	N/A	24,32	8,16,32	300	125
226-2	8Mb 1Mx1						
230-1	4Mb 1Mx1	N/A	Yes	24,32	8,16,32	240**	70-270
230-2	8Mb 1Mx1						

VME/VSB bus DRAM

Module MVME	Capacity Organization	Byte Parity	Error Checking	Address Decoding (Bits)	Data Size (Bits)	Access Time Read (ns)	Access Time Write (ns)
204-2F	2Mb 256Kx8	Yes	N/A	**VME** 24,32 **VSB** 32	8,16,32 32	260	150
224-1	4M 256Kx8	Yes	N/A	**VME** 24,32 **VSB** 32	8,16,32 32	200**	100**
224-2	8Mb 1Mbx1	Yes	N/A				

VMEbus Static RAM (CMOS)

Module MVME	Capacity Organization	Byte Parity	Error Checking	Address Decoding (Bits)	Data Size (Bits)	Access Time Read (ns)	Access Time Write (ns)
215-1	256Kb 8Kx8	N/A	N/A	24,32	8,16,32	230	230
215-2	512Kb 8Kx8						
215-3	1Mb 32Kx8	Yes	N/A				

VMEbus SRAM/ROM

Module MVME	Capacity Organization	Byte Parity	Error Checking	Address Decoding (Bits)	Data Size (Bits)	Access Time Read (ns)	Access Time Write (ns)
211*	to 1Mb Various	N/A	N/A	24	8,16	Selectable 325 to 510	
214*	to 1Mb Various	N/A	N/A	24,32	8,16,32	Selectable 100 to 400	

* = Supplied with sockets only; user supplies memory devices.
** = Faster on cache hits.

VME Interface Modules

MVME340A Parallel Interface Controller Module

Provides 64 parallel I/O lines, three 24-bit timers, one 32-bit and one 16-bit data channel orany combination of 16-bit and 8-bit data channels. Has 4Gb, 16Mb or 64Kb address range.

MVME300 GPIB IEEE-488 Listener/Talker Controller

Uses DMA interface for burst or byte mode data transfer rates up to 500 Kb/s. Includes error checking and status display. Supported by VERSAdos and UNIX.

Serial Interface Controller Modules

Module (MVME)	Serial Ports	Parallel Port	RAM (Kb)	ROM (Kb)	Interrupts	Address Decoding (Bits)	Data Size (Bits)
331	6	no	128	128	1–7	24	8,16
332	8	no	128	128	1–7	24	8,16
332XT	8	Printer	256	128	1 of 7	24,32	8,16
333-2	6*	no	512	128	1–7	24	8,16
335	4	16-bit	None	None	3	24	8,16

*4-channel DMA on two ports

Peripheral Controller Modules

Module (MVME)	Floppy Disk	Hard/Tape Drive		Transfer Rate	Memory (Kb)	Address Decoding (Bits)	Data Size (Bits)
320B-1	2	2	—	5Mb/s	1	24	8,16
321	4	2	—	8Mb/s	32	16,24,32	8,16,32
327A	1	—	—	1.5/4Mb/s	128	16,24,32	8,16,32
350	—	—	1	90Kb	125	32	16

Graphics Display Controllers

MVME393 Multichannel Graphics Display Controller

Uses an MC68010 processor for multitasking/window management operations and a separate TMS34010 graphics processor for bit-mapped display functions. Display memory has four planes with 1024 x 2048 bits each. Supports four 1024 x 512 x 4 or eight 1044 x 256 x 4 displays with draw rates up to 48M pixels /sec. and 68K vectors/sec. Features zoom, pan, scroll and blink/blank control.

Local Area Network (LAN) Interface Controllers

MAP Support Products

MVME372 Advanced MAP Controller

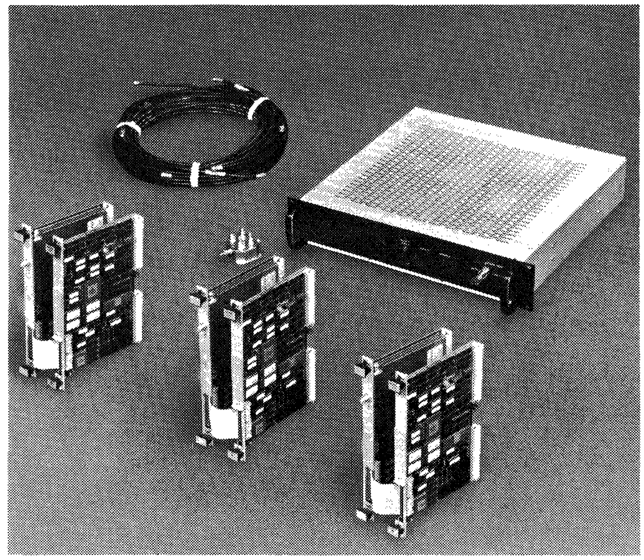
Supports all seven MAP 2.1 layers. Includes MC68020 CPU, MC68824 Token Bus Controller and 640 Kbyte RAM. Has generic serial interface to an off-board Modem which allows connections to a broadband or carrierband physical layer.

MVME372SET VMEbus to MAP Intelligent Interface Set

A two-board set comprising **MVME372 Controller** and 10 Mb/s **broadband modem board** with 16-bit MPU and 512 Kb DRAM. Includes MAP 2.1 (Layers 1–4) software and MAP 2.1 channel group 3′/4′/P/Q. TokenBus logic is supported under SYSTEM V/68 on 5-1/4″ diskette.
MVME372SET with MVME371FA Modem Module
MVME372SET-1 with MVME371FS-1 Modem Module
MVME372SET-2 with MVME371FS-2 Modem Module
MVME372SET-3 with MVME371FS-3 Modem Module

MVME372BBKIT MAP Broadband Kit

Includes three MVME372SET Network Interface Sets, a MAP Headend Remodulator and a Broadband Cable Kit with taps and filters. (Also available with MVME372SET-1 sets and a choice of Remodulators for either 110 V or 120 V operation.)



Broadband Modem Modules

MVME371FA Frequency Agile
MVME371FS-1 uses 3′ frequency channel pairs
MVME371FS-2 uses 4′ frequency channel pairs
MVME371FS-3 uses 6′ frequency channel pairs

MAP Headend Remodulator

Mapher-110 for 110 V operation
Mapher-220 for 220 V operation

Ethernet Support Products

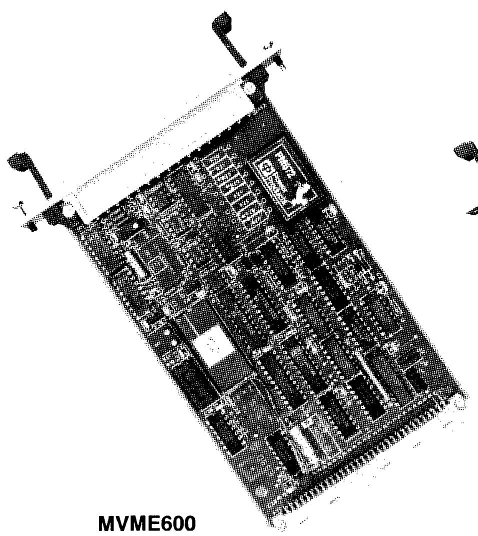
MVME330 Intelligent Ethernet Node Controller

Provides 10 Mb/s Ethernet interface. Includes MC68000 MPU, AM7990 Lance Ethernet Controller, AM7991 Serial I/O Adapter, 128K DRAM and on-board EPROM with power-up self-test routines. Kernel software gives up to 130 1Kb packets/sdata transfer rates. Available with network software including XNS host-resident utilities, drivers, and protocol software for VERSAdos (Suffix VX) and UNIX SYSTEM V/68 (Suffix UX) operating systems.
MVME330-1 with 512K DRAM
MVME330-2 with 512K DRAM and MC68010 MPU

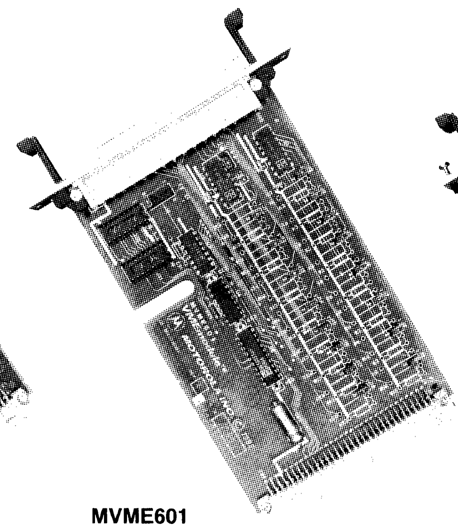
MVME374 Ethernet Control Module

Features Ethernet Controller chip and latest MC68020 microprocessor in conjunction with 1 Mbyte on-chip RAM. This complete front-end processor allows execution of MicroTOP software layers 1–7 on board. Supported by UNIX SYSTEM V/68, Release 2 and Release 3.

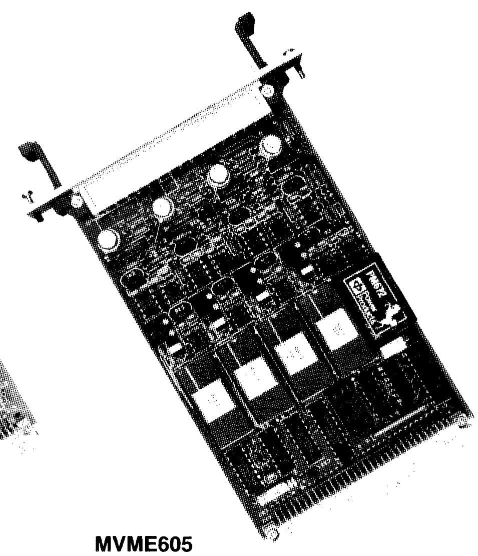
I/O Modules



MVME600



MVME601



MVME605

Typical I/Omodule Configurations

The I/O Channel is a feature of VMEbus systems that permits peripherals of a particular MPU to work on a totally separate bus, dedicated to the MPU exclusively. Thus the main systems bus remains uncluttered by time-consuming processes that can be separately managed by each processor.

The I/O Channel has a 12-bit address bus, 8-bit bidirectional data bus, 4K bytes of memory-mapped I/O, and a data transfer rate of up to 2 Megabytes per second.

Motorola I/Omodules are dedicated to the I/O Channel, and cover the gamut of Input/Output application from general-purpose parallel and serial adapters to dedicated end uses. A number of them are in the Eurocard Format for direct mechanical compatibility with VMEmodule Eurocard packaging.

Industrial I/O modules

MVME600 12-bit A/D Converter Module — provides 8/16 differential/single-ended channels with four full-scale input-voltage ranges of 0.5, 1, 5, or 10 V. The 16-channel multiplexer will accept additional inputs from up to five MVME601 expander input cards. An A/D Input Expander Module, MVME601, adds 8/16 additional differential/single-ended channel inputs to above.

MVME605 12-bit D/A Converter Module — provides four channels of 12-bit D/A conversion with five voltage output ranges of 0–0.5, 0–10, +2.5, +5, and +10 V and two current loop output ranges of 4 to 20 mA and 10 to 50 mA.

MVME610 AC Input Module — monitors status of up to eight 120/240 Vac sources; max input is 300 Vac with isolation to 2500 Vac.

MVME400 Dual Channel RS-232-C Communication Module — provides two I/O Channel compatible, full duplex, serial I/O ports; software and jumper selection enables sync/async baud rates of 50 to 19.2K bits as a terminal or modem.

MVME410 Dual 16-Bit Parallel I/O Module — provides four independent 8-bit ports with 2 handshake lines per port. Outputs provide Centronics type parallel interface for 2 printers.

MVME420 SASI Bus Peripheral Interface Adapter Module — provides single host non-arbitrating SA4400 disk controller interface for I/O Channel.

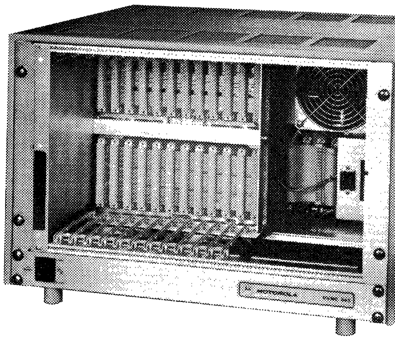
MVME435A Magnetic Tape Interface Adapter Module — provides 1/2″ 9-track, 4K-bit FIFO buffer and interface for two industry standard 9-track 800/1600 bpi magnetic tape formatters, each controlling four 25-/125-ips tape drivers in start/stop mode.

MVME615/616 AC Output Module (Zero Crossover — provides means of switching eight independent outputs of 120/240 Vac; maximum current switching is 3 A rms.

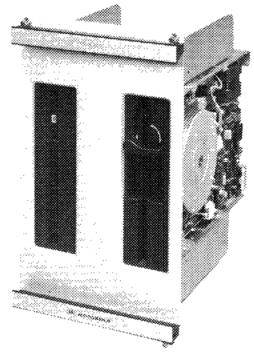
MVME620 DC Input Module — provides eight input channels for 10-to-60 Vdc signal monitoring. Inputs have 2500 volt isolation and provide input overvoltage and transient protection.

MVME625 DC Output Module — provides eight 10–60 Vdc output pairs, each with 2500 volt isolation, inductive load transient suppression, and overcurrent protection. Current limit is 2 A.

VMEmodule Accessories



MVME945-1



MVME822

VME Chassis

19″ rack mount chassis available with and without power supplies and with a variety of slot options to accommodate a number of different board complements.

MVME940-1 Chassis with 200-watt power supply has 7-slot backplane for double-high VMEmodules, and two 5-slot I/Omodule backplanes with single-high hardware and cables. Switching power supply provides 5 V at 30 A, 12 V at 3 A and −12 V at 1 A with overvoltage and overload protection.
MVME941 — Card cage only, without power supply.
MVME942 — Card cage only, with 20-slot double-high VMEbus backplane

MVME943-1 Chassis with 400-watt power supply offers 9-slot double-high VMEbus backplane, two 3-slot single-high I/O Channel backplanes and 16-slot backplane for I/O Transition Modules. Accepts MVME820/821/822 Mass Storage Modules.

MVME945-1 Chassis with 400-watt power supply has 12-slot double-high VMEbus backplane and 16-slot backplane for I/O Transition Modules. Accepts MVME833 and MVME 834 Mass storage Modules.
MVME945I/O — I/O Channel expansion kit for MVME945.

Plug-in Mass Storage Modules

MVME820 — For MVME943 chassis. Has 15Mb Winchester hard-disk drive and 655Kb DS/DD 5-1/4″ floppy disk drive. Requires Controller Module MVME320A-1.

MVME821 — As above, but with two 5-1/4″ floppy disk drives.

MVME822 — Same as MVME820, but with 40 Mb hard-disk drive.

MVME833 — For MVME945 chassis. Has 70Mb Winchester hard disk and one 655Kb DS/DD 5-1/4″ floppy disk drive. Requires MVME320A-1 Controller Module.

MVME834 — Same as above, but with an additional Q1-2C 1/4″ tape drive with formatter. Requires additional MVME350 Tape Controller.

I/O Transition Modules

Transition Modules provide standard connectors and other interface functions, e.g. level conversion, termination resistors, etc. required for specific VME and I/O Modules.

MVME701A — For MVME050 System Controller Module.

MVME702A — For MVME320 Intelligent Floppy/Winchester Interface Module.

MVME705A — For MVME331/332 Intelligent Serial Interface Module.

MVME707A — For MVME130 Series of Monoboard Microcomputers.

MVME708-1 — As above, for MVME117-3FP Monoboard Microcomputer.

MVME710 — For MVME332/MVME332XT Monoboard Microcomputers.

MVME711 — For MVME321 Intelligent Floppy/Winchester Interface Module.

MVME717 — For MVME327A Interface Module.

MVME794-1 — For MVME393 Graphics Display Controller. Supports 4 displays at 1024 x 256 x 4.

MVME794-2 — As above, but supports 8 displays.

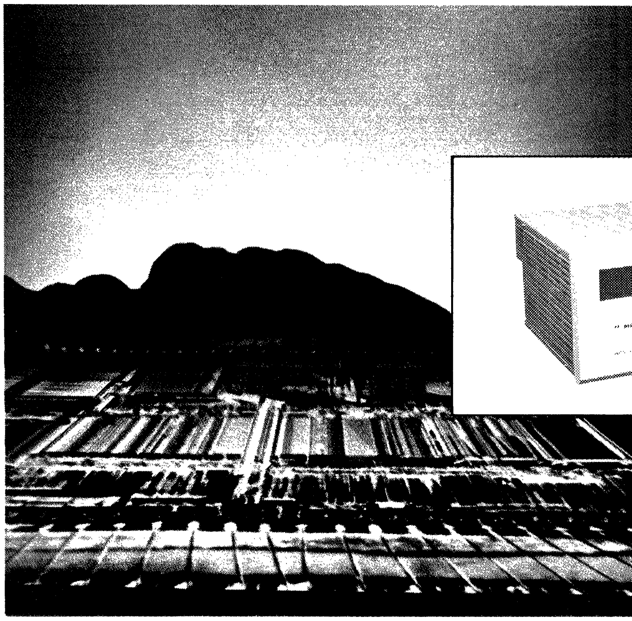
MVME712M — For MVME147 Series of Monoboard Microcomputers.

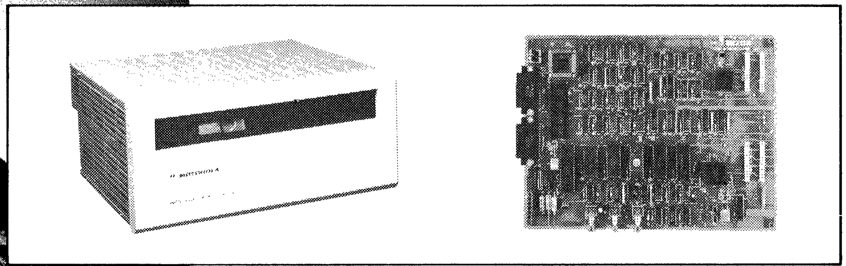
DeltaLink VME HUB Module

Double-High Eurocard Module provides six links, with 1Mbps full duplex transmission per link over two pairs of twisted wires. Services 12 concurrent DMA channels. Contains 6 "X.25" controller chips and 128 Kbytes of 100 ns global RAM. Supports up to six SYS336M16 Servers.

DeltaLink Server

Supports up to 16 RS232 asynchronous devices using retransmission protocol. Communicates with MVME336 over two pairs of twisted wires.





Microcomputer Development Products

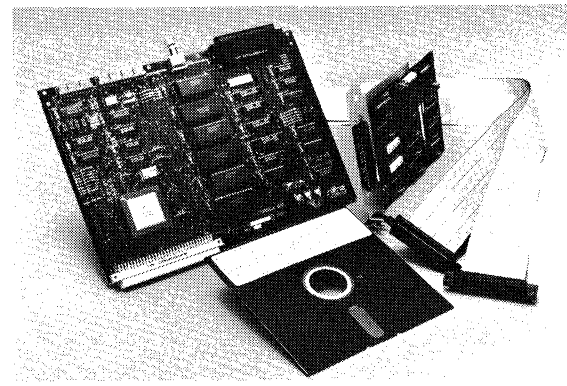
In Brief . . .

Motorola supports its microcomputer component lines with an array of system development tools that meets the full range of customer needs. Two types of capabilities are represented within this product category. The first is a product evaluation capability for basic MCU/MPU chips — a series of functional single board microcomputers, utilizing the appropriate MCU/MPU, which allows the user to fully evaluate chip capabilities under actual operating conditions. The second is a full-featured system analysis and debugging capability using hardware/software stations for detailed investigation of all aspects of an operating program. These capabilities are continually upgraded with the latest component complements, and with software that fully exercises the complete spectrum of system development requirements.

DSP Development System

DSP56000ADS

For DSP56000 Family Products



The DSP56001-based Application Development System (ADS) is a three-component development tool for designing, debugging, and evaluating DSP56000 and DSP56001 target system equipment. The ADS simplifies evaluation of the user's prototype hardware/software product by making all of the essential DSP56000 timing and I/O circuitry easily accessible.

Versions of the ADS are available for the IBM PC and the Macintosh II personal computers. The personal computer acts as the medium between the user and the DSP56000 hardware. The three ADS components are an Application Development Module (ADM) board, a personal computer bus interface board, and a user interface program that runs on the personal computer and interacts with the user, controlling as many as eight ADMs simultaneously. Using a low cost personal computer significantly decreases the overall hardware complexity and cost of development while increasing the capabilities of the system.

DSP algorithm development is simplified with features such as multiple personal computer file I/O capability to the ADM under DSP56001 program control and immediate access to a hex/fractional/decimal calculator. The ADS is fully compatible with the DSP56000CLASx design-in software package and may act as an accelerator for testing DSP56000 family algorithms.

DSP programs may be executed real-time, single instruction traced, or multiple instruction stepped with registers and/or memory block contents displayed.

As many as 99 conditional and/or nonconditional breakpoints may be placed in ADM program memory. Breakpoints may have actions associated with them or may cause an immediate halt and display of enabled registers.

The ADM hardware provides 8K words of user configurable high speed RAM and 1K to 4K words of high speed user program ROM with no wait states required. The ADM provides easy access to all DSP56001 pins via a 96 pin euro-card female connector. This enables the user to design full speed application circuits which may be connected to the DSP56001 using standard euro-card prototype boards.

Two additional connectors provide easy access to the DSP56001 on-chip peripheral circuits. Dedicated Host/DMA and SSI/SCI connectors allow easy access to the host interface port as well as both serial interface ports.

Jumper options allow changing clock inputs, DSP56001 operating mode on reset, reconfiguration of RAM partitioning between Program, X or Y memory spaces, and address relocation of RAM and/or ROM.

Hardware features include:
- Full speed operation at 20.48 MHz
- Multiple ADM support with programmable ADM addressing
- 8K words of configurable RAM for DSP56000/1 code development
- 1K words of monitor ROM expandable to 4K words
- 96 pin euro-card connector for accessing all DSP56001 pins
- Separate connectors for accessing serial or host/DMA ports
- Stand-alone operation of ADM after initial development
- No external supply required when connected to IBM PC or Macintosh II

The minimum hardware requirements for the DSP56000 ADS User Interface Program include:
- IBM PC, XT, or AT with 384K bytes of RAM and PC-DOS/MS-DOS v2.1 or later

  or
- Macintosh II with 1M bytes of RAM and MAC0S4.1

Software features include:
- Single/multiple stepping through DSP56000 object programs
- Conditional or unconditional 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 that support multiple ADM development
- Hexadecimal/decimal/binary calculator
- Personal computer system commands from within ADS user interface program
- Multiple personal computer input/output file access from DSP56000 object programs

Hardware Development Stations

HDS-300 (M68HDS300)

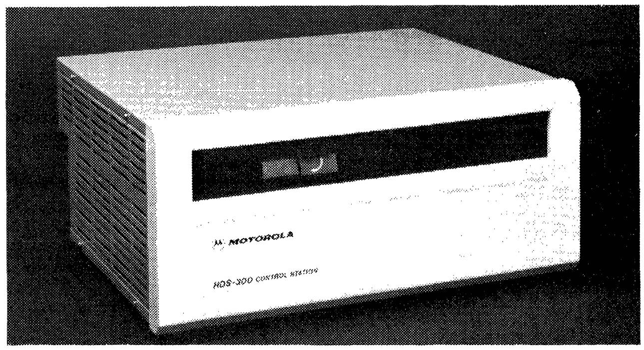
For M68000/M6800-Based Systems

The HDS-300 is the most powerful development support tool in the Motorola line. It serves as the key link between a Host system and a target system under development. It provides a quick, user-friendly way to reduce engineering costs and to minimize project risk. It represents a new generation in development support instrumentation.

The HDS-300 can operate either stand-alone or with a development Host system. With the Hosted HDS-300 System you develop your software on an RS-232-C compatible development host, then download the object code into the HDS-300 for target emulation and debug. When performing source-level debug, a hosted HDS-300 displays source and compiled code to allow easy modification or step-by-step analysis at either level. The HDS-300 one-line assembler/disassembler speeds up software development; its internal Bus State Monitor provides trace history and real-time trace analysis with disassembly. Window support allows easy examination of the trace history and, to streamline debugging and code verification, a versatile breakpoint capability allows up to 6 breakpoints to be active simultaneously.

All these features, plus user macros, emulation memory, target status analysis, thorough on-line HELP screens and user-friendly "windows" make the development process simpler and more effective.

An HDS-Development Station consists of two separate entities — a Control Station and an Emulator Module. The Control Station contains the common control, logic, and memory functions needed to control emulation. The Emulator Module contains the specific MPU/MCU which the station is to emulate, together with supporting control circuitry. Hence, there are different Emulator Modules for different target MPU/MCUs.



HDS-200 (M68HDS201A)

For M6804/05-Based Systems

Not every development project demands the performance capabilities of the full-function HDS-300 System. For less demanding development tasks, Motorola offers the HDS-200 Hardware Development Station.

The HDS-200 Hardware Development Station is the tool of choice for low-cost, real-time emulation for the 8-bit MCU Families.

The HDS-200 features real-time emulation, sixteen prioritized and programmable breakpoints, line-by-line assembler/disassembler, program trace display, HELP commands, and a transparent operation mode. All these features are designed to assist your hardware and software development . . . and to do it cost-effectively.

To support low-cost real-time emulation, Motorola offers a number of emulators for the HDS-200. These modules provide a quick interconnection between the HDS-200 and the target system. By plugging directly into the MCU/MPU socket on the target system, these emulator modules provide the proper electrical connections and interfaces to duplicate the performance of the normal MCU/MPU function.

Control Station/Emulator Combinations

M68000 Families

MPU/MCU	Control Station	Emulator
MC68020 20 MHz	M68HDS300	M68020HM3C-1 (64Kb) -2 (256Kb) -3 (1Mb)
25 MHz		-4 (64Kb) -5 (256Kb) -6 (1Mb)
MC68010		M68010HM3A,B,C
MC68008		M68008HM3A,B
MC68000		M68000HM3A,B,C

M6800 Families

MPU/MCU	Control Station	Emulator
M68HC11	M68HDS300	M68HC11ANHM3A,B
M6801,U4		M6801HM3A
MC6803,U4		
MC6809,E		M6809HM3A
MC68HC05C4,8		M68HC05CHM3A,B
	M68HDS201A	M68HC05CHMA,B
MC6804J2,P2		M6804P2HM
MC6805P2 R2,3 S2 U2		M6805P234HM RU23HM S2HM RU23HM
MC146805E2 F2 G2		M146805E2HM F2HM G2HM

Host Development System

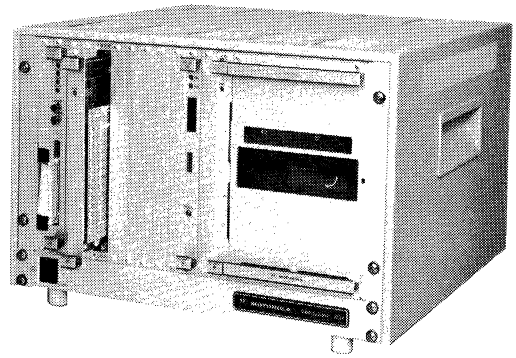
M68DVLP

The M68DVLP Host Development System includes the hardware and software tools for cross development of software for the Motorola microprocessor families. Also, this system serves as the host system when used with the HDS-300 control station for in-circuit-emulation of the microprocessor.

For software development, your systems development team is supported with a complete multi-user, cross development environment. Running the programmer-acclaimed System V/68 operating system, the M68DVLP brings the software development and control environments of UNIX with the power of the 16.67 MHz MC68020 and MC68881 to satisfy the system designers' needs. This system is licensed to support 1 to 8 users.

Software included with the M68DVLP allows cross software development for Motorola's 8-bit and 16-bit microprocessors: cross assembler and linker for the M6800/04/05/09/HC11 family, C language cross compiler for the MC68HC11, macro cross assembler and linker for the MC68000/008/010, and C-language cross compiler for the MC68000/008/010 are all included with the package. In addition a code/file migration utility called the VERSAdos Tool Kit is included for users of early VERSAdos development systems who are migrating to the System V/68 operating system. Cross development software for Motorola's 32-bit MC68020/030 microprocessors is separately available.

The paged, virtual memory operating of System V/68 is supported by 2M bytes of main memory and a 70M byte winchester disk. Disk backups are facilitated by the 60M byte QIC-2 streaming tape drive. Software transports and updates are supported by a 655K byte 5-1/4″ floppy disk drive. Serial interfaces support 7 terminals or any combination of RS-232 and RS-422 serial input/output devices. One interface is available for a parallel device, such as a parallel printer.



Host Development System

The Motorola host development system and the HDS-300 control station is combined with the appropriate emulator module to accomplish real time in-circuit-emulation and source level debug. The system designer develops code on the host and downloads it to the HDS control station for execution in the emulator. Using a terminal attached to the host system, the system designer can debug aspects of both software and hardware design in the target system via the control station and in-circuit-emulator. Also, this configuration is used with Motorola's C compiler and optional Source-Level Debug software to debug the code in the target system at the C source code level rather than debug the code at the machine code or assembly code lower levels.

Supplementary Support Products

System Performance Analyzer

M68HDS300SPA

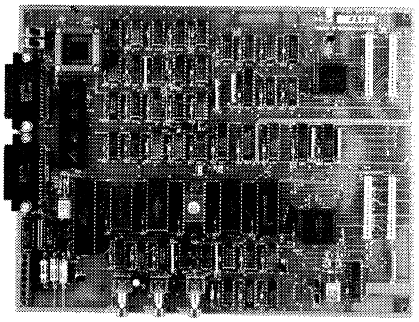
For 32-bit MC68020 designs, the System Performance Analyzer (SPA) offers advanced bus analysis capability to augment the HDS-300's Bus State Monitor (BSM). The SPA supports the MC68020 MPU design at clock rates of up to 20 MHz, and comes with a trace history memory and a state controller. The SPA has the flexibility to program up to 16 independent trace blocks, set seven different breakpoints, trigger on up to four complex 8-bit count events, and capture 4000 qualified bus cycles.

Source Level Debugger

M68NNXBSLD20 — for MC68020 MPU
BSLD00 — for MC68010/68008/68000
M68NEXBSLD11 — for MC68HC11

This debugging tool is available with the hosted HDS-300. Source Level Debug (SLD) enables you to debug code written in the popular "C" high-level language. The window-based debugger allows you to view and manipulate the target system via source code. Key features of the SLD include single stepping, free running execution, restart execution from the beginning of the application, and the ability to set breakpoints at the source line, function, or physical address. With it, you can quickly see how the compiler handled your source code, instruction by instruction, then reprogram where necessary.

Product Evaluation Modules/Boards



M68HC11EVM

Motorola evaluation products provide an economical means of designing, debugging, and evaluating Microprocessor Units (MPUs) and/or Microcontroller Units (MCUs) and peripheral devices in target system equipment. Low cost evaluation modules (EVMs) are available for all major MPU/MCU device families.

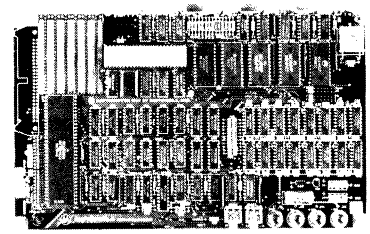
RS-232C compatible terminal/host computer I/O ports and MCU extension I/O ports are provided on all EVMs. Monitor debugging firmware, one-line assembler/disassembler, EPROM/EEPROM MCU programming, and host computer down-loading capabilities are available on all EVMs.

Requiring only a power supply and RS-232C compatible terminal for operation, EVMs assist in software development and hardware evaluation (emulation/simulation). The primary benefit of an EVM is the ability to execute code for performance checking the MPU/MCU device in a target system environment.

The Evaluation Board (EVB) performs similar EVM operations but has more limited capabilities and features.

MC68000 Educational Computer Board

MEX68KECB



MEX68KECB

The MEX68KECB Educational Computer Board serves as an economical instruction tool for systems based on the MC68000 microprocessor. It contains a resident 4 MHz MC68000 MPU and features a 64K byte memory map. Appropriate firmware is contained in a 16K byte EPROM addressed as an 8K by 16 block of memory. Two RS-232C serial ports are implemented with MC6850 ACIAs and an MC14411 baud rate generator, allowing data rate selection from 110 to 9600 baud. The board features both a parallel printer interface and an audio cassette interface, permitting an audio recorder to store and retrieve user programs.

The on-board firmware provides a combined programming and operating environment with debug/monitor functions, program entry, assembling, disassembling and I/O functions. The assembler/disassembler allows programs to be entered, displayed and modified in assembly language.

The debug functions include memory display/modify, register display/modify, program trace, breakpoints, program execution and data conversion.

The Education Board provides an ideal, low-cost, first acquaintance with high-level microcomputer operation. Requires a +12 V, −12 V and +5 V power source.

8-Bit Evaluation Modules/Boards

EVALUATION MODULES/ BOARDS	DEVICE SUPPORTED																								
	MC6801	MC6801U4	MC68701	MC68701U4	MC6803	MC6803U4	MC6804J1/J2	MC6804P2	MC68704P2	MC68HC04J2/P3	MC6805P2/P4/P6	MC6805R2/R3	MC6805U2/U3	MC68705P3/P5	MC68705R3	MC68705U3/U5	MC68HC05A6	MC68HC05B6	MC68HC05C2/C3/C4/C8	MC68HC05L6	MC68HC805C4	MC68HC11A0/A1/A8	MC68HC11E9	MC68HC811A2	MC68HC99
M68701EVM	√	√	√	√	√	√																			
M68705EVM											√	√	√	√	√	√									
M68HC04EVM							√	√	√	√															
M68HC05EVM																	√	√	√	√	√				
M68HC11EVM																						√	√	√	
M68HC99EVM																									√
M68HC11EVB																						√	√	√	

Part Number Descriptions

Part	Description
Software Development Host	
M68DVLP	Host System including 8-, 16-, 32-bit Languages and Tools
M68DVLP2	220 V Version of M68DVLP
Hardware/Software Development Station	
M68HDS201A	HDS-200 Control Station
M68HDS202A	220 V Version of HDS-200 Control Station
M68HDS300	HDS-300 Control Station
M68HDS302	220 V Version of HDS-300 Control Station
Source Level Debugger	
M68(HTM)*BSLD	M68HC11 Source Level Debug Object for C Compiler
M68(HTM)*BSLD00	M68000/008/010 Source Level Debug for HDS-300
M68(HTM)*BSLD20	M68020 Source Level Debug for HDS-300
M68(HTM)*BSLD30	M68030 Source Level Debug for HDS-300
Emulator Module (POD)	
M146805E2HM	MC146805E2 Emulator Module and Software for HDS-200
M146805F2HM	MC146805F2 Emulator Module and Software for HDS-200
M146805G2HM	MC146805G2 Emulator Module and Software for HDS-200
M68HC05CHMA	MC68HC05C4/8 Emulator Module with DIP Cable for HDS-200
M68HC05CHMB	MC68HC05C4/8 Emulator Module with PLCC Cable for HDS-200
M68HC05CHM3A	MC68HC05C4/8 Emulator Module with DIP Cable for HDS-300
M68HC05CHM3B	MC68HC05C4/8 Emulator Module with PLCC Cable for HDS-300
M68HC11ANHM3A	MC68HC11A Emulator Module with DIP Cable for HDS-300
M68HC11ANHM3B	MC68HC11A Emulator Module with PLCC Cable for HDS-300
M68HC11ENHM3A	MC68HC11E Emulator Module with DIP Cable for HDS-300
M68HC11ENHM3B	MC68HC11E Emulator Module with PLCC Cable for HDS-300
M68000HM3A	MC68000 Emulator/Bus State Monitor Module with DIP Cable for HDS-300
M68000HM3B	MC68000 Emulator/Bus State Monitor Module with PLCC Cable for HDS-300

Part	Description
Emulator Module (POD) — continued	
M68000HM3C	MC68000 Emulator/Bus State Monitor Module with PGA Cable for HDS-300
M68008HM3A	MC68008 Emulator/Bus State Monitor Module with DIP Cable for HDS-300
M68008HM3B	MC68008 Emulator/Bus State Monitor Module with PLCC Cable for HDS-300
M6801HM3A	MC6801/701/01U4/701U4/03/03U4 Emulator Module for HDS-300
M68010HM3A	MC68010 Emulator/Bus State Monitor Module with DIP Cable for HDS-300
M68010HM3C	MC68010 Emulator/Bus State Monitor Module with PGA Cable for HDS-300
M68020HM3C-1	20 MHz MC68020 Emulator Module with 64K RAM and PGA Cable for HDS-300
M68020HM3C-2	20 MHz MC68020 Emulator Module with 256K RAM and PGA Cable for HDS-300
M68020HM3C-3	20 MHz MC68020 Emulator Module with 1M RAM and PGA Cable for HDS-300
M68020HM3C-4	25 MHz MC68020 Emulator Module with 64K RAM and PGA Cable for HDS-300
M68020HM3C-5	25 MHz MC68020 Emulator Module with 256K RAM and PGA Cable for HDS-300
M68020HM3C-6	25 MHz MC68020 Emulator Module with 1M RAM and PGA Cable for HDS-300
M68030HM3C-4	25 MHz MC68030 Emulator Module with 64K RAM and PGA Cable for HDS-300
M68030HM3C-5	25 MHz MC68030 Emulator Module with 256K RAM and PGA Cable for HDS-300
M68030HM3C-6	25 MHz MC68030 Emulator Module with 1M RAM and PGA Cable for HDS-300
M6804P2HM	MC6804, J2, P2 Emulator Module and Software for HDS-200
M6805P234HM	M6805P2,P4 and M68705P3 Emulator Module and Software for HDS-200
M6805RU23HM	MC6805R2,R3,U2,U3 Emulator Module and Software for HDS-200
M6805S2HM	MC6805S2 EMU, Firmware Cartridge and Diskettes for HDS-200
M6805T2HM	MC6805T2 EMU, Firmware Cartridge and Diskettes for HDS-200
M6809HM3A	MC6809 Emulator Module and Software for HDS-300

*(HTM) represents the Host, Target, and Media options. Select from choices below to complete the part number.

Host	Target	Media
D = VAX VMS†	E = 6811	G = 3.5″ DSDD Diskette, 800 KB
H = IBM PC MSDOS†	N = M68DVLP SYS V/68, Rel 2.x	H = TK50
W = HDS300	Empty = Target same as host	O = 9 track, 600 ft.
J = Apple Macintosh AOS†		T = Streaming tape M68DVLP is QiC2
N = M68DVLP SYS V/68, Rel 2.x		X = 5.25″ DSDD Diskette

Example: M68JGBCC2A. Binary version of the MC68020 C Compiler operates on the Apple Macintosh, uses 3.5″ DSDD media.
†Notes release in 1988.

Part	Description

System Performance Analyzer

M68HDS300SPA	System Performance Analyzer Module for MC68020 Emulation

Memory Expansion

M68HDS3EMM1	64K EMU Memory Expansion for HDS-300; 68000/008/010, HC11, 6801/03
M68HDS3EMM2	128K EMU Memory Expansion for HDS-300; 68000/008/010
M68HDS3EMM3	256K EMU Memory Expansion for HDS-300; 68000/008/010
M68020MEM2	MC68020 Emulator Memory Expansion to 256K BYTES
M68020MEM3	MC68020 Emulator Memory Expansion to 1M BYTES
M68HDS3FDKT	HDS-300 Second Floppy Drive Kit

Cables/Hardware

M68HC05CDIPT	MC68HC05C4/8 DIP Cable Probe for HDS-300
M68HC05CPCCT	MC68HC05C4/8 PLCC Cable Probe for HDS-300
M68HC11ADIPT	MC68HC11A DIP Cable Probe for HDS-300
M68HC11APCCT	MC68HC11A PLCC Cable Probe for HDS-300
M68HDS3ADPTR	HDS-200 M68HC05C4 Emulation to HDS-300 Adapter Board with S/W
M68000/10DIPT	MC68000/010 DIP Cable Probe for HDS-300
M68000/10PCCT	MC68000/010 PLCC Cable Probe for HDS-300
M68000/10PGAT	MC68000/010 PGA Cable Probe for HDS-300
M68008DIPT	MC68008 DIP Cable Probe for HDS-300
M68008PCCT	MC68008 PLCC Cable Probe for HDS-300

Cross Software

M68(HTM)*BCC20A	MC68020 Cross C Compiler Object, 1–2 Users
M68(HTM)*BCC20B	MC68020 Cross C Compiler Object, 1–8 Users
M68(HTM)*BCC20C	MC68020 Cross C Compiler, 1–16 Users Licensed
M68(HTM)*BCC20D	MC68020 Cross C Compiler, 1–32 Users Licensed
M68(HTM)*BCC20E	MC68020 Cross C Compiler, 1–64 Users Licensed
M68(HTM)*BCC20F	MC68020 Cross C Compiler, >64 Users Licensed

Part	Description

Cross Software — continued

M68(HTM)*BCC2A	MC68030 Cross C Compiler, 1–2 Users Licensed
M68(HTM)*BCC2B	MC68030 Cross C Compiler, 2 Users Licensed
M68KTUTOR-D4	Tutor Source Listing, Rev. 1.3
M68KTUTORS	Tutor Source Code for MEX68KECB on VERSA 8″ Diskette
M68(HTM)*BASM	MC68020 Assembler
M68(HTM)*BCC	MC68K/08/10 C Compiler/Assembler Object, 1–8 Users
M68(HTM)*SASM	MC68020 Assembler Source
M68(HTM)*BPASMLK	PAL Port Assembler/Linker Object
M68(HTM)*SPASMLK	PAL Port Assembler/Linker Source
M68(HTM)*BRASM	M6800/01/04/05/09/11 Cross Assembler/Linker
M68(HTM)*SRASM	M6800/01/04/05/09/11 Source for Cross Assembler/Linker
M68(HTM)*BCC11A	M68HC11 C Compiler/Assembler Linker for 1–2 Users
M68(HTM)*BCC11B	M68HC11 C Compiler/Assembler Linker for 1–8 Users
M68(HTM)*BCC11C	M68HC11 C Compiler/Assembler Linker for 1–16 Users
M68(HTM)*SCC11	M68HC11 Source for C Compiler
M68NNXBTLKT	VERSADOS Tool Kit, System V/68, Object 5.25 Floppy Media
M68W2XBH300D	68020 Release 1.1 Update and SPA Update for HDS-300
M68WEXBH300	68HC11 Release 2.0 Update for HDS-300

MPU Software Support

MC68KTBFA	Token Bus Frame Analyzer (EPROMs for MVME372 Board)

Evaluation Modules

M68701EVM	MC68701, 6801, 6801U4, 6803, 6803U4 Family Evaluation Module
M68HC04EVM	M6804J1,J2,P2, and 68HC04P3 Family Evaluation Module
M68705EVM	MC68705 and 6805P,R, and U Family Evaluation Module
M1468705EVM	M1468705E2,F2,G2 Evaluation Module
M68HC05EVM	M68HC05 Family Evaluation Module
M68HC11EVB	MC68HC11 Family Evaluation Board
M68HC11EVM	MC68HC11 Family Evaluation Module
MEX68KECB	MC68000 Educational Computer Board
M68HC99EVM	MC68HC99/98 Hard Disk Controller Family Evaluation Module

*(HTM) represents the Host, Target, and Media options. Select from choices below to complete the part number.

Host: D = VAX VMS†
H = IBM PC MSDOS†
W = HDS300
J = Apple Macintosh AOS†
N = M68DVLP SYS V/68, Rel 2.x

Target: E = 6811
N = M68DVLP SYS V/68, Rel 2.x
Empty = Target same as host

Media: G = 3.5″ DSDD Diskette, 800 KB
H = TK50
O = 9 track, 600 ft.
T = Streaming tape M68DVLP is QiC2
X = 5.25″ DSDD Diskette

Example: M68JGBCC2A. Binary version of the MC68020 C Compiler operates on the Apple Macintosh, uses 3.5″ DSDD media.
†Notes release in 1988.

Selector Guide

MPU or MCU	Emulator Standard Memory	Control Station	Software Options: Cross Software	Software Options: Source Level Debugger	Other Options: Emulator Memory	Other Options: System Performance Analyzer
MC68020						
20 MHz	M68020HM3C-1 (64KB)	M68HDS300	M68(HTM)*BCC20A, B, C M68(HTM)*BASM	M68(HTM)*BSLD20	M68020MEM2, 3	M68HDS300SPA
	M68020HM3C-2 (256KB)	M68HDS300	M68(HTM)*BCC20A, B, C M68(HTM)*BASM	M68(HTM)*BSLD20	M68020MEM3	M68HDS300SPA
	M68020HM3C-3 (1MB)	M68HDS300	M68(HTM)*BCC20A, B, C M68(HTM)*BASM	M68(HTM)*BSLD20	—	M68HDS300SPA
25 MHz	M68020HM3C-4 (64KB)	M68HDS300	M68(HTM)*BCC20A, B, C M68(HTM)*BASM	M68(HTM)*BSLD20	M68020MEM2, 3	M68HDS300SPA
	M68020HM3C-5 (256KB)	M68HDS300	M68(HTM)*BCC20A, B, C M68(HTM)*BASM	M68(HTM)*BSLD20	M68020MEM3	M68HDS300SPA
	M68020HM3C-6 (1MB)	M68HDS300	M68(HTM)*BCC20A, B, C M68(HTM)*BASM2	M68(HTM)*BSLD20	—	M68HDS300SPA
MC68030						
25 MHz	M68030HM3C-4 (64KB)	M68HDS300	M68(HTM)*BCC2A, B, C M68(HTM)*BASM2	M68(HTM)*BSLD30	M68020MEM2, 3	
25 MHz	M68030HM3C-5 (256KB)	M68HDS300	M68(HTM)*BCC2A, B, C M68(HTM)*BASM2	M68(HTM)*BSLD30	M68020MEM3	
25 MHz	M68030HM3C-6 (1MB)	M68HDS300	M68(HTM)*BCC2A, B, C M68(HTM)*BASM2	M68(HTM)*BSLD30	—	
MC68010	M68010HM3A, B, C	M68HDS300	M68(HTM)*BCC M68(HTM)*BASM	M68(HTM)*BSLD00	M68DHS3EMM1, 2, 3	
MC68008	M68008HM3A, B	M68HDS300	M68(HTM)*BCC M68(HTM)*BASM	M68(HTM)*BSLD00	M68DHS3EMM1, 2, 3	
MC68000	M68000HM3A, B, C	M68HDS300	M68(HTM)*BCC M68(HTM)*BASM	M68(HTM)*BSLD00	M68DHS3EMM1, 2, 3	
MC68HC11A	M68HC11ANHM3A, B	M68HDS300	M68(HTM)*BCC11A, B, C	M68(HTM)*BSLD11	M68DHS3EMM1	
MC68HC11E	MC68HC11ENHM3A, B	M68HDS300	M68(HTM)*BCC11A, B, C	M68(HTM)*BSLD11	M68DHS3EMM1	
MC6801,U4	M6801HM3A	M68HDS300	M68(HTM)*BRASM		M68DHS3EMM1	
MC6803,U4	M6801HM3A	M68HDS300	M68(HTM)*BRASM		M68DHS3EMM1	
MC68HC05C4,8	M68HC05C4HM3A, B	M68HDS300	M68(HTM)*BRASM			
	M68HC05C4HMA, B	M68HDS201A	M68(HTM)*BRASM			
MC6809,E	M6809HM3A	M68HDS300	M68(HTM)*BRASM			
MC6804J2,P2	M6804P2HM	M68HDS201A	M68(HTM)*BRASM			
MC6805P2,5	M6805P234HM	M68HDS201A	M68(HTM)*BRASM			
MC68705P3	M6805P234HM	M68HDS201A	M68(HTM)*BRASM			
MC6805R2,3	M6805RU23HM	M68HDS201A	M68(HTM)*BRASM			
MC6805S2	M6805S2HM	M68HDS201A	M68(HTM)*BRASM			
MC6805T2	M6805T2HM	M68HDS201A	M68(HTM)*BRASM			
MC6805U2,3	M6805RU23HM	M68HDS201A	M68(HTM)*BRASM			
MC146805E2	M146805E2HM	M68HDS201A	M68(HTM)*BRASM			
MC146805F2	M146805F2HM	M68HDS201A	M68(HTM)*BRASM			
MC146805G2	M146805G2HM	M68HDS201A	M68(HTM)*BRASM			

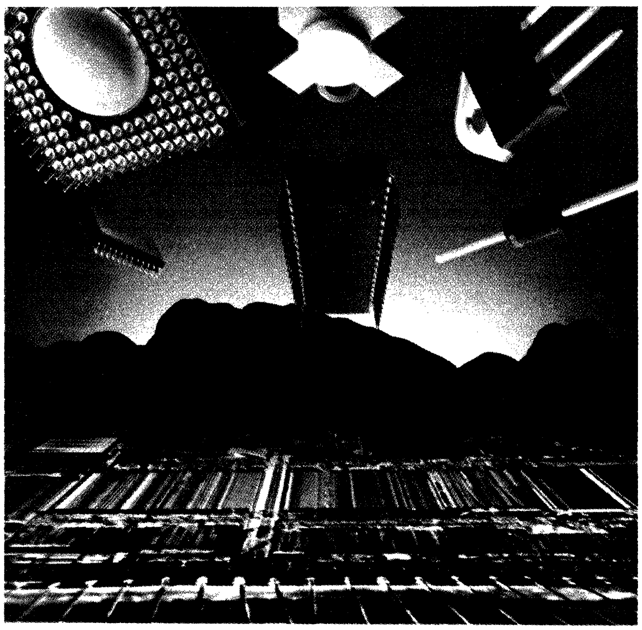
*(HTM) represents the Host, Target, and Media options. Select from choices below to complete the part number.

Host: D = VAX VMS†
H = IBM PC MSDOS†
W = HDS300
J = Apple Macintosh AOS†
N = M68DVLP SYS V/68, Rel 2.x

Target: E = 6811
N = M68DVLP SYS V/68, Rel 2.x
Empty = Target same as host

Media: G = 3.5″ DSDD Diskette, 800 KB
H = TK50
O = 9 track, 600 ft.
T = Streaming tape M68DVLP is QiC2
X = 5.25″ DSDD Diskette

Example: M68JGBCC2A. Binary version of the MC68020 C Compiler operates on the Apple Macintosh, uses 3.5″ DSDD media.
†Notes release in 1988.



Standard Logic Families

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 semi-custom designs. It does so with three technologies:

ECL (four unique families), for highest speed

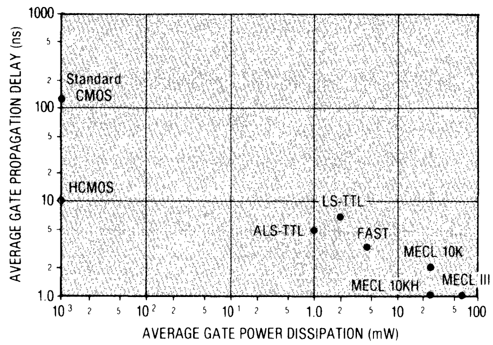
TTL (two families), for high performance at lowest cost

CMOS (three families), for lowest power dissipation.

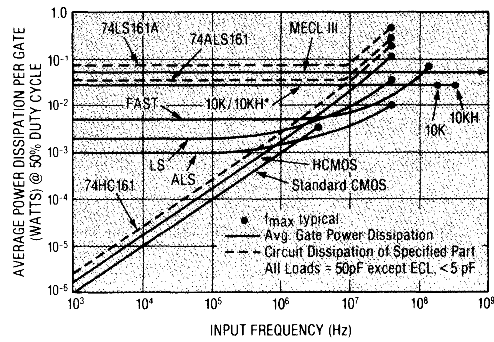
In each category, the selection of available functions permits cost-effective designs with the smallest number of individual packages.

Standard Logic Families

LSTTL:	SN54/74LS Series	**MECL10K:**	MC10000 Series	**Standard CMOS:**	MC14000 Series
FAST:	MC54/74F Series	**MECL10KH:**	MC10H000 Series	**High-Speed CMOS:**	MC54/74HC Series
		ECLinPS:	MC10E/100E Series	**FACT:**	MC74AC(T) Series
		MECL III:	MC1600 Series		



Graph 1 — General Comparison of Speed/ Power Characteristics



Graph 2 — Variations in Power Dissipation as a Function of Operating Frequency

The variety of established and newly introduced logic families challenges the system designer with choosing the best available technology for each design. Each family offers distinct advantages and limitations.

The three most often used characteristics for determining family selection are propagation delay, operating frequency, and power consumption. For Motorola logic families, these characteristics are displayed and compared in the graphs above.

Technical Comparisons

Schottky TTL

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-to-30 percent improvement in performance over the older Standard Schottky family (74S) with a 75-to-80 percent reduction in power. When compared with the Advanced Schottky family (74AS), FAST offers nearly equal performance at a 25-to-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, allowing the FAST family to be designed and specified with improved noise margins, reduced input currents, and superior line driving capabilities. 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. And Motorola's dc and ac characteristics for FAST are specified over a full 10% supply voltage range — a significant improvement over earlier families (5% for dc, 0% for ac) and a considerable improvement over the prevalent FAST standards covering only a 5% range for both dc and ac.

SPEED/POWER CHARACTERISTICS FOR SCHOTTKY TTL LOGIC
(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

MECL (ECL)

Motorola's Emitter Coupled Logic (MECL) is a nonsaturating 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		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

ECLinPS INTRODUCTION SCHEDULE

MC10/ MC100	Function	Features	Output Type	XC Prodn	MC Prodn
E111	1:9 Differential Clock Driver	Low Skew, Enable, V_{BB}	Diff.	Now	3Q88
E142	9-Bit Shift Register, 500 MHz	Async. Reset	SE	Now	3Q88
E155	6-Bit 2:1 Mux-Latch	Common Enable, Reset	SE	Now	3Q88
E167	6-Bit 2:1 Mux-Register	Common CLK, Reset	SE	Now	3Q88
E143	9-Bit Hold Register, 500 MHz	Async. Reset	SE	Now	3Q88
E336	3-Bit Registered Cutoff Bus XCVR	25 Ohm Cutoff Outputs	Diff.	Now	3Q88
E151	6-Bit D Register	Common CLK, Reset	Diff.	Now	3Q88
E158	5-Bit 2:1 Multiplexer	Common Select	Diff.	Now	4Q88
E154	5-Bit 2:1 Mux-Latch	Common Enable, Reset	Diff.	Now	4Q88
E131	4-Bit D Flip-Flop	Individual CLK, Reset	Diff.	Now	4Q88
E171	3-Bit 4:1 Multiplexer	Split Select	Diff.	Now	4Q88
E156	3-Bit 4:1 Mux-Latch	Common Enable, Reset	Diff.	Now	4Q88
E160	12-Bit Parity Generator/Checker	Register — Shiftable	Diff.	3Q88	4Q88
E451	6-Bit D Reg., Diff. Data & CLK Inputs	V_{BB}, Common Reset	SE	3Q88	4Q88

All resets are asynchronous. Diff. = Differential, SE = Single Ended.
XC = Non reliability qualified production. MC = Fully qualified production.
Schedule dates subject to change. Contact sales office for verification.

CMOS

Complementary MOS (CMOS) technology provides the lowest power consumption logic circuits available.

Motorola currently offers three versions of CMOS logic: Standard (MC14000 Series) CMOS in metal gate technology, High-Speed (HC) CMOS in silicon-gate technology, and the latest sub-two micron (FACT) silicon-gate technology.

Standard CMOS logic is best suited for systems which require low power, medium speed operation. It offers a wide operating voltage range (3 to 18 V) and the highest noise immunity of any logic family. Standard CMOS circuits are classified as B or UB series devices, in accordance with JEDEC Standard 13-B. UB series gates and inverters are constructed with a single inverting stage between input and output, as opposed to multiple gain stages in the B series. The subsequent decreased gain in the UB series results in less noise immunity; however, these UB devices exhibit higher speed since only a single stage is involved.

A full line of High Speed CMOS devices (54/74 HC) was developed to be both pinout and functionally equivalent to the most popular LSTTL parts. The HC family also contains devices that are pinout and functionally equivalent to some of the more popular MC14000B series CMOS parts.

The silicon-gate processing technology allows the HC family to combine the fast switching speeds of LSTTL with the low power-consumption advantages and the high noise immunity.

High-Speed CMOS logic circuits can directly interface with LSTTL/NMOS inputs; with pullup resistors HC devices can be driven by LSTTL/NMOS outputs. An alternative method is to use an HCT interface device which accepts LSTTL input levels without the aid of pullup resistors.

FACT devices are faster than any previous CMOS technology, approaching even the speed of advanced bipolar products. In addition, they provide wide logic fanout and higher noise margins than most of its competitors. They are designed to be directly interchangeable with slower-speed CMOS and equivalent bipolar products.

Motorola's initial FACT introductions are given in the table below. They are directly interchangeable with FACT devices from National Semiconductor Corporation, and the Motorola product family is expected to expand rapidly into a full-function line of over 100 devices.

SPEED/POWER CHARACTERISTICS FOR CMOS LOGIC

(ALL TYPICAL RATINGS)

Characteristic	Symbol	Standard CMOS (15 V)	Hi-Speed CMOS (6 V)	FACT	Units
Quiescent Supply Current/Gate	I_G	0.0001	0.0003	0.0002	mA
Power/Gate (Quiescent)	P_G	0.0006	0.001	0.001	mW
Propagation Delay	t_p	50	8.0	5.0	ns
Speed Power Product	—	0.030	0.01	0.01	pJ
Clock Frequency (D-F/F)	f_{max}	14	40	160	MHz
Clock Frequency (Counter)	f_{max}	8.0	40	125	MHz

MOTOROLA FACT FUNCTIONS

MC74AC(T★)00 Series, (−40 to +85°C)
(Available in plastic dual-in-line and SOIC packages.)

Gates — NAND

AC/ACT00	Quad 2-Input
AC10	Triple 3-Input

Gates — OR/NOR/Exclusive-OR

AC32/ACT32	Quad 2-Input OR
AC02/ACT02	Quad 2-Input NOR

Inverters/Non-Inverters

AC04/ACT04	Hex Inverter

Schmitt Triggers

AC14/ACT14	Hex Inverter

★ ACT devices have TTL-compatible inputs.

Flip-Flops

AC/ACT74	Dual D w/Set & Clear
AC174	Hex D w/Set & Clear
AC273	Octal D w/Set & Clear
AC/ACT374	Octal D

AND Gates

AC/ACT08	Quad 2-Input
AC/ACT11	Triple 3-Input

Latches

AC/ACT373	Octal D

Counters

AC163	4-Bit Binary
AC4020	14-Stage Binary
AC4040	12-Stage Binary

Multiplexers

AC/ACT151	8-Input
AC153	Dual 4-Input
AC157	Quad 2-Input

Decoders/Demultiplexers

AC/ACT138	1-of-8
AC139	Dual 1-of-4

Buffers/Line Drivers

AC/ACT240	Octal
AC/ACT244	Octal
AC541	Octal

Transceivers/Registered Transceivers

AC/ACT245	Octal

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
MC834	Hex Inverter
MC835	Hex Inverter (without output resistors)
MC836	Hex Inverter
MC837	Hex Inverter
MC838	Decade Counter
MC839	Divide-by-Sixteen Counter
MC840	Hex Inverter (without input diodes)
MC841	Hex Inverter (without output resistors and input diodes)
MC843	4 Input AND Driver with NOR Strobe
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
MC939	Divide-by-Sixteen Counter
MC940	Hex Inverter (without input diodes)
MC941	Hex Inverter (without output resistors and 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
MC950	Pulse Triggered Binary
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
MC665	Triple Level Translator
MC666	Triple Level Transistor
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)
MC673	Dual 2-Input AND-OR-INVERT Gate
MC674	Dual 2-Input AND-OR-INVERT Gate
MC675	Dual Pulse Stretcher
MC677	Hex Inverter With Strobe (active pullup)
MC678	Hex Inverter With Strobe (without output resistors)

Available Functions

Functionally Comparable Logic Integrated Circuits

The following table offers a quick guide to logic circuits in the various families available from Motorola. Devices within a single (horizontal) row perform similar functions. Pinout configuration are generally identical when the numbers in a row correspond, although there may be exceptions. Consult the appropriate data book for specific details.

The numbers in the (vertical) columns are suffixes that follow the basic line prefixes associated with each specific logic family. These prefixes are as follows:

TTL		CMOS		MECL		
LS	FAST	STD	HC ★	10K	10KH	III
PREFIXES						
SN54/74LS	MC54/74F	MC14	MC54/ 74HC	MC10	MC10H	MC

Thus, the TTL LS Quad 2-input gate (item 1 in the table) can be ordered under the part number SN54LS08 (or SN74LS08). Similarly, the MECL 10KH Quad 2-input gate can be ordered as MC10H104.

Function	TTL LS	TTL FAST	CMOS STD	CMOS HC★	Package*	MECL 10K	MECL 10KH	MECL III	Package*
AND Gates									
Quad 2-Input	08	08	081	08	632	104	104		620
Quad 2-Input, Open-Collector	09				646				648
Triple 3-Input	11	11	073	11					
Triple 3-Input, Open-Collector	15								
Dual 4-Input	21	21	082						
Hex						197			
NAND Gates									
Quad 2-Input	00	00	011	**00**	632				
Quad 2-Input, Open-Collector	01				648				
Quad 2-Input, Open-Collector	03			**03**					
Quad 2-Input, High-Voltage	26								
Quad 2-Input Buffer	37								
Quad 2-Input Buffer, Open-Collector	38								
13-Input	133			133	620,648				
Triple 3-Input	10	10	023	10	632				
Triple 3-Input, Open-Collector	12				648				
Dual 4-Input	20	20	012	20					
Dual 4-Input, Open-Collector	22								
Dual 4-Input Buffer	40								
8-Input	30		068	30					
Quad 2-Input NAND with Schmitt Trigger Inputs	132		093	132					
OR Gates									
Quad 2-Input	32	32	071	32	632	103	103	1664	620
Dual 3-Input 3-Output					646	110			648
High-Speed Dual 3-Input 3-Output						210	210		
Triple 3-Input			075	4075					
Dual 4-Input			072						

(continued)

Temperature Ranges:
TTL 54 Series: −55 to +125°C
TTL 74 Series: 0 to +70°C
CMOS 54/74 Series: −55 to +125°C
CMOS MC14...A Series: −55 to +125°C
CMOS MC14...C Series: −40 to +85°C
MECL 10K/MECL III: −30 to +85°C
MECL 10KH: 0 to 75°C

*See Surface Mount section for SO and PLCC packages.

★ Bold face type numbers are available in both HC and HCT versions.

Function	TTL		CMOS			MECL			
	LS	FAST	STD	HC★	Package*	10K	10KH	III	Package*
NOR Gates									
Quad 2-Input	02	02	001	02(36)	632	102	102	1662	620
Quad 2-Input Buffer	28				646				648
Quad 2-Input Buffer, Open-Collector	33								
Dual 5-Input	260								
Triple 3-Input	27		025	27					
Quad 2-Input with Strobe						100	100		
Triple 4-3-3 Input						106	106		
Dual 3-Input 3-Output						111			
High-Speed Dual 3-Input 3-Output						211	211		
Dual 3-Input, plus Inverter			000						
Dual 4-Input			002	4002					
8-Input			078	4078					
Exclusive OR Gates									
Quad 2-Input	86	86	070	86	632	113	113		620
Quad 2-Input	386				646				648
Quad, Open-Collector	136								
Triple 2-Input								1672	620
Exclusive NOR Gates									
Quad, 2-Input Open Drain Output	266		077		632				
Triple 2-Input					646			1674	620
Quad, 2-Input				7266					
Complex Gates									
Quad OR/NOR					632	101	101		620
Triple 2-3-2 Input OR/NOR					646	105	105	1688	648
Triple 2-Input Exclusive OR/Exclusive NOR						107	107		
Dual 4-5 Input OR/NOR						109	109		
Dual 4-5 Input OR/NOR							209		
Dual 2-Wide 2-3 Input OR-AND/OR-AND-Invert						117	117		
Dual 2-Wide 3-Input OR-AND						118	118		
4-Wide 4-3-3-3 Input OR-AND Gate						119	119		
OR-AND/OR-AND-INVERT Gate						121	121		
High-Speed Dual 3-Input 3-Output OR/NOR						212			
Dual 4-Input OR/NOR								1660	
Dual AND-OR-INVERT Gate	51	51	506	51					
3-2-2-3 Input AND-OR-INVERT Gate	54								
2-Wide and 4-Input AND-OR-INVERT Gate	55								
4-2-2-3 Input AND-OR-INVERT Gate		64							
Triple Gate (Dual 4-Input NAND Gate and 2-Input NOR/OR Gate or 8-Input AND/NAND Gate)			501						
4-Bit AND/OR Selector (Quad 2-Channel Data Selector or Quad Exclusive NOR Gate)			519						
Dual 5-Input Majority Logic Gate			530						
Hex Gate (Quad Inverter plus 2-Input NOR Gate plus 2-Input NAND Gate)			572						
2-Wide, 2-Input/2-Wide, 3-Input AND-OR Gate				58					

*See Surface Mount section for SO and PLCC packages.

★ **Bold face type numbers are available in both HC and HCT versions.**

(continued)

FUNCTIONALLY COMPARABLE LOGIC INTEGRATED CIRCUITS (continued)

Function	TTL LS	TTL FAST	CMOS STD	CMOS HC★	Package*	MECL 10K	MECL 10KH	MECL III	Package*
Inverters/Buffers (Non 3-State)									
Hex Inverter	04	04	069	**04**	632				620
Hex Inverter, Open-Collector	05	05		05	646				648
Dual Complementary Pair plus Inverter			007		620				
Hex Buffer			050	4050	648				
Strobed Hex Inverter/Buffer			502						
Hex Buffer with Enable						188	188		
Hex Inverter with Enable						189	189		
Hex Inverter/Buffer			049	4049		195			
Hex Unbuffered Inverter				U04					
Translators									
Quad MTTL to MECL, ECL Strobe					620	124	124		620
Quad TTL to MECL, TTL Strobe					648		424		648
Quad MECL to MTTL						125	125		
Quad MECL to TTL, Single Supply							350		
Triple MECL to NMOS						177			
TTL or CMOS to CMOS Hex Level Shifter			504						
Quad MST-to-MECL 10,000						190			
Hex MECL 10,000 to MST						191			
Bus-Oriented 3-State Circuits									
Quad Buffer, Low Enable, 3-State	125A			**125**	632				
Quad Buffer, High Enable, 3-State	126A			**126**	646				
Octal Bus/Line Driver, Inverting, 3-State	240	240		**240**	732				
Octal Bus/Line Driver, 3-State	241	241		**241**	738				
Quad Bus Transceiver, Inverting 3-State	242	242		242	632				
Quad Bus Transceiver, Noninverting, 3-State	243	243		243	646				
Octal Driver, Noninverting, 3-State	244	244		**244**	732				
Octal Bus Transceiver, Noninverting, 3-State	245	245		**245**	738				
Hex Buffer, Common Enable, 3-State	365A			365	620				
Hex Inverter, Common Enable, 3-State	366A			366	648				
Hex Buffer, 4-Bit and 2-Bit, 3-State	367A		503	367					
Hex Inverter, 4-Bit and 2-Bit, 3-State	368A			368					

(continued)

Temperature Ranges:
TTL 54 Series: −55 to +125°C
TTL 74 Series: 0 to +70°C
CMOS 54/74 Series: −55 to +125°C
CMOS MC14...A Series: −55 to +125°C
CMOS MC14...C Series: −40 to +85°C
MECL 10K/MECL III: −30 to +85°C
MECL 10KH: 0 to 75°C

*See Surface Mount section for SO and PLCC packages.

★ Bold face type numbers are available in both HC and HCT versions.

Function	TTL LS	TTL FAST	CMOS STD	CMOS HC★	Package*	MECL 10K	MECL 10KH	MECL III	Package*
Bus-Oriented 3-State Circuits (continued)									
Octal Buffer (81LS95), 3-State	795				732				620
Octal Buffer (81LS96), 3-State	796				738				
Octal Buffer (81LS97), 3-State	797								
Octal Buffer (81LS98), 3-State	798								
Octal Buffer/Line Driver, 3-State	540			**540**					
Octal Buffer/Line Driver, 3-State	541			**541**					
Octal Bus Transceiver, Inverting, 3-State	640			**640**					
Octal Bus Transceiver, True, Inverting, 3-State									
Octal Bus Transceiver, Noninverting, 3-State	645								
Octal Transceiver with Storage, 3-State	623								
Octal Transceiver/Latch/Multiplexer, Noninverting, 3-State				646	724				
Octal Transceiver/Latch/Multiplexer, Inverting, 3-State				**648**	758				
Dual Latching Bus Driver						128			
Bus Driver (25 ohm outputs)									
Triple 4-3-3 Input						123	123		620,648
Quad Driver/Receiver with 2-1 Output Multiplexer							330		724,758
Dual Driver/Receiver with 4-to-1 Output Multiplexers							332		732
Quad Driver/Receiver with Transmit and Receiver Latches							334		738
Triple 3-Input Driver with Enable							423		
Open-Collector Bus Transceivers									
Octal Bus, Noninverting, Open-Collector	641				732				
Octal Bus, Inverting, Open-Collector	642				738				
Schmitt Triggers									
Quad 2-Input NAND	132	132	093	132	632,646				
Dual			583		620,648				
Dual 4-Input	13	13			632				
Hex	14	14	584 106	14	646				

*See Surface Mount section for SO and PLCC packages.

(continued)

★ **Bold face type numbers are available in both HC and HCT versions.**

FUNCTIONALLY COMPARABLE LOGIC INTEGRATED CIRCUITS (continued)

Function	TTL		CMOS			MECL			
	LS	FAST	STD	HC★	Package*	10K	10KH	III	Package*
Latches									
4-Bit Bi-Stable Latch with Q and Q	75		042	75	620,648				620
4-Bit Bi-Stable Latch	77				632,646				648
Octal Transparent Latch, 3-State, Noninverting	373	373		**373**	620				
Quad Latch	375				648	168			
Quad NAND R-S Latch	279		044						
8-Bit Addressable Latch (9334)	259	259	099	259					
Dual 4-Bit Addressable Latch	256	256							
Octal Transparent Latch, 3-State				**573**	732				
Octal Transparent Latch, 3-State, Inverting		533		**533**	738				
Dual Latch						130	130		620
Quad (negative transition) Latch					620	133			648
Quad (positive transition) Latch					648	153			
Quint Latch						175	175		
Quad NOR R-S Latch			043						
Dual 4-Bit Latch			508		623,709				
8-Bit, Bus-Compatible, 3-State Latches — Internal Counter			597						
8-Bit, Bus-Compatible, 3-State Latches — Binary Address			598						
8-Bit Addressable Latch with Bidirectional Port			599		707,726				
Octal D-Type Transparent Latch, 3-State				**373**	732,738				
Octal D-Type Latch w/Readback, 3-State				793					
Flip-Flops/Registers									
Dual JK	73A		027	73	620,648	135	135		620
Dual D	74A	74	013	74	632,646	131	131		648
Dual JK	76A			76	620,648				
Dual JK with Preset	109A	109		109	620,648				
Dual JK with Clear	107A			107	632,646				
Dual JK Edge-Triggered	112A			112	620,648				
Dual JK Edge-Triggered	113A			113	632,646				

Temperature Ranges:
TTL 54 Series: −55 to +125°C
TTL 74 Series: 0 to +70°C

CMOS 54/74 Series: −55 to +125°C
CMOS MC14...A Series: −55 to +125°C
CMOS MC14...C Series: −40 to +85°C

MECL 10K/MECL III: −30 to +85°C
MECL 10KH: 0 to 75°C

(continued)

*See Surface Mount section for SO and PLCC packages.

★ **Bold face type numbers are available in both HC and HCT versions.**

	TTL		CMOS			MECL			
Function	**LS**	**FAST**	**STD**	**HC★**	**Package***	**10K**	**10KH**	**III**	**Package***

Flip-Flops/Registers (continued)

Function	LS	FAST	STD	HC★	Package*	10K	10KH	III	Package*
Dual JK Edge-Triggered	114A								620
4-Bit D Register, 3-State	173		076	173	620				648
Hex D with Clear	174	174	174	174	648				
Hex D with Enable	378	378			732,738				
Quad D with Clear	175	175	175	175	620,648				
Octal D with Clear	273			273	620				
Octal D, 3-State	374	374		**374**	648				
Octal D with Enable	377								
4-Bit D with Enable	379	379							
Hex D						176	176		
Hex "D" Master-Slave/with Reset						186	186		
Octal D, Inverting, 3-State				**564**	732				
Octal D					738				
Octal D, Inverting									
Octal D, 3-State				**574**					
High-Speed Dual Type D Master-Slave						231			
Dual Clocked R-S								1666	
Dual Clocked Latch								1668	
Master-Slave Type D								1670	
UHF Prescaler Type D								1690	
Octal D Flip-Flop, 3-State		534		**534**					

Counters

Function	LS	FAST	STD	HC★	Package*	10K	10KH	III	Package*
Decade	90				632				620
Divide-By-12	92				646				648
4-Bit Binary	93					154			
Decade, Asynchronously Presettable	196								
4-Bit Binary, Asynchronously Presettable	197								
BCD Decade, Asynchronously Reset	160A	160A	160	160	620				
4-Bit Binary, Asynchronous Reset	161A	161A	161	161	648	178	016	1654	
BCD Decade, Synchronous Reset	162A	162A	162	162					
4-Bit Binary, Synchronous Reset	163A	163A	163	163					
Up/Down Decade, with Clear	192	192	510						
Up/Down Binary, with Clear	193	193	516						
Up/Down Decade	190	190				137			
Up/Down Binary	191	191	029			136	136		
Decade (Divide By 2 and 5)	290				632	138		1678	
4-Bit Binary	293				646				
Dual Decade	390		518	390	620,648				
Dual 4-Bit Binary	393		520	393	632,646				
Dual Decade	490				620,648				
Decade Up/Down, 3-State		568			732				
Binary Up/Down, 3-State	569	569			738				

*See Surface Mount section for SO and PLCC packages.

(continued)

★ **Bold face type numbers are available in both HC and HCT versions.**

FUNCTIONALLY COMPARABLE LOGIC INTEGRATED CIRCUITS (continued)

Function	TTL		CMOS			MECL			
	LS	FAST	STD	HC★	Package*	10K	10KH	III	Package*
Counters (continued)									
Synchronous 4-Bit Up/Down Binary	669				648				693
Up/Down Decade	168	168		168					
Up/Down Binary	169	169		169					
Programmable Decade			522						
Programmable Binary			526						
Seven-Stage Ripple Counter			024	4024	632,646				
Decade Counter/Divider			017	4017	620				
Presettable Divide-by-N			018		648				
14-Bit Binary Counter/Divider			060	4060					
12-Bit Binary			040	4040					
14-Bit Binary			020	4020					
Octal Counter/Divider			022						
Dual Programmable BCD/Binary			569						
Three-Digit BCD			553						
Real Time 5-Decade			534		623				
1 GHz Divide-by-Four Prescaler					709			1697	
1 GHz Divide-by-Four								1699	620,648
Register Files									
4 x 4 Register File, Open-Collector	170				620				620
4 x 4 Register File, 3-State	670				648				648
16 x 4 Bit Register File							145		
Shift Registers									
8-Bit Serial-In/Parallel-Out Shift Register	164		034	164	632,646				
8-Bit Parallel-In/Serial-Out Shift Register	165		021	165	620,648				

(continued)

Temperature Ranges:
TTL 54 Series: −55 to +125°C
TTL 74 Series: 0 to +70°C
CMOS 54/74 Series: −55 to +125°C
CMOS MC14...A Series: −55 to +125°C
CMOS MC14...C Series: −40 to +85°C
MECL 10K/MECL III: −30 to +85°C
MECL 10KH: 0 to 75°C

*See Surface Mount section for SO and PLCC packages.

★ Bold face type numbers are available in both HC and HCT versions.

Function	TTL LS	TTL FAST	CMOS STD	CMOS HC★	Package*	MECL 10K	MECL 10KH	MECL III	Package*
Shift Registers (continued)									
4-Bit Shift Register	95B				632,646				620
8-Bit Parallel-In/Serial-Out Shift Register	166		014		620,648				648
4-Bit Shift Register	195A	195		195				1694	
4-Bit Universal Shift Register	194A	194	194	194		141	141		
8-Bit Shift/Storage Register, 3-State	299		094	299	732,738				
8-Bit Shift Register with Sign Extend, 3-State	322A								
8-Bit Shift/Storage Register, 3-State	323	323							
4-Bit Shift Register, 3-State	395				620,648				
16-Bit Serial-In/Serial-Out Shift Register, 3-State	673				623,649				
16-Bit Parallel-In/Serial-Out Register, 3-State	674								
18-Bit Static Shift Register			006		632,646				
1-to-64 Bit Variable Length Shift Register			557		620,648				
Dual 64-Bit Static Shift Register			517		648,690				
4-Bit Parallel-In/Parallel-Out Shift Register			035		620,648				
Dual 4-Bit Static Shift Register			015						
128-Bit Static Shift Register			562		632,646				
8-Bit Parallel to Serial S.R. w/Input Latches, 3-State				589	620,648				
8-Bit Serial to Parallel S.R. 3-State				595					
8-Bit Parallel to Serial S.R. w/Input Latches				597					
Multiplexers/Data Selectors									
Quad 2-Input Multiplexer, Noninverting	157	157,A	519	**157**	620	158	158		620
Quad 2-Input Multiplexer, Inverting	158	158,A		**158**	648	159	159		648
Quad 2-Input Multiplexer, Noninverting, 3-State	257A	257,A		**257**					
Quad 2-Input Multiplexer, Inverting, 3-State	258A	258,A							
Quad 2-Multiplexer, with Output Register	298					173	173		
Dual 4-Input Multiplexer	153	153	539	153		174	174		
Dual 4-Input Multiplexer, 3-State	253	253		253					
8-Input Multiplexer	151	151		151		164	164		
8-Input Multiplexer, 3-State	251	251	512	251					
Dual 4-Input Multiplexer (Inverting LS153)	352	352							
Dual 4-Input Multiplexer (3-State LS352)	353	353							
QUAD 2-Input Multiplexer with Output Register	398	398			732,738				
Quad 2-Input Multiplexer with Output Register	399	399			620,648				
Synchronous Address Multiplexer (MC6883)	783				711				
Dual Multiplexer with Latch and Common Reset					734	132			

*See Surface Mount section for SO and PLCC packages.

(continued)

★ **Bold face type numbers are available in both HC and HCT versions.**

FUNCTIONALLY COMPARABLE LOGIC INTEGRATED CIRCUITS (continued)

Function	TTL LS	TTL FAST	CMOS STD	CMOS HC★	Package*	MECL 10K	MECL 10KH	MECL III	Package*
Multiplexers/Data Selectors (continued)									
Dual Multiplexer with Latch					632	134			620
Quad Analog Switch/Quad Multiplexer			016	4016 4316	646				648
Quad Analog Switch/Quad Multiplexer			066	4066					
Triple 2-Channel Analog Multiplexer/Demultiplexer			053	4053 4353	620				
Dual 4-Channel Analog Multiplexer/Demultiplexer			052	4052 4352					
Dual 4-Channel Analog Data Selector			529						
Quad 2-Input Analog Multiplexer/Demultiplexer			551						
8-Channel Analog Multiplexer/Demultiplexer			051	4051 4351					
4-to-16 Decoder				154	724,758				
8-Input Multiplexer, 3-State				354	732				
8-Input Multiplexer, 3-State				356	738				
Decoders/Demultiplexers									
Dual 1-of-4 Decoder/Demultiplexer	139	139		139	620				620
Dual 1-of-4 Decoder (Low)	155		556		648	171	171		648
Dual 1-of-4 Decoder, Open-Collector	156								
1-of-10 Decoder	42			42					
1-of-10 Decoder/Driver, Open-Collector	145								
1-of-8 Decoder/Demultiplexer (Low)	138	138		**138**		161	161		
3-Line to 8-Line Decoder/Demultiplexer	137			137					
1-of-10 Decoder, 3-State		537							
1-of-8 Decoder, 3-State		538							
Dual 1-of-4 Decoder, 3-State		539							
Binary to 1-8 (High)						162	162		
Dual Binary 1-4 (High)			555			172	172		
BCD-to-Decimal/Binary-to-Octal Decoder			028						
4-Bit Latch/4-to-16 Line Decoder (High)			514	4514	724,758,				
4-Bit Latch/4-to-16 Line Decoder (Low)			515		709,623				
1-of-8 Decoder/Demultiplexer w/Latched Inputs				237					
Display Decoder/Drivers									
BCD to 7-Segment Decoder/Driver, Open-Collector	47				620				
BCD to 7-Segment Decoder/Driver with Pull-Ups	48		558		648				
BCD to 7-Segment Decoder/Driver, Open-Collector	247				620				
BCD to 7-Segment Decoder/Driver with Pull-Ups	248				648				

(continued)

Temperature Ranges:
TTL 54 Series: −55 to +125°C
TTL 74 Series: 0 to +70°C
CMOS 54/74 Series: −55 to +125°C
CMOS MC14...A Series: −55 to +125°C
CMOS MC14...C Series: −40 to +85°C
MECL 10K/MECL III: −30 to +85°C
MECL 10KH: 0 to 75°C

*See Surface Mount section for SO and PLCC packages.

★ **Bold face type numbers are available in both HC and HCT versions.**

Function	TTL		CMOS			MECL			
	LS	FAST	STD	HC★	Package*	10K	10KH	III	Package*
Display Decoder/Drivers (continued)									
Hex-to-Seven Segment Decoder/Driver/Latch			495		620				
BCD-to-Seven Segment Latch/Decoder/Driver			511	4511	648				
BCD-to-Seven Segment Latch/Decoder/Driver — Ripple Blanking			513		707,726				
BCD-to-Seven Segment Latch/Decoder/Driver			543	4543	620,648				
BCD-to-Seven Segment Latch/Decoder/Driver — Ripple Blanking			544		707,726				
BCD-to-Seven Segment Decoder/Driver — High Current			547		620,648				
48-Segment Multiplexed LCD Driver (Master)			5000		623,709				
48-Segment Multiplexed LCD Driver (Slave)			5001		707,726				
Priority Encoders									
10-Line Decimal to 4-Line Priority Encoder	147				620				620
8-Input to 3-Line Priority Encoder	148	148	532		648	165	165		648
8-Input to 3-Line Priority Encoder	748								
8-Input to 3-Line Priority Encoder, 3-State	348								
8-Input to 3-Line Priority Encoder, 3-State	848								
Multivibrators									
Retriggerable Monostable Multivibrator	122				632,646	198			620
Dual Retriggerable Monostable Multivibrator	123				620				648
Dual One-Shot (Very Stable)	221				648				
Dual Precision Retriggerable/Resettable Monostable Multivibrator			538						
Oscillators/Timers									
Voltage Controlled Oscillator					626,693			1658	620
25-Stage Frequency Divider			521		620				648
Programmable Timer			536		648				607
Programmable Oscillator/Timer			541		632,646				632
Emitter Coupled Oscillator								1648	646
Receivers									
Triple Line						114			620,648
Quad Line						115	115	1692	620,650
Triple Line						116	116		620,648
High-Speed Triple Line						216			
Quad Bus						129			
Comparators									
4-Bit Magnitude Comparator	85		585	85	620,648				620
8-Bit Magnitude Comparator		521			732				648
8-Bit Magnitude Comparator, 3-State	682				738				
8-Bit Magnitude Comparator, 3-State	684								
8-Bit Magnitude Comparator	688			**688**					
5-Bit Magnitude Comparator						166	166		

*See Surface Mount section for SO and PLCC packages.

(continued)

★ **Bold face type numbers are available in both HC and HCT versions.**

FUNCTIONALLY COMPARABLE LOGIC INTEGRATED CIRCUITS (continued)

Function	TTL LS	TTL FAST	CMOS STD	CMOS HC★	Package*	MECL 10K	MECL 10KH	MECL III	Package*
Arithmetic Operators									
4-Bit Full Adder	83A		008		620				620
4-Bit Full Adder (Rotated LS83A)	283	283			648				648
4-Bit ALU	181	181	581		623	181	181		
4-Bit ALU	181	181 381 382			709 649 624,758				
4-Bit Barrel Shifter		350			620,648				620
Quad 4-Bit Adder Subtractor	385				732,738				648
Look Ahead Carry Generator		182	582		620,648	179	179		
Dual High-Speed Adder/Subtractor						180	180		
2-Bit Logic Unit/Function Generator						182			
4 x 2 Multiplier						183			623
2 x 1 Array Multiplier, High-Speed						287			620
BCD Rate Multiplier			527		620				648
2 x 2 Bit Parallel Binary Multiplier			554		648				
Triple Serial Adder (Positive Logic)			032						
Triple Serial Adder (Negative Logic)			038						
NBCD Adder			560						
9's Complementer			561		632,646				
Parity Generators/Checkers									
9-Bit Odd/Even Parity Generator/Checker	280	280		280	632,646	170			620
12-Bit Parity Generator/Checker			531		620,648	160	160		648
Error Detection-Correction									
IBM Code						163			620
Motorola Code						193			648
Hamming Code		2960			740				

Temperature Ranges:
TTL 54 Series: −55 to +125°C
TTL 74 Series: 0 to +70°C

CMOS 54/74 Series: −55 to +125°C
CMOS MC14...A Series: −55 to +125°C
CMOS MC14...C Series: −40 to +85°C

MECL 10K/MECL III: −30 to +85°C
MECL 10KH: 0 to 75°C

*See Surface Mount section for SO and PLCC packages.

★ **Bold face type numbers are available in both HC and HCT versions.**

Bipolar Memories

ECL RAMs

Emitter-coupled logic (ECL) represents today's fastest logic form; ECL memories complement this characteristic. Motorola ECL RAMs are available to match the speed capabilities of the ECL10K and 10KH logic families, the two most pervasive ECL lines available.

ECL10K/10KH

Organization	Device Type	Suffix	Access Time (ns Max)	Power Dissipation (mW Typ)	Package	Comments
8 x 2	MCM10143	L	15	610	L-Case 623	Multiport Register File
16 x 4	MC10H145	P,L,FN	6	700	P-Case 648 L-Case 620 FN-Case 775	Register File
	MCM10145	L	15	463	L-Case 620	Register File
64 x 1	MCM10148	L	15	420	L-Case 620	
128 x 1	MCM10147	L	15	415		
256 x 1	MCM10144	L	26	468		
1K x 1	MCM10146	L	29	600		

ECL — PROMs

High-speed PROMs fully compatible with MECL 10K and 10KH logic families.

Organization	Device Type	Suffix	Access Time (ns Max)	Power Dissipation (mW Typ)	Package
32 x 8	MCM10139	L	20	520	L-Case 620
256 x 4	MCM10149	L10 L25	10 25	540	

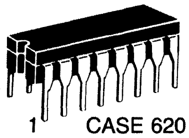
Phase-Locked Loop Functions

(For associated Frequency Synthesizers, see page 4-61)

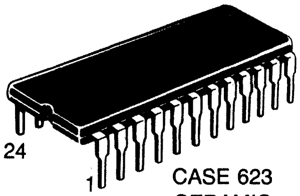
Function	Family	Devices 0 to +75°C	Suffix/Case
Oscillators			
Crystal Oscillator	MECL	MC12061	P/648, L/620
Voltage-Controlled Oscillator	MECL	MC1648#	P/646, L/632, F/607
Voltage-Controlled Multivibrator	MECL	MC1658#	P/648, L/620
Dual Voltage-Controlled Multivibrator	TTL	MC4024/ MC4324*	P/646, L/632, F/607
Phase Detectors			
Phase-Frequency Detector	MECL	MC12040	P/646, L/632
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	MC1494/5/6** MC1594/5/6*	P/646, L/632
Control Functions			
Counter-Control Logic	MECL	MC12014	P/648, L/620
Prescalers/Counters			
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	
Low Power ÷64 Prescaler, Enhanced, (12073), 1.3 GHz	MECL	MC12075 §	
Low Power ÷256 Prescaler, Enhanced, (12074), 1.3 GHz	MECL	MC12076 §	
UHF ÷2 Prescaler, 750 MHz	MECL	MC12090	P/648, L/620
Programmable ÷N Decade	TTL	MC4316/ MC4316*	P/648, L/620, F/650

Notes:
*T_A = −55 to +125°C #T_A = −30 to +85°C ##T_A = −40 to +85°C § = Available 4Q88
Plastic packages available for commercial temperature range only
**T_A = 0 to 70°C

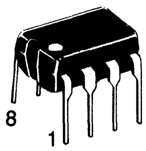
Standard Packages



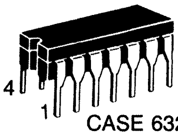
CASE 620
CERAMIC
SUFFIX: MECL-L
TTL/HCMOS-J
STD CMOS-L



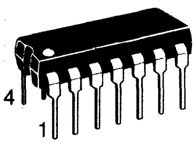
CASE 623
CERAMIC
SUFFIX: TTL-J
STD CMOS-L
MECL-L



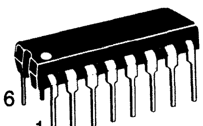
CASE 626
PLASTIC
SUFFIX: MECL-P



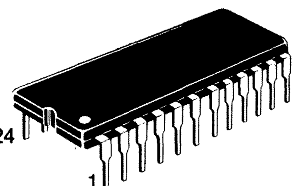
CASE 632
CERAMIC
SUFFIX: MECL-L
TTL/HCMOS-J
STD CMOS-L



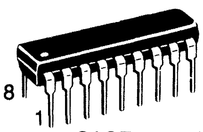
CASE 646
PLASTIC
SUFFIX: MECL-P
TTL/HCMOS-N
STD CMOS-P



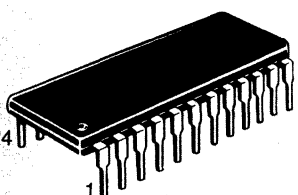
CASE 648
PLASTIC
SUFFIX: MECL-P
TTL/HCMOS-N
STD CMOS-P



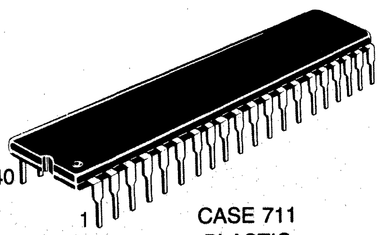
CASE 649
PLASTIC
SUFFIX: TTL-N



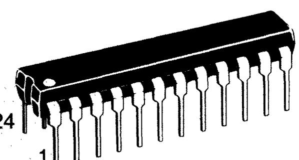
CASE 707-02
PLASTIC
SUFFIX: TTL/HCMOS-N
STD CMOS-P



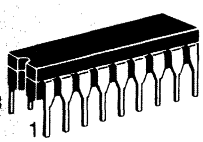
CASE 709
PLASTIC
SUFFIX: TTL/CMOS-P



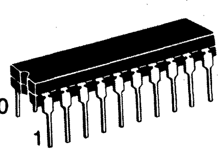
CASE 711
PLASTIC



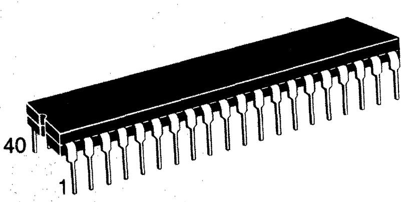
CASE 724
PLASTIC
SUFFIX: MECL-P
CMOS-N



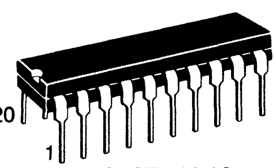
CASE 726
CERAMIC
SUFFIX: TTL/HCMOS-J
STD CMOS-L



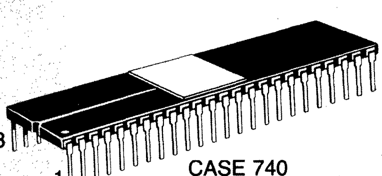
CASE 732
CERAMIC
SUFFIX: MECL-L
TTL/CMOS-J



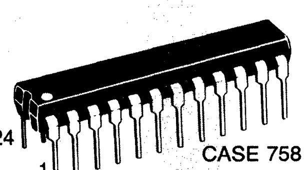
CASE 734
CERAMIC



CASE 738-02
PLASTIC
SUFFIX: MECL-P
TTL/CMOS-N

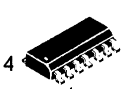


CASE 740
CERAMIC
SUFFIX; TTL-J

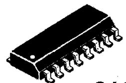


CASE 758
CERAMIC
SUFFIX: MECL-L
TTL/CMOS-J

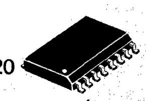
CASE 751
PLASTIC
SUFFIX: D



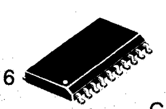
CASE 751A
PLASTIC
SUFFIX: FAST-D



CASE 751B
PLASTIC
SUFFIX: LS-D

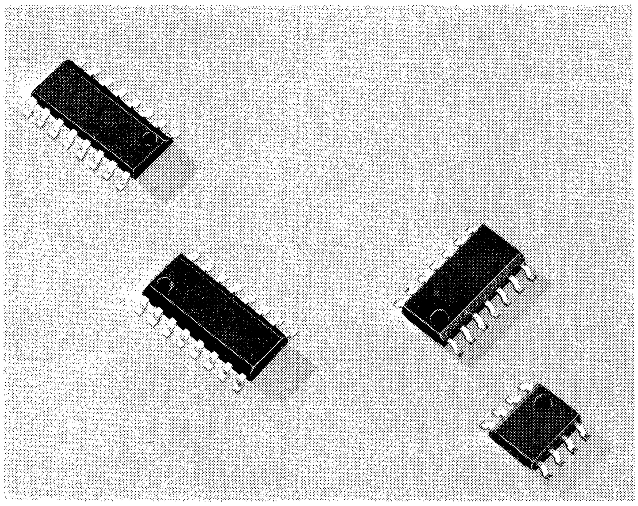


CASE 751D
PLASTIC
SUFFIX: MGCMOS-DW

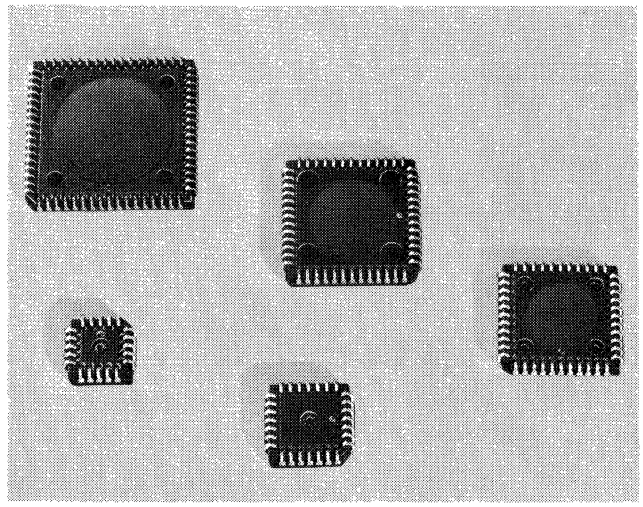


CASE 751G
PLASTIC
SUFFIX: HCMOS-DW

Surface Mount Logic Devices



SOIC packages offer the benefits of very low profile and smaller surface area to the board designer. Add these features to savings of plated through-holes in the PCB, and cost savings are significant. In addition, all packages comply with JEDEC package standards.



Plastic Leaded Chip Carriers (PLCC) offer the designer higher pin-count functions flexibility without the penalty of a much larger DIP package. Surface-area savings of 3X can be realized for a 44 pin PLCC versus 40 pin DIP. All packages are JEDEC registered and approved as industry standards.

Standard JEDEC Packaging Used Throughout

Small-outline integrated circuit (SOIC) packages are assembled in either narrow body (0.155″) or wide body (0.300″) widths. The package depends on the IC die size and/or number of pins. All SOIC packages are the common gull-wing design complying with JEDEC package standards.

Plastic leaded chip carrier (PLCC) packages are available for larger pin-count LSI functions. All packages are symmetrical, having equal lead-count on all four sides. The packages are square for the three logic families. Standard marking for Pin 1 orientation is noted on the package. Each of the PLCC packages complies with JEDEC package standards for dimensions. All PLCC's have rolled-under "J" lead designs.

Major Package Dimensions*

Package	Terminals	Length	Width	Thickness	Suffix
SOIC	8	0.195″	0.155″	0.056″	D
	14	0.340″	0.155″	0.056″	
	16 narrow	0.390″	0.155″	0.055″	
	16 wide	0.405″	0.295″	0.092″	DW
	20 wide	0.505″	0.295″	0.092″	
PLCC	20	0.390″	0.390″	0.173″	FN
	28	0.490″	0.490″	0.173″	
	44	0.690″	0.690″	0.173″	
	52	0.790″	0.790″	0.173″	
	68	0.990″	0.990″	0.173″	

*Nominal

CMOS

Standard Logic

Surface-mount capabilities are becoming essential as systems designers and board-layout engineers deal with size reduction and component densities.

Motorola offers over 300 individual CMOS products in three different families for logic and interface applications. These devices utilize various MOS processes and offer the designer varying speeds, power trade-offs and operating voltages.

Metal-gate (Standard) and Silicon-gate (High Speed) technologies are employed in the fabrication process with gate geometries as low as 1.5 micron used in the designs.

CMOS Standard Logic

Device	Function	Pins
MC14000UBD	Dual 3-Input NOR Gate plus Inverter	14
MC14001BD	Quad 2-Input NOR Gate	14
MC14001UBD	Quad 2-Input NOR Gate	14
MC14002BD	Dual 4-Input NOR Gate	14
MC14002UBD	Dual 4-Input NOR Gate	14
MC14006BD	18-Bit Static Shift Register	14
MC14007UBD	Dual Complementary Pair plus Inverter	14
MC14008BD	4-Bit Full Adder	16
MC14011BD	Quad 2-Input NAND Gate	14
MC14011UBD	Quad 2-Input NAND Gate	14
MC14012BD	Dual 4-Input NAND Gate	14
MC14012UBD	Dual 4-Input NAND Gate	14
MC14013BD	Dual D Flip-Flop	14
MC14014BD	8-Bit Static Shift Register	16
MC14015BD	Dual 5-Bit Static Shift Register	16
MC14016BD	Quad Analog Switch/Quad Multiplexer	14
MC14017BD	Decade Counter/Divider	16
MC14018BD	Presettable Divide-by-N Counter	16
MC14020BD	14-Bit Binary Counter	16
MC14021BD	8-Bit Static Shift Register	16
MC14022BD	Octal Counter/Divider	16
MC14023BD	Triple 3-Input NAND Gate	14
MC14024BD	7-Stage Ripple Counter	14
MC14025BD	Triple 3-Input NOR Gate	14
MC14027BD	Dual J-K Flip-Flop	16
MC14028BD	BCD-to-Decimal Decoder	16
MC14029BD	4-Bit Presettable Up/Down Counter	16
MC14032BD	Triple Serial Adder (Positive Logic)	16
MC14035BD	4-Bit Shift Register	16
MC14038BD	Triple Serial Adder (Negative Logic)	16
MC14040BD	12-Bit Binary Counter	16
MC14042BD	Quad Latch	16
MC14043BD	Quad NOR R-S Latch	16
MC14044BD	Quad NAND R-S Latch	16
MC14046BDW	Phase-Locked Loop	16
MC14049UBD	Hex Inverter/Buffer	16
MC14050BD	Hex Buffer	16
MC14051BD	8-Channel Analog Multiplexer	16
MC14052BD	Dual 4-Channel Analog Multiplexer	16
MC14053BD	Triple 2-Channel Analog Multiplexer	16
MC14060BD	14-Bit Binary Counter and Osc.	16
MC14066BD	Quad Analog Switch	14
MC14068BD	8-Input NAND Gate	14
MC14069UBD	Hex Inverter	14
MC14070BD	Quad Exclusive OR Gate	14
MC14071BD	Quad 2-Input OR Gate	14
MC14072BD	Dual 4-Input OR Gate	14
MC14073BD	Triple 3-Input AND Gate	14
MC14075BD	Triple 3-Input OR Gate	14
MC14076BD	Quad D-Type Register	16
MC14077BD	Quad Exlcusive NOR Gate	14
MC14078BD	8-Input NOR Gate	14
MC14081BD	Quad 2-Input AND Gate	14
MC14082BD	Dual 4-Input AND Gate	14
MC14093BD	Quad 2-Input NAND Schmitt Trigger	14
MC14094BD	8-Bit Bus-Compatible Shift Store Latch	16
MC14099BDW	8-Bit Addressable Latch	16
MC14106BD	Hex Schmitt Trigger	14
MC14160BD	Decade Counter (Asynchronous Clear)	16
MC14161BD	Binary Counter (Asynchronous Clear)	16
MC14162BD	Decade Counter (Synchronous Clear)	16
MC14163BD	Binary Counter (Synchronous Clear)	16
MC14174BD	Hex D Flip-Flop	
MC14175BD	Quad D Flip-Flop	16
MC14194BD	4-Bit Universal Shift Register	16
MC14415BDW	Quad Precision Timer/Driver	16
MC14490BDW	Hex Contact Bounce Eliminator	16
MC14500BDW	Industrial Control Unit	16
MC14501UBD	Triple Gate	16
MC14502BDW	Strobed Hex Inverter/Buffer	16
MC14503BD	Hex 3-State Buffer	16
MC14504BD	Hex TTL or CMOS to CMOS Level Shifter	16
MC14506UBD	Dual Expandable AOI Gate	16
MC14510BD	BCD Up/Down Counter	16
MC14512BD	8-Channel Data Selector	16
MC14513BDW	BCD to 7-Segment Latch/Decoder/ Driver	18
MC14516BD	Binary Up/Down Counter	16
MC14517BDW	Dual 64-Bit Static Shift Register	16
MC14518BDW	Dual BCD Up Counter	16
MC14519BD	4-Bit AND/OR Selector	16
MC14520BDW	Dual Binary Up Counter	16
MC14521BD	24-Stage Frequency Divider	16
MC14522BDW	Programmable BCD Divide-by-N Counter	16
MC14526BDW	Programmable Binary Divide-by-N Counter	16
MC14527BDW	BCD Rate Multiplier	16
MC14528BD	Dual Monostable Multivibrator	16
MC14529BD	Dual 4-Channel Analog Data Selector	16
MC14530BD	Dual 5-Input Majority Logic Gate	16
MC14531BD	12-Bit Parity Tree	16

(continued)

SURFACE MOUNT LOGIC DEVICES (continued)

CMOS Standard Logic (continued)

Device	Function	Pins
MC14532BD	8-Bit Priority Encoder	16
MC14536BDW	Programmable Timer	16
MC14538BDW	Dual Precision Monostable Multivibrator	16
MC14539BD	Dual 4-Channel Data Selector/ Multiplexer	16
MC14541BD	Programmable Oscillator-Timer	14
MC14551BD	Quad 2-Channel Analog MUX	16
MC14553BDW	3-Digit BCD Counter	16
MC14554BD	2 x 2-Bit Parallel Binary Multiplier	16
MC14555BD	Dual Binary to 1-of-4 Decoder	16
MC14556BD	Dual Binary to 1-of-4 Decoder (Inverting)	16
MC14557BDW	1-to-64-Bit Variable Length Shift Register	16
MC14560BD	NBCD Adder	16
MC14561BD	9's Complementer	14
MC14566BD	Industrial Time Base Generator	16
MC14568BD	Phase Comparator Programmable Counter	16
MC14569BDW	Dual Programmable BCD Binary Counter	16
MC14572UBD	Hex Gate	16
MC14582BD	Look-Ahead Carry Block	16
MC14583BD	Dual Schmitt Trigger	16
MC14584BD	Hex Schmitt Trigger	14
MC14585BD	4-Bit Magnitude Comparator	16
MC14597BDW	8-Bit Bus Compatible Counter/Latch	16

*CF = Consult Factory
List includes "B" or "UB" series parts. Packages are the same.

CMOS High-Speed Logic

MC74HC00 Series (−40 to +85°C)

Device	Function	Pins
HC00D	Quad 2-Input NAND Gate	14
HC02AD	Quad 2-Input NOR Gate	14
HC03D	Quad 2-Input NAND, Open Drain Outputs	14
HC04AD HCT04AD	Hex Inverter	14
HCU04D	Hex Unbuffered Inverter	14
HC08D	Quad 2-Input AND Gate	14
HC10D	Triple 3-Input NAND Gate	14
HC11D	Triple 3-Input AND Gate	14
HC14AD	Hex Schmitt-Trigger Inverter	14
HC20D	Dual 4-Input NAND Gate	14
HC27D	Triple 3-Input NOR Gate	14
HC30D	8-Input NAND Gate	14
HC32D	Quad 2-Input OR Gate	14
HC42D	BCD to 1-of-10 Decoder	16
HC51D	2-Wide, 2-Input/2-Wide, 3-Input AND-OR-INVERT Gates	14
HC58D	2-Wide, 2-Input/2-Wide, 3-Input AND-OR Gates	14
HC73D	Dual J-K Flip-Flop with Reset	14
HC74AD	Dual D-Type Flip-Flop w/Set/Reset, Pos-Edge Triggered	14
HC75D	4-Bit D-Type Latch	16
HC76D	Dual J-K Flip-Flop with Set and Reset	16
HC86D	Quad 2-Input Exclusive OR Gate	14
HC109D	Dual J-K Flip-Flop w/Set/Reset, Pos-Edge Triggered	16
HC112D	Dual J-K Flip-Flop w/Set/Reset	16
HC113D	Dual J-K Flip-Flop w/Set	14
HC125D	Quad 3-State Buffer	14
HC126D	Quad 3-State Buffer	14
HC132D	Quad 2-Input Schmitt-Trigger NAND Gate	14
HC133D	13-Input NAND Gate	16
HC137D	1-of-8 Decoder/Demux w/Latched Inputs, Inverting Output	16
HC138AD	1-of-8 Decoder/Demultiplexer	16
HCT138A	1-of-8 Decoder/Demultiplexer TTL Logic Level	16
HC139AD	Dual 1-of-4 Decoder (Active-Low Outputs)	16
HC151D	8-Channel Digital Multiplexer	16
HC153D	Dual 4-Channel Digital Multiplexer	16
HC157D	Quad 2-Input Data Selector/Multiplexer	16
HC158D	Quad 2-Input Data Sel/Mux, Inv Output	16
HC160D	Programmable Decade Counter, Asynchronous Reset	16
HC161D	Programmable 4-Bit Binary Counter, Asynchronous Reset	16
HC162D	Programmable Decade Counter, Synchronous Reset	16
HC163D	Programmable 4-Bit Binary Counter, Synchronous Reset	16
HC164D	8-Bit Serial Input/Parallel Output Shift Register	14
HC165D	8-Bit Serial or Parallel Input/Serial Output Shift Reg	16
HC173D	4-Bit D-Type Flip-Flop with Common Clock and Reset, 3-State	16
HC174D	Hex D-Type Flip-Flop with Common Clock and Reset	16
HC175D	Quad D-Type Flip-Flop	16
HC237D	1-of-8 Decoder/Demultiplexer with Latched Inputs	16
HC240ADW	Octal Buffer/Line Driver/Line Receiver, 3-State, Inv Output	20
HCT240ADW	Octal Buffer/Line Driver/Line Receiver, 3-State, Inverting Output, TTL Logic Level	20
HC241ADW	Octal Buffer/Line Driver/Line Receiver, 3-State	20
HCT241ADW	Octal Buffer/Line Driver/Line Receiver, 3-State, TTL Logic Level	20
HC242D	Quad Bus Transceiver, 3-State, Inverting Output	14
HC244ADW	Octal Buffer/Line Driver/Line Receiver, 3-State	20
HCT244ADW	Octal Buffer/Line Driver/Line Receiver, 3-State, TTL Logic Level	20
HC245ADW	Octal Bus Transceiver, 3-State	20
HCT245ADW	Octal Bus Transceiver, 3-State, TTL Logic Level	20

(continued)

MC74HC00 Series (−40 to +85°C) (continued)

Device	Function	Pins
HC251D	8-Input Multiplexer, 3-State	16
HC253D	Dual 4-Input Multiplexer, 3-State	16
HC257D	Quad 2-Input Data Sel/Mux, 3-State	16
HC259D	8-Bit Addressable Latch	16
HC273DW	Octal D-Type Flip-Flop with Common Clock/Reset	20
HC280D	9-Bit Odd/Even Parity Generator/ Checker	14
HC299DW	8-Bit Universal Shift/Store Register, 3-State	20
HC354DW	8-Input Multiplexer, 3-State	20
HC373DW	Octal D-Type Transparent Latch, 3-State	20
HCT373DW	Octal D-Type Transparent Latch, 3-State, TTL Logic Level	20
HC374DW	Octal D-Type Flip-Flop, 3-State	20
HCT374DW	Octal D-Type Flip-Flop, 3-State, TTL Logic Level	20
HC533DW	Octal D-Type Transparent Latch, 3-State, Inverting Output	20
HCT533DW	Octal D-Type Transparent Latch, 3-State, Inverting Output, TTL Logic Level	20
HC534DW	Octal D-Type Flip-Flop, 3-State, Inverting Output	20
HCT534DW	Octal D-Type Flip-Flop, 3-State, Inv Output, TTL Logic Level	20
HC540DW	Octal Buffer/Line Driver/Line Rec, 3-State, Inv Output	20
HCT540DW	Octal 3-State Buffer/Line Driver/Line Receiver, Inverting Output, TTL Logic Level	20
HC541DW	Octal Buffer/Line Driver/Line Receiver, 3-State	20
HCT541DW	Octal 3-State Buffer/Line Driver/Line Receiver, TTL Logic Level	20
HC563DW	Octal Transparent Latch, 3-State, Inverting Output	20
HC564DW	Octal D-Type Flip-Flop, 3-State, Inverting Output	20
HC573DW	Octal Transparent Latch, 3-State	20

Device	Function	Pins
HC574DW	Octal D-Type, Flip-Flop, 3-State	20
HC589D	8-Bit Parallel-to-Serial Shift Register with Input Latches, 3-State	16
HC597D	8-Bit Parallel-to-Serial Shift Register with Input Latches	16
HC640ADW	Octal 3-State Inv Bus Transceiver	20
HCT640DW	Octal 3-State Inv Bus Transceiver w/LSTTL Compatible Inputs	20
HC4002D	Dual 4-Input NOR Gate	14
HC4016D	Quad Analog Switch	14
HC4017D	Decade Counter/Divider	16
HC4024D	7-Stage Binary Ripple Counter	14
HC4049D	Hex Inverting Buffer/Logic Level Down Converter	16
HC4050D	Hex Buffer/Logic Level Down Converter	16
HC4051DW	8-Channel Analog Multiplexer/ Demultiplexer	16
HC4052DW	8-Channel Analog Multiplexer/ Demultiplexer	16
HC4053DW	8-Channel Analog Multiplexer/ Demultiplexer	16
HC4066D	Quad Analog Switch	14
HC4075D	Triple 3-Input OR Gate	14
HC4078D	8-Input NOR Gate	14
HC4316D	Quad Analog Switch Demux w/ Separate Analog and Dig. P.S.	16
HC4351DW	Quad Analog Mux/Demux w/Latched Select Inputs	20
HC4352DW	Dual 4-Channel Analog Multiplexer/ Demultiplexer with Latched Select Inputs	20
HC4353DW	Triple 2-Channel Analog Multiplexer/ Demultiplexer with Latched Select Inputs	20
HC4511D	BCD-to-7 Segment Latch/Decoder/ Driver	16
HC4543D	BCD-to-7 Segment Latch/Decoder/ Driver for LCDs	14
HC7266D	Quad 2-Input Exclusive NOR Totem Pole Outputs	16

Bipolar Logic

Motorola currently offers four of the most popular bipolar logic lines in surface mounted packages.

The following tables for LS-TTL, FAST-TTL, MECL 10K and MECL 10KH indicate the packages used for the four families. These may be ordered in rails or Tape and Reel.

LS TTL Devices Available in SOIC Package

SN74LS00 Series (0 to +70°C)

Suffix: D . . . Narrow Body Width SOIC
DW . . . Wide Body Width SOIC

Device	Function	Pins
LS00D	Quad 2-Input NAND Gate	14
LS01D	Quad 2-Input NAND Gate, Open-Collector	14
LS02D	Quad 2-Input NOR Gate	14
LS03D	Quad 2-Input NAND Gate, Open-Collector	14
LS04D	Hex Inverter	14
LS05D	Hex Inverter, Open-Collector	14
LS08D	Quad 2-Input AND Gate	14
LS09D	Quad 2-Input AND Gate, Open-Collector	14
LS10D	Triple 3-Input NAND Gate	14
LS11D	Triple 3-Input AND Gate	14
LS12D	Triple 3-Input NAND Gate, Open-Collector	14
LS13D	Dual 4-Input Schmitt Trigger	14
LS14D	Hex Schmitt Trigger	14
LS15D	Triple 3-Input AND Gate, Open-Collector	14
LS20D	Dual 4-Input NAND Gate	14
LS21D	Dual 4-Input AND Gate	14
LS22D	Dual 4-Input NAND Gate, Open-Collector	14
LS26D	Quad 2-Input NAND, High Voltage	14
LS27D	Triple 3-Input NOR Gate	14
LS28D	Quad 2-Input NOR Buffer	14
LS30D	8-Input NAND Gate	14
LS32D	Quad 2-Input OR Gate	14
LS33D	Quad 2-Input NOR Buffer, Open-Collector	14
LS37D	Quad 2-Input NAND Buffer	14
LS38D	Quad 2-Input NAND Buffer, Open-Collector	14
LS40D	Dual 4-Input NAND Buffer	14
LS42D	1-of-10 Decoder	16
LS47D	BCD to 7-Segment Decoder/Driver, Open-Collector	16
LS51D	Dual AND-OR-INVERT Gate	14
LS54D	3-2-2-3 Input AND-OR-INVERT Gate	14
LS55D	2-Wide 4-Input AND-OR-INVERT Gate	14
LS73AD	Dual JK Flip-Flop	14
LS74AD	Dual D Flip-Flop	14
LS75D	4-Bit Bi-Stable Latch with Q and $\overline{Q}$	16
LS76AD	Dual JK Flip-Flop	16
LS77D	4-Bit Bi-Stable Latch	14
LS78AD	Dual JK Flip-Flop with Preset	14
LS83AD	4-Bit Full Adder	16
LS85D	4-Bit Magnitude Comparator	16
LS86D	Quad Exclusive OR Gate	14
LS90D	Decade Counter	14
LS92D	Divide-By-12 Counter	14
LS93D	4-Bit Binary Counter	14
LS95BD	4-Bit Shift Register	14

Device	Function	Pins
LS107AD	Dual JK Flip-Flop with Clear	14
LS109AD	Dual JK Flip-Flop with Preset	16
LS112AD	Dual JK Edge-Triggered Flip-Flop	16
LS113AD	Dual JK Edge-Triggered Flip-Flop	14
LS114AD	Dual JK Edge-Triggered Flip-Flop	14
LS122D	Retriggerable Monostable Multivibrator	14
LS123D	Dual Retriggerable Monostable Multivibrator	16
LS125AD	Quad Buffer, Low Enable, 3-State	14
LS126AD	Quad Buffer, High Enable, 3-State	14
LS132D	Quad 2-Input Schmitt Trigger	14
LS133D	13-Input NAND Gate	16
LS136D	Quad Exclusive OR Gate, Open-Collector	14
LS137D	3-Line to 8-Line Decoder/Demultiplexer	16
LS138D	1-of-8 Decoder/Demultiplexer	16
LS139D	Dual 1-of-4 Decoder/Demultiplexer	16
LS145D	1-of-10 Decoder/Driver, Open-Collector	16
LS147D	10-Line Decimal to 4-Line Priority Encoder	16
LS148D	8-Input to 3-Line Priority Encoder	16
LS151D	8-Input Multiplexer	16
LS153D	Dual 4-Input Multiplexer	16
LS155D	Dual 1-of-4 Decoder	16
LS156D	Dual 1-of-4 Decoder, Open-Collector	16
LS157D	Quad 2-Input Multiplexer, Non-Inverting	16
LS158D	Quad 2-Input Multiplexer, Inverting	16
LS160AD	BCD Decade Counter, Asynchronous Reset (9310 Type)	16
LS161AD	4-Bit Binary Counter, Asynchronous Reset (9316 Type)	16
LS162AD	BCD Decade Counter, Synchronous Reset	16
LS163AD	4-Bit Binary Counter, Synchronous Reset	16
LS164D	8-Bit Serial-In/Parallel-Out Shift Register	14
LS165D	8-Bit Parallel-In/Serial-Out Shift Register	16
LS166D	8-Bit Parallel-In/Serial-Out Shift Register	16
LS170D	4 x 4 Register File, Open-Collector	16
LS173AD	4-Bit D Register, 3-State	16
LS174D	Hex D Flip-Flop with Clear	16
LS175D	Quad D Flip-Flop with Clear	16
LS190D	Up/Down Decade Counter	16
LS191D	Up/Down Binary Counter	16
LS192D	Up/Down Decade Counter with Clear	16

(continued)

LS TTL Devices Available in SOIC Package (continued)

Device	Function	Pins
LS193D	Up/Down Binary Counter with Clear	16
LS194AD	4-Bit Right/Left Shift Register	16
LS195AD	4-Bit Shift Register (9300 Type)	16
LS196D	Decade Counter, Asynchronously Presettable	14
LS197D	4-Bit Binary Counter, Asynchronously Presettable	14
LS221D	Dual One-Shot (Very Stable)	16
LS240DW	Octal Bus/Line Driver, Inverting 3-State	20
LS241DW	Octal Bus/Line Driver, 3-State	20
LS244DW	Octal Driver, Non-Inverting, 3-State	20
LS245DW	Octal Bus Transceiver, Non-Inverting, 3-State	20
LS247D	BCD to 7-Segment Decoder/Driver, Open-Collector	16
LS251D	8-Input Multiplexer, 3-State	16
LS253D	Dual 4-Input Multiplexer, 3-State	16
LS256D	Dual 4-Bit Addressable Latch	16
LS257AD	Quad 2-Input Multiplexer, Non-Inverting, 3-State	16
LS258AD	Quad 2-Input Multiplexer, Inverting 3-State	16
LS259D	8-Bit Addressable Latch (9334)	16
LS260D	Dual 5-Input NOR Gate	14
LS266D	Quad Exclusive NOR Gate, Open-Collector	14
LS273DW	Octal D Flip-Flop with Clear	20
LS279D	Quad Set/Reset Latch	16
LS280D	8-Bit Odd/Even Parity Generator/ Checker	14
LS283D	4-Bit Full Adder (Rotated LS83A)	16
LS290D	Decade Counter (Divide By 2 and 5)	14
LS293D	4-Bit Binary Counter	16
LS295AD	4-Bit Shift Register, 3-State	14
LS298D	Quad 2-Multiplexer, with Output Register	16
LS299DW	8-Bit Shift/Storage Register, 3-State	20
LS322ADW	8-Bit Shift Register with Sign Extend, 3-State	20
LS323DW	8-Bit Shift/Storage Register, 3-State	20
LS348D	8-Input to 3-Line Priority Encoder, 3-State	16
LS352D	Dual 4-Multiplexer (Inverting LS153)	16
LS353D	Dual 4-Multiplexer (3-State LS352)	16
LS365AD	Hex Buffer, Common Enable, 3-State	16
LS366AD	Hex Inverter, Common Enable, 3-State	16

Device	Function	Pins
LS367AD	Hex Buffer, 4-Bit and 2-Bit, 3-State	16
LS368AD	Hex Inverter, 4-Bit and 2-Bit, 3-State	16
LS373DW	Octal Transparent Latch, 3-State	20
LS374DW	Octal D Flip-Flop, 3-State	20
LS375D	Quad Latch	16
LS377DW	Octal D Flip-Flop with Enable	20
LS378D	Hex D Flip-Flop with Enable	16
LS379D	4-Bit D Flip-Flop with Enable	16
LS386D	2-Input Quad/Exclusive OR Gate	14
LS390D	Dual Decade Counter	16
LS393D	Dual 4-Bit Binary Counter	14
LS395D	4-Bit Shift Register, 3-State	16
LS398DW	Quad 2-Input Multiplexer with Output Register	20
LS399D	Quad 2-Input Multiplexer with Output Register	16
LS540DW	Octal Buffer/Line Driver, 3-State	20
LS541DW	Octal Buffer/Line Driver, 3-State	20
LS568DW	Decade Up/Down Counter, 3-State	20
LS569DW	Binary Up/Down Counter, 3-State	20
LS620DW	Octal Transceiver with Storage, 3-State	20
LS622DW	Octal Transceiver with Storage, Open-Collector	20
LS623DW	Octal Transceiver with Storage, 3-State	20
LS640DW	Octal Bus Transceiver, Inverting, 3-State	20
LS641DW	Octal Bus Transceiver, Non-Inverting, Open-Collector	20
LS642DW	Octal Bus Transceiver, Inverting, Open-Collector	20
LS670D	4 x 4 Register File, 3-State	16
LS682DW	8-Bit Magnitude Comparator	20
LS683DW	8-Bit Magnitude Comparator, Open-Collector	20
LS684DW	8-Bit Magnitude Comparator	20
LS685DW	8-Bit Magnitude Comparator, Open-Collector	20
LS688DW	8-Bit Magnitude Comparator	20
LS689DW	8-Bit Magnitude Comparator, Open-Collector	20
LS724D	Voltage Controlled Multivibrator	8
LS795DW	Octal Buffer (81LS95), 3-State	20
LS796DW	Octal Buffer (81LS96), 3-State	20
LS797DW	Octal Buffer (81LS97), 3-State	20
LS798DW	Octal Buffer (81LS98), 3-State	20

FAST TTL Devices Available in SOIC

MC74F00 Series (0 to +70°C)

Suffix: D . . . Narrow Body Width SOIC
DW . . . Wide Body Width SOIC

Device	Function	Pins
F00D	Quad 2-Input NAND Gate	14
F02D	Quad 2-Input NOR Gate	14
F04D	Hex Inverter	14
F08D	Quad 2-Input AND Gate	14
F10D	Triple 3-Input NAND Gate	14
F11D	Triple 3-Input AND Gate	14
F13D	Dual 4-Input NAND Schmitt Trigger	14
F14D	Hex Inverter Schmitt Trigger	14
F20D	Dual 4-Input NAND Gate	14
F21D	Dual 4-Input AND Gate	14
F32D	Quad 2-Input OR Gate	14
F51D	2 Wide 2-3 Input AND-OR INVERT Gate	14
F64D	4-2-2-3 Input AND-OR-INVERT Gate	14
F74D	Dual D Flip-Flop	14
F86D	Quad Ex/OR Gate	14
F109D	Dual J-K Flip-Flop w/Preset	16
F125D	Quad Buffer, 3-State	14
F126D	Quad Buffer, 3-State	14
F132D	Quad 2-Input NAND Schmitt Trigger	14
F138D	1-of-8 Decoder/Demultiplexer	16
F139D	Dual 1-of-4 Decoder/Demultiplexer	16
F148D	8-Line to 3-Line Priority Encoder	16
F151D	8-Input Multiplexer	16
F153D	Dual 4-Input Multiplexer	16
F157D	Quad 2-Input Multiplexer	16
F158D	Quad 2-Input Multiplexer	16
F160AD	BCD Decade Counter, Asynchronous Reset	16
F161AD	4-Bit Binary Counter, Asynchronous Reset	16
F162AD	BCD Decade Counter, Synchronous Reset	16
F163AD	4-Bit Binary Counter, Synchronous Reset	16
F174D	Hex D Flip-Flop	16
F175D	Quad D Flip-Flop	16
F182D	Look Ahead Carry Generator	16

Device	Function	Pins
F240DW	Octal Bus/Line Driver/Inverting/ 3-State	20
F241DW	Octal Bus/Line Driver/3-State	20
F242D	Quad Bus Transceiver/Inverting/ 3-State	14
F243D	Quad Bus Transceiver/Non-Inverting/ 3-State	14
F244DW	Octal Bus Driver/Non-Inverting/ 3-State	20
F245DW	Octal Bus Transceiver	20
F251D	8-Input Multiplexer/3-State	16
F253D	Dual 4-Input Multiplexer/3-State	16
F257D	Quad 2-Input Multiplexer/3-State	16
F258D	Quad 2-Input Multiplexer, Inverting/ 3-State	16
F280D	9-Bit Odd/Even Parity Gen/Checker	14
F283D	4-Bit Full Adder	16
F352D	Dual 4-Input Multiplexer	16
F353D	Dual 4-Input Multiplexer/3-State	20
F365D	Hex Buffer Driver Gated Enable Non-Inverting/3-State	16
F366D	Hex Buffer Driver Gated Enable Inverting/3-State	16
F367D	Hex Buffer Driver/4-2-Bit/Non-Inverting/3-State	16
F368D	Hex Buffer Driver/4-2-Bit/Inverting/ 3-State	16
F373DW	Octal Transparent Latch/3-State	20
F374DW	Octal D Flip-Flop/3-State	20
F378D	Hex Parallel D Register w/Enable	16
F379D	Quad Parallel Register w/Enable	16
F398DW	Quad 2-Port Register	20
F399D	Quad 2-Port Register	16
F521DW	Octal Comparator	20
F533DW	Octal Transparent Latch/3-State	20
F534DW	Octal D Flip-Flop/3-State	20
F537DW	1-of-10 Decoder/3-State	20
F538DW	1-of-8 Decoder/3-State	20
F539DW	1-of-4 Decoder/3-State	20

MECL 10K Devices Available in PLCC

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

Device	Function	Pins
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

MECL 10K Devices Available in PLCC (continued)

MC10100/10200 — (− 30°C to + 85°C)

Suffix: FN . . . Plastic Leaded Chip Carrier

Device	Function	Pins
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

Device	Function	Pins
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

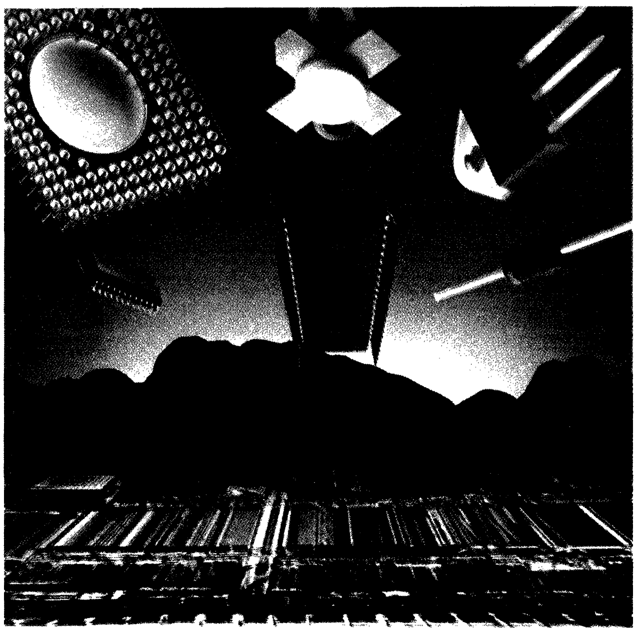
MECL 10KH Devices Available in PLCC

MC10H100 Series — (0 to + 75°C)

Suffix: FN . . . Plastic Leaded Chip Carrier

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 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

Device	Function	Pins
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
H186	Dual High Speed Adder/Subtractor	20
H187	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
H301	2-4/1-2 Input X-OR Gate	16
H302	2-4 or 1-6/1-4 Input X-OR Gate	16
H303	2-5 Input X-OR Gate	16
H304	1-8 or 2-4 Input X-OR Gate	16
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 V)	20
H423	Triple 3-Input Bus Driver w/Enable (25 Ohm)	20
H424	Quad TTL-to-MECL Translator (ECL Strobe)	20



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.

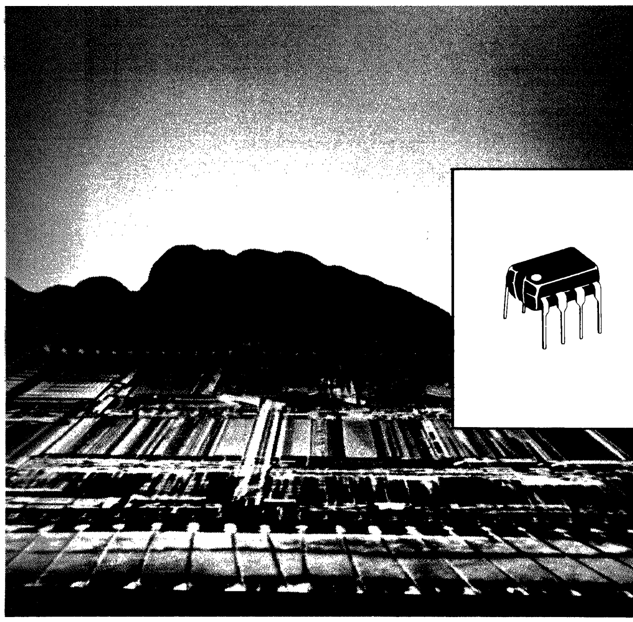
Operational amplifiers have utilized JFET inputs for improved performance, plus innovative design and trimming concepts have evolved for improved high performance and precision characteristics. In linear power IC's, basic voltage regulators have been refined to include higher current levels and more 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.

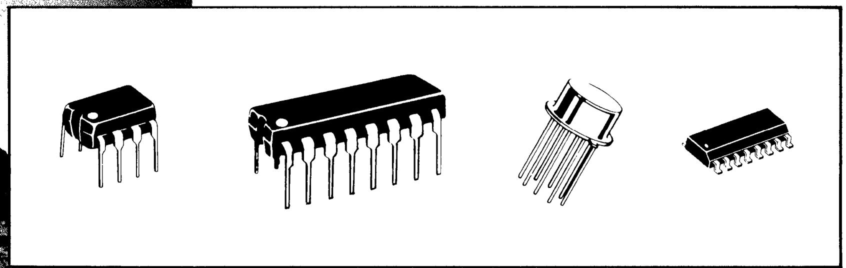
Linear designs also offer a wide array of line drivers, receivers and transceivers for many of the EIA, European, IEEE and IBM interface standards. Peripheral drivers for a variety of devices are also offered. In addition to these key interface functions, a variety of magnetic and semiconductor memory 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 IC's and of Motorola's involvement in these areas.





Amplifiers and Comparators

In Brief . . .

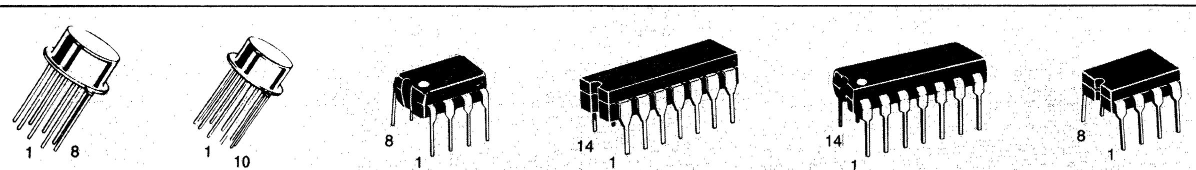
For over two decades, Motorola has continually refined and updated integrated circuit technologies, analog circuit design techniques and processes in response to the ever-expanding needs of the market place. The enhanced performance of present day operational amplifiers and comparators have come into being through innovative application of these technologies, designs and processes. Some early designs, though of inferior performance by today's standards, are still available but are rapidly 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 segments of society to include 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 601 METAL **H, G SUFFIX**	CASE 603 METAL **G SUFFIX**	CASE 626 PLASTIC **N, P OR P1 SUFFIX**	CASE 632 CERAMIC **J, L SUFFIX**	CASE 646 PLASTIC **N, N-14, P OR P2 SUFFIX**	CASE 693 CERAMIC **J OR J-8, U, Z, JG SUFFIX**

Single Operational Amplifiers

Device	I_{IB} μA Max	V_{IO} mV Max	TCV_{IO} 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	Package Suffix
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	H, N/626, J/693
LM308	7.0	7.5	15	1.0	25	1.0	0.3	±3.0	±18	Precision	H, N/626
LM308A	7.0	0.5	5.0	1.0	80	1.0	0.3	±3.0	±18	Precision	H, N/626
MC1439	1.0	7.5	15	100	15	2.0	4.2	±6.0	±18	High Slew Rate	G/601, P1
MC1709C	1.5	7.5	15	500	15	1.0	0.3	±3.0	±18	General Purpose	G/601, P1, U
MC1748C	0.5	6.0	15	200	20	1.0	0.5	±3.0	±18	General Purpose	G/601, P1, U
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	H, N/626, J/693
LM208	0.002	2.0	3.0	0.2	50	1.0	0.3	±3.0	±20	Precision	H, N/626, J/632, J-8
LM208A	0.002	0.5	1.0	0.2	80	1.0	0.3	±3.0	±20	Precision	H, N/626, J/632, J-8
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	H, J/693
LM108	0.002	2.0	3.0	0.2	50	1.0	0.3	±3.0	±20	Precision	H, J, J-8/693
LM108A	0.002	0.5	1.0	0.2	80	1.0	0.3	±3.0	±20	Precision	H, J, J-8/693
MC1539	0.5	3.0	15	60	50	2.0	4.2	±4.0	±18	High Slew Rate	G/601
MC1709	0.5	5.0	15	200	25	1.0	0.3	±3.0	±18	General Purpose	G/601, U
MC1709A	0.6	3.0	5.0	100	25	1.0	0.5	±3.0	±18	High Performance MC1709	G/601
MC1748	0.5	5.0	15	200	50	1.0	0.5	±3.0	±22	General Purpose	G/601, U

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	Package Suffix
LF351	200 pA	10	10	100 pA	25	4.0	13	±5.0	±18	JFET Input	N/626
LF355	200 pA	10	5.0	50 pA	50	1.0	5.0	±5.0	±18	JFET Input	H/601, J/693
LF355B	100 pA	5.0	5.0	20 pA	50	2.5	5.0	±5.0	±22	JFET Input	H/601, J/693
LF356	200 pA	10	5.0	50 pA	50	2.0	15	±5.0	±18	JFET Input	H/601, J/693
LF356B	100 pA	5.0	5.0	20 pA	50	5.0	12	±5.0	±22	JFET Input	H/601, J/693
LF357	200 pA	10	5.0	50 pA	50	3.0	75	±5.0	±18	Wideband FET Input	H/601, J/693
LF357B	100 pA	5.0	5.0	20 pA	50	20	50	±5.0	±22	JFET Input	H/601, 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	H, N/626, J/632, J-8/693
LM11CL	200 pA	5.0	3.0	25 pA	50	1.0	0.3	±3.0	±20	Precision	H, N/626, J/632, J-8/693
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	G/601, U
MC1456	0.03	10	12	10	70	1.0	2.5	±3.0	±18	High Performance	G/601, P1, U
MC1733C	30	—	—	5.0 µA	80	90	—	±4.0	±8.0	Differential Wideband Video Amp	G/601, L, P/646
MC1741C	0.5	6.0	15	200	20	1.0	0.5	±3.0	±18	General Purpose	G/601, P1, U
MC1741SC	0.5	6.0	15	200	20	1.0	10	±3.0	±18	High Slew Rate	G/601, P1
MC1776C	0.003	6.0	15	3.0	100	1.0	0.2	±1.2	±18	µPower, Programmable	G/601, P1, U
MC3476	0.05	6.0	15	25	50	1.0	0.2	±1.5	±18	Low Cost µPower, Programmable	G/601, P1, U
MC34001	200 pA	10	10	100 pA	25	4.0	13	±5.0	±18	JFET Input	G/601, P/626, U
MC34001A	100 pA	2.0	10	50 pA	50	4.0	13	±5.0	±18	JFET Input	G/601, P/626, U
MC34001B	200 pA	5.0	10	100 pA	50	4.0	13	±5.0	±18	JFET Input	G/601, P/626, U
MC34071	0.50	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
MC34080A	200 pA	0.5	10	100 pA	50	16	55	±5.0	±22	MC34081 for $A_V \geqslant 2$	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
MC34081A	200 pA	0.5	10	100 pA	50	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
OP-27E	0.040	0.025	0.2	35	1000	8.0	2.8	±4.0	±22	Low Noise, Precision	P/626
OP-27F	0.055	0.060	0.3	50	1000	8.0	2.8	±4.0	±22	Low Noise, Precision	P/626
OP-27G	0.080	0.100	0.4	75	700	8.0	2.8	±4.0	±22	Low Noise, Precision	P/626
TL061AC	200 pA	6.0	10	100 pA	4.0	2.0	6.0	±2.5	±18	Low Power JFET Input	P/626
TL061BC	200 pA	3.0	10	100 pA	4.0	2.0	6.0	±2.5	±18	Low Power JFET Input	P/626
TL061C	200 pA	15	10	200 pA	4.0	2.0	6.0	±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
TL071BC	200 pA	3.0	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
TL081BC	200 pA	3.0	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

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	Package Suffix
OP-27E	0.040	0.025	0.2	35	1000	8.0	2.8	±4.0	±22	Low Noise, Precision	Z
OP-27F	0.055	0.060	0.3	50	1000	8.0	2.8	±4.0	±22	Low Noise, Precision	Z
OP-27G	0.080	0.100	0.4	75	700	8.0	2.8	±4.0	±22	Low Noise, Precision	Z

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	Package Suffix
MC33071	0.50	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	0.10	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
TL061V	200 pA	6.0	10	100 pA	4.0	2.0	6.0	±2.5	±18	Low Power JFET Input	P/626

Single Operational Amplifiers (continued)

Internally Compensated

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	Package Suffix
LM11	50 pA	0.3	1.0	10 pA	250	1.0	0.3	±3.0	±20	Precision	H, J/632, J-8/693
MC1536	0.02	5.0	10	3.0	100	1.0	2.0	±15	±40	High Voltage	G/601, U
MC1556	0.015	4.0	10	2.0	100	1.0	2.5	±3.0	±22	High Performance	G/601, 693, U
MC1733	0.20	—	—	3.0 μA	90	90	—	±4.0	±8.0	Differential Wideband Video Amp	G/603, L
MC1741	0.5	5.0	15	200	50	1.0	0.5	±3.0	±22	General Purpose	G/601, U
MC1741S	0.5	5.0	15	200	50	1.0	10	±3.0	±22	High Slew Rate	G/601, U
MC1776	0.0075	5.0	15	3.0	200	1.0	0.2	±1.2	±18	μPower, Programmable	G/601, L
MC35001	100 pA	10	10	100 pA	25	4.0	13	±5.0	±22	JFET Input	G/601, U
MC35001A	75 pA	2.0	10	25 pA	50	4.0	13	±5.0	±22	JFET Input	G/601, U
MC35001B	100 pA	5.0	10	50 pA	50	4.0	13	±5.0	±22	JFET Input	G/601, U
MC35071	0.50	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
MC35080A	200 pA	0.5	10	100 pA	50	16	55	±5.0	±22	MC35081 for $A_V \geq 2$	U
MC35081	200 pA	1.0	10	100 pA	25	8.0	30	±5.0	±22	High Speed, JFET Input	U
MC35081A	200 pA	0.5	10	100 pA	50	8.0	30	±5.0	±22	High Speed, JFET Input	U
MC35171	0.10	4.5	10	20	50	1.8	2.1	+3.0	+44	Low Power, Single Supply	U
MC35181	0.1 nA	2.0	10	0.05	25	4.0	10	±2.5	±18	Low Power JFET Input	U
OP-27A	0.040	0.025	0.2	35	1000	8.0	2.8	±4.0	±22	Low Noise, Precision	Z
OP-27B	0.055	0.060	0.3	50	1000	8.0	2.8	±4.0	±22	Low Noise, Precision	Z
OP-27C	0.080	0.100	0.4	75	700	8.0	2.8	±4.0	±22	Low Noise, Precision	Z
TL061M	200 pA	6.0	10	100 pA	4.0	2.0	6.0	±2.5	±18	Low Power JFET Input	JG
TL071M	200 pA	6.0	10	50 pA	35	4.0	13	±5.0	±18	Low Noise, JFET Input	JG
TL081M	200 pA	9.0	10	100 pA	25	4.0	13	±5.0	±18	JFET Input	JG

Dual Operational Amplifiers

Noncompensated

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	Package Suffix
MC1437	1.5	7.5	10	500	15	1.0	0.25	±3.0	±18	Dual MC1709	L, P/646

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	Package Suffix
MC1537	0.5	5.0	10	200	25	1.0	0.25	±3.0	±18	Dual MC1709	L

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	Package Suffix
LF353	200 pA	10	10	100 pA	25	4.0	13	±5.0	±18	JFET Input	N/626
LF442C	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 +3.0	±18 +36	Single Supply (Low Power Consumption)	H, N/626, J/693
LM833	1.0	5.0	2.0	200	31.6	15	7.0	±2.5	±18	Dual, Low Noise, Audio	P/626
MC1458	0.5	6.0	10	200	20	1.1	0.8	±3.0	±18	Dual MC1741	G/601, P1, U
MC1458C	0.70	10	10	300	20	1.1	0.8	±3.0	±18	Dual General Purpose	G/601, P1
MC1458S	0.5	6.0	10	200	20	1.0	10	±3.0	±18	High Slew Rate	G/601, P1, U
MC1747C	0.5	6.0	10	200	25	1.0	0.5	±3.0	±18	Dual MC1741	G/603, L, P2
MC3458	0.5	10	7.0	50	20	1.0	0.6	±1.5 +3.0	±18 +36	Split Supplies Single Supply (Low Crossover Distortion)	G/601, P1, U

Dual 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	Package Suffix
Commercial Temperature Range (0°C to +70°C) (continued)											
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	G/601, P1, U
MC34002	100 pA	10	10	100 pA	25	4.0	13	±5.0	±18	JFET Input	G/601, P/626, U
MC34002A	75 pA	2.0	10	50 pA	50	4.0	13	±5.0	±18	JFET Input	G/601, P/626, U
MC34002B	100 pA	5.0	10	70 pA	25	4.0	13	±5.0	±18	JFET Input	G/601, P/626, U
MC34072	0.50	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
MC34082A	200 pA	1.0	10	100 pA	50	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
MC34083A	200 pA	1.0	10	100 pA	50	16	55	±5.0	±22	MC34082 for $A_V \geq 2$	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
TL062BC	200 pA	3.0	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
TL072BC	200 pA	3.0	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
TL082BC	200 pA	3.0	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)											
LM258	0.15	5.0	10	30	50	1.0	0.6	±1.5	±18	Split or Single	H, N/626, J/693
								±3.0	±36	Supply Op Amp	
Automotive Temperature Range (−40°C to +85°C)											
LM2904	0.25	7.0	7.0	50	100 typ	1.0	0.6	±1.5	±13	Split or Single	H, N/626, J/693
								±3.0	±26	Supply Op Amp	
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	Dual, 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
Military Temperature Range (−55°C to +125°C)											
LM158	0.15	5.0	10	30	50	1.0	0.6	±1.5	±18	Split Supplies	H, 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	G/601, U
MC1558S	0.5	5.0	10	200	50	1.0	10	±3.0	±22	High Slew Rate	G/601, U
MC1747	0.5	5.0	10	200	50	1.0	0.5	±3.0	±22	Dual MC1741	G/601, L
MC3558	0.5	5.0	10	50	50	1.0	0.6	±1.5	±18	Split Supplies	G/601, U
								+3.0	+36	Single Supply	
MC4558	0.5	5.0	10	200	50	2.8	1.6	±3.0	±22	High Frequency	G/601, U
MC35002	100 pA	10	10	100 pA	25	4.0	13	±5.0	±22	JFET Input	G/601, U
MC35002A	75 pA	2.0	10	25 pA	50	4.0	13	±5.0	±22	JFET Input	G/601, U
MC35002B	100 pA	5.0	10	50 pA	50	4.0	13	±5.0	±22	JFET Input	G/601, U
MC35072	0.50	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
MC35082	200 pA	3.0	10	100 pA	25	8.0	30	±5.0	±22	High Speed, JFET Input	U
MC35082A	200 pA	1.0	10	100 pA	50	8.0	30	±5.0	±22	High Speed, JFET Input	U

Dual 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	Package Suffix
Military Temperature Range (−55°C to +125°C)											
MC35083	200 pA	3.0	10	100 pA	25	16	55	±5.0	±22	Decompensated	U
MC35083A	200 pA	1.0	10	100 pA	50	16	55	±5.0	±22	MC35082 for $A_V \geq 2$	U
MC35172	0.10	4.5	10	20	50	1.8	2.1	+3.0	+44	Low Power, Single	U
										Supply	
MC35182	0.1 nA	3.0	10	0.05	25	4.0	10	±2.5	±18	Low Power JFET Input	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

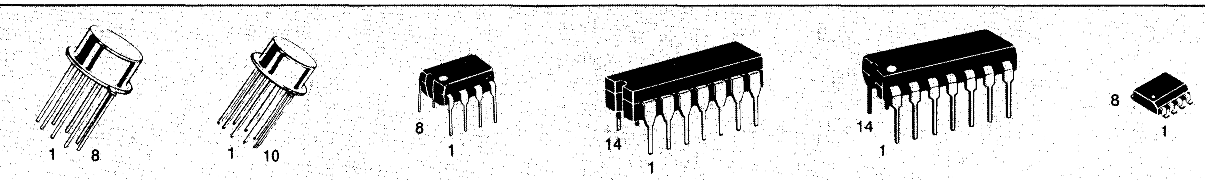
Device	I_{IB} μA Max	V_{IO} mV Max	TC_{VIO} μV/°C Typ	I_{IO} nA Max	A_{vol} V/mV Min	BW ($A_V=1$) MHz Typ	SR ($A_V=1$) V/μs Typ	Supply Voltage V Min	Supply Voltage V Max	Description	Package Suffix
Internally Compensated											
Commercial Temperature Range (0°C to +70°C)											
LF347	200 pA	10	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	0.20	6.0	—	50	25	1.0	0.5	±3.0	±18	Quad MC1741	J/632, N/646
MC3401/	0.3	—	—	—	1.0	5.0	0.6	±1.5	±18	Norton Input	J/632, N/646
LM3900								+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	0.50	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
MC34084A	200 pA	6.0	10	100 pA	50	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
MC34085A	200 pA	6.0	10	100 pA	50	16	55	±5.0	±22	MC34084 for $A_V \geq 2$	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
TL064BC	200 pA	3.0	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
TL084BC	200 pA	3.0	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
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 or Single	J/632, N/646
								±3.0	±32	Supply Op Amp	
LM248	0.20	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)											
LM2902	0.5	10	—	50	—	1.0	0.6	±1.5	±13	Differential	N/646
								+3.0	+26	Low Power	

Quad 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	Package Suffix
Automotive Temperature Range (−40°C to +85°C) (continued)											
MC3301/ LM2900	0.3	—	—	—	1.0	4.0	0.6	±2.0 +4.0	±15 +28	Norton Input	P/646 N/646
MC3303	0.5	8.0	10	75	20	1.0	0.6	±1.5 +3.0	±18 +36	Differential General Purpose	P/646
MC33074	0.50	5.0	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	Quad High Performance	L, P/646
MC33079	750 nA	2.5	2.0	150	31.6	16	7.0	±5.0	±18	Quad Low Noise	N/646
MC33174	0.10	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
MC33284	100pA	200µV	5.0	50pA	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 +3.0	±16 +32	Low Power Consumption	J/632, N/646
LM148	0.10	5.0	—	25	50	1.0	0.5	±3.0	±18	Quad MC1741	J/632
MC3503	0.5	5.0	7.0	50	50	1.0	0.6	±1.5 +3.0	±18 +36	General Purpose Low Power	L, P/646
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	0.50	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	Quad High Performance	L
MC35084	200 pA	12	10	100 pA	25	8.0	30	±5.0	±22	High Speed, JFET Input	L
MC35084A	200 pA	6.0	10	100 pA	50	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
MC35085A	200 pA	6.0	10	100 pA	50	16	55	±5.0	±22	MC35084 for $A_V \geq 2$	L
MC35174	0.10	4.5	10	20	50	1.8	2.1	+3.0	+44	Low Power, Single Supply	L
MC35184	0.1 nA	10	10	0.05	25	4.0	10	±2.5	±18	Low Power JFET Input	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 601 METAL **G SUFFIX**	CASE 603 METAL **H, G SUFFIX**	CASE 626 PLASTIC **P SUFFIX**	CASE 632 CERAMIC **F, L SUFFIX**	CASE 646 PLASTIC **N, P SUFFIX**	CASE 751 PLASTIC SO-8 **D SUFFIX**

AGC Amplifiers

MC1590G Family — Wide-Band General Purpose Amplifiers

The MC1590G, MC1490, 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 IC's 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 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.

Non-AGC Amplifiers

SE/NE592 — Differential Two Stage Video Amplifier

A monolithic, two stage differential output, wideband video amplifier. It offers fixed gains of 100 and 400 without external components and adjustable gains from 400 to 0 with one external resistor. The input stage has been designed so that with the addition of a few external reactive elements between the gain select terminals, the circuit can function as a high pass, low pass, or band pass filter. This feature makes the circuit ideal for use as a video or pulse amplifier in communications, magnetic memories, display and video recorder systems.

MC1733/MC1733C — Video Amplifier

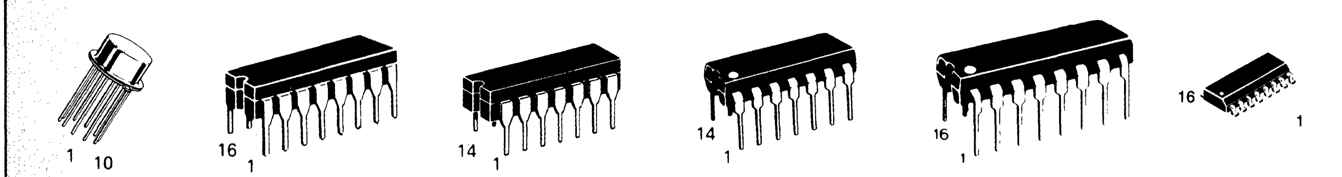
Differential input and output amplifier provides three fixed gain options with bandwidth to 120 MHz. External resistor permits any gain setting from 10 to 400 V/V. Extremely fast rise time (2.5 ns typ) and propagation delay time (3.6 ns typ) makes this unit particularly useful as pulse amplifier in tape, drum, or disc memory read applications.

High-Frequency Amplifier Specifications

Operating Temperature Range			A_V dB @ (Typ)	Bandwidth MHz	V_{CC}/V_{EE} Vdc		Case/Suffix
−55° to +125°C	−40° to +85°C	0° to +70°C			Min	Max	
MC1590G	—	—	50 35	10 100	+6.0	+18	601
—	—	MC1350	50 50	45 45	+6.0	+18	626/P, 751/D
—	MC1490	—	50 35	10 100	+6.0	+18	626/P
MC1545	—	MC1445	19	50	±4.0	±12	603/G, 632/L
SE592	—	NE592	52 40	40 90	±4.0	±8.0	603/H, 632/F 646/N
MC1733	—	MC1733C	52 40 20	40 90 120	±4.0	±8.0	603/G, 632/L 646/P

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.

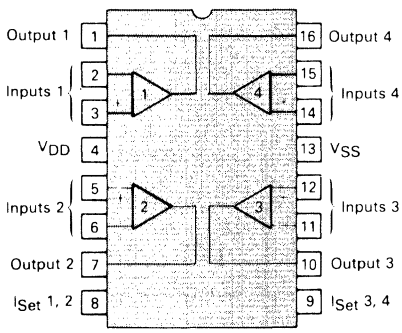


CASE 603C METAL **G SUFFIX** | CASE 620 CERAMIC **L SUFFIX** | CASE 632 CERAMIC **L SUFFIX** | CASE 646 PLASTIC **P SUFFIX** | CASE 648 PLASTIC **P SUFFIX** | CASE 751B PLASTIC **D SUFFIX**

CMOS

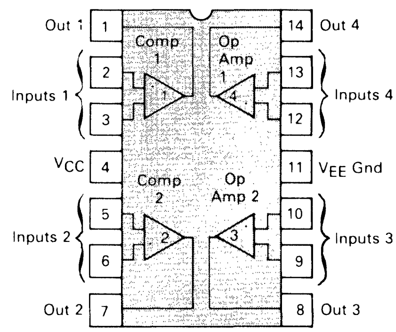
MC14573: Quad Programmable Operational Amplifier
MC14574: Quad Programmable Comparator
MC14575: Dual Programmable Operational Amplifier and Dual Programmable Comparator

These low power devices are designed for applications such as active filters, voltage reference circuits, function generators, oscillators, and limit set alarms.



MC3505/MC3405: Dual Operational Amplifier and Dual 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	Package Suffix
Bipolar								
MC3505	0.5	5.0	50	20	1.3	3.0 to 36	±1.5 to ±18	L/632
MC3405		10						L/632, P/646
CMOS								
MC14573	0.001	±30	0.0001	1.0	10*	3.0 to 15	±1.5 to ±7.5	D/751B, P/648
MC14574								
MC14575								

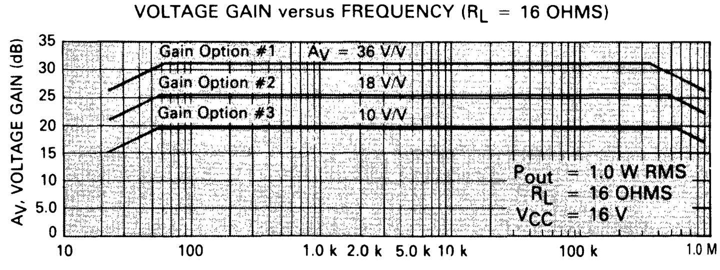
*Propagation Delay

Power Amplifiers Variable Gain

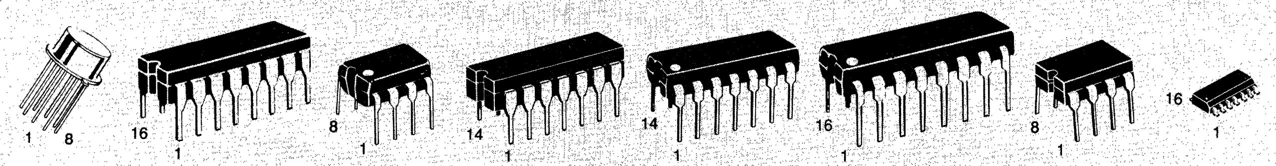
MC1554G—T_A = −55° to +125°C, Case 603C
MC1454G—T_A = 0° to +70°C, Case 603C

One-watt Power Amplifier for single or split supply operation. Typical voltage gain of 10, 18, or 33 V/V with 0.4% THD.

VOLTAGE GAIN versus FREQUENCY (R_L = 16 OHMS)



Comparators



CASE 601 METAL **H SUFFIX**	CASE 620 CERAMIC **L SUFFIX**	CASE 626 PLASTIC **N SUFFIX**	CASE 632 CERAMIC **J SUFFIX**	CASE 646 PLASTIC **N SUFFIX**	CASE 648 PLASTIC **P SUFFIX**	CASE 693 CERAMIC **J-8 SUFFIX**	CASE 751B PLASTIC **D SUFFIX**

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix

Single
BIPOLAR

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix
LM111	0.10	3.0	0.01	200K	8.0	200	+15, −15	With strobe, will operate	−55 to +125	H, J-8
LM211	0.10	3.0	0.01	200K	8.0	200	+15, −15	from single supply	−25 to +85	H, J-8
LM311	0.25	7.5	0.05	200K	8.0	200	+15, −15		0 to +70	H, N/626, J-8

CMOS

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix
MC14578	1.0 pA	50	—	—	1.1	—	+3.5 to +14	Requires only 10 µA from single-ended supply	−30 to +70	D/751B, P/648

Dual
BIPOLAR

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix
LM193	0.10	5.0	0.025	200K	6.0	1300	±1.5 to	Designed for single or split	−55 to +125	H
LM193A	0.10	2.0	0.025	200K	6.0	1300	±18 or	supply operation, input	−55 to +125	H
LM293	0.25	5.0	0.050	200K	6.0	1300	+3.0 to +36	common mode includes	−25 to +85	H
LM293A	0.25	2.0	0.050	200K	6.0	1300		ground (negative supply)	−25 to +85	H
LM393	0.25	5.0	0.050	200K	6.0	1300			0 to +70	H, N/626
LM393A	0.25	2.0	0.050	200K	6.0	1300			0 to +70	H, N/626
LM2903	0.25	7.0	0.050	200K	6.0	1500			−40 to +85	N/626
MC3405	0.5	10	0.050	200K	6.0	1300	±1.5 to	This device contains two	0 to +70	L/632, P/646
MC3505	0.5	5.0	0.050	200K	6.0	1300	±7.5 or	op amps and two	−55 to +125	L/632
							+3.0 to 15	comparators in a single package		

CMOS

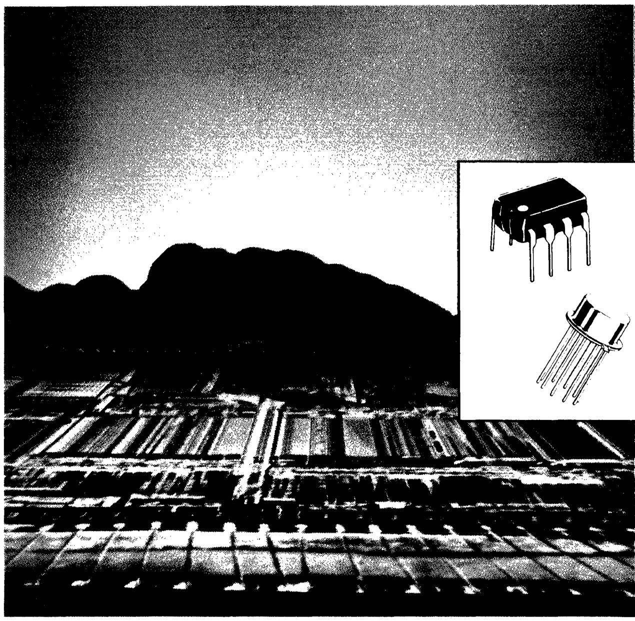
Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix
MC14575	0.001	30	0.0001	20K	3.0	1000	±1.5 to ±7.5 or +3.0 to 15	This device contains two op amps and two comparators in a single package	−40 to +85	P/648 D/751B

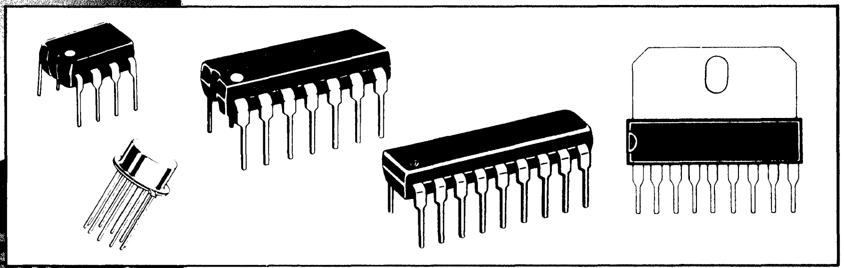
Quad
BIPOLAR

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix
LM139	0.10	5.0	0.025	200K	6.0	1300	±1.5 to	Designed for single or split	−55 to +125	J
LM139A	0.10	2.0	0.025	200K	6.0	1300	±18 or	supply operation, input	−55 to +125	J
LM239	0.25	5.0	0.050	200K	6.0	1300	+3.0 to +36	common mode includes	−25 to +85	J, N/646
LM239A	0.25	2.0	0.050	200K	6.0	1300		ground (negative supply)	−25 to +85	J, N/646
LM339	0.25	5.0	0.050	200K	6.0	1300			0 to +70	J, N/646
LM339A	0.25	2.0	0.050	200K	6.0	1300			0 to +70	J, N/646
LM2901	0.25	7.0	0.050	100K	6.0	1300			−40 to +85	N/646
MC3302	0.50	20	0.500	30K	6.0	1300			−40 to +85	N/646
MC3430	40	6.0	1.0 Typ	1.2K	16	33	+5.0, −5.0	High speed comparator/	0 to +70	L, P
MC3431	40	10	1.0 Typ	1.2K	16	33	+5.0, −5.0	sense-amplifier	0 to +70	L, P
MC3432	40	6.0	1.0 Typ	1.2K	16	40	+5.0, −5.0		0 to +70	L, P
MC3433	40	10	1.0 Typ	1.2K	16	40	+5.0, −5.0		0 to +70	L, P

CMOS

Device	I_{IB} µA Max	V_{IO} mV Max	I_{IO} µA Max	A_V V/V Typ	I_O mA Min	Response Time ns	Supply Voltage V	Description	Temperature Range (°C)	Package Suffix
MC14574	0.001	30	0.0001	20K	3.0	1000	±1.5 to ±7.5 or +3.0 to +15	Externally programmable power dissipation with one or two resistors	−40 to +85	P/648 D/751B





Power Supply Circuits

In Brief . . .

In most electronic systems some form of voltage regulation is required. Yesterday 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 reduced considerably. The designer now has a wide choice of fixed, low V_{diff}, adjustable, and tracking series-type 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 that of linear series-pass regulators. These advantages include significant advancements in the areas of size and weight reduction, efficiency, and the ability to perform voltage step-up and voltage-inverting. Motorola offers an ever increasing diverse portfolio of full featured switching regulator control circuits which meet the needs of today's modern compact electronic equipment.

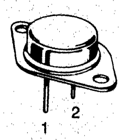
Power Supply Circuits

Linear Voltage Regulators

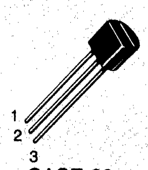
Fixed Output

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.

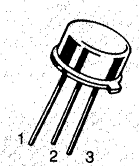
Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.



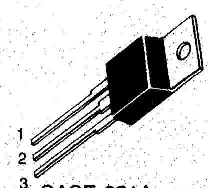
CASE 1
METAL
K SUFFIX



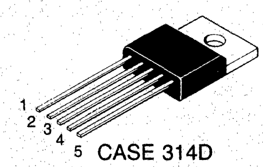
CASE 29
PLASTIC
P, Z SUFFIX



CASE 79
METAL
G, H SUFFIX



CASE 221A
PLASTIC POWER
T, KC SUFFIX



CASE 314D
PLASTIC
T SUFFIX

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

V_{out} Volts	Tol.† Volts	I_O mA Max	Device Positive Output	Device Negative Output	V_{in} Min/Max	Reg_{line} mV	Reg_{load} mV	$\Delta V_O/\Delta T$ mV/°C Typ	Case Suffix
5	±0.5	100	LM2931-5.0	—	5.6/40	30	50	1.0	Z, T
	±0.25		MC78L05C	MC79L05C	6.7/30	200	60		P, G
			LM2931A-5.0	—	5.6/40	30	50		Z, T
			MC78L05AC	MC79L05AC	6.7/30	150	60		P, G
		500	MC78M05C	MC79M05C	7/35	100	100	1.0	G, T
	±0.4	1500	LM109	—				1.1	K, H
			LM209	—					
	±0.25		LM309	—		50		1.0	
	±0.35		MC7805*	—	8.0/35			0.6	K
	±0.25		MC7805B#	—	8/35	100		1.0	T
			MC7805C	MC7905C	7/35				K, T
	±0.2		MC7805A*	—	7.5/35	10	50	0.6	K
			MC7805AC	MC7905AC			100		K, T
	±0.25		LM140-5*	—	7.0/35	50	50		K
	±0.2		LM140A-5*	—		10	25		
	±0.25		LM340-5	—		50	50		K, T
	±0.2		LM340A-5	—		10	25		
	±0.1		TL780-05C	—	7.0/35	5.0	25	0.06	KC
	±0.25	3000	MC78T05C	—	7.3/35	25	30	0.1	K, T
	±0.2		MC78T05AC	—		10	25		

#T_J = −40° to +125°C †Output Voltage Tolerance for Worst Case *T_J = −55° to +150°C

(continued)

Fixed Output Voltage Regulators (continued)

V_{out} Volts	Tol.† Volts	I_O mA Max	Device Positive Output	Device Negative Output	V_{in} Min/Max	Reg_{line} mV	Reg_{load} mV	$\Delta V_O/\Delta T$ mV/°C Typ	Case Suffix
5	±0.4	3000	LM123*	—	7.5/20	25	100	0.1	K
			LM223	—					
	±0.25		LM323	—					T
	±0.2		LM123A	—					K
			LM223A	—		15	50		
			LM323A	—					T
5.2	±0.26	1500	—	MC7905.2C	7.2/35	105	105	1.0	T
6	±0.3	500	MC78M06C	—	8/35	100	120	1.0	T
	±0.35	1500	MC7806*	—	9/35	60	100	0.7	K
	±0.3		MC7806B#	—		120	120		T
			MC7806C	MC7906C	8/35				K, T
	±0.24		MC7806AC	—	8.6/35	11	100		T
			LM140-6*	—	8/35	60	60		K
	±0.3		LM340-6	—					K, T
8	±0.8	100	MC78L08C	—	9.7/30	200	80	—	P, G
			MC78L08AC	—		175			
	±0.4	500	MC78M08C	—	10/35	100	160	1.0	G, T
		1500	MC7808*	—	11.5/35	80	100		K
			MC7808B#	—		160	160		T
			MC7808C	MC7908C	10.5/35				K, T
	±0.3		MC7808AC	—	10.6/35	13	100		T
	±0.4		LM140-8*	—	10.5/35	80	80		K
			LM340-8	—					K, T
		3000	MC78T08C	—	10.4/35	35	30	0.16	
12	±1.2	100	MC78L12C	MC79L12C	13.7/35	250	100	—	P, G
	±0.6		MC78L12AC	MC79L12AC					
		500	MC78M12C	MC79M12C	14/35	100	240	1.0	G, T
		1500	MC7812*	—	15.5/35	120	120	1.5	K
			MC7812B#	—		240	240		T
			MC7812C	MC7912C	14.5/35				K, T
	±0.5		MC7812A*	—	14.8/35	18	50		K
			MC7812AC	—			100		T
	±0.6		LM140-12*	—	14.5/35	120	120	1.5	K
	±0.5		LM140A-12*	—		18	32		
	±0.6		LM340-12	—		120	120		K, T
	±0.5		LM340A-12	—		18	32		
	±0.24		TL780-12C	—		5.0		0.15	KC
	±0.6	3000	MC78T12C	—	14.5/35	45	30	0.24	K, T
	±0.5		MC78T12AC	—		18	25		

#T_J = −40° to +125°C †Output Voltage Tolerance for Worst Case *T_J = −55° to +150°C

(continued)

Fixed Output Voltage Regulators (continued)

V_{out} Volts	Tol.† Volts	I_O mA Max	Device Positive Output	Device Negative Output	V_{in} Min/Max	Reg_{line} mV	Reg_{load} mV	$\Delta V_O/\Delta T$ mV/°C Typ	Case Suffix
15	±1.5	100	MC78L15C	MC79L15C	16.7/35	300	150	—	P, G
	±0.75		MC78L15AC	MC79L15A					
		500	MC78M15C	MC79M15C	17/35	100	300	1.0	G, T
		1500	MC7815*	—	18.5/35	150	150	1.8	K
			MC7815B#	—		300	300		T
			MC7815C	MC7915C	17.5/35				K, T
	±0.6		MC7815A*	—	17.9/35	22	50		K
			MC7815AC	—			100		K, T
	±0.75		LM140-15*	—	17.5/35	150	150		K
	±0.6		LM140A-15*	—		22	35		
	±0.75		LM340-15	—		150	150		K, T
	±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	K, 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	G, T
		1500	MC7818*	—	22/35	180	180	2.3	K
			MC7818B#	—		360	360		T
	±0.7		MC7818C	MC7918C	21/35				K, T
			MC7818AC	—		31	100		T
	±0.9		LM340-18	—		180	180		T
20	±1.0	500	MC78M20C	—	22/40	10	400	1.1	G, 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	G, T
		1500	MC7824*	—	28/40	240	240	3.0	K
			MC7824B#	—		480	480		T
			MC7824C	MC7924C	27/40				K, T
	±1.0		MC7824AC	—	27.3/40	36	100		T
	±1.2		LM340-24	—		240	240		T

#T_J = −40° to +125°C †Output Voltage Tolerance for Worst Case *T_J = −55° to +150°C

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 providing 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.

Positive Output Regulators

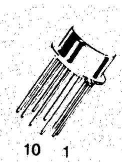
I_O mA Max	Device	Suffix	V_{out} Volts Min	V_{out} Volts Max	V_{in} Volts Min	V_{in} Volts Max	$V_{in} - V_{out}$ Differential Volts Min	P_D Watts Max $T_A = 25°C$	P_D Watts Max $T_C = 25°C$	Regulation % V_{out} @ $T_A = 25°C$ Max Line	Regulation Load	TC V_{out} Typ %/°C	T_J = °C Max	Case
100	LM317L	H,Z	1.2	37	5.0	40	3.0	Internally Limited		0.04	0.5	0.006	125	29,79
	LM217L#									0.02	0.3	0.004	150	
	LM117L*											0.003		
	LM2931C	T	3.0	24	3.16		0.6			0.15	1.0	—	125	314D
150	MC1723	CP	2.0	37	9.5	40	3.0	1.25	—	0.1	0.3	0.003	150	646
		CG						1.0	2.1			0.003		603C
		G										0.002		
		CL						1.5	—			0.003	175	632
		L							—			0.002		
500	LM317M	T	1.2	37	5.0	40	3.0	Internally Limited		0.04	0.5	0.0056	125	221A
1500	LM317	T	1.2	37	5.0	40	3.0	Internally Limited		0.04	0.5	0.006	125	221A
	LM317	H, K												79, 1
	LM217#											0.004		
	LM117*									0.02	0.3	0.003	150	
3000	LM350	T	1.2	33	5.0	36	3.0	Internally Limited		0.03	0.5	0.008	125	221A
	LM350	K												1
	LM250#									0.01	0.3	0.0057	150	
	LM150*											0.0051		

Negative Output Regulators

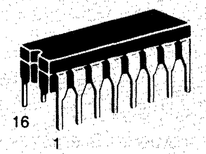
I_O mA Max	Device	Suffix	V_{out} Volts Min	V_{out} Volts Max	V_{in} Volts Min	V_{in} Volts Max	$V_{in} - V_{out}$ Differential Volts Min	P_D Watts Max $T_A = 25°C$	P_D Watts Max $T_C = 25°C$	Regulation % V_{out} @ $T_A = 25°C$ Max Line	Regulation Load	TC V_{out} Typ %/°C	T_J = °C Max	Case
500	LM337M	T	−1.2	−37	5.0	40	3.0	Internally Limited		0.04	1.0	0.0048	125	221A
1500	LM337	T	−1.2	−37	5.0	40	3.0	Internally Limited		0.04	1.0	0.0048	125	221A
	LM337	H, K												79, 1
	LM237#									0.02	0.5	0.0034	150	
	LM137*											0.0031		

#T_J = −25° to +150°C *T_J = −55° to +150°C

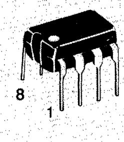
Special Regulators



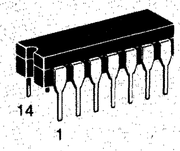
CASE 603C
METAL
G SUFFIX



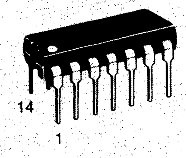
CASE 620
CERAMIC
D, J, N SUFFIX



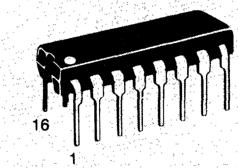
CASE 626
PLASTIC
N, P1 SUFFIX



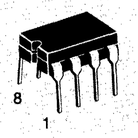
CASE 632
CERAMIC
L SUFFIX



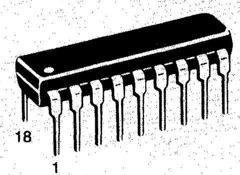
CASE 646
PLASTIC
P SUFFIX



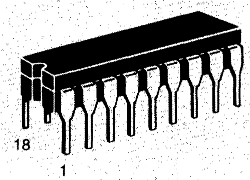
CASE 648
PLASTIC
P, N SUFFIX



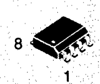
CASE 693
CERAMIC
U SUFFIX



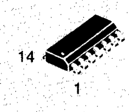
CASE 707
PLASTIC
N SUFFIX



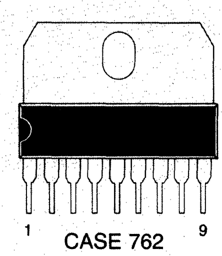
CASE 726
CERAMIC
J SUFFIX



CASE 751
PLASTIC
D SUFFIX



CASE 751A
PLASTIC
D SUFFIX



CASE 762
PLASTIC
SIP-9

Floating Voltage and Current Regulators

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

V_{out} Volts		I_O mA			V_{aux} Volts		P_D Watts	$\Delta V_{ref}/V_{ref}$ %		$\Delta I_L/I_L$ %	TC V_{out} %/°C	
Min	Max	Max	Device	Suffix	Min	Max	Max	Line	Load	Max	Typ	Case
0	*	*	MC1466	L	21	30	0.75	0.015	0.015	0.2	0.001	632

*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.

V_{out} Volts		I_O mA	V_{in} Volts				P_D Watts			TC %/°C (T_{low} to T_{high})	T_A	
Min	Max	Max	Min	Max	Device	Suffix	Max	Reg_{line} mV	Reg_{load} mV	Typ	°C	Case
14.8	15.2	±100	−17	30	MC1468	G	0.8	10	10	3.0	0 to +75	603C
						L	1.0					632
					MC1568	G	0.8				−55 to +125	603C
						L	1.0					632

Microprocessor Voltage Regulator/Supervisory Circuit

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

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

Switching Regulators

Used as a control circuit in PWM, push-pull, bridge and series type Switchmode supplies, the devices include a voltage reference, oscillator, pulse-width modulator, phase splitter and output drive sections. Frequency and duty cycle are independently adjustable. Most of these devices also include one or two on-chip error amplifiers for voltage or current error signal feedback.

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	V_{CC} Volts Min	V_{CC} Volts Max	V/I Operating Mode	Ref. Volts	Max Osc. Freq. (kHz)	Device	Suffix	T_A °C	Case
250	7.0	40	V	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	12	I	1.25 ± 2.0%	300	MC34129	D	0 to +70	751A
							P		646
						MC33129	D	−40 to +85	751A
							P		646
	11.5	30		5.0 ± 2.0%	500	UC3842A	D	0 to +70	751A
							N		626
	11			5.0 ± 1.0%		UC2842A	D	−25 to +85	751A
							J		693
							N		626
	8.2			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
1500	2.5	40	V	1.24 ± 5.2%#	100	μA78S40	PC	0 to +70	648
							DC		620
							PV	−40 to +85	648
							DM	−55 to +125	620
				1.25 ± 5.6%#		MC34063	P1	0 to +70	626
							U		693
						MC33063	P1	−40 to +85	626
							U		693
						MC35063	U	−55 to +125	
				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

Tolerance applies over the specified operating temperature range.

Double-Ended Controllers

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

I_O mA Max	V_{CC} Volts Min	V_{CC} Volts Max	V/I Operating Mode	Ref. Volts	Max Osc. Freq. (kHz)	Device	Suffix	T_A °C	Case
500	7.0	40	V	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			5.1 ± 2.0%	400	SG3525A	N	0 to +70	648
							J		620
				5.1 ± 1.0%		SG2525A	N	−25 to +85	648
							J		620
						SG1525A	J	−55 to +125	
				5.1 ± 2.0%		SG3527A	N	0 to +70	648
							J		620
				5.1 ± 1.0%		SG2527A	N	−25 to +85	648
							J		620
						SG1527A	J	−55 to +125	
±200				5.0 ± 2.0%	350	SG3526	N	0 to +125*	707
							J		726
				5.0 ± 1.0%		SG2526	N	−25 to +150*	707
							J		726
						SG1526	J	−55 to +150*	

*Junction Temperature Range
#Tolerance applies over the specified operating temperature range.

Special Power Supply Controllers

High Performance Dual Current-Mode Controllers

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	V_{CC} Volts		V/I Operating Mode	Ref. Volts	Max Osc. Freq. (kHz)	Device	Suffix	T_A °C	Case
	Min	Max							
±1000	11	15.5	I	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

TCA5600 — T_A = −40° to +75°C, Case 707

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

Regulated Outputs	Output Current mA	V_{CC} Volts		Ref. Volts	Key Supervisory Features
		Min	Max		
E^2PROM Programmable Output: 24 Volts (Write Mode) 5.0 Volts (Read Mode)	150 peak	6.0	35	2.5±3.2%	MPU Reset and Watchdog Circuit
Fixed Linear Output: 5.0 Volts	10 to external buffer transistor				

Control IC for Line-Isolated Free Running Flyback Converter

Regulates and monitors the switching transistor in power supplies based on the free oscillating flyback converter principle. Provides excellent Switchmode performance in Hi-Fi equipment, active loudspeakers, as well as applications in TV receivers and video recorders.

I_O mA Max	V_{CC} Volts		V/I Operating Mode	Ref. Volts	Max Osc. Freq. (kHz)	Device	Suffix	T_A °C	Case
	Min	Max							
±1500	12.3	20	V	4.2±5.0%	100	TDA4601	—	−15 to +85	762
							B		707

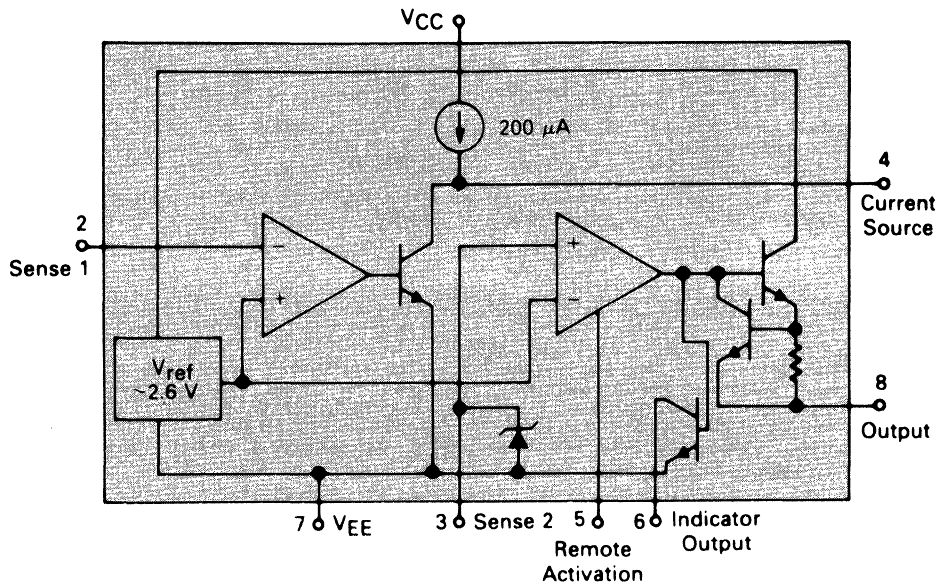
Power Supervisory

A variety of Power Supervisory Circuits are offered. Overvoltage sensing circuits which drive "crowbar" SCR's 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-under-voltage 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

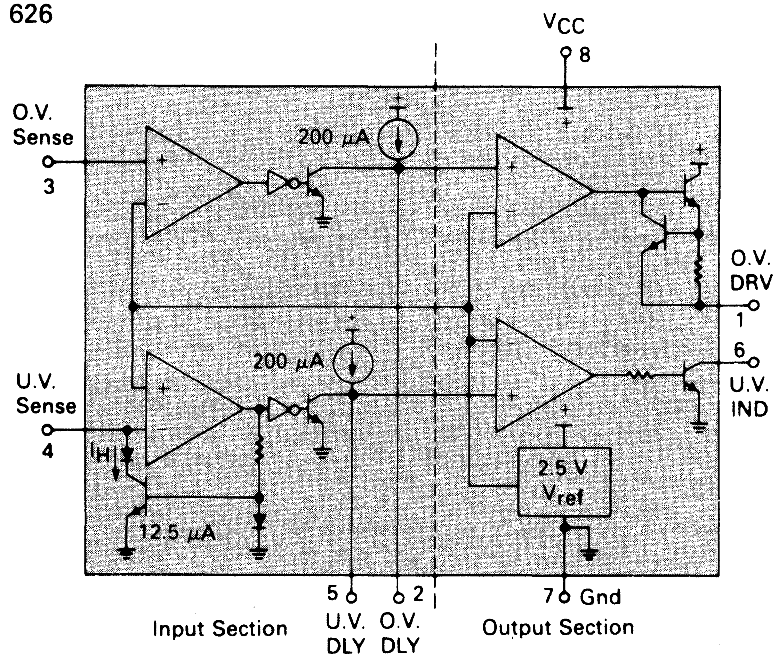
This device can protect sensitive circuitry from power supply transients or regulator failure when used with an external "Crowbar" SCR. The device senses voltage and compares it to an internal 2.6 V reference. Overvoltage trip is adjustable by means of an external resistive voltage divider. A minimum 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-Under Voltage 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 under-voltage fault conditions. This device features dedicated over- and under-voltage sensing channels with independently programmable time delays. The over-voltage channel has a high current Drive Output for use in conjunction with an external SCR "Crowbar" for shutdown. The under-voltage channel input comparator has hysteresis which is externally programmable, and an open-collector output for fault indication.

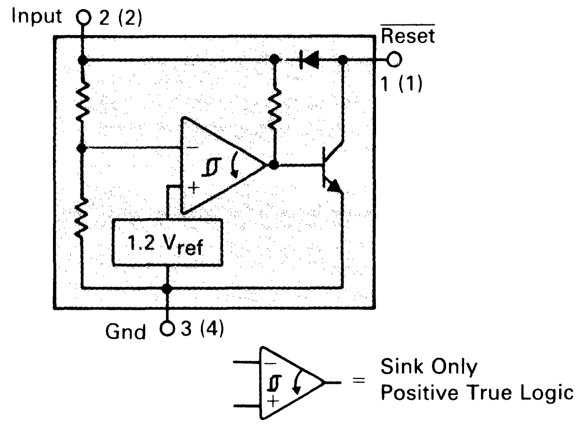


Undervoltage Sensing Circuit

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

The MC34064 is an undervoltage sensing circuit specifically designed for use as a reset controller in microprocessor-based systems. It offers the designer an economical solution for low voltage detection with a single external resistor. The MC34064 features a trimmed-in-package bandgap reference, and a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation. The open collector reset output is capable of sinking in excess of 10 mA, and operation is guaranteed down to 1.0 volt input with low standby current. These devices are packaged in 3-pin TO-92 and 8-pin surface mount packages.

Applications include direct monitoring of the 5.0 volt MPU/logic power supply used in appliance, automotive, consumer, and industrial equipment.



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.

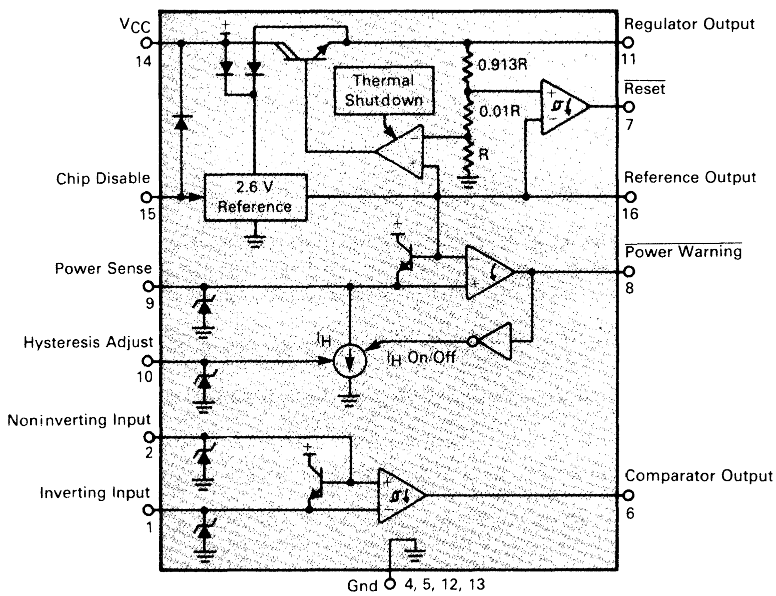
Microprocessor Voltage Regulator and Supervisory Circuit

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 shut-down for over temperature protection.

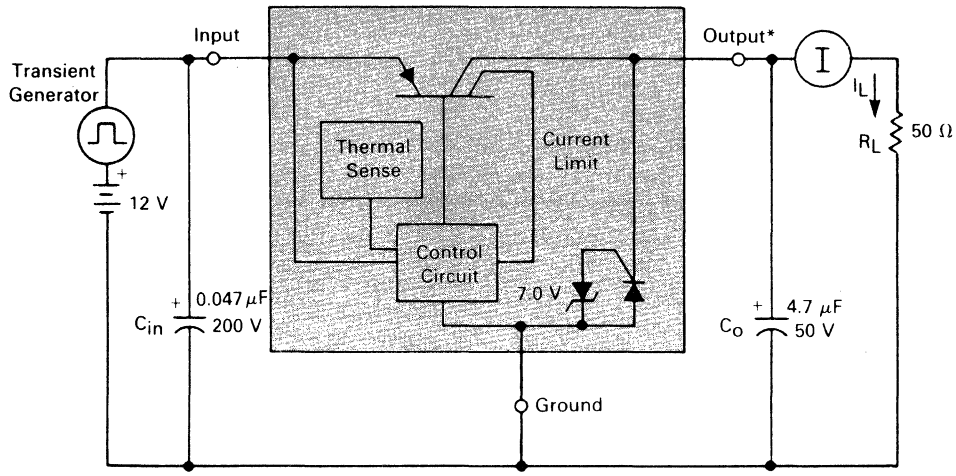
These devices are contained in a 16 pin dual-in-line heat tab plastic package for improved thermal conduction.



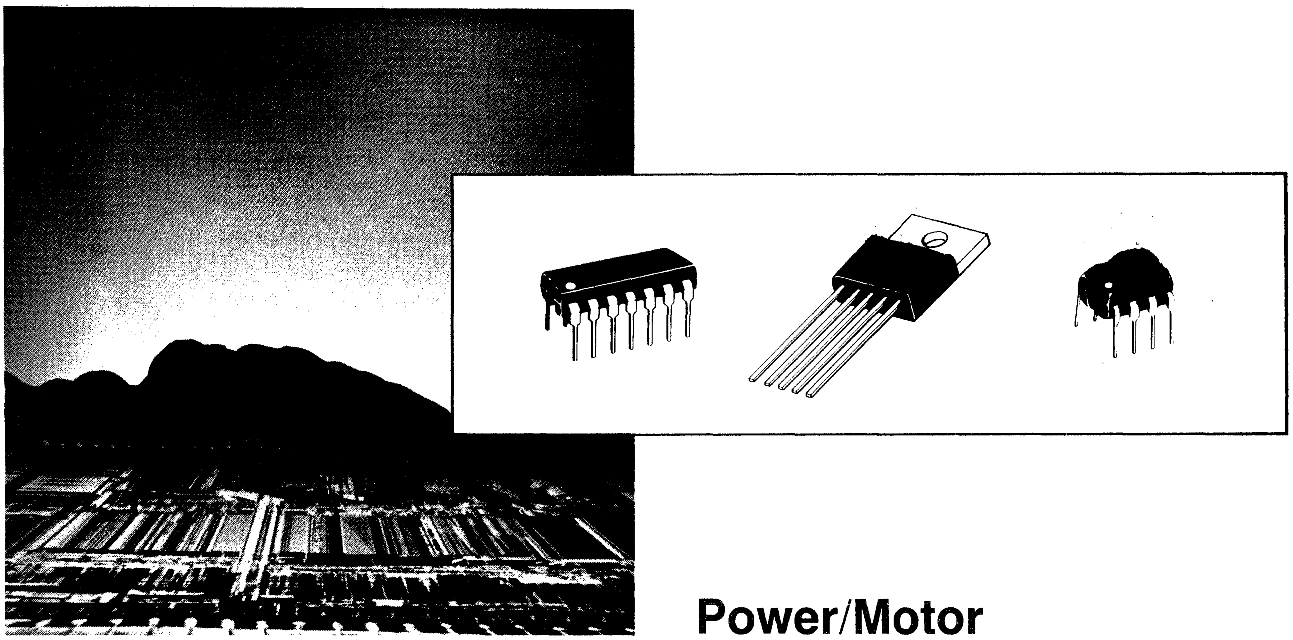
Series Switch Transient Protection Circuit

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 over voltage condition (≥17.5 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.



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.



Power/Motor Control Circuits

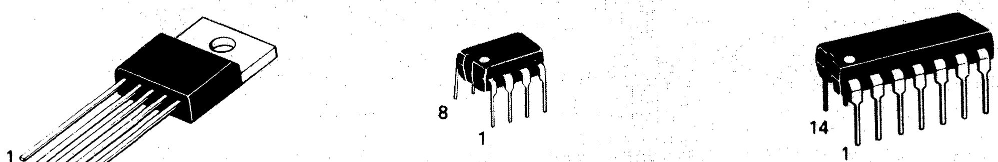
In Brief . . .

With the expansion of electronics into more and more mechanical systems there comes an ever increasing demand for simple but intelligent circuits that can blend these two technologies together. In past years, the task of power/motor control was once the domain of discrete devices. But today, increasingly, this task is being performed by bipolar IC technology because of 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 application.

Power/Motor Control Circuits

Power Controllers

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



CASE 314D
PLASTIC
T SUFFIX

CASE 626
PLASTIC

CASE 646
PLASTIC
P SUFFIX

Zero Voltage Switches

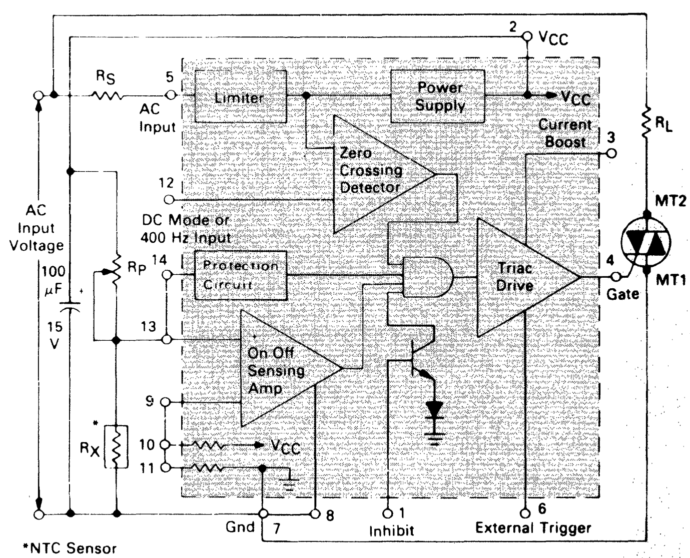
CA3079P/CA3059P

$T_A = -40°$ to $+85°C$, Case 646

. . . 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).

CA3079



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

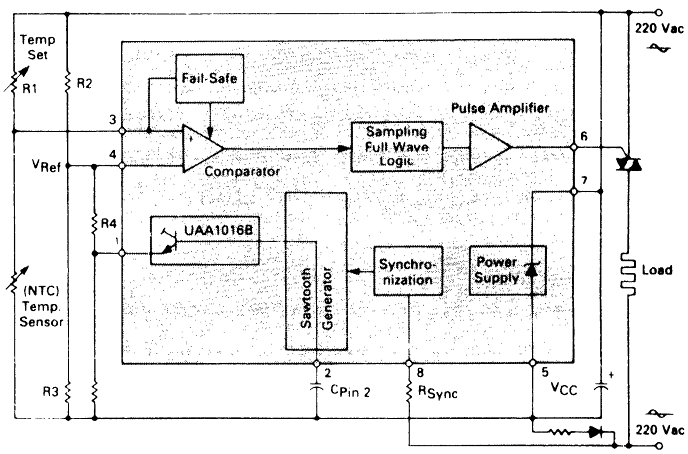
Zero Voltage Controller

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

. . . 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

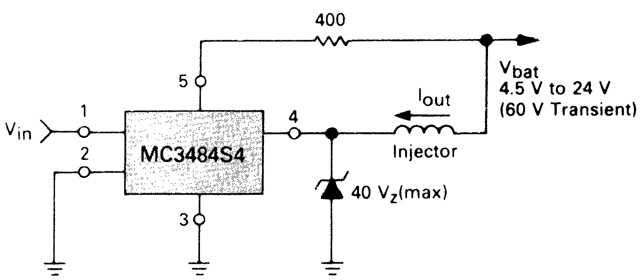


Integrated Solenoid Driver

MC3484S2,S4 — 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 or 2.4 A in MC3484S2) 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



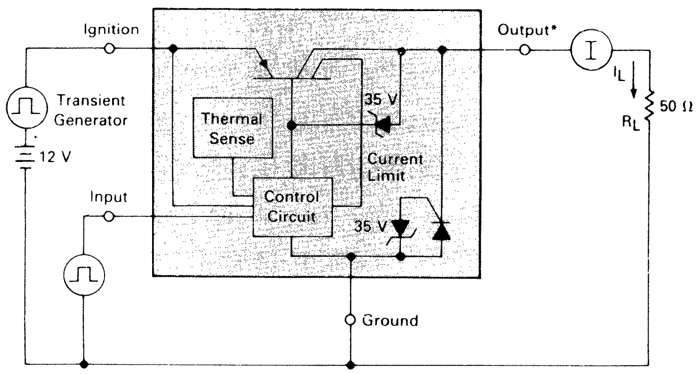
High-Side Driver Switch

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.

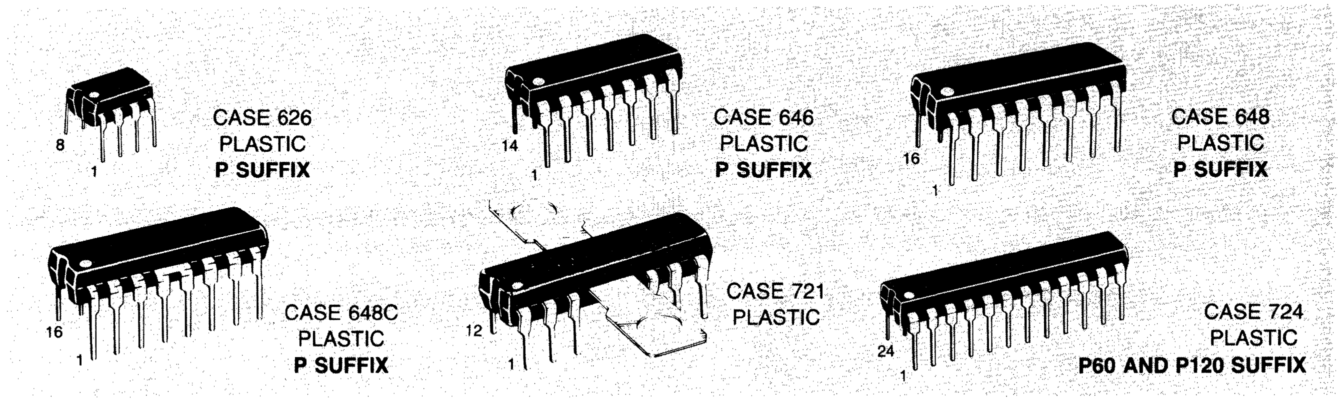
MC3399T



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.

Motor Controllers

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

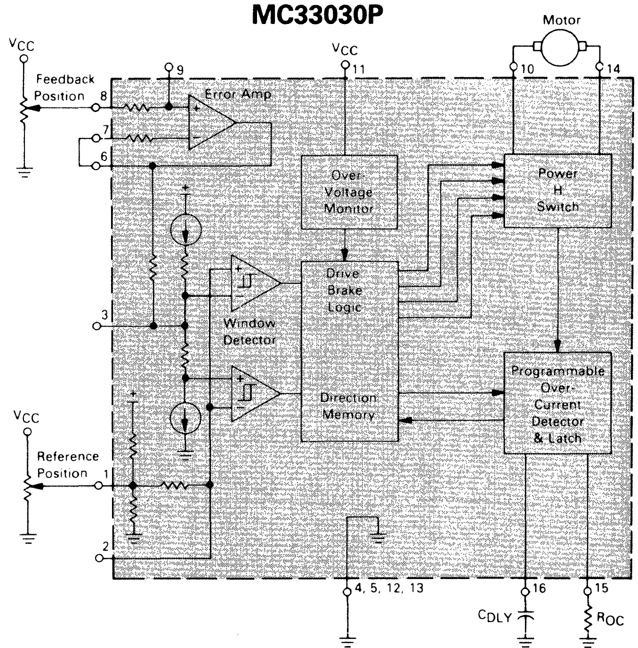


DC Servo Motor Controller/Driver

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, 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

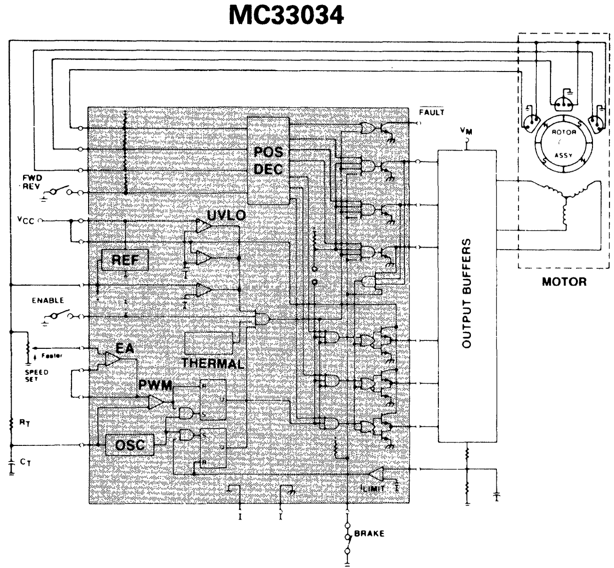


DC Brushless Motor Controller

MC33034P60,P120 — $T_A = -40°C$ to $+85°C$, Case 724

The MC33034 Series is a high performance monolithic 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, temperature compensated reference capable of supplying sensor power, frequency programmable sawtooth oscillator, 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.

MC33034

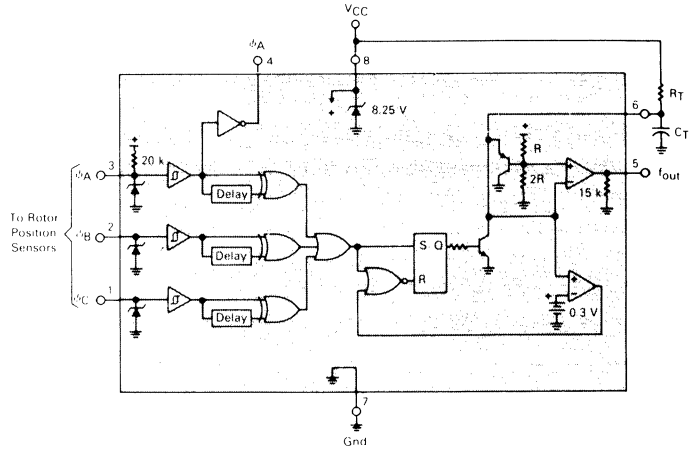


Closed-Loop Brushless Motor Adapter

MC33039P — T_A = −40° to +85°C, Case 626

The MC33039P is a high performance closed-loop speed control adapter specifically designed for use in dc brushless motor control systems. Implementation will allow precise speed regulation without the need for a magnetic or optical tachometer. This device contains 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 MC33034 brushless motor controller, it can be used cost effectively in many other closed-loop speed control applications.

MC33039

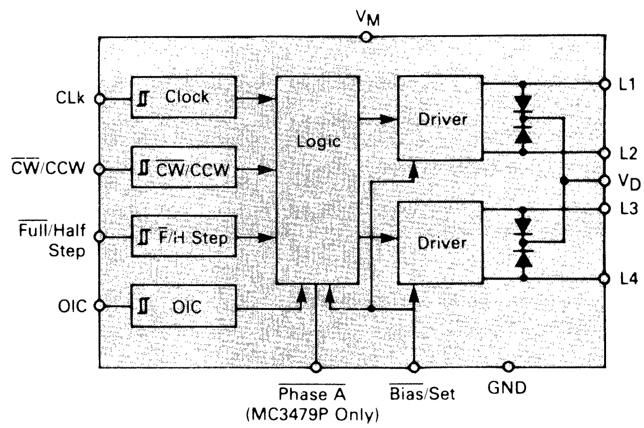


Stepper Motor Drivers

MC3479P — T_A = 0° to +70°C, Case 648C
SAA1042,A — T_A = 0° to +70°C, Case 721

Stepper Motor Drivers provide 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. MC3479P has added Output Impedance Control (OIC) and Phase A drive state indicator (not available on SAA1042 devices).

MC3479



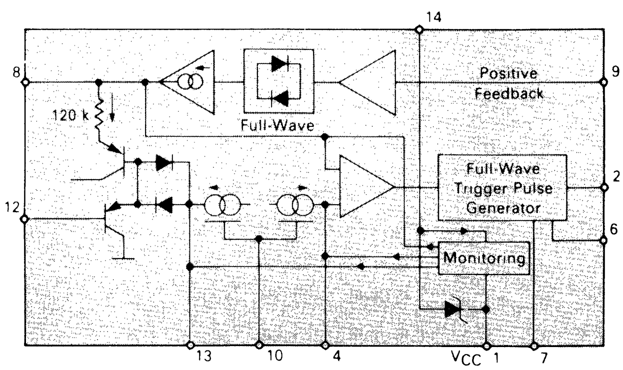
Triac Phase Angle Controller

TDA1185A T_A = 0° to +70°C, Case 646

. . . 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



Universal Motor Speed Controllers

TDA1085A T_A = 0° to +70°C, Case 648

. . . 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 circuits provide 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

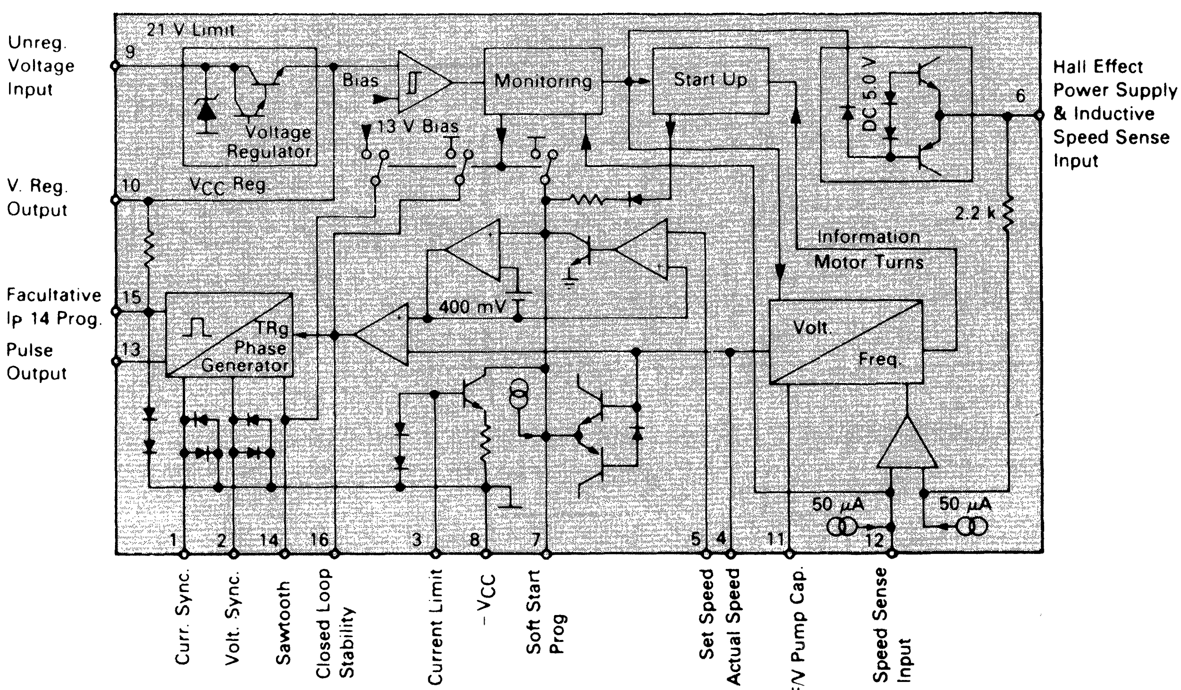
Similar to TDA1085A, but designed for commercial washing machine service.

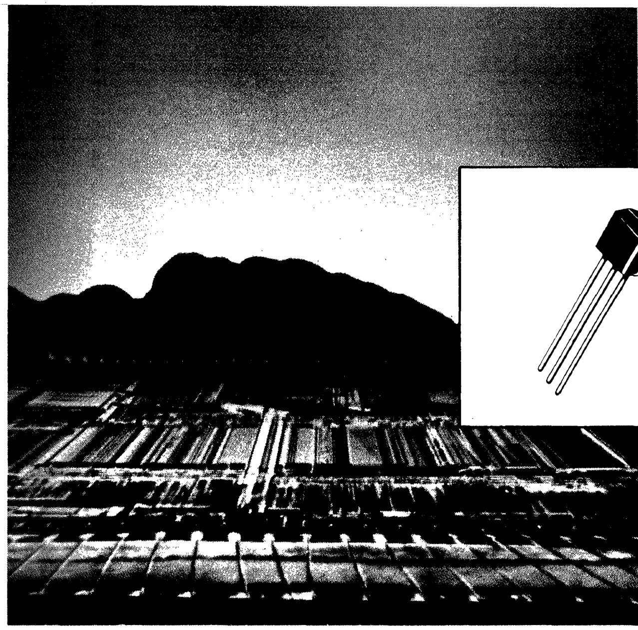
TDA1285A T_A = 0° to +70°C, Case 648

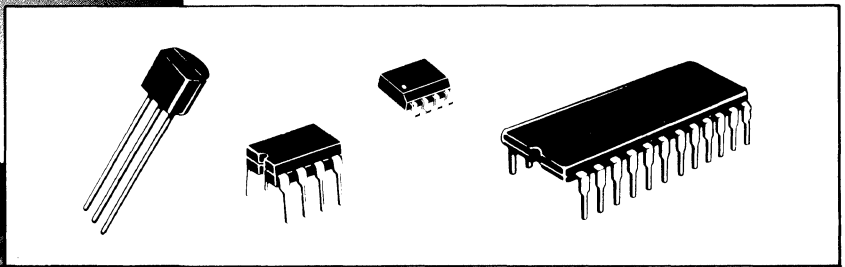
Similar to TDA1085A, plus:

- Repeated Trigger Pulse if Triac Fails to Latch
- Over 65 mA Output Pulse Current
- Automatic Adaptation to Inductive or Hall Effect Sensors
- Sensor Circuit Continuity Detection

TDA1285A







Voltage References

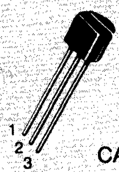
In Brief . . .

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% means 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 others.

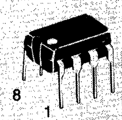
Voltage References

Precision Low Voltage References

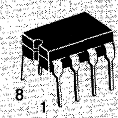
A family of precision low voltage bandgap reference devices designed for applications requiring low temperature drift.



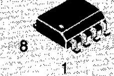
CASE 29
PLASTIC
P, Z SUFFIX



CASE 626
PLASTIC
N, P1 SUFFIX



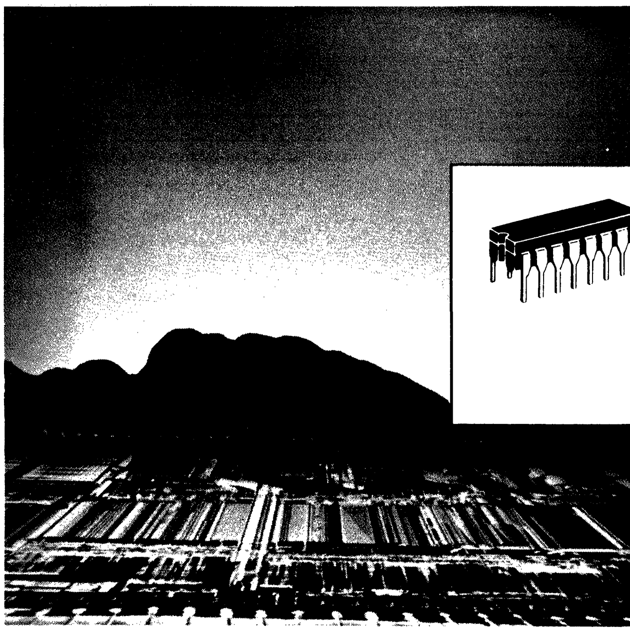
CASE 693
CERAMIC
U SUFFIX

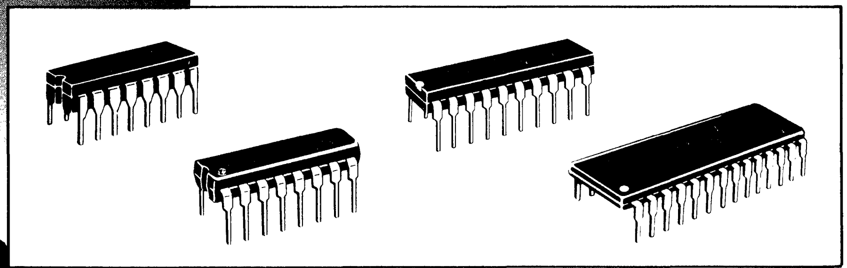


CASE 751
PLASTIC
SO-8
D SUFFIX

V_{out} Volts 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	Case
1.235 ± 12 mV 1.235 ± 25 mV	20	20 Typ	LM385BZ-1.2 LM385Z-1.2	LM285Z-1.2 (−40° to +85°C)	(Note 1)	1.0 (Note 2)	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 (Note 4)	10 (Note 6)	693, 751
		40	MC1403				
		55		MC1503			
5.0 ± 50 mV		25	MC1404AU5		6.0 (Note 5)		693
		40	MC1404U5				
		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 $z \leq 0.5$		29,626 693
				TL431M			693

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





Data Conversion

In Brief . . .

Motorola's line of digital-to-analog and analog-to-digital converters include 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, a 1.8 μs SAR converter, 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 pallette for color graphics applications.

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	Package	Comments
8	MC145040	± 1/2 LSB	10 μs	0 to V_{DD}	+5.0 ±10%	−40°C to +85°C	P/738 FN/775	Requires External Clock, 11-Ch MUX
	MC145041		20 μs					Includes Internal Clock, 11-Ch MUX
	MC14442		20 μs				P/710 FN/776	μP Compatible 11-Channel MUX S.A.R.
	MC14549B MC14559B	successive approximation registers			+3.0 to +18	−55°C to +125°C −40°C to +85°C	L/620 P/648	Compatible with MC1408 S.A.R. 8-bit D-A Converter
8–10	MC14443/47	±0.5% Full Scale	300 μs	Variable w/Supply	+5.0 to +18	−40°C to +85°C	P/648 DW/751G	μP Compatible, Single Slope, 6-Channel MUX
3-1/2 Digit	MC14433	±0.05% ±1 Count	40 ms	±2.0 V ±200 mV	+5.0 to +8.0 −2.8 to −8.0		P/709	Dual Slope

Bipolar

Resolution (Bits)	Device	Nonlinearity (Max)	Conversion Time	Input Voltage Range	Supplies (V)	Temperature Range	Package	Comments
7	MC10321	±1/2 LSB	40 ns	0 to 2.0 V_{p-p} Max	+5.0 V and −3.0 V to −6.0 V	0°C to +70°C	P/738 DW/751D	Video Speed, Grey Code
8	MC10319	±1 LSB					L/623 P/709 DW/751F Die Form	Video Speed Flash Converter, Internal Grey Code
	MC6108	±1/2 LSB	1.8 μs	±5.0 V 0 to 5.0 V 0 to 10 V	+5.0, −5.2		P/710	μP Compatible, Three-State Outputs, includes Reference

D-A Converters

CMOS

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

Bipolar

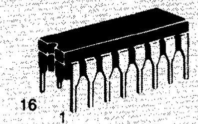
Resolution (Bits)	Device	Suffix	Accuracy @ 25°C (Max)	Max Settling Time (±1/2 LSB)	Supplies (V)	Temperature Range	Package	Comments
8	DAC-08	Q	±1/2 LSB	150 ns	±4.5 to ±18	−55°C to +125°C	620	High-Speed Multiplying
		AQ	±1/4 LSB	135 ns				
		C	±1 LSB	150 ns		0°C to +70°C	620 648 D/751B	
		E	±1/2 LSB					
		H	±1/4 LSB	135 ns				
	MC1408	L6/P6	±2 LSB	300 ns Typ	+5.0, −5.0 to −15	0°C to +75°C	620 648	Multiplying
		L7/P7	±1 LSB					
		L8/P8	±1/2 LSB					
	MC1508	L8				−55°C to +125°C	620	
	MC10318	CL6	±2 LSB	10 ns Typ	−5.2	0°C to +70°C	620	ECL input Logic Levels Video Applications
		CL7	±1 LSB					
		L	±1/2 LSB				690	
		L9	±1/4 LSB					
4 x 3	MC10320	L		3 ns	+5.0, or ±5.0		733	125 MHz Color Graphics Triple DAC
	MC10320-1							90 MHz Color

A-D/D-A Converters

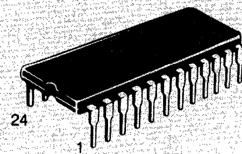
CMOS — For Telecommunications

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

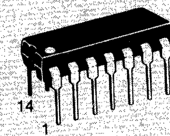
Data Conversion Package Overview



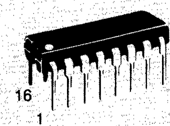
CASE 620
CERAMIC
L SUFFIX



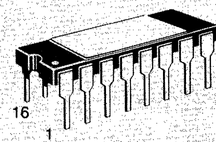
CASE 623
CERAMIC
L SUFFIX



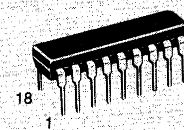
CASE 646
PLASTIC
P SUFFIX



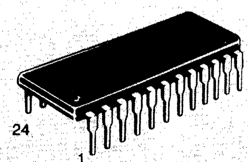
CASE 648
PLASTIC
P SUFFIX



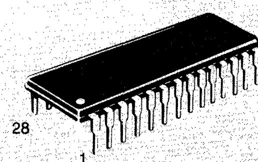
CASE 690
CERAMIC
L SUFFIX



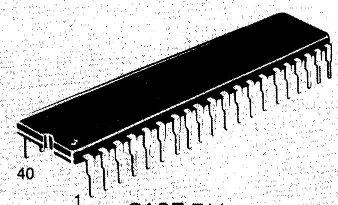
CASE 707
PLASTIC
P SUFFIX



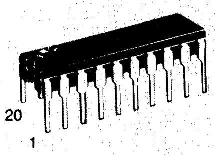
CASE 709
PLASTIC
P SUFFIX



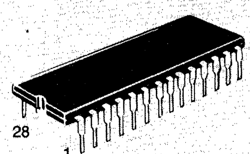
CASE 710
PLASTIC
P SUFFIX



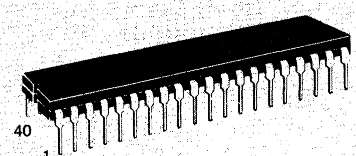
CASE 711
PLASTIC
P SUFFIX



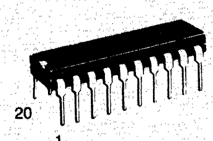
CASE 732
CERAMIC
L SUFFIX



CASE 733
CERAMIC
L SUFFIX



CASE 734
CERAMIC
L SUFFIX



CASE 738
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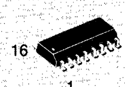
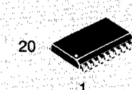
P SUFFIX



CASE 751B
PLASTIC
D SUFFIX



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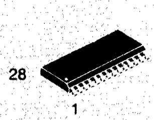
PLASTIC
DW SUFFIX



CASE 751F
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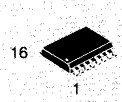
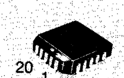
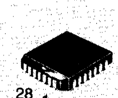
DW SUFFIX



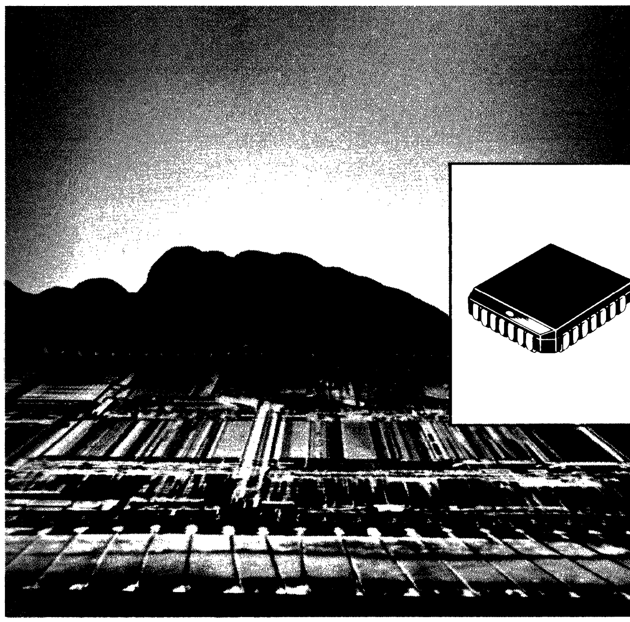
CASE 751G
PLASTIC
DW SUFFIX

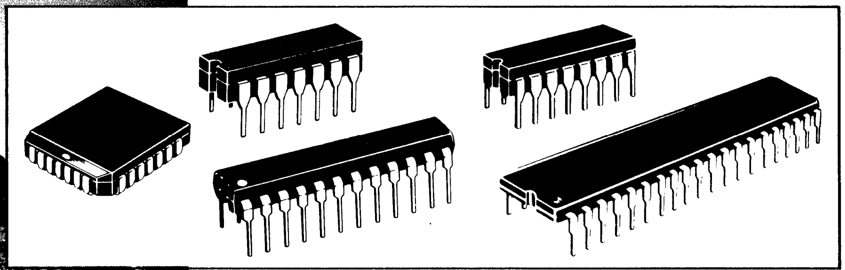


CASE 775
PLASTIC
FN SUFFIX



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

Memory Interface and Control

Motorola's line of circuits in this category have 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 the circuitry for peak detection, filtering, wave shaping, and guaranteed peak shift specifications.

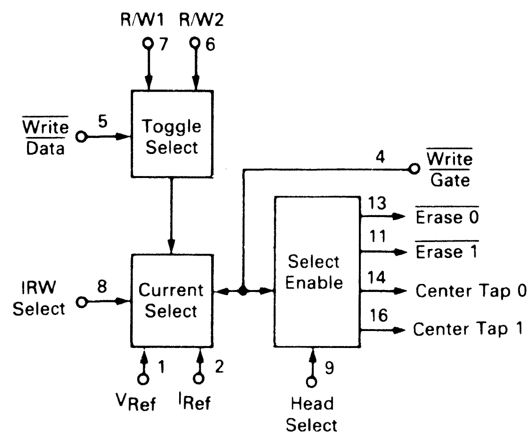
Floppy Disk Write Controllers

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.

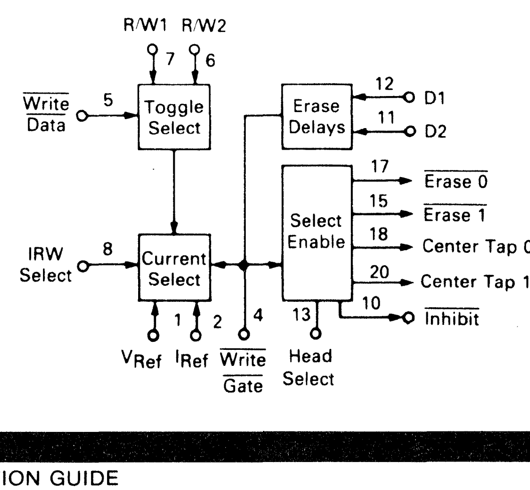


Tunnel/Straddle Erase Controller

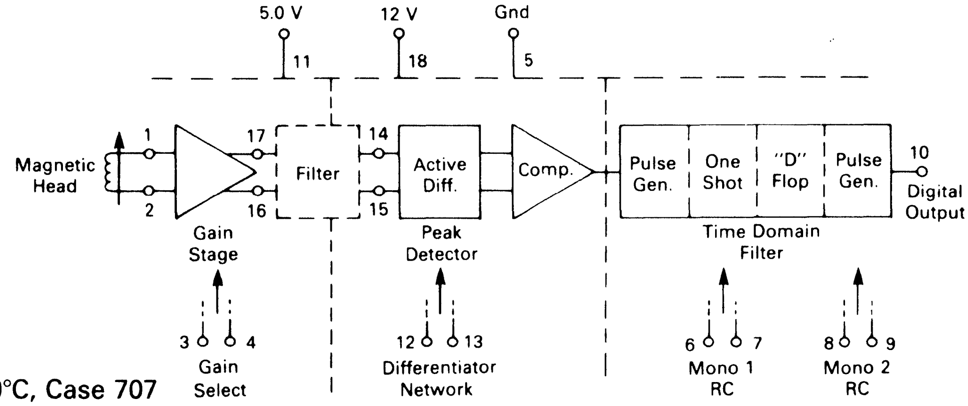
MC3471P — T_A = 0° to +70°C, Case 738

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



MC3470,A — T_A = 0° to +70°C, Case 707

Designed as monolithic Read Amplifier System for obtaining digital information from floppy disk storage. These devices accept differential ac signals produced by the magnetic head and provides 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 Number	Peak Shift (f = 250 kHz, V_{ID} = 1.0 Vpp)	Differential Input Voltage Gain (f = 200 kHz, V_{ID} = 5.0 mV [RMS])		Input Common Mode Range (5% Max THD)	
		V/V		V	
	% Max	Min	Max	Min	Max
MC3470	5.0	80	130	−0.1	1.5
MC3470A	2.0	100	130		

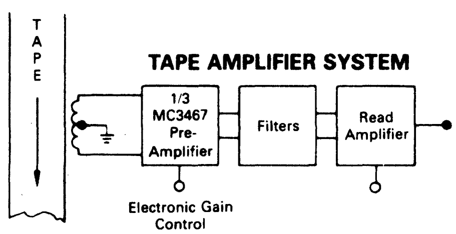
Magnetic Tape Sense Amplifier

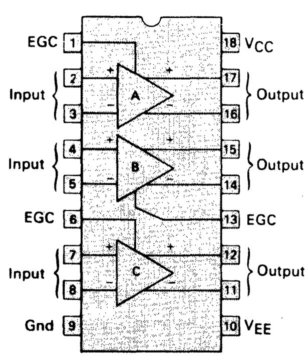
MC3467I,P — T_A = 0° to +70°C, Case 726, 707

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 min.

TAPE AMPLIFIER SYSTEM



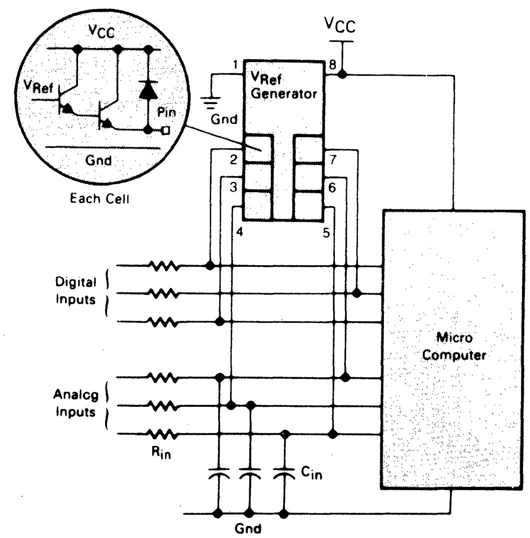


Peripheral Clamping Array

TCF6000P1,D — T_A = −40° to +85°C, Case 626, 751

. . . 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
- Applications Areas Include Automotive, Industrial, Telecommunications and Consumer Goods



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.

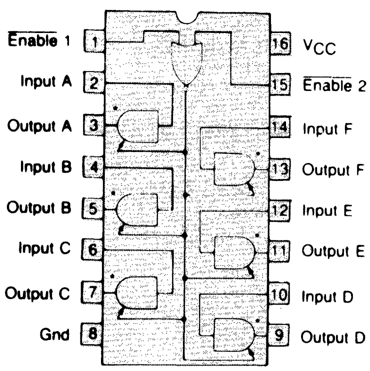
$V_{OL(max)}$ @ 48 mA	$V_{OH(min)}$ @ −5.2 mA	Propagation Delay Max (ns)	Buffers Per Package	Device	Package	Comments
0.5	2.4	13	6	MC8T95/ MC6885	L/620 P/648	Noninverting
0.5	2.4	11	6	MC8T96/ MC6886	L/620 P/648	Inverting
0.5	2.4	13	6	MC8T97/ MC6887	L/620 P/648	Noninverting
0.5	2.4	11	6	MC8T98/ MC6888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

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

These devices differ in that the non-inverting 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.

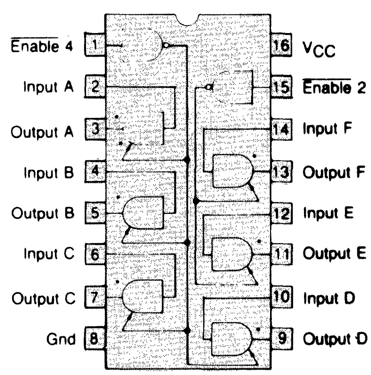
#These devices may be ordered by either of the paired numbers.

MC8T95/MC6885# — Noninverting
MC8T96/MC6886# — Inverting
Two-input Enable controls all six buffers



*Add inverter for

MC8T97/MC6887# — Noninverting
MC8T98/MC6888# — Inverting
Two Enable inputs, one controlling four buffers and the other controlling the remaining two buffers.



*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	Package/ Suffix	Comments
48	14	14	4	MC8T26A (MC6880A)	P/648 L/620	Inverting Logic
48	17	17	4	MC8T28 (MC6889)	P/648 L/620	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	Package/ Suffix	Comments
48	50	50	4	MC3446A	P/648	MOS Compatible, Input Hysteresis
48	30	50	8	MC3447	P3/724 L/623	Input Hysteresis, Open Collector, 3-State Outputs with Terminations
48	17	25	4	MC3448A	P/648 L/620	Input Hysteresis, Open Collector 3-State Outputs with Terminations
100	30	30	4	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 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	Package/ Suffix	Receivers Per Package	Companion Drivers	Comments
D D	TP OC	25 25	Yes Yes	Yes Yes	±5 ±5	MC3450 MC3452	P/648 L/620	4 4	MC3453	Quad version of MC75107/8
D D	TP OC	25 25	Yes Yes	Yes Yes	±5 ±5	MC75107 MC75108	P/646 L/632	2 2	MC75S110	Dual version of MC3450/2
S	TP	30	Yes	Yes	+5	MC3437	P/648 L/620	6		Input Hysteresis

360/370 I/O Interface

S	TP	30	Yes	No	+5	MC75125 MC75127	P/648 L/620	7	MC3481 MC3485	Schottky Circuitry
S	TP	30	Yes	Yes	+5	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	Package/ Suffix	Receivers Per Package	Companion Drivers	EIA Standard
S	R	85	No	No	+5	MC1489 MC1489A	P/646 L/632	4	MC1488	(RS-232) EIA-232-D
S, D S, D	TP TP	30 30	Yes Yes	Yes Yes	+5 +5	AM26LS32 MC3486	P/648 L/620	4 4	AM26LS31 MC3487	(RS-422/423) EIA-422/423
S, D S, D	TP TP	35 35	Yes Yes	Yes Yes	+5 +5	SN75173 SN75175	N/648 J/620	4 4	SN75172 SN75174	(RS-422/423/485) 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	Package/ Suffix	Drivers Per package	Companion Receivers	Comments
15	15	D	Yes	Yes	±5	MC3453	P/648 L/620	4	MC3450 MC3452	Quad version of MC75S110
15	15	D	Yes	Yes	±5	MC75S110	P/646 L/632	2	MC75107 MC75108	Dual version of MC3453

360/370 I/O Interface

60	45	S	Yes	Yes	+5	MC3481	P/648 L/620	4	MC75125 MC75127	Short Circuit Fault Flag
60	45	S	Yes	Yes	+5	MC3485	P/648 L/620	4	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	Package/ Suffix	Drivers Per Package	Companion Receivers	EIA Standard
85 85	35 35	D D	Yes Yes	Yes Yes	+5 +5	SN75172 SN75174	N/648 J/620	4 4	SN75173 SN75175	(RS-485) EIA-485
48	20	D	Yes	Yes	+5	MC3487	P/648 L/620	4	MC3486	(RS-422) EIA-422 with 3-State Outputs
48	20	D	Yes	Yes	+5	AM26LS31	P/648 D/620	4	AM26LS32	
20	—	S	No	No	±12	MC3488A (μA9636A)	P1/626 U/693	2	MC3486 AM26LS32	(RS-423/232) EIA-423/232-D
10	350	S	No	Yes	±9 to ±12	MC1488	P/646 L/632	4	MC1489 MC1489A	(RS-232) EIA-232-D

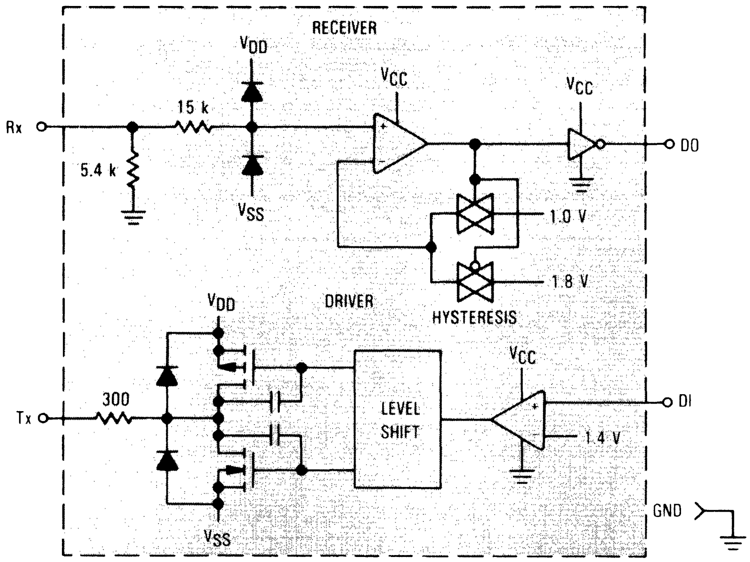
Line Transceivers

Driver Prop Delay (Max ns)	Receiver Prop Delay (Max ns)	CE = Common Enable DE = Driver Enable RE = Receiver Enable	Party Line Operation	Power Supply (V)	Device	Package/ Suffix	Drivers Per Package	Receivers Per Package	EIA Standard
20	30	DE, RE	Yes	+5	MC34050	L/620 P/648	2	2	(RS-422) EIA-422
20	30	DE	Yes	+5	MC34051	L/620 P/648	2	2	(RS-422) EIA-422

EIA-232-D/V.28 Driver/Receiver

MC145406L,P — T_A = −40° to +85°C, Case 620, 648

The MC145406 is a silicon-gate CMOS IC that combines three drivers and three receivers to fulfill the electrical specifications of EIA-232-D and CCITT V.28. Using ±12 volt supplies and a +5.0 volt supply, this 16-pin device consumes a maximum of 15 mW.



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	Package/ Suffix	Logic Function
300	TTL, DTL	1.0	Yes	70	MC1472	2	P1/626 U/693	NAND
500	TTL, CMOS, PMOS	1.0	Yes	50	ULN2801	8	A/707	Invert
500	14 V to 25 V PMOS	1.0	Yes	50	ULN2802	8	A/707	Invert
500	TTL, CMOS	1.0	Yes	50	ULN2803	8	A/707	Invert
500	6.0 V to 15 V MOS	1.0	Yes	50	ULN2804	8	A/707	Invert
500	TTL, CMOS PMOS	1.0	Yes	50	MC1411,B	7	P/648	Invert
500	14 V to 25 V PMOS	1.0	Yes	50	MC1412,B	7	P/648	Invert
500	TTL, 5.0 V CMOS	1.0	Yes	50	MC1413,B	7	P/648	Invert
500	8.0 V to 18 V MOS	1.0	Yes	50	MC1416,B	7	P/648	Invert
1500	TTL, 5.0 V CMOS	1.0	Yes	50	ULN2068B	4	B/648	Invert
1500	TTL, 5.0 V CMOS	1.0	No	50	ULN2074	4	B/648	Collector, Emitter available at Pins

Display Drivers/Decoders, CMOS

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

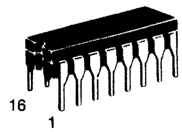
Display Type	Input Format	Drive Capability Per Package	On-Chip Latch	Display Control	Segment Drive Current	Device Number
LCD (Direct Drive)	Parallel BCD	7 Segments	✓	Blank	~1 mA	MC14543B
			✓	Blank, Ripple Blank	~1 mA	MC14544B
	Serial Binary [Compatible with the Serial Peripheral Interface (SPI) on CMOS MCUs]	33 Segments or Dots	✓		20 µA	MC145453
Muxed LCD (1/4 Mux)	Serial Binary [Compatible with the Serial Peripheral Interface (SPI) on CMOS MCUs]	48 Segments or Dots	✓		~200 µA	MC145000
		44 Segments or Dots	✓		~200 µA	MC145001
LED, Incandescent, Fluorescent*	Parallel BCD	7 Segments	✓	Blank, Lamp Test	25 mA	MC14511B
			✓	Blank, Ripple Blank, Lamp Test	25 mA	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	25 mA (Peak)	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).

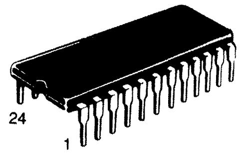
Functions

Device Number	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

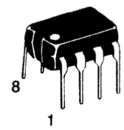
Interface Package Overview



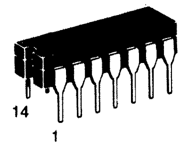
CASE 620
CERAMIC
D, J, L SUFFIX



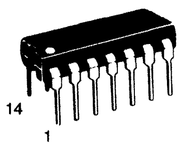
CASE 623
CERAMIC
L SUFFIX



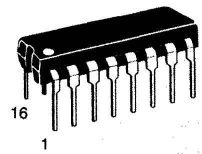
CASE 626
PLASTIC
P1 SUFFIX



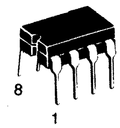
CASE 632
CERAMIC
L SUFFIX



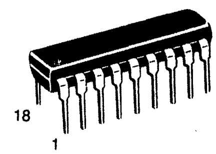
CASE 646
PLASTIC
P SUFFIX



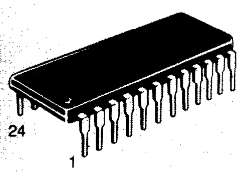
CASE 648
PLASTIC
N, P SUFFIX



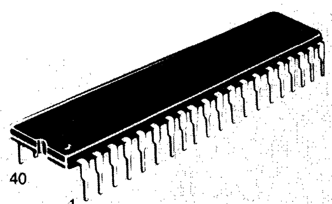
CASE 693
CERAMIC
U SUFFIX



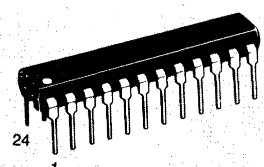
CASE 707
PLASTIC
A SUFFIX



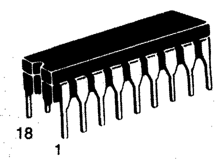
CASE 709
PLASTIC
P SUFFIX



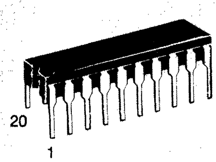
CASE 711
PLASTIC
P SUFFIX



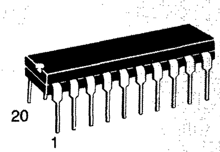
CASE 724
PLASTIC
P3 SUFFIX



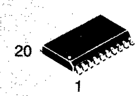
CASE 726
CERAMIC
L SUFFIX



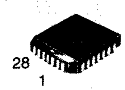
CASE 732
CERAMIC
L SUFFIX



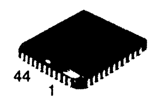
CASE 738
PLASTIC
P SUFFIX



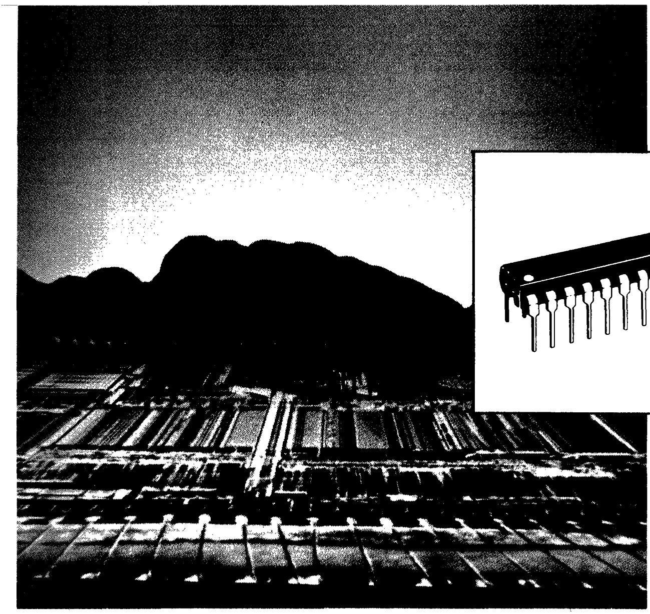
CASE 751D
PLASTIC
DW SUFFIX

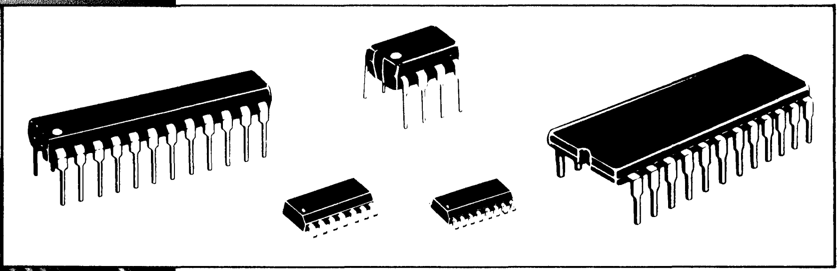


CASE 776
PLASTIC
FN SUFFIX



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 products 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 Datacommunications. 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 coax cable for Datacom. But times have changed. Today, Telecom and Datacom coexist comfortably on inexpensive twisted wire pairs and utilize 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 components serve a wide range of requirements for the voice/data marketplace. They encompass both CMOS and linear technologies, each to its best advantage, and 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 (Monocircuit) 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

Narrowband Dual Conversion Receivers — FM/FSK — VHF

Type	V_{CC}	I_{CC}	Sensitivity	RF Input (Max)	IF1 (Max)	IF2 (limiter in)	Mute	RSSI	Max Data Rate	Notes	Package	Case Suffix
MC3362	2–7 V	3 mA	<1 µV	180 MHz	10.7 MHz	455 kHz	—	√	1.2 kb	Includes buffered VCO output	24 Pin DIP, SOIC	P/724 DW/751E
MC3363	2–7 V	4 mA	<1 µV	180 MHz	10.7 MHz	455 kHz	√	√	1.2 kb	Includes RF amp, mute	28 Pin SOIC	DW/751F

AM Receiver Medium/Short Wave

MC13041	6.5–16.5 V	25 mA	6 µV	10 MHz	455 kHz	—	—	√	—	Includes scan stop	20 Pin DIP	P/738 DW/751D

Wideband Data (FM/FSK) Receiver — VHF

Type	V_{CC}	I_{CC}	Sensitivity	IF1 (Max)	IF2 (limiter in)	Mute	RSSI	Max Data Rate	Notes	Package	Case Suffix
MC3356	3–9 V	25 mA	30 µV	200 MHz	10.7 MHz	√	√	500 kb	Includes front end mixer/L.O.	20 Pin DIP/PLCC	P/738 FN/775

Narrowband IF's — Wideband (FM/FSK) IF

MC3357	4–8 V	5 mA	5 µV	45 MHz	455 kHz	√	—	—		16 Pin DIP/SOIC	P/648 D/751B
MC3359	4–9 V	7 mA	2 µV	45 MHz	455 kHz	√	—	—		18 Pin DIP/SOIC	P/707 DW/751C
MC3361	2–8 V	6 mA	2 µV	60 MHz	455 kHz	√	—	—		16 Pin DIP/SOIC	P/648 D/751B
MC3367	1–5 V	1 mA	<1 µV	75 MHz	455 kHz	√	—	1.2 kb	1 Cell Operation	28 Pin SOIC	DW/751F
MC3371	2–8 V	6 mA	2 µV	60 MHz	455 kHz	√	√	—	(3Q88 Intro)	16 Pin DIP/SOIC	P/648 D/751B
MC13055	3–12 V	25 mA	20 µV	—	40 MHz	√	√	2 Mb	Wideband Data IF	16 Pin DIP/SOIC	P/648 D/751B

Transmitters — FM/FSK

Type	V_{CC}	I_{CC}	P_{out}	Max RF Freq. Out	Battery Check	Tone OSC	Max Mod. Freq.	Notes	Package	Case Suffix
MC2831A	3–8 Vdc	5 mA	−30 dBm	50 MHz	√	√	5.0 kHz (xtal ctl)	Includes low battery checker, tone osc.	16 Pin DIP/SOIC	P/648 D/751B
MC2833	3–8 Vdc	3 mA	−30 dBm to +10 dBm	150 MHz	—	—	5.0 kHz (xtal ctl)	Includes two frequency multiplier/amplifier transistors	16 Pin DIP/SOIC	P/648 D/751B

Balanced Modulator/Demodulator

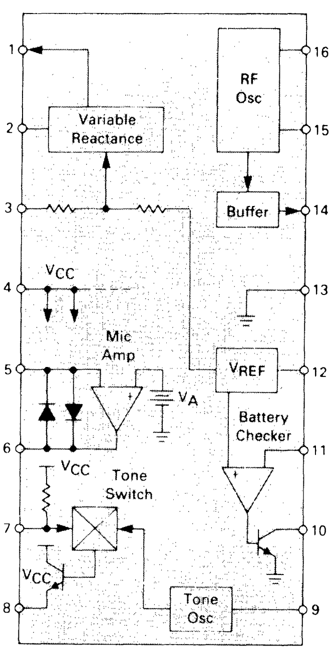
Type	V_{CC}	I_{CC}	Function	Package	Case Suffix
MC1596 MC1496	5–30 V 5–30 V	10 mA 10 mA	Carrier Balance >50 dB General purpose balanced modulator/ demodulator for AM, SSB, FM Detection	10 Pin Metal 14 Pin Ceramic DIL, DIP, SOIC	G/603 L/632 P/646 D/751A

Low Power FM Transmitter System

MC2831A — $T_A = -30°$ 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
- Low Voltage (internal reference) Warning Circuit
- Easily Partitioned for Semicustom Applications

MC2831A



Low Voltage FM Narrowband Receiver

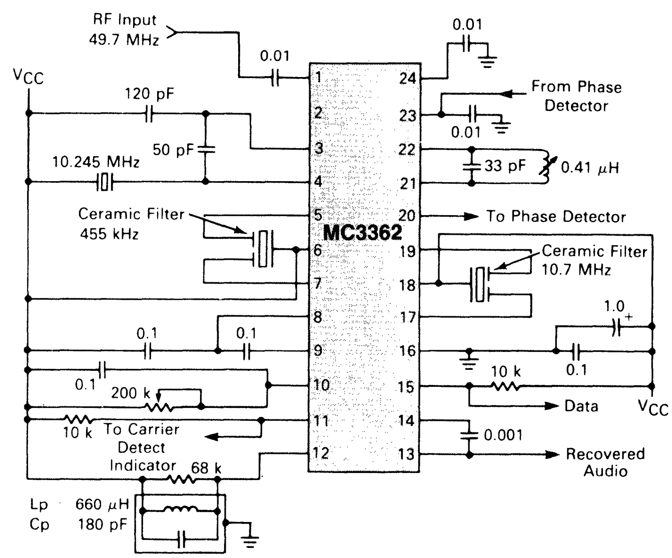
MC3367 — $T_A = 0°C$ to $+70°C$, Case 751F

Single Cell Operation to 0.9 V_{CC}
Single Conversion Operation to 75 MHz
Current Drain of 1 mA
Split I.F. Amplifier for Single or Dual Filters
Analog and Data Outputs
Sensitivity of 0.7 μV Typ for 20 dB Quieting
Low Battery Voltage Indicator

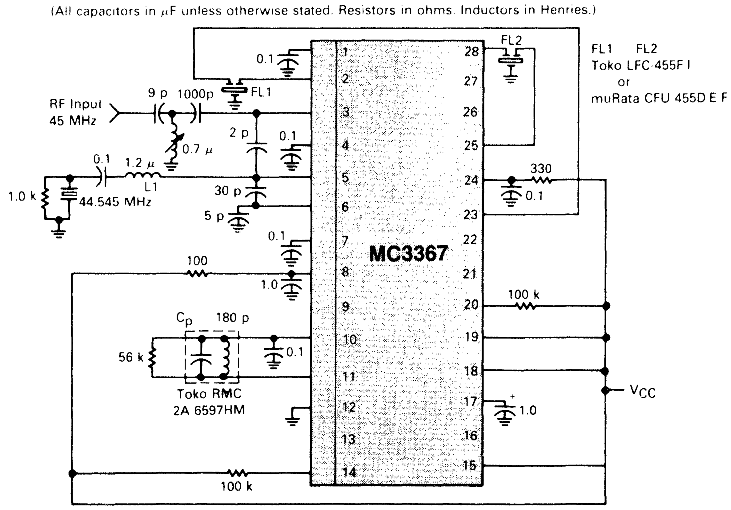
MOSAIC® 1.5 VHF Narrowband Dual-Conversion Receivers

MC3362/MC3363 — $T_A = -40°C$ to $+85°C$, Case 724, 751A

Operation to 180 MHz
2–8 V dc Supply
>1 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

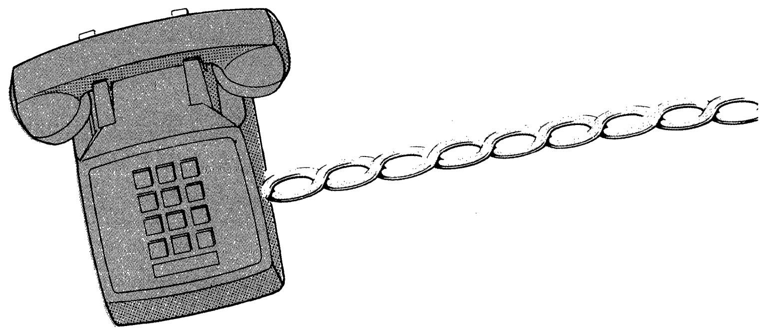


(All capacitors in µF unless otherwise stated. Resistors in ohms. Inductors in Henries.)



Telecommunications

PBX Architecture (Analog Transmission)



ANALOG PHONE

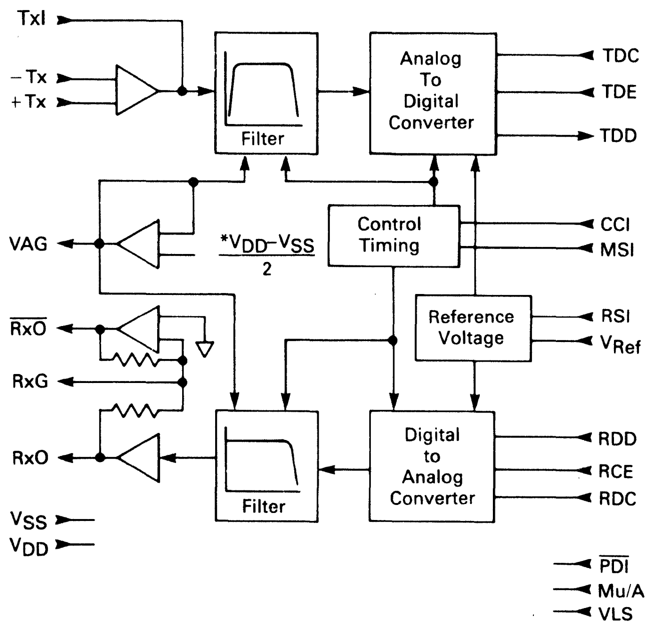
PCM Mono-Circuits Codec-Filters (CMOS LSI)

MC145500 Series — Case 620, 726, 736, 763

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 monocircuits 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.

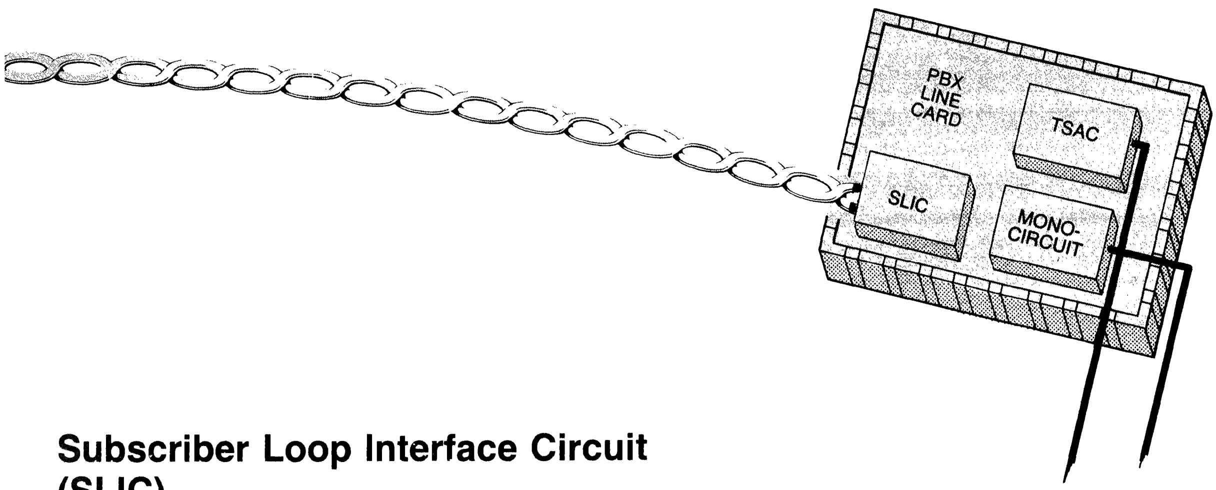
Motorola supplies five versions of the PCM Mono-circuit. The MC145500, MC145503 and MC145505 are general-purpose devices in 16-pin packages designed to operate in digital telephone or line card applications. The MC145501 is the same device (in an 18-pin package) that offers the capability of selecting 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 — separate integrated circuit filters:

MC14413	PCM Filter with Transmit Band-Pass and RCV Low-Pass
MC14414	PCM Filter with Transmit and RCV Low-Pass
MC145414	Dual Tuneable Low-Pass Sampled Data Filter
MC145415	Dual Tuneable Linear Phase Low-Pass Filter
MC145432	2600 Hz Tone Signalling Filter
MC145440	300 Baud Modem Filter-Bill 103
MC145441	300 Baud Modem Filter-CCITT V.21

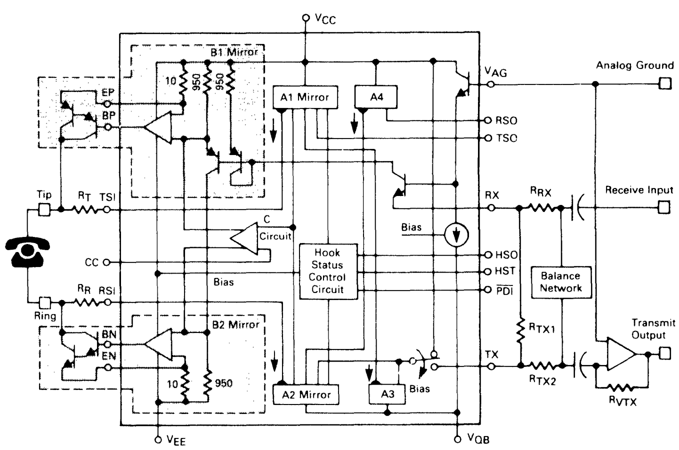


Subscriber Loop Interface Circuit (SLIC)

MC3419-1L — 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 telephony equipment. The SLIC family performs this task, along with all the 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); and *T*esting.

- 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.



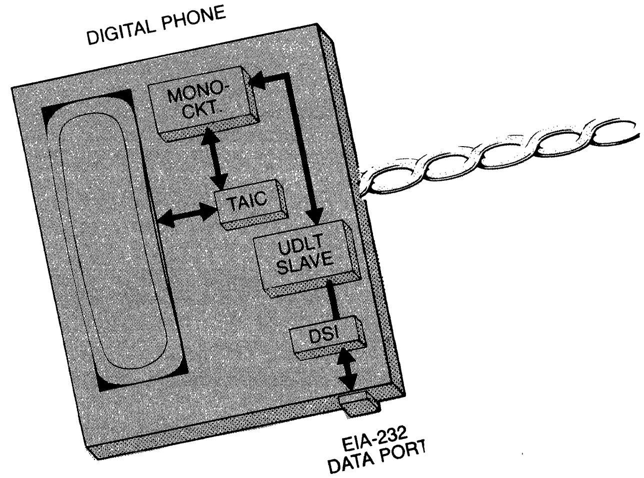
Crosspoint Switches

Today's semiconductor 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 x 4 x 1 Analog Switch • Control Memory • 4.2–18 V Operation • Low On-State Resistance	CL, CP (620) (648)	16 DIP
MC145100	4 x 4 x 1 Analog Switch • 4.2–18 V Operation • Low On-State Resistance	CP (648)	16 DIP

Voice/Data Communication (Digital Transmission)



2-Wire Universal Digital Loop Transceiver (UDLT)

MC145422 Master Station
MC145426 Slave Station
Case 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, electromagnetic, and crosstalk interference. Implementation through CMOS technology takes advantage of low-power operation, increased reliability, and the proven capability 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 and Data 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 MC14400 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

Digital Loop Transceivers (DLT)

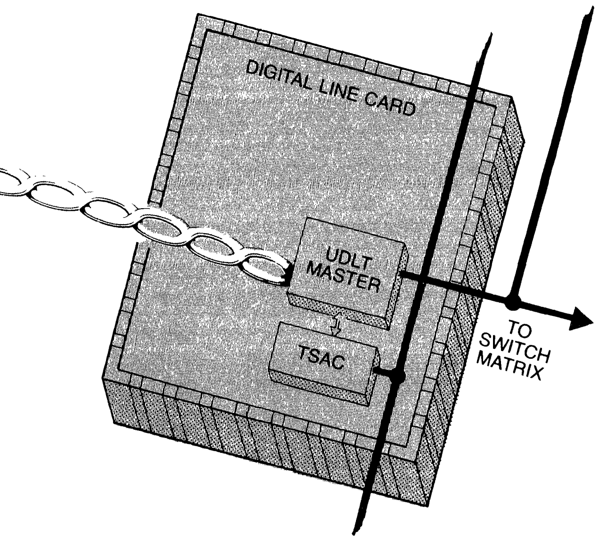
MC145418 Master
MC145419 Slave
Case 708

Similar to UDLTs, but require external drivers and limiters.

2-Wire ISDN Universal Digital Loop Transceiver II (UDLT II)

MC145421 Master
MC145425 Slave
Case 623

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)

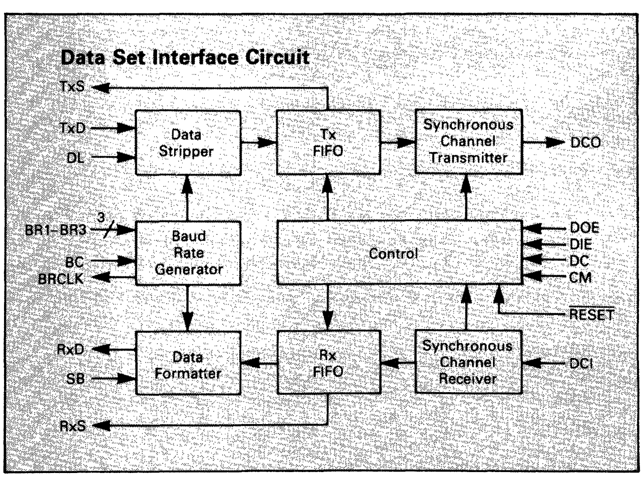
MC145428 — T_A = −40° to +85°C, Case 738

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 AIE-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 at rates up to 19.2 k bits/s.

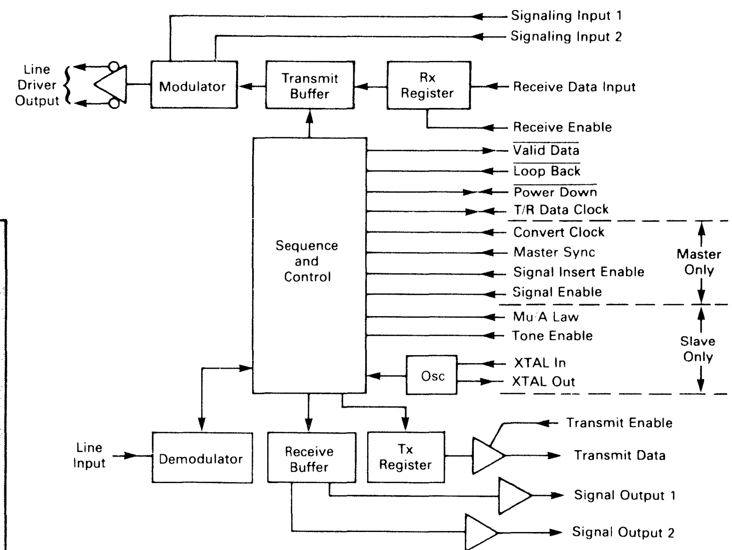
DSI circuits are also used for data multiplexers, concentrators and deconcentrators, data rate changers, data-only switching, and PBX-based local area networks.

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



Time Slot Assigner Circuit (TSAC)

Under external MPU control, the TSAC permits time-multiplexed interaction between the various phones in a PBX system.

The TSAC associated with each UDLT in a typical PBX system provides a unique time-slot identity for each of the 32 digital telephones associated with a typical PBX bank. Each TSAC in the system is assigned a specific address, permitting the 32 telephones to be selectively interconnected by means of an 8-bit control bus associated with the MPU.

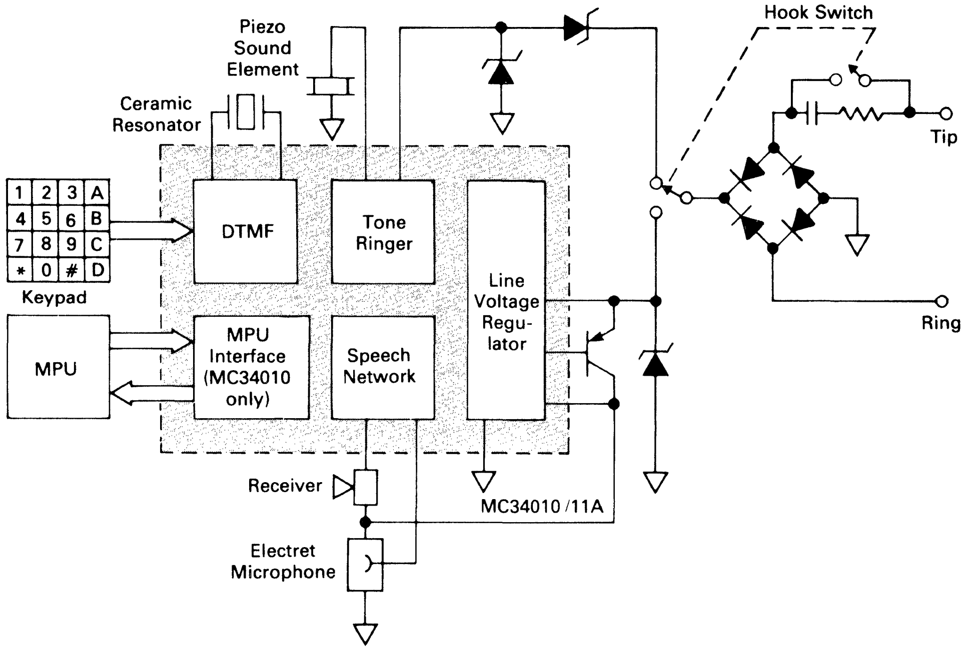
MC14416/14418 allows variable codec time slot assignments to be programmed through a *serial* MPU port. MC14416 provides the ability to multiplex off-hook signals for an entire bank of TSACs. Case 648/Case 708

MC14417 provides for 8-bit parallel signal programming. Case 707

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 IC's 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.

Features

- 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 Two–Four 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 Volt 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 earpiece, speaker and ringer volume.

Dialer Circuits

MC14408/9 Binary-to-phone pulse converter changes 4-bit binary input code to corresponding serial output pulses.

MC14410 2-of-8 tone encoder converts digital input code to corresponding high- and low-band sine waves.

MC14419 2-of-8 key pad-to-binary encoder accepts inputs from 16-key switches arranged in a 4 x 4 matrix. Contains illegal-state detector to eliminate false data outputs.

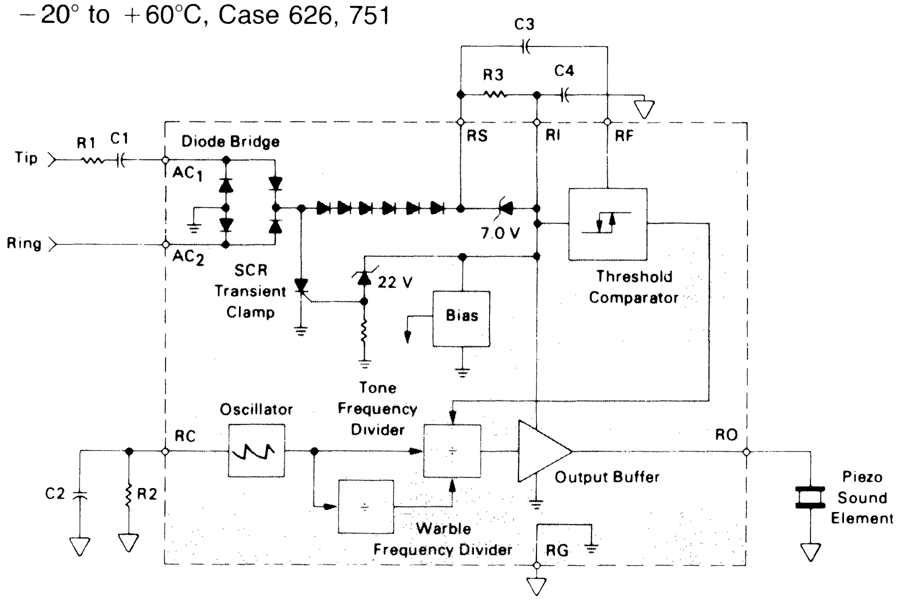
MC145410 Integrated tone/pulse dialer with 18-digit redial. Operates at 2.5 to 6 volt range.

MC145412/13 Integrated Tone/Pulse 10-number Repertory Dialer.

Tone Ringers

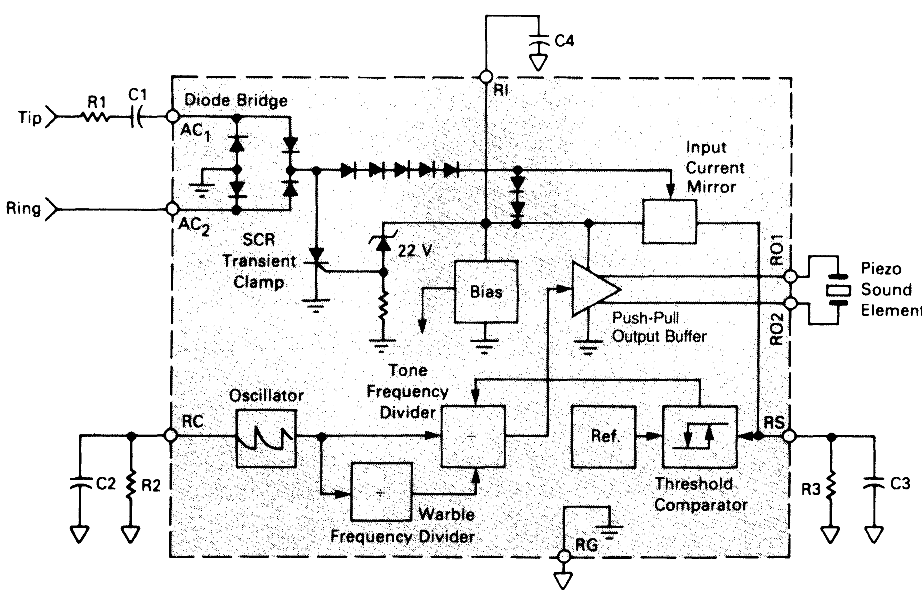
The MC34012 and MC34017 Tone Ringers are designed to replace the bulky bell assembly of a telephone, while providing the same function and performance under a variety of conditions. The operational requirements spelled out by the FCC and the EIA, simply stated, are that a ringer circuit MUST function when a ringing signal is provided, and MUST NOT ring when other signals (speech, dialing signals, noise) are on the line. The MC34012 series and the MC34017 series were designed to meet those requirements.

MC34012 — T_A = −20° to +60°C, Case 626, 751



- Complete Telephone Bell Replacement Circuit with Minimum External Components
- On-Chip Diode Bridge and Transient Protection
- Direct Drive for Piezoelectric Transducers
- Base Frequency Options — MC34012-1: 1.0 kHz
  MC34012-2: 2.0 kHz
  MC34012-3: 500 Hz
- Push-Pull Output Stage for Greater Output Power Capability (MC34017)
- Base Frequency Options — MC34017-1: 1.0 kHz
  MC34017-2: 2.0 kHz
  MC34017-3: 500 Hz
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial Transients

MC34017 — T_A = −20° to +60°C, Case 626, 751

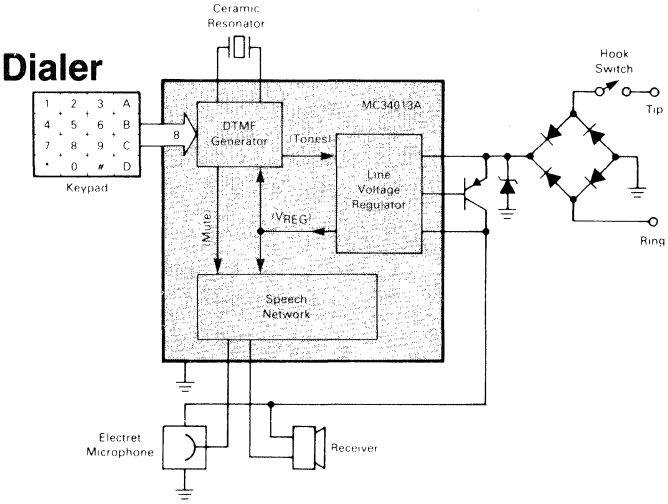


Speech Networks

Telephone Speech Network and Tone Dialer

MC34013A — T_A = −20° to +60°C, Case 710,776

- Linear/I^2L Technology Provides Low 1.4 Volt 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

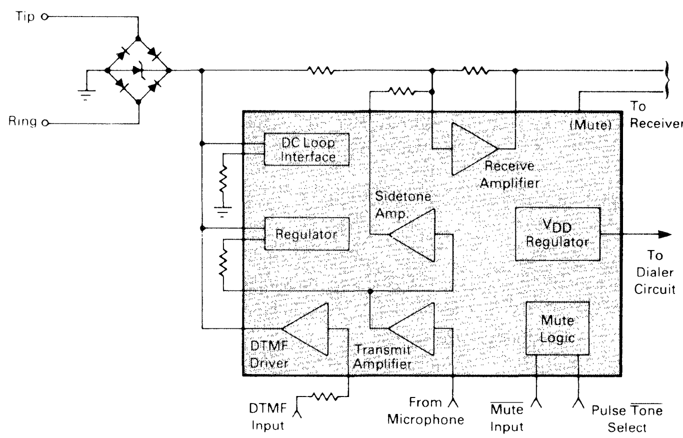


Speech Network with Dialer Interface

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 volts.

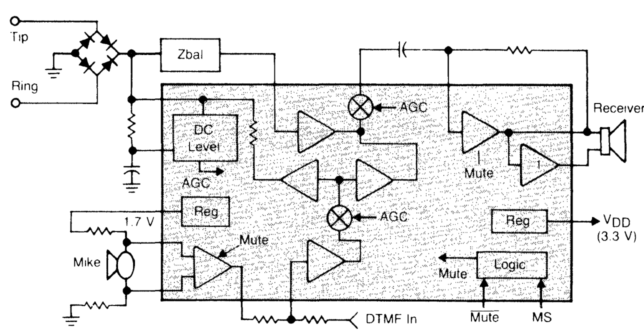
- Transmit, Receive, and Sidetone Gains Set By External Resistors
- Loop Length Equalization for Transmit, Receive, and Sidetone Functions
- Operates Down to 1.5 Volts (V+) in Speech Mode
- Provides Regulated Voltage for CMOS Dialer
- Speech Amplifiers Muted During Pulse and Tone Dialing
- DTMF Output 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 — T_A = −20° to +70°C, Case 707, 751D

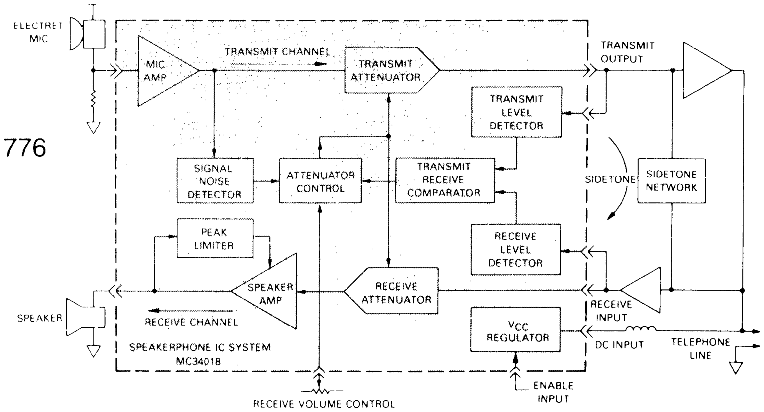
- Operation Down to 1.2 Volts
- Externally Adjustable Transmit, Receive, and Sidetone Gains
- Differential Microphone Amplifier Input Minimizes RFI
- Transmit, Receive, and Sidetone Equalization on both Voice and DTMF Signals
- Regulated 1.7 Volts Output for Biasing Microphone
- Regulated 3.3 Volts Output for Powering External Dialer
- Microphone and Receive Amplifiers Muted During Dialing
- Differential Receive Amplifier Output Eliminates Coupling Capacitor
- Operates with Receiver Impedances of 150 Ω and Higher
- MC34114 Complies with Bell Telephone and BT Standards



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 use, intercom systems, automotive telephones, and others.

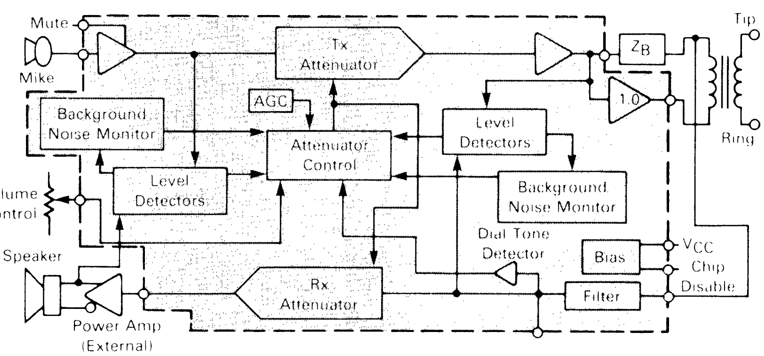
- All Necessary Level Detection and Attenuation Controls for a Hands-Free Telephone in a Single Integrated Circuit
- Background Noise Level Monitoring with Long Time Constant
- Wide Operating Dynamic Range Through Signal Compression
- On-chip Supply and Reference Voltage Regulation
- Typical 100 mW Output 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 operate 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.



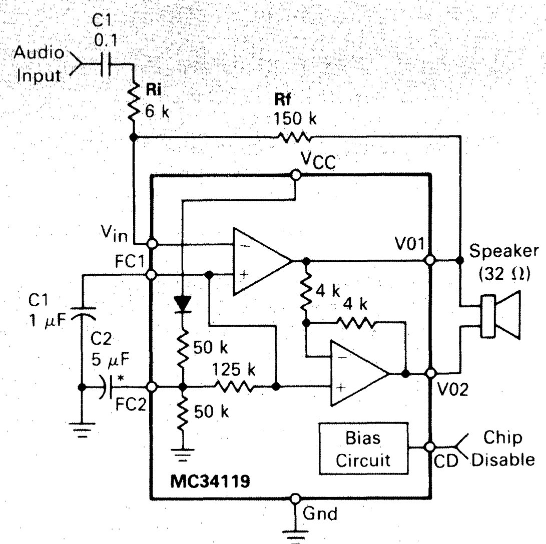
- Improved Attenuator Gain Range: 52 dB Between Transmit and Receive
- Low Voltage Operation for Line-Powered Applications (3.0–6.5 V)
- 4-Point Signal Sensing for Improved Sensitivity
- Background Noise Monitors for Both Transmit and Receive Paths
- Microphone Amplifier Gain Set by External Resistors — Mute Function Included
- Chip Disable for Active/Standby Operation
- On Board Filter Pinned-Out for User Defined Function
- Dial Tone Detector to Inhibit Receive Idle Mode During Dial Tone Presence
- Compatible with MC34119 Speaker Amplifier

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 (16–100 Ω)
- Output Power Exceeds 250 mW with 32 Ω Speaker
- Low Distortion (THD = 0.4% Typical)
- Wide Operating Supply Voltage (2–16 Volts) — 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

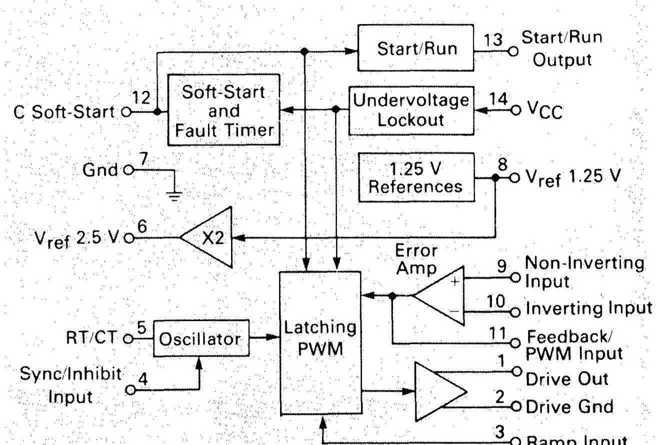
MC34129 — T_A = 0° to +70°C, Case 646, 751A

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

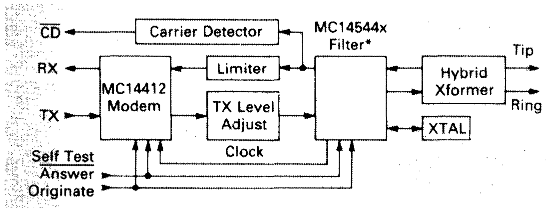


Modem/Filter

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.

300/600 Baud FSK Modem/Filter Sets

MC14412/MC14544x Set



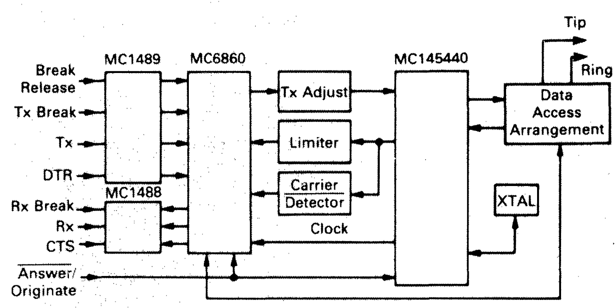
*MC145440 for Bell 103
MC145441 for CCITT V.21

This CMOS subsystem provides the necessary modulation, demodulation and supervisory control functions to implement a serial data communications link at bit rates up to 300 bps.

An accompanying switched capacitor bandpass filter may be selected to meet Bell 103 specifications (MC145440) or CCITT V.21 specifications (MC145441).

- Originate and Answer Modes
- Simplex, Half-Duplex, and Full-Duplex Operation
- On-Chip Sine Wave Generator
- Modem Self Test Mode
- Single Supply
  V_{DD} = 4.75 to 15 Vdc MC14412FP, MC14412FL
  V_{DD} = 4.75 to 6.0 Vdc MC14412VP, MC14412VL
- Post Detection Filter
- TTL or CMOS Compatible Inputs and Outputs
- Case 620, 648, 707, 726

MC6860/MC145440 Set



This N-channel MOS Modem adds a telephone interface feature, with automatic answering of a Ring Indicator signal.

The modem is compatible with the M6800 microprocessor family and interfaces directly with the Asynchronous Communications Interface Adapter (ACIA) of this Family.

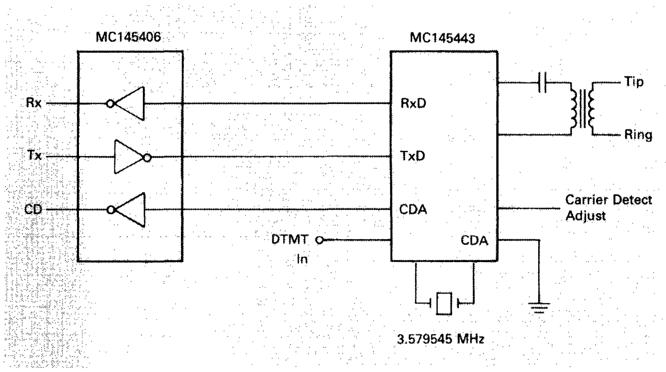
- Originate and Answer Mode
- Crystal or External Reference Control
- Modem Self Test
- Terminal Interfaces TTL-Compatible
- Full-Duplex or Half-Duplex Operation
- Automatic Answer and Disconnect
- Case 623, 707, 709, 726

MC145442/MC145443

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 Case 738 (suffix P), and wide body SOIC Case 751D (suffix DW).



MC145442 Modem, compatible with CCITT V.21
MC145443 Modem, compatible with Bell 102

MC14411 Bit Rate Generator

Internal (crystal controlled) 1.843 MHz oscillator and subsequent divider networks provide 16 different output clock rates ranging from 75 Hz to 1.843 MHz for data communications equipment such as teleprinters, printers, CRT terminals and microprocessor systems. In 24-pin plastic (Case 709) and ceramic (Case 623) packages.

MC145411 Bit Rate Generator

Similar to the MC14411, above, 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. In 16-pin plastic package (Case 648).

MC145450 1200 Baud FSK Modem

This CMOS modem is intended for use in Bell 202 and CCITT V.23 applications. Features include eight selectable handshake (RTS-CTS) options, soft turn-off capability, Answer-Back tone generator and Carrier-Detect input.

Operates from a single-voltage supply between 4.5 and 6.5 volts for TTL compatibility. On-board crystal oscillator operates with 3.6864 MHz external crystal. The device is available in a 22-pin plastic (Case 708) and ceramic (Case 736) package.

MC145415 Dual Tunable Linear Phase Low-Pass Sampled Data Filters

This CMOS sampled data, switched capacitor filter IC provides band limiting and signal restoration filtering. It is capable of operating from either a single or split power supply and can be powered-down when not in use. Included on the IC are two uncommitted comparators for use elsewhere in the system. Available in 16-pin plastic (Case 648) and ceramic (Case 620) package.

- Low Operating Power Consumption — 20 mW (Typical)
- ±2.5 to ±8.0 Volt Power Supply Ranges
- Useful in High Speed Data Modem Applications
- Pass-Band Edges Tunable With Clock Frequency from 1.25 kHz to 10 kHz

Continuously Variable Slope Delta (CVSD) Modulator/Demodulator

Provides the A/D-D/A function of voice communications by digital transmission.

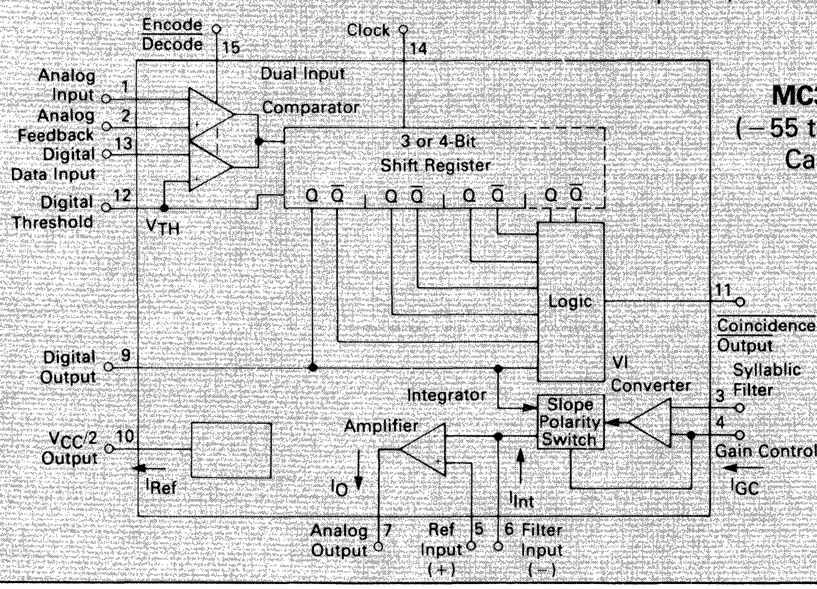
The MC3517/18 series of CVSDs is designed for military secure communications and commercial telephone applications. A single IC provides both encoding and decoding functions in 16-pin package.

- 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 has a 3-Bit Algorithm (General Communications)
- MC3418/MC3518 has a 4-Bit Algorithm (Commercial Telephone)

MC3417/18
(0 to 70°C)
Case 620

MC34115
(0 to 70°C)
Case 648

MC3517/18
(−55 to +125°C)
Case 620



Phase-Locked Loop Components

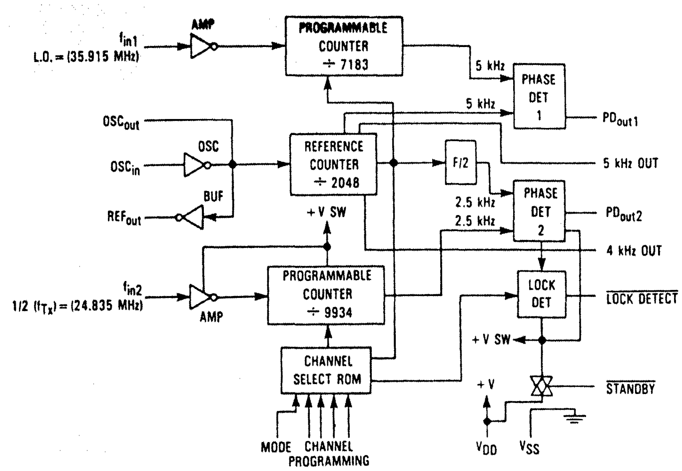
Motorola offers a choice of phase-locked loop components ranging from complete functional frequency synthesizers for dedicated applications to a wide selection of general purpose PLL circuit elements. Technologies include CMOS for lowest power consumption and bipolar for high speed operation. Typical applications include TV, CATV, radio, scanners, cordless telephones plus home and personal computers.

Frequency Synthesizers

Application-Focused, HCMOS for Cordless Telephones

MC145160 —
Dual phase-locked loop for 46/49 MHz cordless telephone Tx and Rx channels.
Features:

- Full-duplex synthesizer
- 50 MHz maximum operating frequency
- 3.0 to 5.5 V, low power drain operation
- Standby pin
- On-chip ROM for programming the 10 FCC channel pairs from a BCD input
- Mode select gives either handset or base station operation
- 4 kHz and 5 kHz square wave tone outputs
- 18-pin dual-in-line plastic package, 20-pin SOIC



MC145160 Dual Loop Frequency Synthesizer

MC145166 —
Similar to MC145160, at left, but without 4 kHz tone output and buffered reference oscillator output. Accommodates fundamental transmit frequency. 16-pin dual-in-line plastic package, 16-pin SOIC.

MC145167 —
Similar to MC145166, above, but with serial interface. 16-pin dual-in-line plastic package, 16-pin SOIC.

General Purpose, CMOS

Designed for a wide range of applications, this family of CMOS devices accommodates serial, parallel, or 4-bit interface to MPUs/MCUs. The chips handle single- or dual-modulus prescalers. Other options include choice of phase detectors, transmit/receive offsets, and choice of reference divider values. Common characteristics for most devices include:

- 3.0 to 9.0 Vdc Supply Range
- On- or Off-Chip Reference Oscillator Operation
- Lock Detect Signal
- Single-Ended or Double-Ended Error Signal Option

The specific variations for individual family members are given below.

Divider Programming Format	Prescaler Modulus	Single-Ended 3-State Phase Detector Output	Double-Ended Phase Detector Output	Number of Divider Stages ÷R	÷A	÷N	Device Number	Suffix/Case
Serial*	Single	X	X	14**	—	14	MC145155★	P/707, FN/775
		X	X	14	—	14	MC145157★	P/648, FN/775
	Dual	X	X	12**	7	10	MC145156★	P/738, FN/775
		X	X	14	7	10	MC145158★	P/648, FN/775
		Analog Detector	—	14	7	10	MC145159★	P/738, FN/775
Parallel	Single	X	—	11**	—	9	MC145106	P/707, FN 775
		X	X	14**	—	14	MC145151★	P/710, FN/776
	Dual	—	X	12**	6	10	MC145152★	P/710, FN/776
		X	—	7/11**	—	4	MC14568B	P/648
4-Bit Bus	Single	X	X	12	—	14	MC145145★	P/707, FN/775
	Dual	X	X	12	7	10	MC145146★	P/738, FN/775
No Divider	—	X	—	—	—	—	MC14046B	P/648

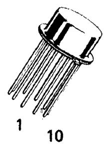
*Compatible with SPI output of CMOS MPUs   **Limited number of selectable values
★ Electrical variations may require a numerical suffix after the package suffix. Contact your Motorola representative for details.

Additional Phase-Locked Loop Functions

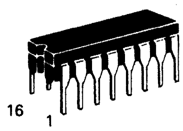
Function	Family	Devices 0 to +75°C	Suffix/Case
Oscillators			
Crystal Oscillator	MECL	MC12061	P/648, L/620
Voltage-Controlled Oscillator	MECL	MC1648#	P/646, L/632, F/607
Voltage-Controlled Multivibrator	MECL	MC1658#	P/648, L/620
Dual Voltage-Controlled Multivibrator	TTL	MC4024/ MC4324*	P/646, L/632, F/607
Voltage-Controlled Oscillator	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	MC1290	P/648, L/620
Programmable ÷N Decade	TTL	MC4316/ MC4316*	P/648, L/620, F/650

Notes:
*T_A = −55 to +125°C   #T_A = −30 to +85°C   ##T_A = −40 to +85°C
Plastic packages available for commercial temperature range only
**T_A = 0 to 70°C

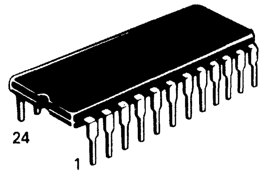
Communications Circuits Package Overview



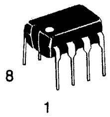
CASE 603
METAL
G SUFFIX



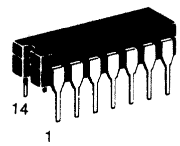
CASE 620
CERAMIC
L SUFFIX



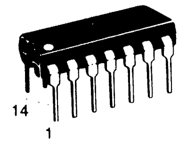
CASE 623
CERAMIC
L SUFFIX



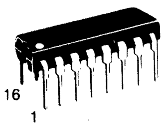
CASE 626
PLASTIC
P SUFFIX



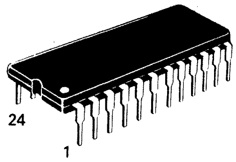
CASE 632
CERAMIC
L SUFFIX



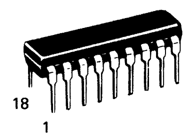
CASE 646
PLASTIC
P SUFFIX



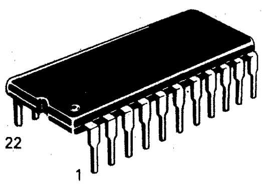
CASE 648
PLASTIC
P SUFFIX



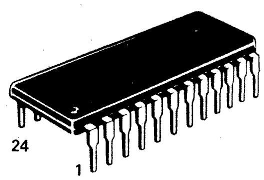
CASE 649
PLASTIC
P SUFFIX



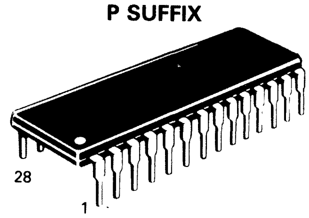
CASE 707
PLASTIC
P SUFFIX



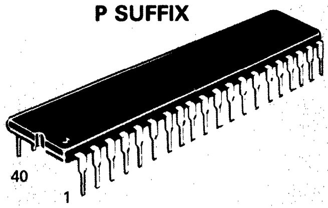
CASE 708
PLASTIC
P SUFFIX



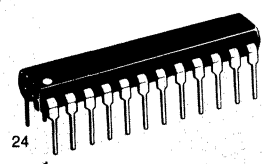
CASE 709
PLASTIC
P SUFFIX



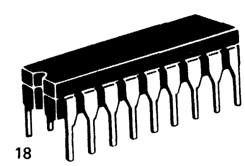
CASE 710
PLASTIC
P SUFFIX



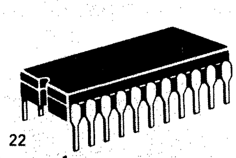
CASE 711
PLASTIC
P SUFFIX



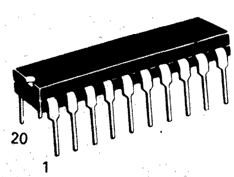
CASE 724
PLASTIC
N SUFFIX



CASE 726
CERAMIC
L SUFFIX

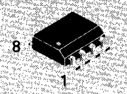


CASE 736
CERAMIC
L SUFFIX

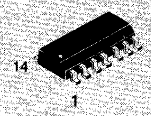


CASE 738
PLASTIC
P SUFFIX

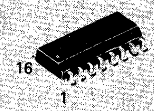
COMMUNICATIONS CIRCUITS PACKAGE OVERVIEW (continued)



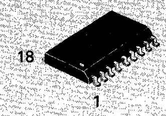
CASE 751
PLASTIC
D SUFFIX



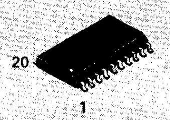
CASE 751A
PLASTIC
D SUFFIX



CASE 751B
PLASTIC
D SUFFIX



CASE 751C
PLASTIC
DW SUFFIX



CASE 751D
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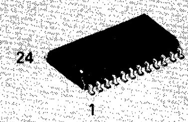
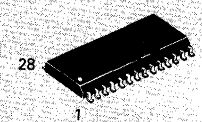
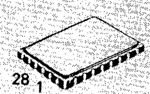
DW SUFFIX



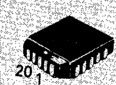
CASE 751E
PLASTIC
DW SUFFIX



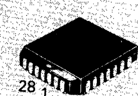
CASE 751F
PLASTIC
DW SUFFIX



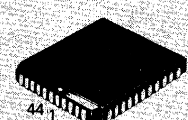
CASE 763
28-PIN CHIP CARRIER
Z SUFFIX



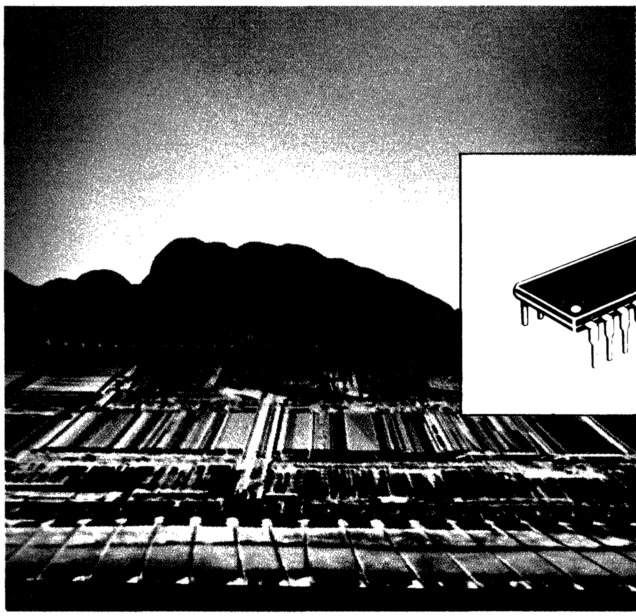
CASE 775
PLASTIC
FN SUFFIX

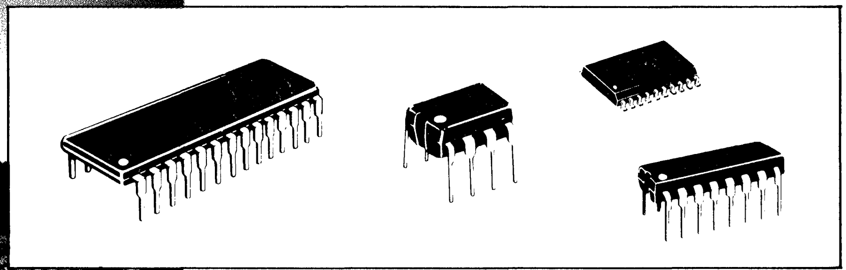


CASE 776
PLASTIC
FN SUFFIX



CASE 777
PLASTIC
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, 6–10 V Operation	P/738	MC13020
Advanced AM Stereo Decoder	Medium Voltage 2–8 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
Tuning Stabilizer	Companion for MC13020 for Manual Tuned Receivers	P/648	MC13021
AM Broadcast Receiver	AM Receiver Subsystem — Ideal Companion for MC13020	P/738	MC13041

FM Stereo Decoder

Function	Channel Separation dB Typ	THD % Typ	Stereo/Indicator Lamp Driver mA Max	Features	Suffix/Case	Device
FM Multiplex Stereo Decoder	62	0.1	100	Low Signal Blend for Noise Reduction	—/648	TCA4500A

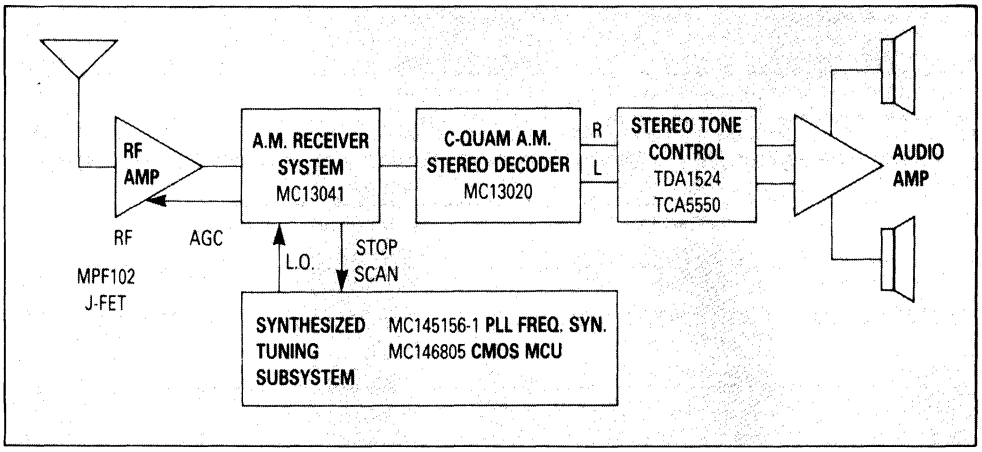
Audio Amplifiers

Function	P_O Watts	V_{CC} Vdc Max	V_{in} @ rated P_O mV Typ	I_D mA Typ	R_L Ohms	Suffix/Case	Type
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 Attenuators/Controls

Function	V_{CC} Range Vdc	THD %	Tone Control Range dB Typ	Attenuation Range dB Typ	Suffix/Case	Device
Stereo, Volume, Bass, Treble, Balance	8.5–18	0.1 Typ	±14	80	P/707	TCA5550
Stereo, Volume, Bass, Treble, Balance	3–18	0.5 Max	±15	80	P/707	TDA1524

C-QUAM® A.M. Stereo Broadcast 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., 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 (for as little as $60 in a basic tuner).

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.

Radio Circuits (See Communications Section)

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.

Video Circuits

Modulators

Function	Features	Suffix/Case	Device
TV Modulator (Hi 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	TDA3301 TDA3303
Color Processor	PAL/NTSC Input, RGB Outputs, On-Chip Hue Control	P/724	TDA3330
Color Processor	PAL/NTSC Input, Color Difference Outputs On-Chip Hue Control	P/707	TDA3333

VIDEO CIRCUITS (continued)

Tuning System

Function	Features	Suffix/Case	Device
Remote Control Amplifier	Infrared Diode Signal Amplifier Shaper	P/626	MC3373
PLL-Tuning Circuit	TV Tuning System — Prescaler — M-Bus Control	DW/751C	MC44802

Deflection

Horizontal Processor	Linear Balanced Phase Detector, Oscillator and Predriver, Adjustable dc Loop Gain, Adjustable Duty Cycle	P/626	MC1391

Sound

Sound IF Detector, dc Volume Control, Preamplifier	30 μV, 3.0 dB Limiting, Excellent AMR	—/646	TBA120C
Sound IF, Low Pass Filter, Detector, dc Volume Control, Preamplifier	Complete TV Sound System; 100 μV, 3 dB Limiting Sensitivity; 4 Watts Output; $V_{CC} = 24$ V; $R_L = 16\ \Omega$	P/648C	TDA3190
	750 mW Output	P/648C	TDA1190
Stereo Sound Control System	Stereo Balance, Volume, Bass, Treble Control	P/707	TCA5550

Transistor Arrays

Function	$I_{C(max)}$ mA	V_{CEO} Volts Max	V_{CBO} Volts Max	V_{EBO} Volts 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

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	P/710	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; $R_L = 16\ \Omega$	P/648C	TDA3190
	Same as TDA1190Z Except for 750 mW Output	P/648C	TDA1190
MONOMAX Audio/Vertical Output	High Level 750 mW Audio Output — Vertical Yoke Driver	P/648C	MC13014

Video IF Amplifiers

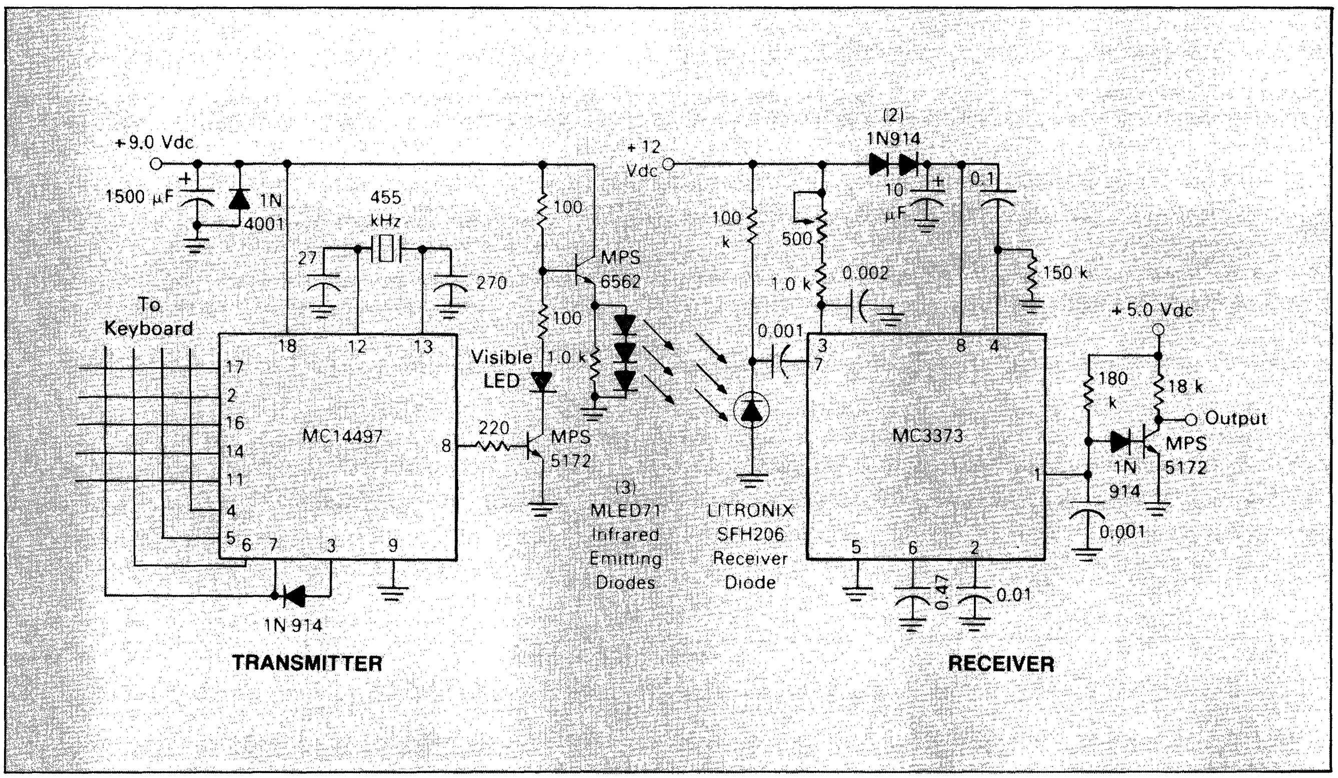
Function	Features	Suffix/Case	Device
1st and 2nd Video IF Amplifier	IF Gain @ 45 MHz = 50 dB typ, AGC Range = 60 dB min	P/626	MC1350
3rd IF, Video Detector, Video Buffer, and AFC Buffer	Low Level Detection, Low Harmonic Generation, Zero Signal dc Output Voltage of 7.0 to 8.2 V	P/626	MC1330A1P
	Same as MC1330A1 Except Zero Signal dc Output Voltage of 7.8 to 9.0 V	P/626	MC1330A2P
SAW Preamp, IF Amplifier, Detector, AGC, AFC	Complete Video IF or Parallel Sound IF System Complete AFT System with Simple Quadrature Detector	P/707	MC13010P
Advanced Video IF	Complete Video/Audio IF System for High Performance Analog TV Receivers	DW/751F	MC44301

Remote Control Circuits

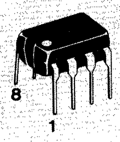
MC3373 Amplifier/Detector (Bipolar), Case 626
MC14497 Transmitter (CMOS), Case 707

The MC3373 remote control receiver is specifically designed for infra-red 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.

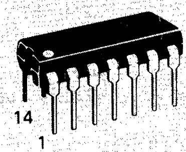
Functional Block Diagram of Remote Control System



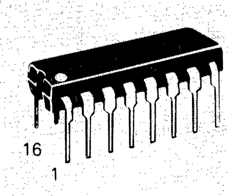
Consumer Electronic Circuits
Package Overview



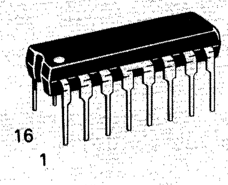
CASE 626
PLASTIC
P SUFFIX



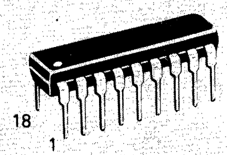
CASE 646
PLASTIC
P SUFFIX



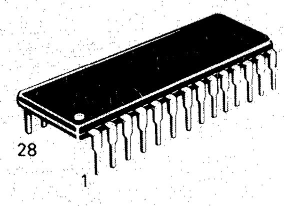
CASE 648
PLASTIC
P SUFFIX



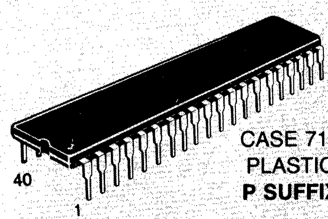
CASE 648C
PLASTIC
P SUFFIX



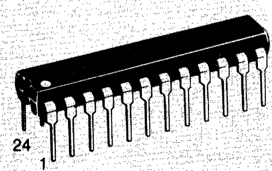
CASE 707
PLASTIC
P SUFFIX



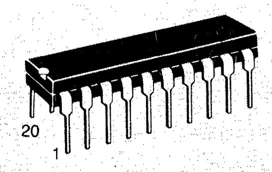
CASE 710
PLASTIC
P SUFFIX



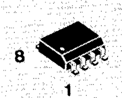
CASE 711
PLASTIC
P SUFFIX



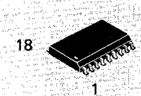
CASE 724
PLASTIC
P SUFFIX



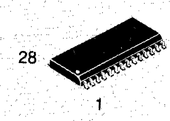
CASE 738
PLASTIC
P SUFFIX



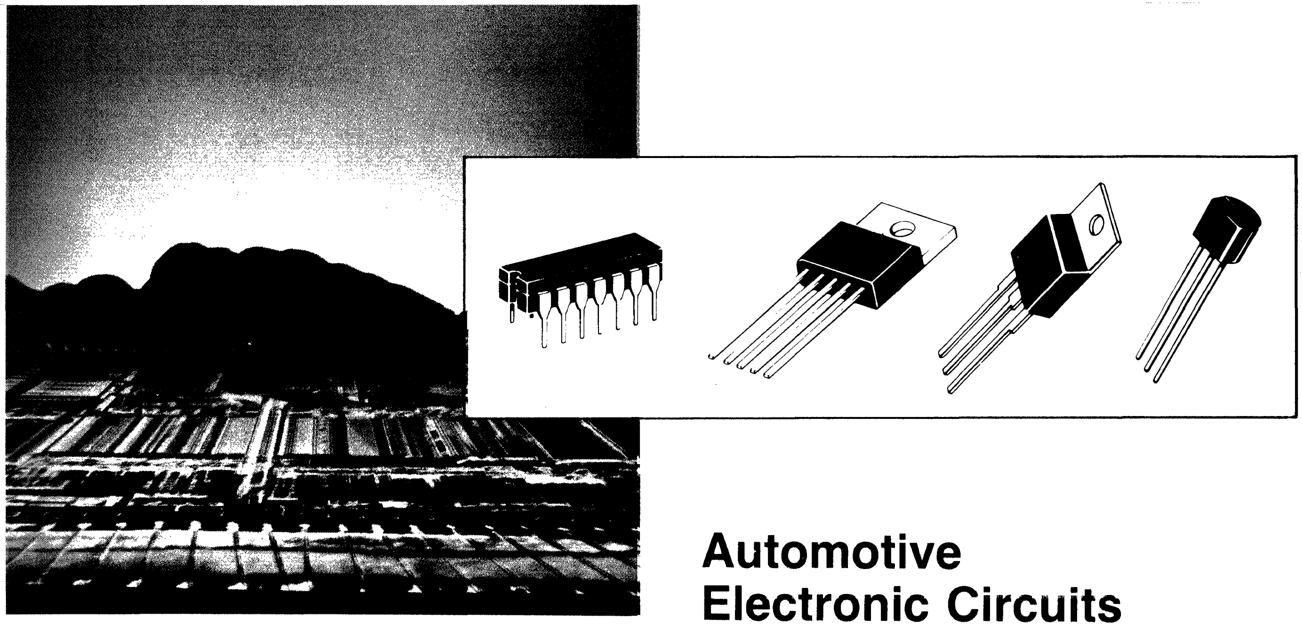
CASE 751
PLASTIC
D SUFFIX



CASE 751C
PLASTIC
DW SUFFIX



CASE 751F
PLASTIC
DW SUFFIX

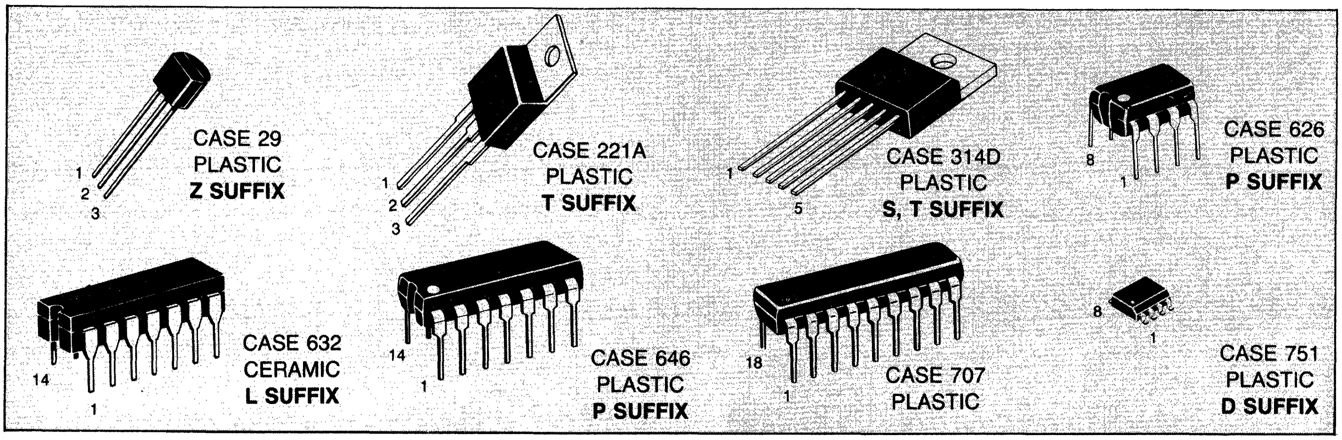


Automotive Electronic Circuits

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 and series transient protectors. 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. The automotive entertainment products are summarized in the Consumer section of this selector guide.

Automotive Electronic Circuits



Voltage Regulators

Function	Features	Case Suffix	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

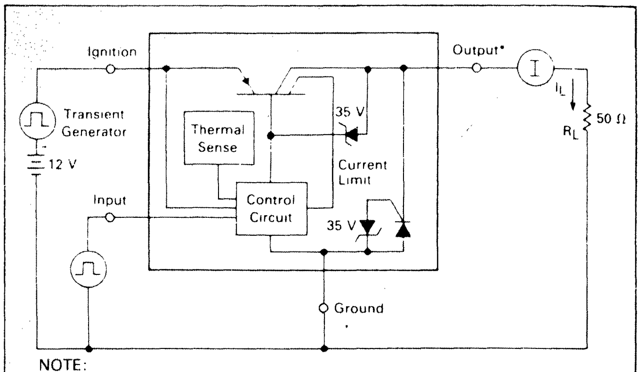
Injector Driver	Power Driver for Automotive Fuel Injection Systems, Reduced Hold Current MC3484S2 — 2 Amps MC3484S4 — 4 Amps	S/314D	MC3484
Transient Suppressor	Series Transient, opens circuit to protect	T/221A,	MC3397T
High Side Driver Switch	Drives loads from positive side of power supply and protects 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.	626	TCF6000
Pressure Transducer Amplifier	Consists of 2 Low Power Operational amplifiers with identical characteristics, except for the outputs.	626, D/751	TCF7000

SPECIAL FUNCTIONS (continued)

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.



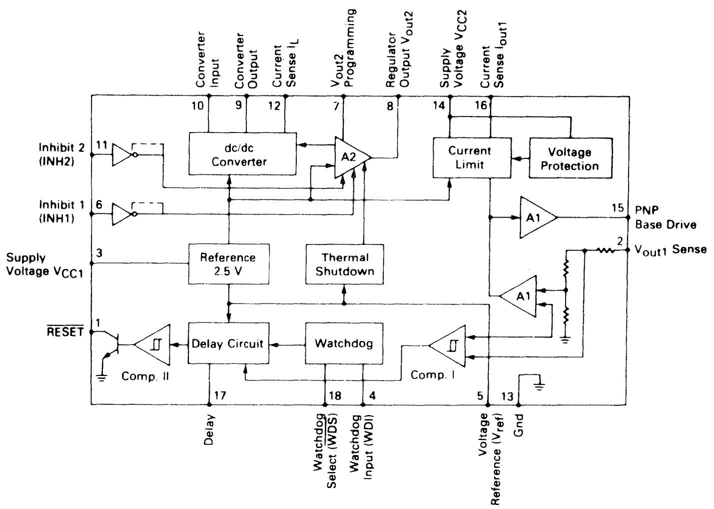
NOTE:
*Depending on Load Current and Transient Duration, an Output Capacitor (C_O) of sufficient value may be used to hold up Output Voltage during the Transient, and absorb Turn-off Delay Voltage Overshoot.

Universal Microprocessor Power Supply Controller

TCA5600 — T_A = −40° to +75°C, Case 707

This device is a versatile power supply control circuit for microprocessor based systems and mainly intended for automotive applications and battery powered instruments. To cover a wide range of applications, the device offers high circuit flexibility with minimum of external components.

Functions included in this IC 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.

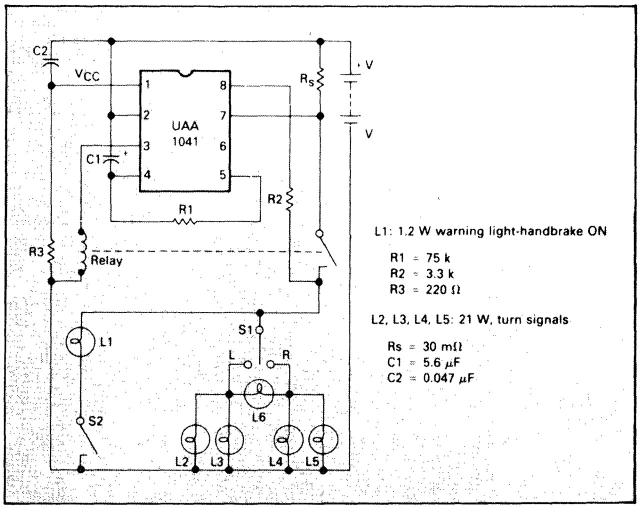


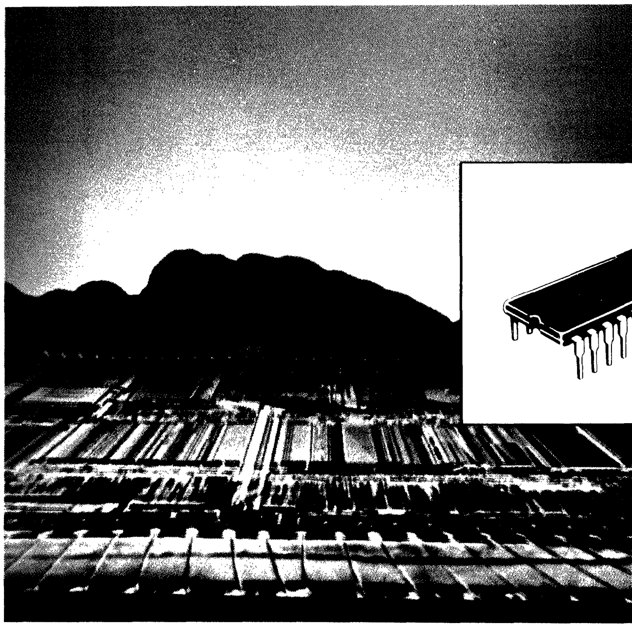
Automotive Direction Indicator

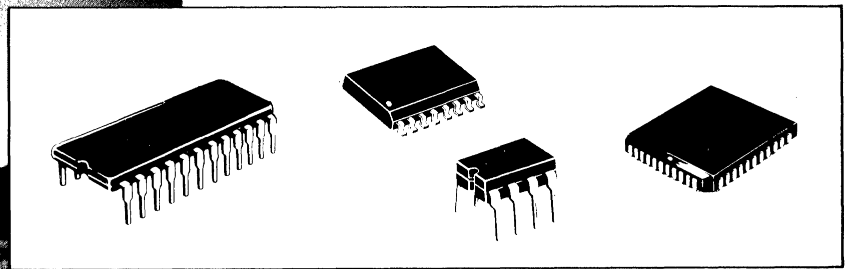
UAA1041,D — T_A = −40° to +100°C, Case 626, 751

. . . 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







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.

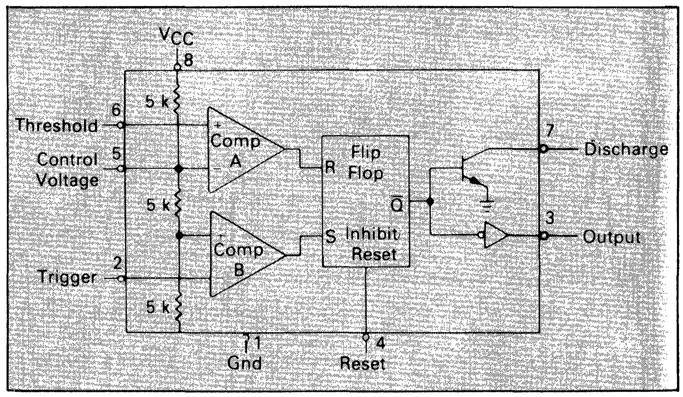
Other Linear Circuits

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 astable 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

MC1455G,P1,U T_A = 0° to +70°C, Case 601, 626, 693
MC1455BP1 T_A = −40° to +85°C, Case 626



Duals

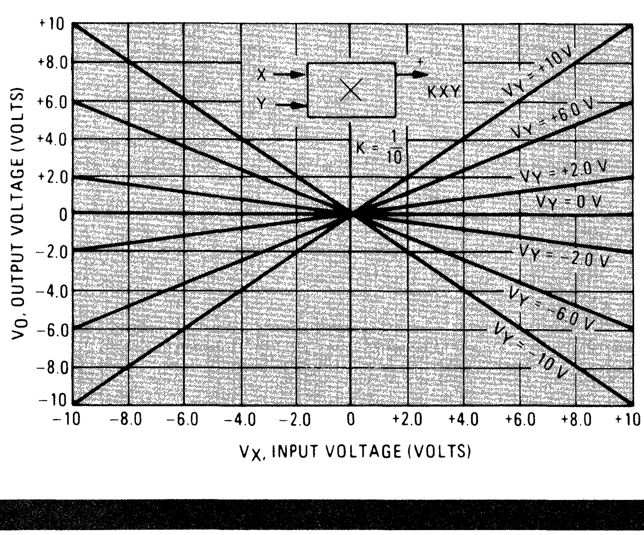
MC3556L T_A = −55° to +125°C, Case 632
MC3456L,P T_A = 0° to +70°C, Case 632, 646

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.

FOUR-QUADRANT MULTIPLIER TRANSFER CHARACTERISTIC



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

. . . 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.

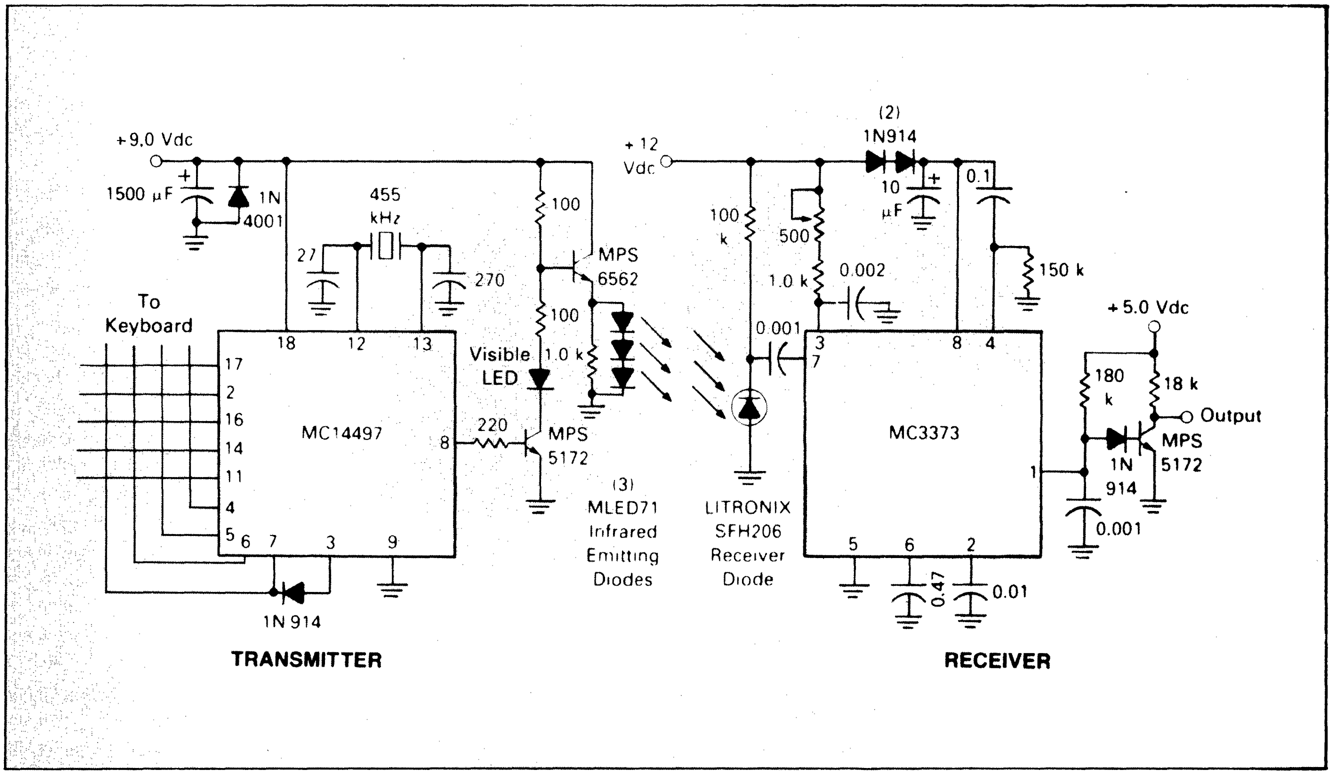
*When used with an operational amplifier.

Remote Control Circuits

MC3373 Amplifier/Detector (Bipolar), Case 626
MC14497 Transmitter (CMOS), Case 707

The MC3373 remote control receiver is specifically designed for infra-red 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.

Functional Block Diagram of Remote Control System

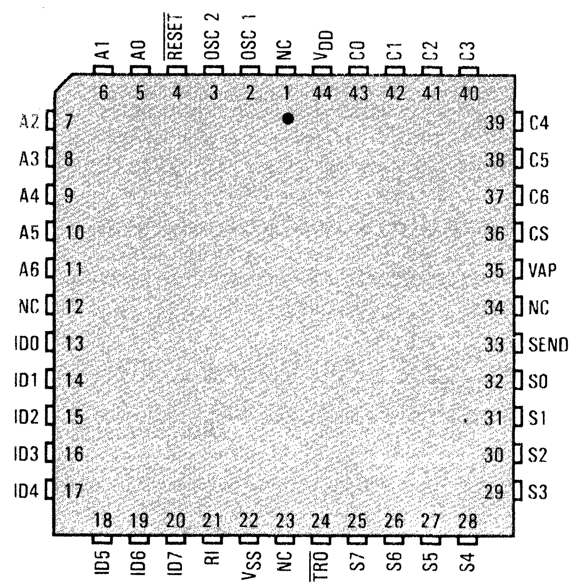


Addressable Asynchronous System

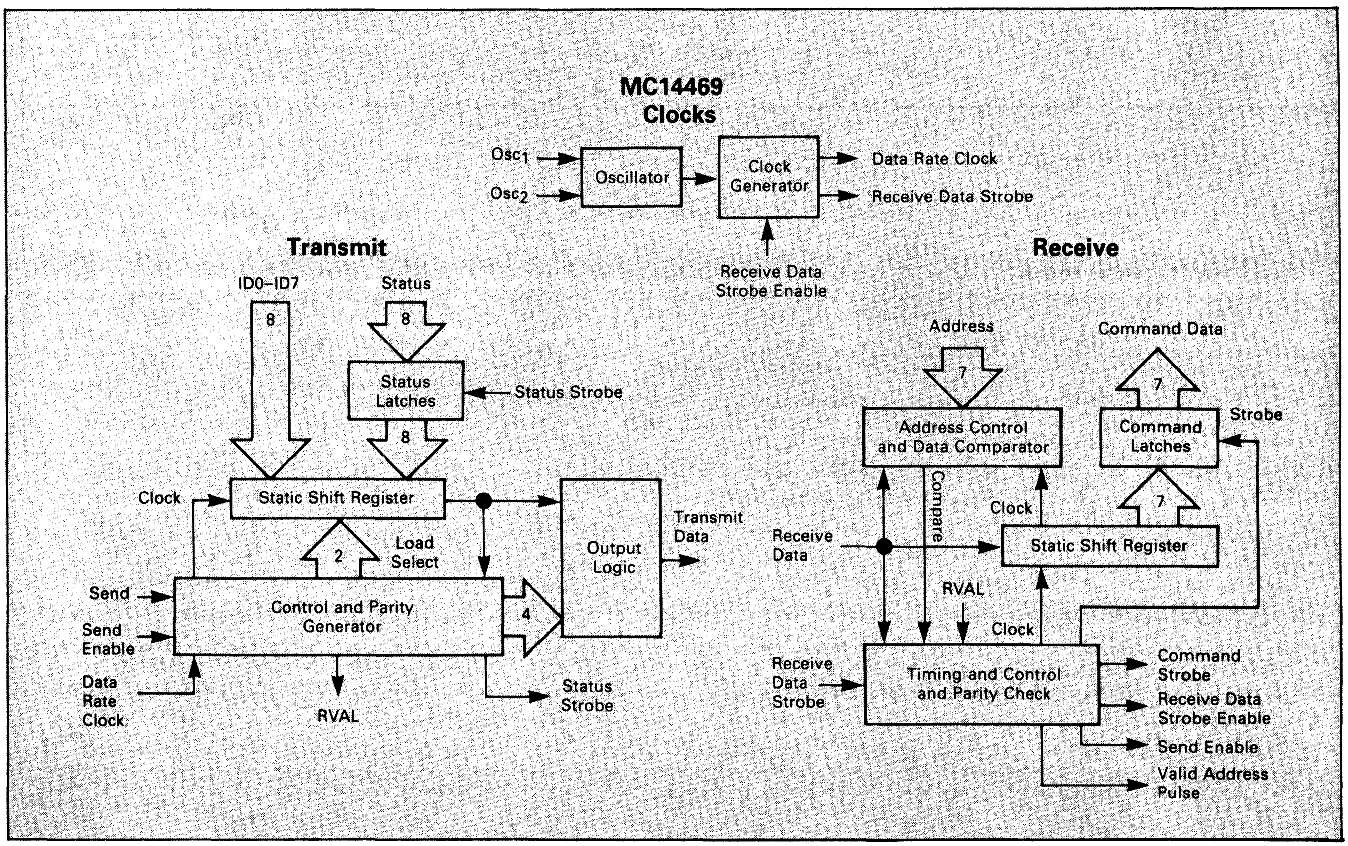
MC14469P,FN Receiver/Transmitter (CMOS),
Case 711, 777

For application in transmitting data from remote A-to-D converters, remote MPUs or remote digital transducers to the master computer or MPU. Features:

- Supply Voltage Range — 4.5 Vdc to 18 Vdc
- Low Quiescent Current — 75 μAdc maximum @ 5 Vdc
- Data Rates to 4800 Baud @ 5 V, to 9600 Baud @ 12 V
- Receive — Serial to Parallel
  Transmit — Parallel to Serial
- Transmit and Receive Simultaneously in Full Duplex
- Crystal or Resonator Operation for On-Chip Oscillator



MC14469FN
Surface-Mount Case 777



Encoder/Decoder Pairs (CMOS)

MC145026 Encoder — Case 648, 751B
MC145027 Decoder — Case 648, 751G
MC145028 Decoder — Case 648, 751G

The MC145026 encodes nine lines of information and serially transmits this information. The nine inputs may be encoded with trinary data (0, 1, open) allowing 19,683 different codes.

The two decoders receive the 9-bit word and interpret some of the bits as address codes and some as data. The MC145027 interprets the first five transmitted bits as address and the last four bits as data. The MC145028 treats all nine bits as address.

Features:

- Interfaces with RF, Ultrasonic, or Infrared Transmission Media
- 4.5 V to 18 V Operation
- On-Chip RC Oscillator; No Crystal Required
- High External Component Tolerance; Can use ±5% Components

Remote Control Encoder/Decoder (LSI CMOS)

MC145030 Encoder/Decoder — Case 738, 751D

The MC145030 encodes and decodes nine bits of information, which allows 512 different codes.

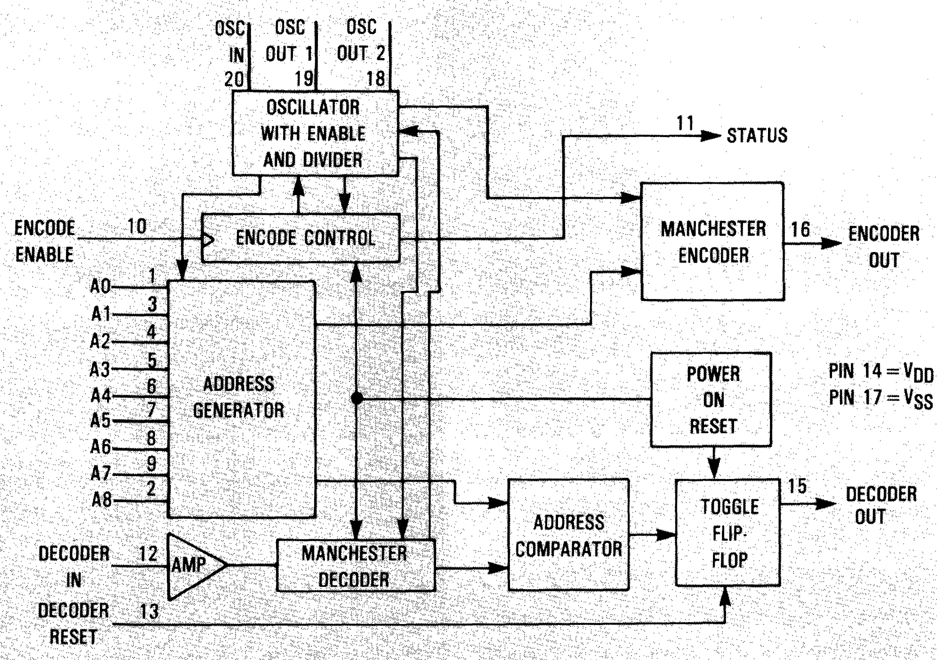
The encoder section samples the 9-bit parallel address input, encodes the bits into Manchester Code, and sends the serial information via the Encoder Out pin. The address is issued twice per encoding sequence; initialization occurs with a rising edge on Encode Enable.

The decoder accepts serial information at the Decoder In pin, and decodes the Manchester information. The decoded address is compared with the local address. If a match occurs, Decoder Out toggles once per sequence. The active-high Decoder Reset input is used to clear Decoder Out.

The Status pin, when high, indicates the device is encoding. During decoding or standby, Status is low.

- Applications: Cordless Phones
  Half-Duplex Remote Control
- Interfaces with RF, Ultrasonic, or Infrared Modulators and Demodulators
- Operating Temperature Range: −40 to 85°C
- Operating Voltage Range: 2 to 6 V
- Standby Supply Current: 20 μA Maximum @ 2 V
- Operating Supply Current: 700 μA Maximum @ 2.5 V
- Address Inputs Have On-Chip Pull-Up Devices
- RC Oscillator, No Crystal Required
- On-Chip Amplifier in Decode Section

MC145030
BLOCK DIAGRAM



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.

For Photoelectric Detectors

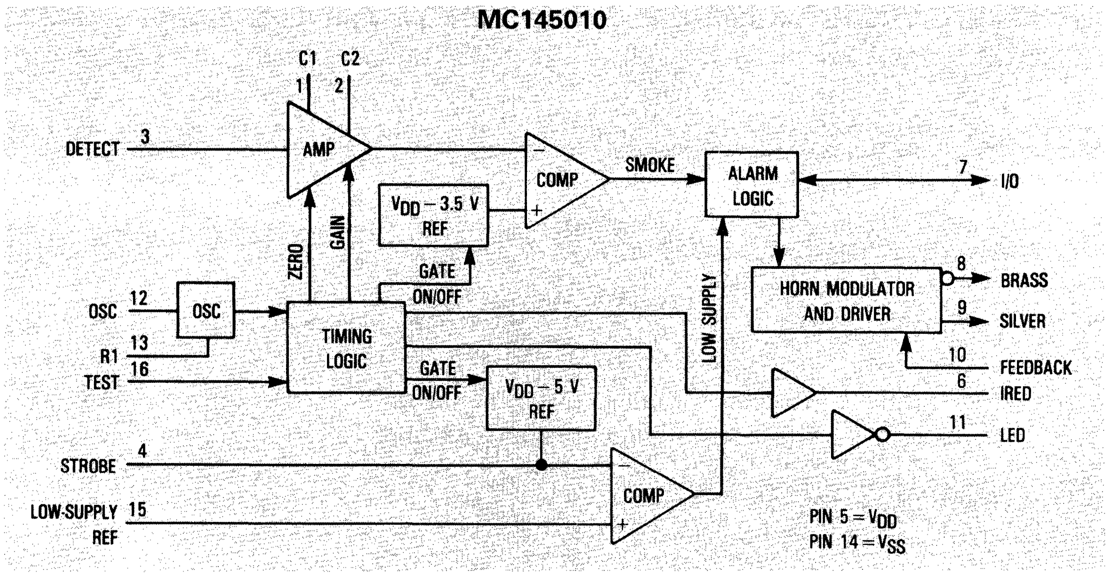
MC145010 — This advanced smoke detector design contains sophisticated very-low-power analog and digital circuitry for use with an infrared photoelectric chamber. On-chip amplifier allows direct interface to photo diodes. Has I/O pin for interconnecting to other units or MPUs. Available in Cases 648 and 751G.

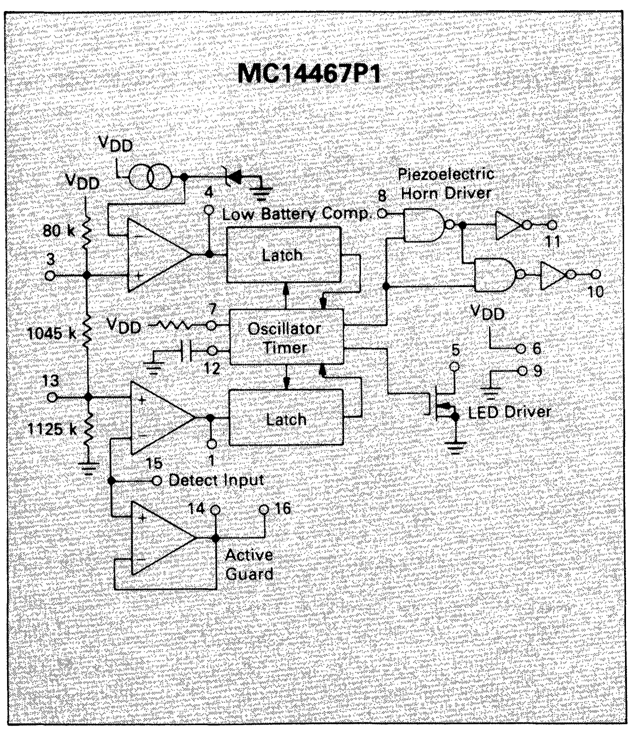
For Ionization-Type Detectors

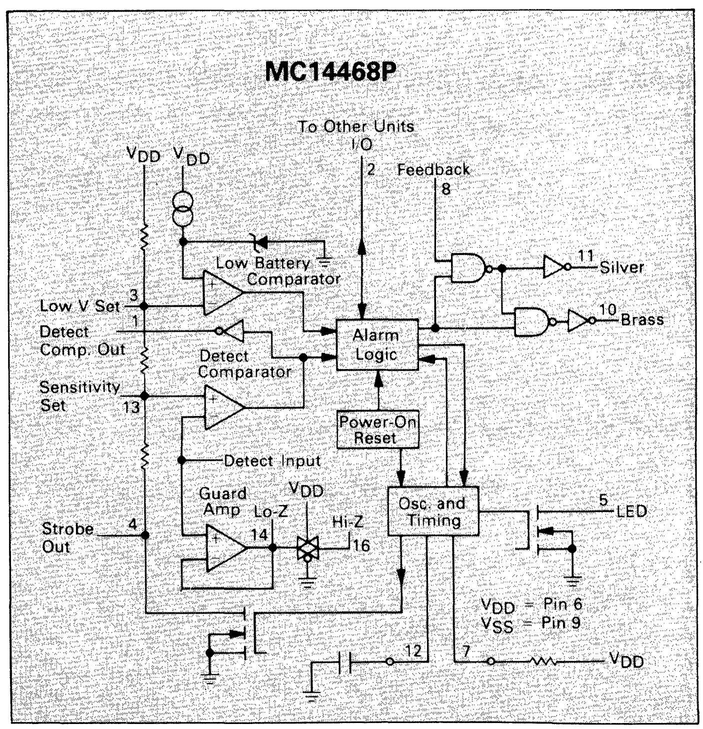
MC14467P1 — Has protection network on the Detect input. Standard package, with no shorting bar. Direct replacement for the MC14466P1. In Case 648.

MC14468P — Allows up to 40 units to be interconnected for common signalling. Electrostatic discharge protection similar to MC14467P1. In Case 648.

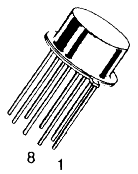
MC14578 — Micropower comparator can be used in line-powered ionization-type detectors. In Case 648.



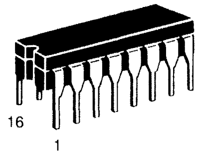




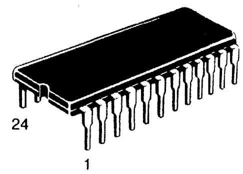
Other Linear Circuits Package Overview



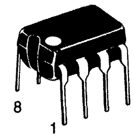
CASE 601
METAL
G SUFFIX



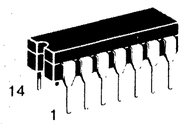
CASE 620
CERAMIC
L SUFFIX



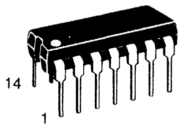
CASE 623
CERAMIC
L SUFFIX



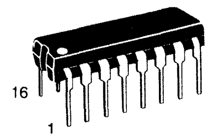
CASE 626
PLASTIC
P1 SUFFIX



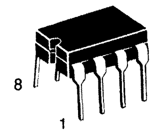
CASE 632
CERAMIC
L SUFFIX



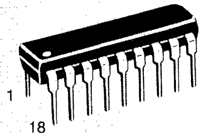
CASE 646
PLASTIC
P SUFFIX



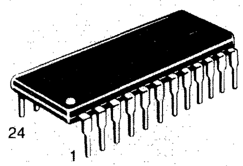
CASE 648
PLASTIC
P SUFFIX



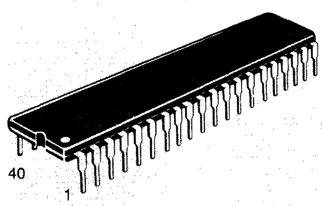
CASE 693
CERAMIC
U SUFFIX



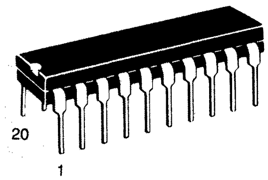
CASE 707
PLASTIC
P SUFFIX



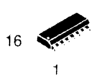
CASE 709
PLASTIC
P SUFFIX



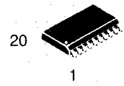
CASE 711
PLASTIC
P SUFFIX



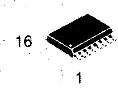
CASE 738
PLASTIC
P SUFFIX



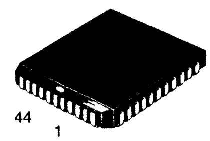
CASE 751B
PLASTIC
D SUFFIX



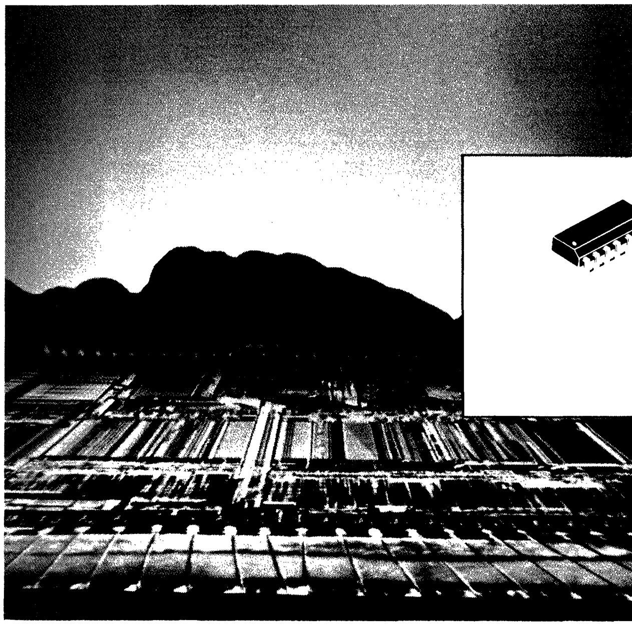
CASE 751D
PLASTIC
DW SUFFIX

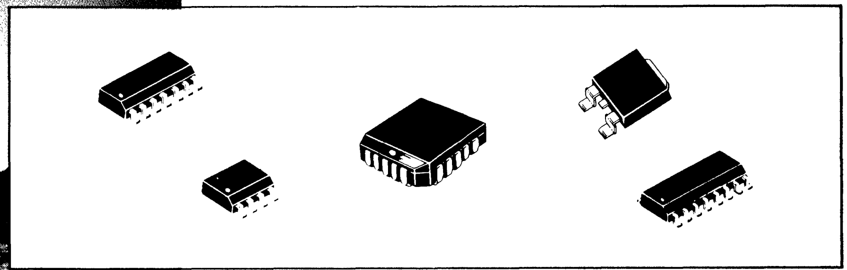


CASE 751G
PLASTIC
DW SUFFIX



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 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 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 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 offer increased functions with the same size product.

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 op-amps, regulators, interface, data conversion, consumer, telecom and automotive Linear ICs.

Device	Function	Package
DAC-08CD,ED	High Speed 8-Bit Multiplying D-to-A Converter	SO-16
LF347D	Quad BIFET Operational Amplifiers	SO-14
LF351D	Single BIFET Operational Amplifier	SO-8
LF353D	Dual BIFET Operational Amplifiers	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
LM208D,AD	Precision 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
LM293D	Dual Comparators	SO-8
LM301AD	General Purpose Adjustable Operational Amplifier	SO-8
LM308D,AD	Precision Operational Amplifier	SO-8
LM311D	High Performance Voltage Comparator	SO-8
LM317LD	Positive Adjustable 100 mA Voltage Regulator	SOP-8
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 Diodes	SO-8
LM385D-2.5	Micropower Voltage Reference Diodes	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
MC1377DW*	Color Television RGB to PAL/NTSC Encoder	SO-20
MC1378FN	Video Overlay Synchronizer	PLCC-44
MC1403D	Precision Low Voltage Reference	SO-8
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
MC1458SD	High Slew Rate Dual Operational Amplifiers	SO-8
MC1488D	Quad EIA-232C Drivers	SO-14
MC1489D	Quad EIA-232C Receivers	SO-14
MC1496D	Balanced Modulator-Demodulator	SO-14
MC1723CD	Adjustable Positive Or Negative Voltage Regulator	SO-14
MC1733CD	Differential Video Amplifier	SO-14
MC1741CD	General Purpose Operational Amplifier	SO-8
MC1741SCD	High Slew Rate Operational Amplifier	SO-8
MC1747CD	Dual MC1741 Operational Amplifiers	SO-14
MC1776CD	Programmable Operational Amplifier	SO-8
MC26LS31D	Quad EIA-422 3 Drivers	SO-16

*To Be Introduced.

Bipolar (continued)

Device	Function	Package
MC26LS32D	Quad EIA-422 Receivers	SO-16
MC2831AD	FM Transmitter	SO-16
MC3346D	General Purpose Transistor Array	SO-14
MC3356FN	FSK Receiver	PLCC-20
MC3357D	Low Power FM IF Amplifier	SO-16
MC3359DW	Low Power Narrowband FM IF Amplifier	SO-20
MC3361D	Low Voltage Narrowband FM IF Amplifier	SO-16
MC3362DW	Dual Conversion Receivers	SO-28
MC3363DW*	Dual Conversion Receivers	SO-28
MC3367DW	Low Voltage VHF Receiver	SO-28
MC3371D*	Low Voltage FM Receiver with RSSI	SO-16
MC3401D	Quad Operational Amplifiers	SO-14
MC3403D	Quad Differential-Input Operational Amplifiers	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
MC3458D	Dual Low Power Operational Amplifiers	SO-8
MC3486D	Quad EIA-422 3 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
MC78M12CDT*	Positive Voltage 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
MC13022DW*	Medium Voltage AM Stereo C-QUAM Decoder	SO-28
MC13024DW*	Low Voltage C-QUAM Receiver	SO-24
MC13041DW*	AM Receiver Subsystem	SO-20
MC13055D	VHF LAN Receiver — FSK	SO-16
MC13060D	1 Watt Audio Amp	SOP-8
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
MC33171D	Single, Low Power, Single Supply Operational Amplifier	SO-8
MC33172D*	Dual, Low Power, Single Supply Operational Amplifiers	SO-8
MC33174D*	Quad, Low Power, Single Supply Operational Amplifiers	SO-14
MC33282D*	Dual Precision Low Input JFET Operational Amplifiers	SO-14
MC33284D*	Quad Precision JFET Operational Amplifiers (Trim-in-the-Package)	SO-14
MC34001D,AD,BD	Single JFET Input Operational Amplifier	SO-8
MC34002D,AD,BD	Dual JFET Input Operational Amplifiers	SO-8
MC34004D,BD	Quad JFET Input Operational Amplifiers	SO-14
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	Telephone Speech Network with Dialer Interface	PLCC-20
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-28

*To Be Introduced.

LINEAR AND INTERFACE (continued)

Bipolar (continued)

Device	Function	Package
MC34018FN	Voice Switched Speakerphone Circuit	PLCC-28
MC34060AD*	Switchmode Pulse Width Modulation Control Circuit	SO-14
MC34063AD	Precision DC-to-DC Converter Control Circuit	SO-8
MC34071D	Single, High Speed, Single Supply Operational Amplifier	SO-8
MC34072D*	Dual, High Speed, Single Supply Operational Amplifiers	SO-8
MC34074D*	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
MC34114DW	Speech Network II	SO-18
MC34118DW	Speakerphone II	SO-28
MC34119D	Telephone Speaker Amplifier	SO-8
MC34129D	Power Supply Controller	SO-14
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-28
NE592D	Video Amplifier	SO-14
TL061CD	Single BIFET Low Power Operational Amplifier	SO-8
TL062CD	Dual BIFET Low Power Operational Amplifiers	SO-8
TL064CD	Quad BIFET Low Power Operational Amplifiers	SO-14
TL071CD,ACD,BCD	Single, Low Noise JFET Input Operational Amplifier	SO-8
TL072CD,ACD,BCD	Dual, Low Noise JFET Input Operational Amplifiers	SO-8
TL074CD,ACD,BCD	Quad, Low Noise JFET Input Operational Amplifiers	SO-14
TL081CD,ACD,BCD	Single, JFET Input Operational Amplifier	SO-8
TL082CD,ACD,BCD	Dual, JFET Input Operational Amplifiers	SO-8
TL084CD,ACD,BCD*	Quad, JFET Input Operational Amplifiers	SO-14
TL431CD	Programmable Precision Reference	SOP-8
TYA1350D	IF Amplifier (M1350D)	SO-8
UAA1041D	Automotive Direction Indicator	SO-8
UC2842AD	Off-Line Current Mode PWM Controller	SO-14
UC2843AD	Current Mode PWM Controller	SO-14
UC3842AD	Off-Line Current Mode PWM Controller	SO-14
UC3843AD	Current Mode PWM Controller	SO-14

*To Be Introduced.
†Formerly MC13011DW

CMOS

Both the SOIC and PLCC packages are offered by Motorola for these CMOS products. The SOIC packages are denoted by a common suffix of "D" or "DW." This package identifier is added to the end of each standard part number. In the case of PLCC packages, the "FN" suffix is utilized — again after the standard device part number.

SOIC packages with a suffix "L" in the Package column indicate wide-body version (e.g., SO-24L).

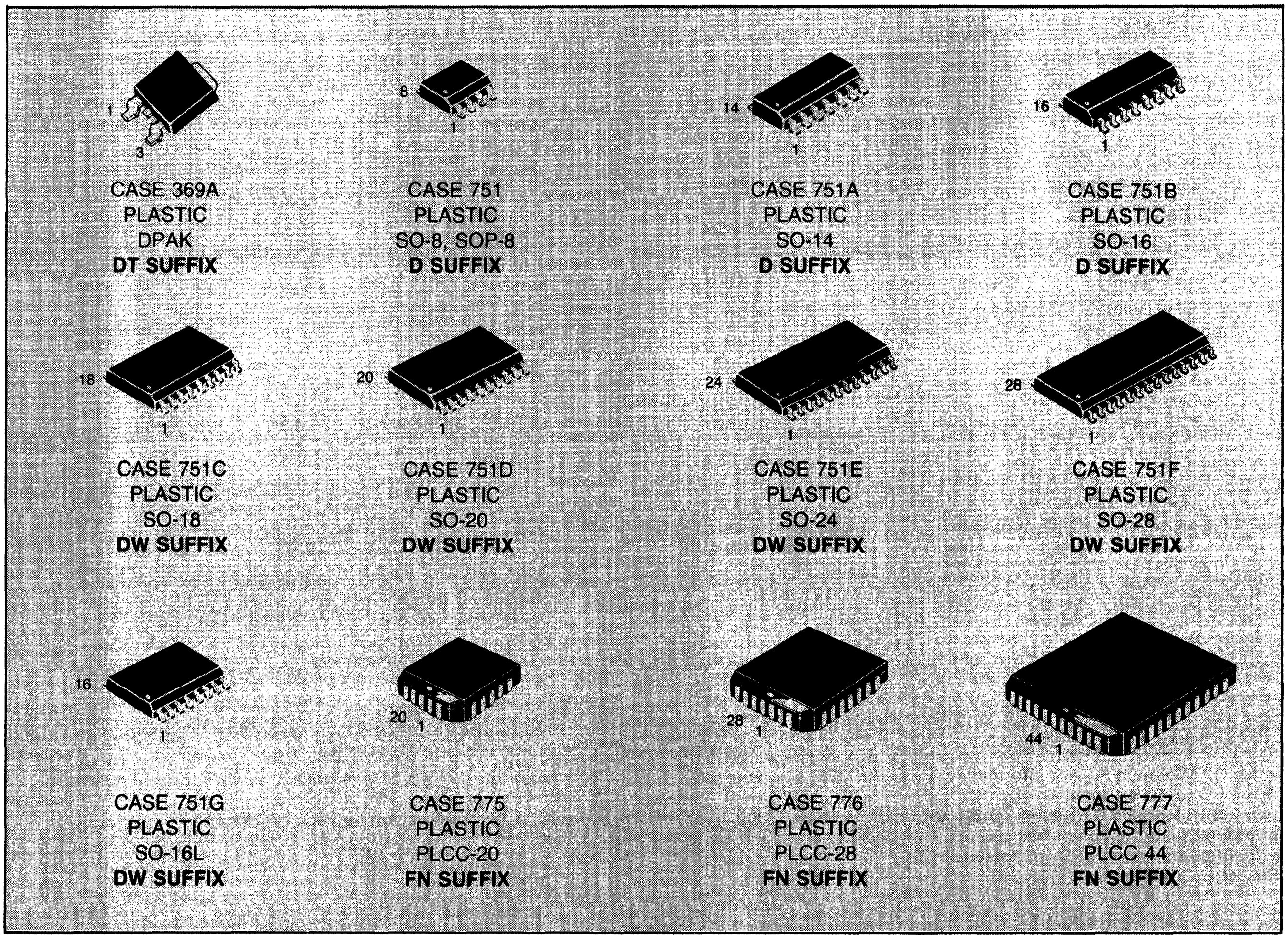
Device	Function	Package
MC14433DW	3-1/2 Digit A/D Converter	SO-24
MC14442FN	11-Channel, 8-Bit A/D Converter with Parallel Interface	PLCC-28
MC14443DW	6-Channel A/D Converter Subsystem	SO-16L
MC14447*	6-Channel A/D Converter Subsystem	
MC14469FN	Addressable Asynchronous Receiver/Transmitter	PLCC-44
MC14495DW1**	Hex-to-7 Segment Latch/Decoder ROM/Driver	SO-16L
MC14497*	PCM Remote Control Transmitter	
MC14499DW	7-Segment LED Display Decoder/Driver with Serial Interface	SO-20L
MC14573D	Quad Programmable Operational Amplifier	SO-16
MC14574D	Quad Programmable Comparator	SO-16
MC14575D	Dual/Dual Programmable Amplifier-Comparator	SO-16
MC14578D	Micro-Power Comparator plus Voltage Follower	SO-16
MC144110DW	Hex D/A Converter with Serial Interface	SO-20L
MC144111DW	Quad D/A Converter with Serial Interface	SO-16L
MC145000FN	48-Segment Multiplexed LCD Driver (Master)	PLCC-28
MC145001FN	44-Segment Multiplexed LCD Driver (Slave)	PLCC-28
MC145026D	Remote Control Encoder	SO-16
MC145027DW	Remote Control Decoder	SO-16L
MC145028DW	Remote Control Decoder	SO-16L

CMOS — continued

Device	Function	Package
MC145030DW	Remote Control Encoder/Decoder	SO-20L
MC145040FN1**	A/D Converter with Serial Interface	PLCC-20
MC145040FN2**	A/D Converter with Serial Interface	PLCC-20
MC145041FN1**	A/D Converter with Serial Interface	PLCC-20
MC145041FN2**	A/D Converter with Serial Interface	PLCC-20
MC145106FN	PLL Frequency Synthesizer	PLCC-20
MC145145FN★	4-Bit Data Bus Input PLL Frequency Synthesizer	PLCC-20
MC145146FN★	4-Bit Data Bus Input PLL Frequency Synthesizer	PLCC-20
MC145151FN★	Parallel Input PLL Frequency Synthesizer	PLCC-28
MC145152FN★	Parallel Input PLL Frequency Synthesizer	PLCC-28
MC145155FN★	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145155DW★	Serial Input PLL Frequency Synthesizer	SO-20L
MC145156FN★	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145156DW★	Serial Input PLL Frequency Synthesizer	SO-20L
MC145157FN★	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145157DW★	Serial Input PLL Frequency Synthesizer	SO-16L
MC145158FN★	Serial Input PLL Frequency Synthesizer	PLCC-20
MC145158DW★	Serial Input PLL Frequency Synthesizer	SO-16L
MC145159FN★	Serial Input PLL Frequency Synthesizer with Analog Phase Detector	PLCC-20
MC145453FN	33-Segment LCD Driver with Serial Interface	PLCC-44

*Introduction of these devices in surface mount packages is dependent on market demand.
**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.

Surface Mount Technology Package Overview



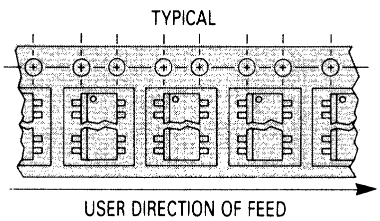
Tape and Reel

Standard Bipolar Logic, Bipolar Analog and MOS Integrated Circuits

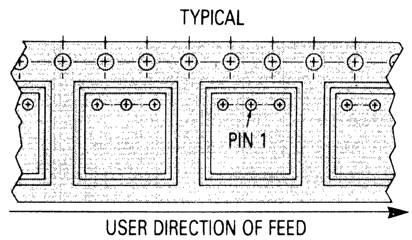
Motorola has now added the convenience of Tape and Reel packaging for our growing family of standard Integrated Circuit products. Two reel sizes are available, for all but the largest types, to support the requirements of both first and second generation pick-and-place equipment. The packaging fully conforms to the latest EIA-481A specification. The anti-static embossed tape provides a secure cavity, sealed with a peel-back cover tape.

Mechanical Polarization

SOIC DEVICES



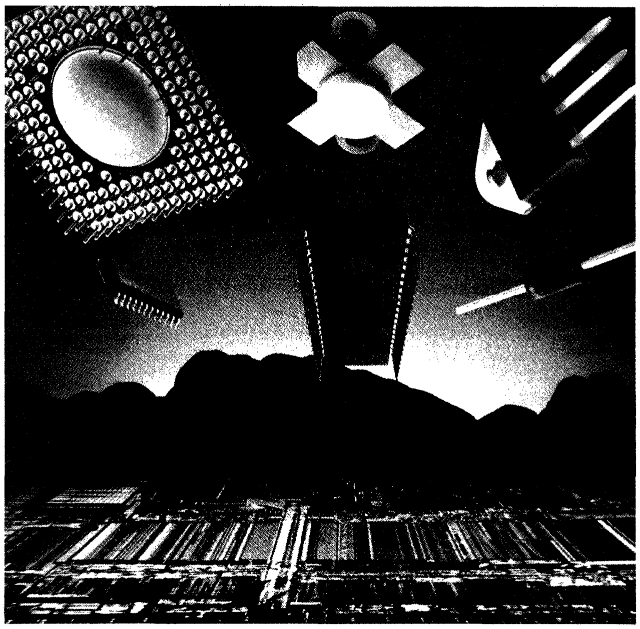
PLCC DEVICES



Package	Tape Width (mm)	Device per Reel	Reel Size* (inch)	Tape & Reel Lot Size(1) (Min)	Device Suffix
SO-8, SOP-8	12	750	7	5,000	R1
	12	2,500	13	5,000	R2
SO-14	16	750	7	5,000	R1
	16	2,500	13	5,000	R2
SO-16	16	750	7	5,000	R1
	16	2,500	13	5,000	R2
SO-16L (WIDE)	16	250	7	5,000	R1
	16	1,000	13	5,000	R2
SO-20L (WIDE)	24	250	7	5,000	R1
	24	1,000	13	5,000	R2
SO-24L (WIDE)	24	250	7	5,000	R1
	24	1,000	13	5,000	R2
SO-28L (WIDE)	24	200	7	3,000	R1
	24	1,000	13	3,000	R2
PLCC-20	16	200	7	3,000	R1
	16	1,000	13	3,000	R2
PLCC-28	24	200	7	2,400	R1
	24	500	13	2,500	R2
PLCC-44	32	200	7	2,000	R1
	32	500	13	2,000	R2
PLCC-52	32	500	13	2,000	R2
PLCC-68	44	250	13	2,000	R2
PLCC-84	44	250	13	2,000	R2
TO-226AA	18	1800	13	10,000	RA, RB or RP only

Notes: 1. Minimum lot size information applies to OEM customers. Distributors 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 and B only, with optional "Ammo Pack" (Suffix RP).

For ordering information please contact your local Motorola Semiconductor Sales Office.
Distribution minimum order quantity is 1 reel.
*Reel size: 7"/178 mm, 13"/330 mm.



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.

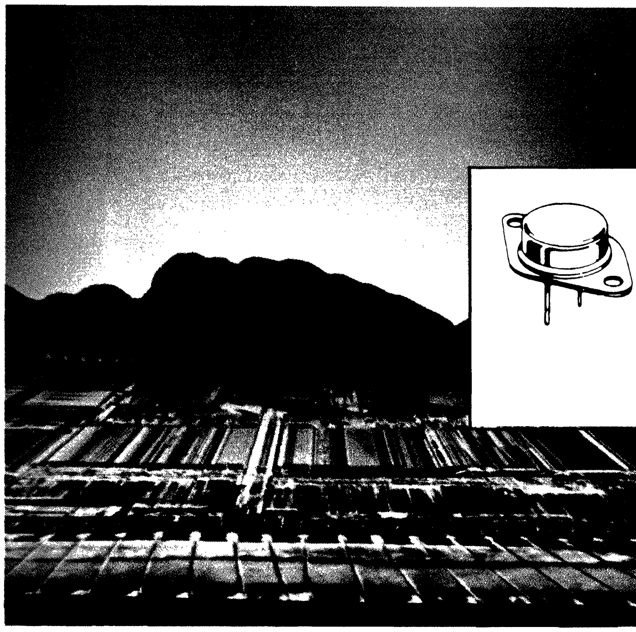
But things are changing . . . significantly . . . and the changes are not limited simply to the expansion of product lines through enhancement of specification limits. For example:

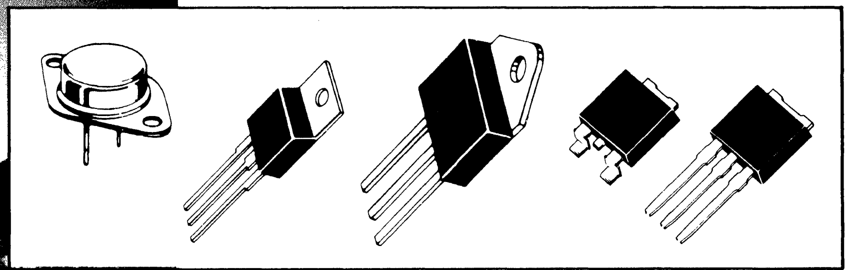
The power transistor category, which had been dominated by bipolar technology, is now getting major competition from expanding MOS products. Already the voltage and current range of bipolar power is challenged by Motorola TMOS products and TMOS prices have reached parity with bipolar prices. With the 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 most important, perhaps, 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 Smartpower which unites logic capability with output drive power on a single chip. 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 "multifunction" capability, and Motorola will continue to be the one-stop shopping center for 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 — the two primary discrete transistor categories — they enhance these capabilities with multiple-device structures to meet even greater gain, voltage, current and power requirements. In addition, the emerging field of Smartpower (trademarked SMARTMOS) already offers basic integrated-circuit logic functions with outputs sufficient to drive motors and other power hungry appliances. Briefly, 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 ratings to 300 A and 1200 V.

SMARTMOS™ Circuits
- Power Circuits for Motor Control, Power Supply and Switching Applications

Power Transistor Packages

Motorola power transistors are available in a variety of metal and plastic packages, each with its advantages and limitations, both electrically and mechanically.

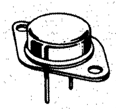
Metal cases are hermetically sealed and are capable of operating at junction temperatures of 200°C. Plastic packaged devices operate at junction temperatures up to 150°C, but offer extremely high package density per watt. Present day plastic packaged devices, using state-of-the-art packaging techniques, provide equivalent "metal can" hermetic capability in almost all areas.

The following charts indicate the power dissipation ranges of standard Motorola power transistors in various packages. More detailed specifications for these devices are given on the subsequent pages.

METAL PACKAGES

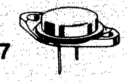
TO-204AA TO-204AE (60 mil pins)

(Formerly TO-3)



Case 1

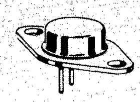
Case 197



Power Dissipation — to 350 W

TO-213AA

(Formerly TO-66)

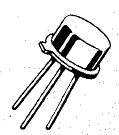


Case 80

Power Dissipation — to 90 W

TO-205AD

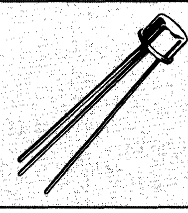
(Formerly TO-39)



Case 79
Power Dissipation — to 10 W

TO-205AA

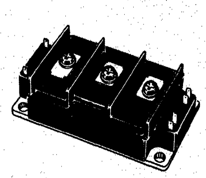
(Formerly TO-5)



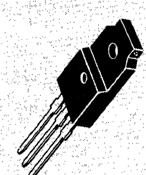
Case 31
Power Dissipation — to 6 W

PLASTIC PACKAGES

Energy Management Series

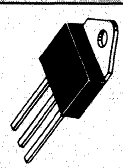


Case 814-01
Power Dissipation — to 1600 W



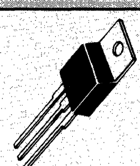
Case 221C-02
Power Dissipation — 50 W

TO-218AC



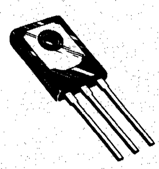
Case 340
Power Dissipation — to 150 W

TO-220AB



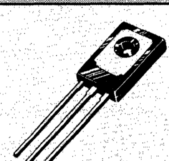
Case 221A
Power Dissipation — to 125 W

TO-225AB



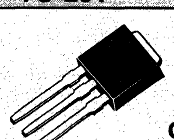
Case 90
Power Dissipation — to 100 W

TO-225AA

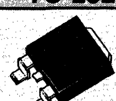


(Formerly TO-126)
Case 77
Power Dissipation — to 40 W

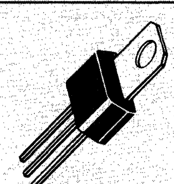
TO-251 DPAK TO-252



Case 369
Power Dissipation — to 20 W



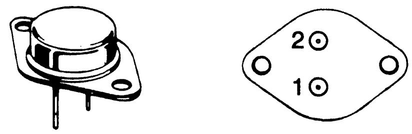
Case 369A
Surface Mount



Case 152
Power Dissipation — to 10 W

TMOS Power MOSFETs

Selection By Package
Metal Packages
TO-204



TO-204 (Formerly TO-3)
CASE 1-04 and CASE 1-05

P-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
500	6	1	MTM2P50	2	75
450			MTM2P45		
250	4	1.5	MTM3P25	3	
	3	2.5	MTM5P25	5	
	2	4	MTM8P25	8	
200	1	2.5	MTM5P20	5	
	0.7	4	MTM8P20	8	125
180	1	2.5	MTM5P18	5	75
	0.7	4	MTM8P18	8	125
100	0.4		MTM8P10		75
	0.3	6	MTM12P10	12	
	0.15	10	MTM20P10	20	125
80	0.4	4	MTM8P08	8	75
	0.3	6	MTM12P08	12	
	0.15	10	MTM20P08	20	125
60	0.3	6	MTM12P06	12	75
	0.14	12.5	MTM25P06	25	125
50	0.3	6	MTM12P05	12	75
	0.2	10	MTM20P05	20	100
	0.14	12.5	MTM25P05	25	125

* @ 25°C

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
1000	10	0.5	MTM1N100	1	75
	4	1.5	MTM3N100	3	125
	3	2.5	MTM5N100	5	150
950	10	0.5	MTM1N95	1	75
	4	1.5	MTM3N95	3	125
	3	2.5	MTM5N95	5	150
900	8	1	MTM2N90	2	75
	4	2	MTM4N90	4	125
	3	3	MTM6N90	6	150
850	8	1	MTM2N85	2	75
	4	2	MTM4N85	4	125
	3	3	MTM6N85	6	150
800	7	1.5	MTM3N80	3	75
	2	3	BUZ84	5.3	125
	1.5		BUZ84A	6	
750	7	1.5	MTM3N75	3	75
600	2.8	3	2N6823		
	2.5	1.5	MTM3N60		
	1.6	6	2N6826	6	150
	1.2	3	MTM6N60		
	0.5	4	MTM8N60	8	

* @ 25°C

Shaded device types are key industry standard devices recommended for new designs.

TMOS POWER MOSFETs — METAL PACKAGES (continued)

TO-204 (continued)

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
500	4	1	MTM2N50	2	75
	1.5	2	MTM4N50	4	
		3	2N6762**	4.5	
	0.85	4	IRF440	8	125
	0.8	3.5	MTM7N50	7	150
	0.5	7	IRF452	12	
	0.4		IRF450	13	
		7.75	2N6770**	12	
		7.5	MTM15N50	15	250
450	1.5	2	MTM4N45	4	75
	0.85	4	IRF441	8	125
	0.8	3.5	MTM7N45	7	150
	0.4	7	IRF451	13	
		7.5	MTM15N45	15	250
400	1	3	IRF330	5.5	75
		2.5	MTM5N40	5	
		3.5	2N6760**	5.5	
	0.55	5	IRF340	10	125
		4	MTM8N40	8	150
	0.3	8	IRF350	15	
		9	2N6768**	14	
		7.5	MTM15N40	15	250
350	1.5	3	IRF333	4.5	75
			2N6759		
	1		IRF331	5.5	
		2.5	MTM5N35	5	
	0.3	8	IRF351	15	150
		7.5	MTM15N35		250
250	0.45	5	MTM10N25	10	100
200	0.4		IRF230	9	75
			2N6758**		
		4	MTM8N20	8	
	0.18	10	IRF240	18	125
	0.16	7.5	MTM15N20	15	150

* @ 25°C **Available at JTX and JTXV levels

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
200	0.12	16	IRF252	25	150
	0.085		IRF250	30	
		19	2N6766**		
	0.08	20	MTM40N20	40	250
150	0.22	10	IRF243	16	125
	0.18	16	IRF241	18	
	0.12	10	MTM20N15	20	150
		16	IRF253	25	
	0.085		IRF251	30	
	0.06	22.5	MTM45N15	45	250
100	0.18	8	IRF130	14	75
		6	MTM12N10	12	
		9	2N6756**	14	
	0.15	10	MTM20N10	20	100
	0.11	15	IRF142	24	125
	0.085		IRF140	27	
	0.08	20	IRF152	33	150
	0.075	12.5	MTM25N10E†	25	
	0.07		MTM25N10		
	0.055	20	IRF150	40	
		24	2N6764	38	
	0.04	27.5	MTM55N10	55	250
80			MTM55N08		
60	0.15	7.5	MTM15N06E†	15	75
	0.085	15	IRF141	27	125
	0.055	17.5	MTM35N06	35	150
			MTM35N06E†		
		20	IRF151	40	
	0.028	30	MTM60N06	60	250
50	0.2	6	MTM12N05	12	75
	0.055	17.5	MTM35N05	35	150
	0.035	29	MTM45N05E†	45	125
	0.028	30	MTM60N05	60	250
		25	MTM50N05E†	50	125

† Indicates E-FET device, with avalanche energy specified.

Shaded device types are key industry standard devices recommended for new designs.

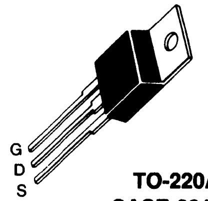
TMOS Power MOSFETs

Plastic Packages

TO-220

P-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
500	6	1	MTP2P50	2	75
450			MTP2P45		
250	4	1.5	MTP3P25	3	
	3	2.5	MTP5P25	5	
	2	4	MTP8P25	8	
200	0.5	6	IRF9640	11	125
	0.8	3.5	IRF9630	6.5	75
	1	2.5	MTP5P20	5	
180			MTP5P18		
100	0.4	4	MTP8P10	8	



TO-220AB
CASE 221A-04

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
100	0.3	6	MTP12P10	12	75
80	0.4	4	MTP8P08	8	
	0.3	6	MTP12P08	12	
60	0.6	3.5	MTP7P06	7	
	0.3	6	MTP2955	12	
			MTP12P06		
	0.2	10	MTP20P06	20	100
50	0.6	3.5	MTP7P05	7	75
	0.3	6	MTP12P05	12	

* @ 25°C

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
1000	10	0.5	MTP1N100	1	75
	4	1.5	MTP3N100	3	
950	10	0.5	MTP1N95	1	
	4	1.5	MTP3N95	3	
900	8	1	MTP2N90	2	
	4	2	MTP4N90	4	
850	8	1	MTP2N85	2	
	4	2	MTP4N85	4	
800	7	1.5	MTP3N80	3	
	3	1.7	BUZ80A		
750	7	1.5	MTP3N75		
600	12	0.5	MTP1N60	1	
	6	1	MTP2N60	2	
	2.5	1.5	MTP3N60	3	
	2	2.5	BUZ90	4	
	1.2	3	MTP6N60	6	125
550	12	0.5	MTP1N55	1	75
	6	1	MTP2N55	2	
	2.5	1.5	MTP3N55	3	
	1.2	3	MTP6N55	6	125
500	8	0.5	MTP1N50	1	50
	4	1	MTP2N50	2	75

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
500	3	1.5	IRF820	2.5	40
			MTP3N50	3	75
	2		IRF832	4	
	1.5		IRF830	4.5	
			MTP4N50	4	
	1.1	4	IRF842	7	125
	0.85		IRF840	8	
	0.8		MTP8N50		
450	8	0.5	MTP1N45	1	50
	4	1	MTP2N45	2	75
			IRF823		40
	3		IRF821	2.5	
		1.5	MTP3N45	3	75
	2	2.5	IRF833	4	
	1.5	2	MTP4N45		
		2.5	IRF831	4.5	
	1.1	4	IRF843	7	125
	0.85		IRF841	8	
	0.8		MTP8N45		
400	5	1	MTP2N40	2	50
	3.6	0.8	IRF710	1.5	20

* @ 25°C

Shaded device types are key industry standard devices recommended for new designs.

TMOS POWER MOSFETs — PLASTIC PACKAGES (continued)

TO-220AB (continued)

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
400	3.3	1.5	MTP3N40	3	75
	2.5		IRF722	2.5	40
	1.8		IRF720	3	
	1.5	3	IRF732	4.5	75
	1		IRF730		
		2.5	MTP5N40	5	
	0.55	5	IRF740	10	125
			MTP10N40		
350	5	1	MTP2N35	2	50
	1.5	3	IRF733	4.5	75
	1		IRF731	5.5	
		2.5	MTP5N35	5	
	0.55	5	IRF741	10	125
			MTP10N35		
250	2	1	MTP2N25	2	50
	0.45	5	MTP10N25	10	100
200	2.4	1.25	IRF612	2	20
	1.8	1	MTP2N20		50
	1.5	1.25	IRF610	2.5	20
	1	2.5	MTP5N20	5	75
	0.8		IRF620		40
	0.7	3.5	MTP7N20	7	75
	0.6	5	IRF632	8	
	0.4		IRF630	9	
		4	MTP8N20	8	
	0.35	6	MTP12N20	12	100
	0.22	10	IRF642	16	125
	0.18		IRF640	18	
150	0.8	2.5	IRF621	4	40
	0.4	5	IRF631	9	75
	0.3		MTP10N15	10	
	0.25	7.5	MTP15N15	15	100
	0.22	10	IRF643	16	125
	0.18		IRF641	18	
120	0.3	5	MTP10N12	10	75
	0.9	2.5	MTP5N12	5	50

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
100	0.8	3	MTP6N10	6	50
		2	IRF512	3.5	20
	0.6		IRF510	4	
	0.5	4	MTP8N10	8	75
			MTP8N10E†		
	0.4		IRF522	7	40
	0.33	5	MTP10N10	10	75
	0.3	4	IRF520	8	40
	0.25	5	MTP10N10E†	10	75
		8	IRF532	12	
	0.18		IRF530	14	
		6	MTP12N10	12	
	0.15	10	MTP20N10	20	100
			MTP20N10E†		
	0.11	15	IRF542	24	
	0.085		IRF540	27	
		12.5	MTP25N10	25	
	0.075		MTP25N10E†		125
80	0.8	2	MTP4N08	4	50
	0.5	4	MTP8N08	8	75
	0.33	5	MTP10N08	10	
	0.18	6	MTP12N08	12	
	0.15	10	MTP20N08	20	100
60	0.8	2	IRF513	3.5	20
	0.6		IRF511	4	
		2.5	MTP5N06	5	50
	0.4	3.5	MTP7N06	7	
		4	IRF523		40
	0.3		IRF521	8	
	0.28	5	MTP10N06	10	75
	0.25	8	IRF533	12	
	0.2	5	MTP10N06E†	10	
		6	MTP12N06	12	
	0.18	8	IRF531	14	
	0.16	7.5	MTP15N06	15	
	0.15	6	MTP3055E†	12	40
		7.5	MTP15N06E†	15	75

Shaded device types are key industry standard devices recommended for new designs.

* @ 25°C † Indicates E-FET devices with avalanche energy specified.

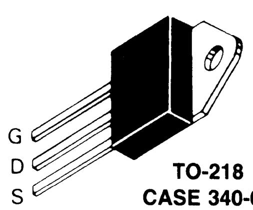
TO-220AB (continued)

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
60	0.085	15	IRF541	27	125
	0.08	12.5	MTP25N06	25	100
			MTP25N06E†		125
	0.055	17.5	MTP35N06E†	35	
50	0.6	2.5	MTP5N05	5	50
	0.28	5	MTP10N05	10	75
	0.16	7.5	MTP15N05	15	
	0.12	6	BUZ71A	12	40
			MTP12N05E†		
			IRFZ22	14	
	0.1		BUZ71	12	
		7.5	MTP15N05E†	15	
			IRFZ20		

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
50	0.1	7	MTP14N05A	14	40
	0.08	12.5	MTP25N05	25	100
	0.07		MTP25N05E†		75
			IRFZ32		
	0.06	15	BUZ11A		
	0.05		MTP30N05E†	30	
			IRFZ30		
	0.04		BUZ11		
	0.035	29	MTP45N05E†	45	125
			IRFZ42	46	
	0.028	25	MTP50N05E†	50	
			IRFZ40	51	

* @ 25°C
† Indicates E-FET devices with avalanche energy specified.



TO-218
CASE 340-01

TO-218

P-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
200	0.7	4	MTH8P20	8	125
180			MTH8P18		
100	0.15	10	MTH20P10	20	
80			MTH20P08		
60	0.14	12.5	MTH25P06	25	
50			MTH25P05		

* @ 25°C

N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
1000	3	2.5	MTH5N100	5	150
	2	3	MTH6N100	6	
950	3	2.5	MTH5N95	5	
900	1.8	4	MTH8N90	8	170
900	3	3	MTH6N90	6	150
850			MTH6N85		
800	1.5	3.8	BUZ355		125
600	1.2	3	MTH6N60		150
	0.5	4	MTH8N60	8	
550	1.2	3	MTH6N55	6	
	0.5	4	MTH8N55	8	
500	0.8	3.5	MTH7N50	7	
	0.6	6	BUZ330	9.5	125
	0.4	7	MTH13N50	13	150
450	0.8	3.5	MTH7N45	7	
	0.4	7	MTH13N45	13	
400	0.55	4	MTH8N40	8	
	0.3	7.5	MTH15N40	15	

* @ 25°C

Shaded device types are key industry standard devices recommended for new designs.

TMOS POWER MOSFETs — PLASTIC PACKAGES (continued)

TO-218 (continued)

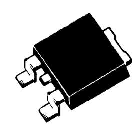
N-Channel Transistors

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
350	0.55	4	MTH8N35	8	150
	0.3	7.5	MTH15N35	15	
250	0.14	15	MTH30N25	20	125
200	0.16	7.5	MTH15N20	15	150
	0.08	15	MTH30N20	30	
150	0.12	10	MTH20N15	20	
	0.06	17.5	MTH35N15	35	
100	0.07	12.5	MTH25N10	25	
	0.04	20	MTH40N10	40	

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
80	0.07	12.5	MTH25N08	25	150
	0.04	20	MTH40N08	40	125
60	0.055	17.5	MTH35N06	35	150
			MTH35N06E		
	0.028	20	MTH40N06	40	
50	0.055	17.5	MTH35N05	35	
	0.028	20	MTH40N05	40	
		25	MTH50N05E	50	125

Shaded device types are key industry standard devices recommended for new designs.

DPAK — Case 369A, Surface Mount



CASE 369A-04
TO-252

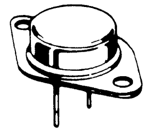
All N-Channel except † = P-Channel

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
500	4	1	MTD2N50	2	20
400	5	0.5	MTD1N40	1	
200	0.7	2	MTD4N20	4	
	1.5	1	MTD2N20	2	
150	0.3	3	MTD6N15	6	
100	0.25		MTD6N10		
80			MTD6N08		

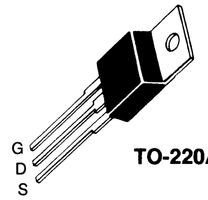
$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max	@ I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
60	0.6	2	MTD4P06†	4	1.75
	0.4	2.5	MTD5N06	5	
	0.3	6	MTD2955	12	
	0.18		MTD3055EL		
	0.15	4	MTD3055E	8	
50	0.6	2	MTD4P05†	4	
	0.4	2.5	MTD5N05	5	
	0.1	5	MTD10N05E	10	

* @ 25°C — When mounted on board with minimum pad size recommended.

Logic Level MOSFETs



TO-204AA
(TO-3)

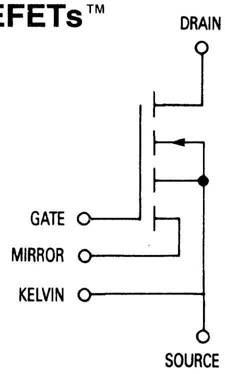


TO-220AB

N-Channel Logic Level Power MOSFETs (TO-204AA and TO-220AB)

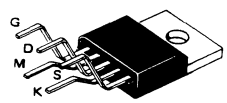
$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max @	I_D (Amps)	Device	$I_{D(cont)}$ Amps	P_D @ T_C = 25°C Watts	Package TO-
150	0.3	5	MTM10N15L	10	75	204AA
			MTP10N15L			220AB
	0.45	4	MTP8N15L	8		
120	0.3	5	MTM10N12L	10		204AA
			MTP10N12L			220AB
100	0.2	6	MTM12N10L	12		204AA
			MTP12N10L			220AB
	1.25	2	MTP3N10L	3		
80	0.135	7.5	MTP15N08L	15		
	0.2	6	MTM12N08L	12		204AA
	0.18	6	MTP12N08L			220AB
	1.25	2	MTP3N08L	3		
60	0.08	12.5	MTM25N06L	25	100	204AA
			MTP25N06L			220AB
	0.15	7.5	MTM15N06L	15	75	204AA
			MTP15N06L			220AB
	0.18	6	MTP3055EL	12	40	
	0.6	2	MTP4N06L	4	25	
50	0.08	12.5	MTM25N05L	25	100	204AA
			MTP25N05L			220AB
	0.15	7.5	MTM15N05L	15	75	204AA
			MTP15N05L			220AB
	0.6	2	MTP4N05L	4	25	

TMOS SENSEFETs™



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. All are N-Channel devices.

CASE 314B
(5 PIN TO-220)



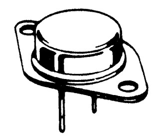
Case 314B

$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ @ (Ohms) Max	I_D (Amps)	Device	I_D (Amps) Max	P_D* (Watts) Max
60	0.04	20	MTP40N06M	40	125
80	0.065	15	MTP30N08M	30	
100	0.25	5	MTP10N10M	10	75
	0.085	12.5	MTP25N10M**	25	125
250	1.5	4	MTP4N25M**	4	75
	0.45	2	MTP10N25M**	10	100
500	1.5	2.5	MTP4N45M**	5	75
	0.85	4	MTP8N50M**	8	125

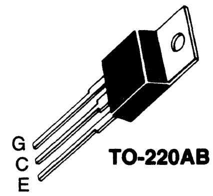
* @ 25°C
** Indicates devices planned for future introductions.

Insulated Gate Bipolar Transistors (IGBTs)

This relatively new series of insulated gate bipolar transistors combines the high input resistance of a MOSFET with the low internal on-resistance of a bipolar transistor to provide more efficient performance than either a MOSFET or bipolar device in low-frequency switching service. Recommended for motor drive circuits, home appliances, and other applications where high switching speed is not a requirement. All are all N-Channel.



TO-204AA (TO-3)



TO-220AB

TO-204AA

$V_{(BR)CES}$ (Volts) Min	$r_{CE(on)}$ (Ohms) Max	@ I_C (Amps)	Device	I_C (Amps) Max	P_D* (Watts) Max
500	0.27	10	MGM20N50	20	100
	1.6	2.5	MGM5N50	5	50
450	0.27	10	MGM20N45	20	100
	1.6	2.5	MGM5N45	5	50

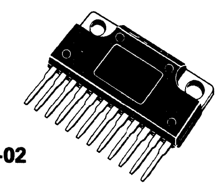
* @ 25°C

TO-220AB

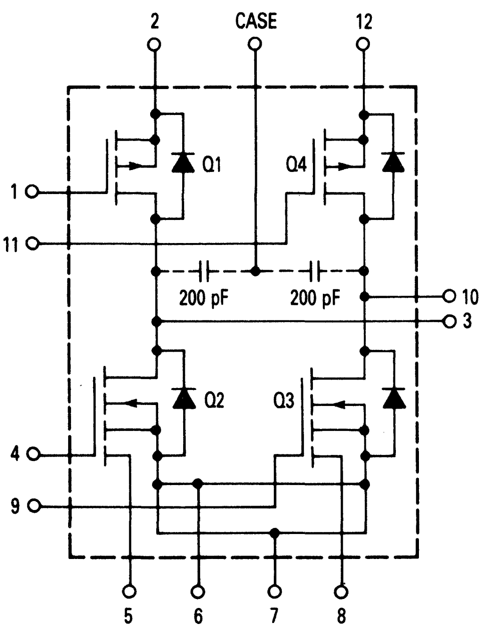
$V_{(BR)CES}$ (Volts) Min	$r_{CE(on)}$ (Ohms) Max	@ I_C (Amps)	Device	I_C (Amps) Max	P_D* (Watts) Max
500	0.27	10	MGP20N50	20	100
	1.6	2.5	MGP5N50	5	50
450	0.27	10	MGP20N45	20	100
	1.6	2.5	MGP5N45	5	50

* @ 25°C

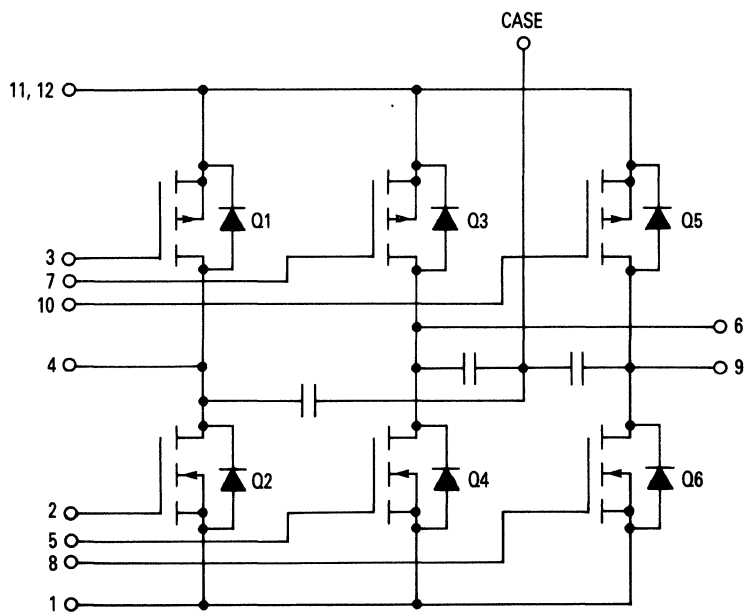
Multiple Chip Products in the ICePAK™



CASE 806-02



MPM3002
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



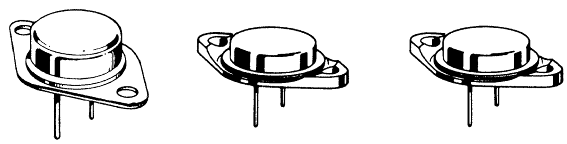
MPM3003
Three-Phase Bridge with Complementary Outputs
60 Volts and 10 Amperes
N-Channel — $r_{DS(on)}$ = 0.15 Ohms Max
P-Channel — $r_{DS(on)}$ = 0.28 Ohms Max

Bipolar Power Transistors

Selection By Package

Selection By Package
Metal Packages

CASE 1-04, 1-06 — 40 mil pins (TO-204AA)
CASE 11-01, 11-03 — 40 mil pins (TO-204AA)
CASE 197-01 — 60 mil pins (TO-204AE TYPE)



TO-204AA/AE

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		
2.5	800	MJ8501		7.5 min	0.5	4	2	1		125
	1500*	BU205		2 min		2	0.75 typ	2	4 typ	36
		MJ12002		1.11 min	2		1	2	4 typ	75
3.5	325	2N3902		30/90	1	1.2 typ	0.1 typ	1	2.8	100
4	1500*	MJ12003		2.5 min	3		1	3		100
5	200	MJ410		30/90	1				2.5	100
	250	MJ3029		30 min	0.4		1	3		125
	300	MJ411		30/90	1				2.5	100
	400	2N6543		7/35	3	4	0.8	3	6	100
		MJ13070		8 min	3	1.5	0.5	3		125
	450	MJ16002		5 min	5	3	0.3	3		125
		MJ16004		7 min	5	2.7	0.35	3		125
		2N6834		10/30	3	2.7	0.35	3	15	125
	500	MJ16002A		5 min	5	3	0.3	3		125
	700	MJ8502		7.5 min	1	4	2	2.5		150
	800	MJ8503		7.5 min	1	4	2	2.5		150
	850*	MJ12020		5 min	5		0.13 typ	3	15	125
	1500*	BU208		2.25 min	4.5		0.6 typ	4.5	4 typ	60
		BU208A		2.25 min	4.5	8 typ	0.4 typ	4.5	4 typ	90
		BU208D†		2.25 min	4.5		0.6 typ	4.5	4 typ	60
		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
	120	2N5759		20/80	3	0.7 typ	0.5 typ	3	1	150
	140	2N5760		15/60	3	0.7 typ	0.5 typ	3	1	150

$|h_{fe}|$ @ 1 MHz, ## Darlington
* $V_{(BR)CEX}$ or $V_{(BR)CES}$
† D Suffix on this device signifies internal C-E Diode

(continued)

BIPOLAR POWER TRANSISTORS — METAL PACKAGES (continued)

TO-204AA/AE (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		
6	375	BU326		30 typ	0.6	3.5	1**	2.5	6	90
	400	BU326A		30 typ	0.6	3.5	1**	2.5	6	90
7	300	MJ3041##		250 min	2.5					175
	350	MJ3042##		250 min	2.5					175
7.5	80	2N3448		40/120	5	2	0.35	5	10	115
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
	250	2N6306		15/75	3	1.6	0.4	3	5	125
	300	2N6307		15/75	3	1.6	0.4	3	5	125
	350	2N6308		12/60	3	1.6	0.4	5	5	125
	400	2N6545		7/35	5	4	1	5	6	125
			MJ6503	15 min	2	2	0.5	4		125
		MJ13080		8 min	5	1.5	0.5	5		150
	450	MJ16006		5 min	8	2.5	0.25	5		150
		MJ16008		7 min	8	2.2	0.25	5		150
		2N6835		10/30	5	2.5	0.25	5	10	150
	500	MJ16006A		5 min	8	3	0.4	5		150
	850*	MJ12021		5 min	8		0.1 typ	5		150
	1400*	MJ10011##		20 min	4		1	4		80
	1500*	MJ12005		5 min	5		1	5		100
9	400	BUX47		7 min	6	2	0.4	6		150
	450	BUX47A		7 min	5	2	0.4	5		150
10	40	2N6383##	2N6648##	1k/20k	5				20#	100
	60	BD311	BD312	25 min	5				4	115
			2N3789	15 min	3	0.3 typ	0.4 typ	5	4	150
		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
		2N6384##		1k/20k	5				20#	100
		MJ3000##	MJ2500##	1k min	5					150
	80	2N3714	2N3790	15 min	3	0.3 typ	0.4 typ	5	4	150
		2N3716	2N3792	30 min	3	0.3 typ	0.4 typ	5	4	150
		2N5878	2N5876	20/100	4	1	0.8	4	4	150
		2N6385##		1k/20k	5				20#	100
		MJ3001##	MJ2501##	1k min	5					150
	140	2N5634		15/60	5	0.9 typ	0.9 typ	5	1	150
		2N3442		20/70	4					117

* $V_{(BR)CEX}$, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

JAN, JTX, JTXV Available

TO-204AA/AE (continued)

I_C Cont 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
10	250	MJ15011	MJ15012	20/100	2					200
	325	BUX43		8 min	5	2.2	0.9	5	8	120
		MJ413		20/80	0.5				2.5	125
		MJ423		30/90	1				2.5	125
		MJ431		15/35	2.5				2.5	125
	350	BU323##		150 min	6	7.5 typ	5.2 typ	6		175
		MJ13014		8/20	5	2	0.5	5		150
		MJ10002##		3/300	5	2.5	1	5	10#	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
	700	MJ8504		7.5 min	1.5	4	2	5		175
	800	MJ8505		7.5 min	1.5	4	2	5		175
		MJ16018		4 min	5	4.5 typ	0.2 typ	5		150
	950*	MJ12010		4.2 min	5		1	5		100
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##	2N6052##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	250	BUX42		8 min	6	2	0.4	6	8	120
15	60	2N3055	MJ2955	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	2N5880	20/100	6	1	0.8	6	4	160
	90	2N6577##		2k/20k	4	2	7	10	10-200#	120
	120	MJ15015	MJ15016	20/70	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
		2N6249		10/50	10	3.5	1	10	2.5	175
		MJ11020##	MJ11019##	100 min	15				3#	175
	250	MJ11022##	MJ11021##	100 min	15				3#	175
	275	2N6250		8/50	10	3.5	1	10	2.5	175
	300	2N6546		6/30	10	4	0.7	10	6 to 24	175
	325	BUX13		8 min	8	2.5	0.8	8	8	150
	400	BUX48		8 min	10	2	0.4	10		175
		2N6547		6/30	10	4	0.7	10	6 to 24	175
		MJ13090		8 min	10	2.5	0.5	10		175
	450	BUX48A		8 min	8	2	0.4	10		175
		MJ16010		5 min	15	1.2 typ	0.2 typ	10		175

* $V_{(BR)CEX}$, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

JAN, JTX, JTXV Available

TO-204AA/AE (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		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
	850*	MJ12022		5 min	15		0.1 typ	10		175
16	80	BD315	BD316	25 min	5				1	200
	100	BD317	BD318	25 min	5				1	200
		2N5629	2N6029	25/100	8	1.2 typ	1.2 typ	8	1	200
	120	2N5630	2N6030	20/80	8	1.2 typ	1.2 typ	8	1	200
	140	2N3773	2N6609	15/60	8	1.1 typ	1.5 typ	8	4	150
		2N5631	2N6031	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		20/100	12	1.5	0.5	12	60	140
	100	2N6284##	2N6287##	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	MJ15004	25/150	5				2	250
	160	BUV11N		10 min	15	1.2	0.25	15	8	150
	200	BUV11		10 min	12	1.8	0.4	12	8	150
		MJ13330		8/40	10	3.5	0.7	10	5 to 40	175
	250	BUV12		10 min	10	1.5	0.5	10	8	150
		MJ13331		8/40	10	3.5	0.7	10	5 to 40	175
	350	MJ10000##		40/400	10	3	1.8	10	10#	175
		MJ10004##		40/400	10	1.5	0.5	10	10#	175
	400	BUV24		8 min	12	3	0.9	12	8	250
		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
	700	BUT15##		15 min	12	2.5	0.8	12		175
	750	MJ10024##		50/600	20	5	1.8	10		250
	850	MJ10025##		50/600	20	5	1.8	10		250

* $V_{(BR)CEX}$, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

JAN, JTX, JTXV Available

TO-204AA/AE (continued)

I_C Cont 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
24	1000	BUT36##		5 min	16	6	2.5	16		250
25	60	2N5885	2N5883	20/100	10	1	0.8	10	4	200
	80	2N5886	2N5884	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	2N6438	30/120	10	1	0.25	10	40	200
	125	BUV10		10 min	20	1.2	0.25	20	8	150
		BUV10N		10 min	20	1.55	0.45	15	10	175
	140	2N6340		30/120	10	1	0.25	10	40	200
	150	2N6341		30/120	10	1	0.25	10	40	200
	500	BUT14##		15 min	16	2.8	0.8	16		175
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##	MJ11015##	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
40	160	BUV21N•		10 min	40	1	0.2	40	8	250
	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	120	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•	2N5684•	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
	150	2N6277•		30/120	20	0.8	0.25	20	30	250

JAN, JTX, JTXV Available

• Modified TO-3, 60 mil pins, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

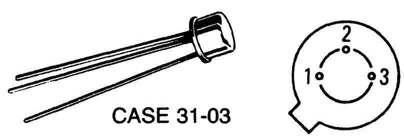
BIPOLAR POWER TRANSISTORS — METAL PACKAGES (continued)

TO-204AA/AE (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		
50	200	BUS51●		15 min	50					350
	400	MJ10015●##		10 min	40	2.5	1	20		250
	500	BUT34●## MJ10016●##		15 min 10 min	32 40	3 2.5	1.5 1	32 20		250 250
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●##		75 min	15	3.5	0.5	30		250
70	125	BUS50●		15 min	50					350

● Modified TO-3, 60 mil pins, # $|h_{fe}|$ @ 1 MHz, ## Darlington

TO-205AA (Formerly TO-5)



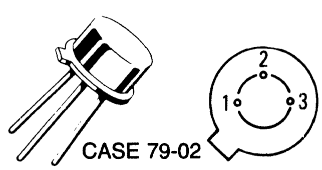
CASE 31-03

PIN 1. EMITTER
2. BASE
3. COLLECTOR

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		
3	40		2N3719 2N3867	25/180 40/200	1 1.5	0.4* 0.4*		1 1.5	60 60	6 6
	60		2N3720 2N3868	25/180 30/150	1 1.5	0.4* 0.4*		1 1.5	60 60	6 6
	80		2N6303	30/150	1.5	0.4*		1.5	60	6

*t_{off}

TO-205AD (Formerly TO-39)



CASE 79-02

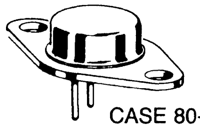
PIN 1. EMITTER
2. BASE
3. COLLECTOR
(Pin 3 connected to case)

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		
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
4	60	2N4877		20/100	4	1.5	0.5	4	4	10
5	80	2N5336 2N5337	2N6190 2N6191	30/120 60/240	2 2	2 2	0.2 0.2	2 2	30 30	6 6
	100	2N5338 2N5339	 2N6193	30/120 60/240	2 2	2 2	0.2 0.2	2 2	30 30	10 6

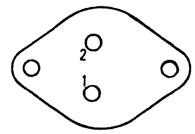
*t_{off}

(shaded box) JAN, JTX, JTXV Available

TO-213AA (Formerly TO-66)



CASE 80-02



PIN 1. BASE
2. EMITTER
CASE. COLLECTOR

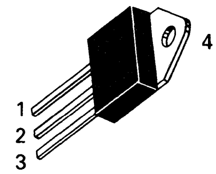
I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s μs Max	t_f μs Max	@ I_C Amp		
1	40		2N4898	20/100	0.5	0.6 typ	0.3 typ	0.5	3	25
	60		2N4899	20/100	0.5	0.6 typ	0.3 typ	0.5	3	25
	80	2N4912	2N4900	20/100	0.5	0.6 typ	0.3 typ	0.5	3	25
	175	2N3583	2N6420	40/200	0.5	2 typ	0.23 typ	0.5	10	35
	225	2N3738		40/200	0.1	3 typ	0.3 typ	0.1	10	20
	250		2N5344	25/100	0.5	0.6	0.1	0.5	60	40
	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	2N6422	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	2N6049	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##	2N6297##	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
	275	2N6233		25/125	1	3.5	0.5	1	20	50
	325	2N6235		25/125	1	3.5	0.5	1	20	50
7	60	2N6315	2N6317	20/100	2.5	1	0.8	2.5	4	90
	80	2N5428		60/240	2	2	0.2	2	30	40
		2N6316	2N6318	20/100	2.5	1	0.8	2.5	4	90
	100	2N5429		30/120	2	2	0.2	2	30	40
		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##	2N6299##	750/18k	4	1.5 typ	1.5 typ	4	4#	75
10	80	2N6495		10/60	10	0.15 typ	0.05 typ	10	25	70

$|h_{fe}|$ @ 1 MHz, ## Darlington

JAN, JTX, JTXV Available

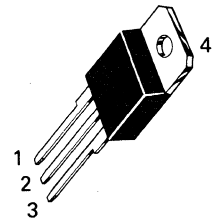
Bipolar Power Transistors

Plastic Packages
TO-218AC



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)

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
3	750	MJH16032		4 min	3	2	1.5	2		125
	850	MJH16034		4 min	3	2	1.5	2		125
5	400	BUW11		6 min	3	4	0.8	3		125
	450	BUW11A		6 min	2.5	4	0.8	2.5		125
		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
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	400	BUW12		6 min	6	4	0.8	5		125
	450	BUW12A		6 min	5	4	0.8	5		125
		MJH16006		5 min	8	2.5	0.25	5		125
		MJH16008		7 min	8	2.2	0.25	5		125
	500	BUT50P##†		30 min	2	0.75 typ	0.1 typ	5		100
		MJH16006A		5 min	8	2.5	0.25	5		125
	700	BU508,A		2.25 min	4.5	8 typ	0.5 typ	4.5	7	125
		BU508D,AD		2.25 min	4.5	8 typ	0.5 typ	4.5	7	125
	750	MJH12005					0.4 typ	5	4	100
9	400	BUV47†		7 min	5	2	0.4	6		128
	450	BUV47A†		7 min	6	2	0.4	6		128
10	40	TIP33	TIP34	20 min	3				3	80
	60	BDV65##†	BDV64##†	1k min	5					125
		TIP33A	TIP34A	20 min	3				3	80
		TIP140##	TIP145##	500 min	10	2.5 typ	2.5 typ	5	4#	125
	80	BDV65A##†	BDV64A##†	1k min	5					125
		TIP33B	TIP34B	20 min	3				3	80
		TIP141##	TIP146##	500 min	10	2.5 typ	2.5 typ	5	4#	125
	100	BDV65B##†	BDV64B##†	1k min	5					125
		TIP33C	TIP34C	20 min	3				3	80
		TIP142##	TIP147##	500 min	10	2.5 typ	2.5 typ	5	4#	125
	120	BDV65C##†	BDV64C##†	1k min	5					125
	200	BU323P##†		150 min	6	15	15	6		125
	250	BU323AP##†		150 min	6	15	15	6		125
	400	MJH10012##		100/2k	6	15	15	6		118
	800	MJH16018		4 min	5	4.5 typ	0.2 typ	5		150
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

$|h_{fe}|$ @ 1 MHz, ## Darlington
* $V_{(BR)CEX}$ or $V_{(BR)CES}$
† These devices supplied in Case 340D-01. Consult Motorola for details.

(continued)

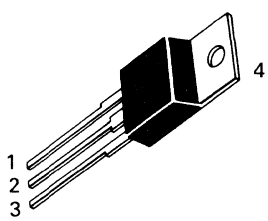
PLASTIC TO-218 (continued)

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	BUV48†		8 min	10	2	0.4	10		150
		MJH13090		8 min	10	2.5	0.5	10		125
	450	BUV48A†		8 min	8	2	0.4	10		150
		MJH16010		5 min	15	1.2	0.2	10		150
		MJH16012		7 min	15	0.9	0.15	10		150
	500	BUT51P##†		40 min	5	1.1	0.16	10		125
		MJH16010A		5 min	15	3	0.4	10		150
16	100	MJE4340	MJE4350	15 min	8	1.2 typ	1.2 typ	8	1	125
	120	MJE4341	MJE4351	15 min	8	1.2 typ	1.2 typ	8	1	125
	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	40	TIP35	TIP36	10/75	15	0.6 typ	0.3 typ	10	3	125
	45	BD249†	BD250†	10 min	15				3	125
	60	BD249A†	BD250A†	10 min	15				3	125
		TIP35A	TIP36A	10/75	15	0.6 typ	0.3 typ	10	3	125
	80	BD249B†	BD250B†	10 min	15				3	125
		TIP35B	TIP36B	10/75	15	0.6 typ	0.3 typ	10	3	125
	100	BD249C†	BD250C†	10 min	15				3	125
		TIP35C	TIP36C	10/75	15	0.6 typ	0.3 typ	10	3	125

$|h_{fe}|$ @ 1 MHz, ## Darlington
† These devices supplied in Case 340D-01. Consult Motorola for details.

PLASTIC TO-220

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR



CASE 221A-04 (TO-220AB)

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
0.5	350	MJE2360T		15 min	0.1				10 typ	30
		MJE2361T		40 min	0.1				10 typ	30
1	40	TIP29	TIP30	15/75	1	0.6 typ	0.3 typ	1	3	30
	60	TIP29A	TIP30A	15/75	1	0.6 typ	0.3 typ	1	3	30
	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		30/150	0.3	2 typ	0.18 typ	0.3	10	40
	350	TIP49		30/150	0.3	2 typ	0.18 typ	0.3	10	40
	400	TIP50		30/150	0.3	2 typ	0.18 typ	0.3	10	40

BIPOLAR POWER TRANSISTORS — PLASTIC PACKAGES (continued)
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	45	BD239	BD240	15 min	1				3	30
	60	BD239A	BD240A	15 min	1				3	30
		TIP110##	TIP115##	500 min	2	1.7 typ	1.3 typ	2	25#	50
	80	BD239B	BD240B	15 min	1				3	30
		TIP111##	TIP116##	500 min	2	1.7 typ	1.3 typ	2	25#	50
	100	BD239C	BD240C	25 min	1				3	30
		TIP112##	TIP117##	500 min	2	1.7 typ	1.3 typ	2	25#	50
	400	BUX84		30 min	0.1	3.5	1.4	1	4	50
	450	BUX85		30 min	0.1	3.5	1.4	1	4	50
	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		1.1 min	2		1	2	4 typ	65
	800	MJE8501		7.5 min	0.5	4	2	1		65
3	40	TIP31	TIP32	25 min	1	0.6 typ	0.3 typ	1	3	40
	45	BD241	BD242	25 min	1				3	40
	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	TIP32C	25 min	1	0.6 typ	0.3 typ	1	3	40
	750	MJE16032		4 min	3	2	1.5	2		80
	850	MJE16034		4 min	3	2	1.5	2		80
4	45	2N6121	2N6124	25/100	1.5	0.4 typ	0.3 typ	1.5	2.5	40
		BD533	BD534	25 min	2				3	50
	60	2N6122	2N6125	25/100	1.5	0.4 typ	0.3 typ	1.5	2.5	40
		BD535	BD536	25 min	2				3	50
		MJE800T##	MJE700T##	750 min	1.5				1#	40
	80	2N6123		20/80	1.5	0.4 typ	0.3 typ	1.5	2.5	40
		BD537	BD538	15 min	2				3	50
	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##	TIP127##	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	MJE13070		8 min	3	1.5	0.5	3		80
	450	BUS46P		7 min	3	1.5	0.5	2		75
		MJE16002		5 min	5	3	0.3	3		80
		MJE16004		7 min	5	2.7	0.35	3		80
	700	MJE8502		7.5 min	1	4	2	2.5		80
	800	MJE8503		7.5 min	1	4	2	2.5		80
6	40	TIP41	TIP42	15/75	3	0.4 typ	0.15 typ	3	3	65
	45	BD243	BD244	15 min	3				3	65
	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
7	30	2N6288	2N6111	30/150	3	0.4 typ	0.15 typ	3	4	40

$|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

PLASTIC TO-220 (continued)

I_C Cont 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	45	BD795	BD796	25 min	3				3	65
	50	2N6290	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	3	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	40	2N6386##		1k/20k	3				20#	65
	45	BDX53##	BDX54##	750 min	3				4#	60
		BD895##	BD896##	750 min	3				1#	70
		BD895A##	BD896A##	750 min	4				1#	70
	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				4#	60
		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	MJE15031	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
	300	MJE13006		5/30	5	3	0.7	5	4	80
		MJE5740##		200 min	4	8 typ	2 typ	6		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	MJE5742##		200 min	4	8 typ	2 typ	6		80
		MJE13007		5/30	5	3	0.7	5	4	80
			MJE5852	15 min	2	2	0.5	4		80
		MJE16080		5 min	8	2	0.5	5		80
	450	MJE16081		5 min	8	2	0.5	5		80
10	30		D45H1	20 min	4					50
			D45H2	40 min	4					50
	40	D44E1##		1000 min	5	2 typ	0.5 typ	10		50
	45	BDX33##	BDX34##	750 min	4				3	70
		BD805	BD806	15 min	4				1.5	90
			D45H4	20 min	4					50
		D44H5	D45H5	40 min	4					50
	60	BDX33A##	BDX34A##	750 min	4				3	70
		BD807	BD808	15 min	4				1.5	90

$|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

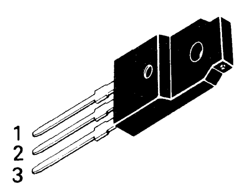
BIPOLAR POWER TRANSISTORS — PLASTIC PACKAGES (continued)

PLASTIC TO-220 (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	60	D44H7	D45H7	20 min	4					50
		D44H8	D45H8	40 min	4					50
			D45H9	40 min	4					50
		MJE2801T		25/100	3					75
		MJE3055T	MJE2955T	20/70	4					75
		2N6387##	2N6667##	1k/20k	5				20#	65
		SE9300##	SE9400##	1k min	4				1#	70
	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
			D45H12	40 min	4					50
		2N6388##	2N6668##	1k/20k	5				20#	65
		D44H10	D45H10	20 min	4	0.5 typ	0.14 typ	5	50 typ	50
		D44H11	D45H11	40 min	4	0.5 typ	0.14 typ	5	50 typ	50
		SE9301##	SE9401##	1k min	4				1#	70
	100	BDX33C##	BDX34C##	750 min	3				3	70
		SE9302##	SE9402##	1k min	4				1#	70
12	300	MJE13008		6/30	8	3	0.7	8	4	100
	400	MJE13009		6/30	8	3	0.7	8	4	100
15	30	D44VH1	D45VH1	20 min	4	0.7	0.09	8	50 typ	83
	40	2N6486	2N6489	20/150	5	0.6 typ	0.3 typ	5	5	75
	45	D44VH4	D45VH4	20 min	4	0.5	0.09	8	50 typ	83
	60	2N6487	2N6490	20/150	5	0.6 typ	0.3 typ	5	5	75
		D44VH7		20 min	4	0.5	0.09	8	50 typ	83
		MJE5220	MJE5230	20 min	4	0.7	0.1	8		83
	80	2N6488	2N6491	20/150	5	0.6 typ	0.3 typ	5	5	75
		D44VH10	D45VH10	20 min	4	0.5	0.09	8	50 typ	83
		MJE5221	MJE5231	20 min	4	0.7	0.1	8		83

$|h_{fe}|$ @ 1 MHz, ## Darlington

PLASTIC Full Pak (TO-220 Type)



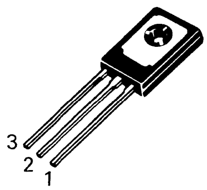
CASE 221C-02

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
5	100	MJF122##	MJF127##	2000 min	3	1.5 typ	1.5 typ	3	4#	28
8	80		MJF6107	30/90	2	0.5 typ	0.13 typ	2	4	35
	100	MJF102##	MJF107##	3000 min	3	1.5 typ	1.5 typ	3	4#	35
	150	MJF15030	MJF15031	40 min	3	1 typ	0.15 typ	3	30	35
10	60	MJF3055	MJF2955	20/100	4				2	40

$|h_{fe}|$ @ 1 MHz, ## Darlington

TO-225AA (Formerly TO-126)

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. BASE



STYLE 3:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

CASE 77-06

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		
0.3	250	MJE3440		40/160	0.02				15	15
	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	MJE350	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	40	MJE720		8 min	1					20
	45	BD165	BD166	15 min	0.5				6	20
		BD135	BD136	40/250	0.15					12.5
		BD135.6	BD136.6	40/100	0.15					12.5
		BD135.10	BD136.10	63/160	0.15					12.5
		BD135.16	BD136.16	100/250	0.15					12.5
	60	BD167	BD168	15 min	0.5				6	20
		BD137	BD138	40/250	0.15					12.5
		BD137.6	BD138.6	40/100	0.15					12.5
		BD137.10	BD138.10	63/160	0.15					12.5
		BD137.16	BD138.16	100/250	0.15					12.5
	80	BD169	BD170	15 min	0.5				6	20
		BD139	BD140	40/250	0.15					12.5
		BD139.6	BD140.6	40/100	0.15					12.5
		BD139.10	BD140.10	63/160	0.15					12.5
		BD139.16	BD140.16	100/250	0.15					12.5
	300	MJE13002●		5/25	1	4	0.7	1	5	40
	400	MJE13003●		5/25	1	4	0.7	1	5	40
2	45	BD233	BD234	25 min	1				3	25
	60	BD235	BD236	25 min	1				3	25
	80	BD237	BD238	25 min	1				3	25
	100	MJE270##	MJE271##	1.5k min	0.12				6	15
3	30	MJE520	MJE370	25 min	1					25
	40	MJE180	MJE170	50/250	0.1	0.6 typ	0.12 typ	0.1	50	12.5

● Case 77 (Style 3), # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

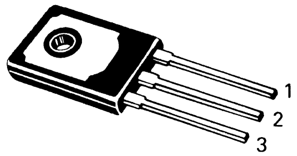
TO-225AA (continued)

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
3	45	BD175	BD176	40/250	0.15				3	30
		BD175.6	BD176.6	40/100	0.15				3	30
		BD175.10	BD176.10	63/160	0.15				3	30
		BD175.16	BD176.16	100/250	0.15				3	30
	60	BD177	BD178	40/250	0.15				3	30
		BD177.6	BD178.6	40/100	0.15				3	30
		BD177.10	BD178.10	63/160	0.15				3	30
		BD177.16	BD178.16	100/250	0.15				3	30
		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
		BD179.6	BD180.6	40/100	0.15				3	30
		BD179.10	BD180.10	63/160	0.15				3	30
		BD179.16	BD180.16	100/250	0.15				3	30
		MJE182	MJE172	50/250	0.1	0.6 typ	0.12 typ	0.1	50	12.5
	200	BUY49P		30 min	0.5				25	20
4	20	BD433	BD434	50 min	2				3	36
	30	BD185	BD186	15 min	2				20	40
		BD435	BD436	50 min	2				3	36
	40	2N5190	2N5193	25/100	1.5	0.4 typ	0.4 typ	1.5	2	40
		MJE521	MJE371	40 min	1					40
		2N6037##	2N6034##	750/18k	2	1.7 typ	1.2 typ	2	25	40
	45	BD187	BD188	15 min	2				20	40
		BD437	BD438	40 min	2				3	36
		BD675##	BD676##	750 min	1.5					40
		BD675A##	BD676A##	750 min	2					40
		BD785	BD786	20 min	2				50	15
		BD775##	BD776##	750 min	2				20	15
	60	BD189	BD190	15 min	2				20	40
		BD439	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
		MJE801##	MJE701##	750 min	2				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##	2N6036##	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
		MJE244		25 min	0.2	0.15 typ	0.07 typ	2	40	15
		MJE243	MJE253	40/120	0.2	0.7 typ	0.08 typ	0.2	40	15
5	25	MJE200	MJE210	45/180	2	0.13 typ	0.035 typ	2	65	15

• Case 77 (Style 3), # $|h_{fe}|$ @ 1 MHz, ## Darlington

PLASTIC TO-225 (Formerly TO-127)†

STYLE 2:
PIN 1. EMITTER
2. COLLECTOR
3. BASE



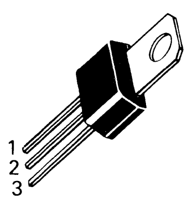
CASE 90-05 (TO-225AB)

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
5	50		MJE105	25/100	2					65
	60	MJE1100##	MJE1090##	750 min	3A				1	70
		MJE1101##		750 min	4A				1	70
	80	MJE1102##	MJE1092##	750 min	3A				1	70
		MJE1103##	MJE1093##	750 min	4A				1	70
8	60	MJE6043##	MJE6040##	1k/20k	4	1.5 typ	1.5 typ	4	4#	75
	80	MJE6044##	MJE6041##	1k/20k	4	1.5 typ	1.5 typ	4	4#	75
	100	MJE6045##		1k/20k	4	1.5 typ	1.5 typ	4	4#	75
10	45		BD206	15 min	4				1.5	90
	60	BD207	BD208	15 min	4				1.5	90
		MJE2801	MJE2901	25/100	3					90
		MJE3055	MJE2955	20/70	4				2	90
12	40	2N5989	2N5986	20/120	6	0.5 typ	0.25 typ	6	2	100
	60		2N5987	20/120	6	0.5 typ	0.25 typ	6	2	100
	80	2N5991	2N5988	20/120	6	0.5 typ	0.25 typ	6	2	100
15	40	MJE1660		20/100	5				3	90
	60	MJE1661		20/100	5				3	90

$|h_{fe}|$ @ 1 MHz, ## Darlington
† Not recommended for new designs (check TO-220 for alternates)

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 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
0.5	300	MPS-U10	MPS-U60	30 min	0.03				60	10
0.8	40	MPS-U02	MPS-U52	30 min	0.5				150	10
1	120	MPS-U03		40 min	0.01				100	10
	180	MPS-U04		40 min	0.01				100	10
2	20	BD505	BD506	40 min	1				50	10
	30	BD507	BD508	40 min	1				50	10
		MPS-U01	MPS-U51	50 min	1				50	10
	40	BD509	BD510	40 min	1				50	10
		MPS-U01A	MPS-U51A	50 min	1				50	10
		MPS-U45##	MPS-U95##	4k min	1				100	10

Darlington
(continued)
† Not recommended for new designs (check TO-225 or TO-220 for alternates)

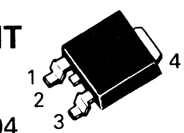
BIPOLAR POWER TRANSISTORS — PLASTIC PACKAGES (continued)

PLASTIC CASE 152 (continued)

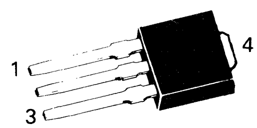
I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C
		NPN	PNP			t_s μs Max	t_f μs Max	@ I_C Amp		
2	45	BD515	BD516	25 min	0.5				50	10
	60	BD517 MPS-U05	BD518 MPS-U55	25 min 60 min	0.5 0.25				50 50	10 10
	80	BD519 MPS-U06	BD520 MPS-U56	25 min 60 min	0.5 0.25				50 50	10 10
	100	BD529 MPS-U07	BD530 MPS-U57	30 min 30 min	0.25 0.25				50 50	10 10

Darlington

DPAK — SURFACE MOUNT POWER PACKAGE



CASE 369A-04

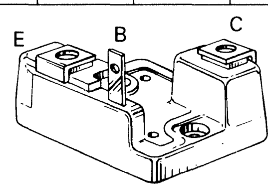


CASE 369-03

STYLE 1:
1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

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 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
	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
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 369-03 may be ordered by adding -1 suffix to part number.



PLASTIC CASE 353†

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	t_s μs Max	t_f μs Max	@ I_C Amp	P_D (Case) Watts @ 25°C
		NPN	PNP						
50	450	MJ10044##		50 min	50	3.8	1.3	50	250
100	250	MJ10047## MJ10048##		75 min 75 min	100 100	4 20	1 8	100 100	250 250

Darlington **† Not recommended for new designs — consult Motorola.**

MIL Specified Power Transistors

IC Cont Amps Max	VCEO(sus) Volts Min	Device Type NPN/#	Device Type PNP/#	hFE Min/Max	@ IC Amp	Resistive Switching ts µs Max	Resistive Switching tf µs Max	Resistive Switching @ IC Amp	fT MHz Min	PD (Case) Watts @ 25°C	Case JEDEC/MOT
1	300	2N3739J,/402A TX, TXV		40/200	0.1	3.5*		0.5	10	20	TO-213AA/80
3	40		2N3867SJ,350A TX, TXV	40/200	1.5	0.5	0.1	1.5	60	10	TO-205AD/79
	60		2N3868SJ,/350A TX, TXV	30/150	1.5	0.055	0.035	1.5	60	5	TO-205AD/79
4	60		2N3740J,/441A TX, TXV	30/100	0.25	1*		1	5	25	TO-213AA/80
		2N3766J,/518 TX, TXV		40/160	0.5	2.5*		0.5	10	25	TO-213AA/80
	80		2N3741J,/441A TX, TXV	30/100	0.25	1*		1	5	25	TO-213AA/80
		2N3767J,/518 TX, TXV		40/160	0.5	2.5*		0.5	10	25	TO-213AA/80
5	100	2N5339J/560 TX, TXV	2N6193J/561 TX, TXV	60/240	2	2	0.2	2	30	6	TO-205AD/79
8	60	2N6300J,/540 TX, TXV	2N6298J,/540 TX, TXV	750/18k	4	8*		4	25	75	TO-213AA/80
	80	2N6301J,/540 TX, TXV	2N6299J,/540 TX, TXV	750/18k	4	8*		4	25	75	TO-213AA/80
	250	2N6306J,/498 TX		15/75	3	3*		3	5	125	TO-204/1
	300	2N6671J,/536 TX, TXV		10/40	5	2.5	0.4	5	15	150	TO-204/1
	350	2N6308J,/498 TX		12/60	3	3*		3	5	125	TO-204/1
	400	2N6673J,/536 TX, TXV		10/40	5	2.5	0.4	5	15	150	TO-204/1
10	40	2N6383J,/523 TX, TXV	2N6648J,527 TX, TXV	1k/20k	5	10*		5	20	100	TO-204/1
	60	2N3715J,/408B TX, TXV	2N3791J,/379B TX, TXV	30/120	3	2*		5	4	150	TO-204/1
		2N6384J,/523 TX, TXV		1k/20k	5	10*		5	20	100	TO-204/1
			2N6649J,/527 TX, TXV	1k/20k	5	10*		5	50	85	TO-204/1
	80	2N3716J,/408B TX, TXV	2N3792J,/379B TX, TXV	30/120	3	2*		5	4	150	TO-204/1
		2N6385J,/523 TX, TXV		1k/20k	5	10*		5	20	100	TO-204/1
			2N6650J,/527 TX, TXV	1k/20k	5	10*		5	50	85	TO-204/1
12	80	2N6058J,/502 TX, TXV	2N6051J,/501 TX, TXV	1k/18k	6	10*		5	10	150	TO-204/1
	100	2N6059J,/502 TX, TXV	2N6052J,/501 TX, TXV	1k/18k	6	10*		5	10	150	TO-204/1
15	300	2N6546J,/525 TX		12/60	5	4.7*		10	6	175	TO-204/1
		2N6674J,/537 TX, TXV**		8/20	10	2.5	0.5	10	15	175	TO-204/1

MIL-S-19500 Detailed Spec. shown by Device Type

* t_{off}

** Consult Factory for qualification status.

BIPOLAR POWER TRANSISTORS (continued)

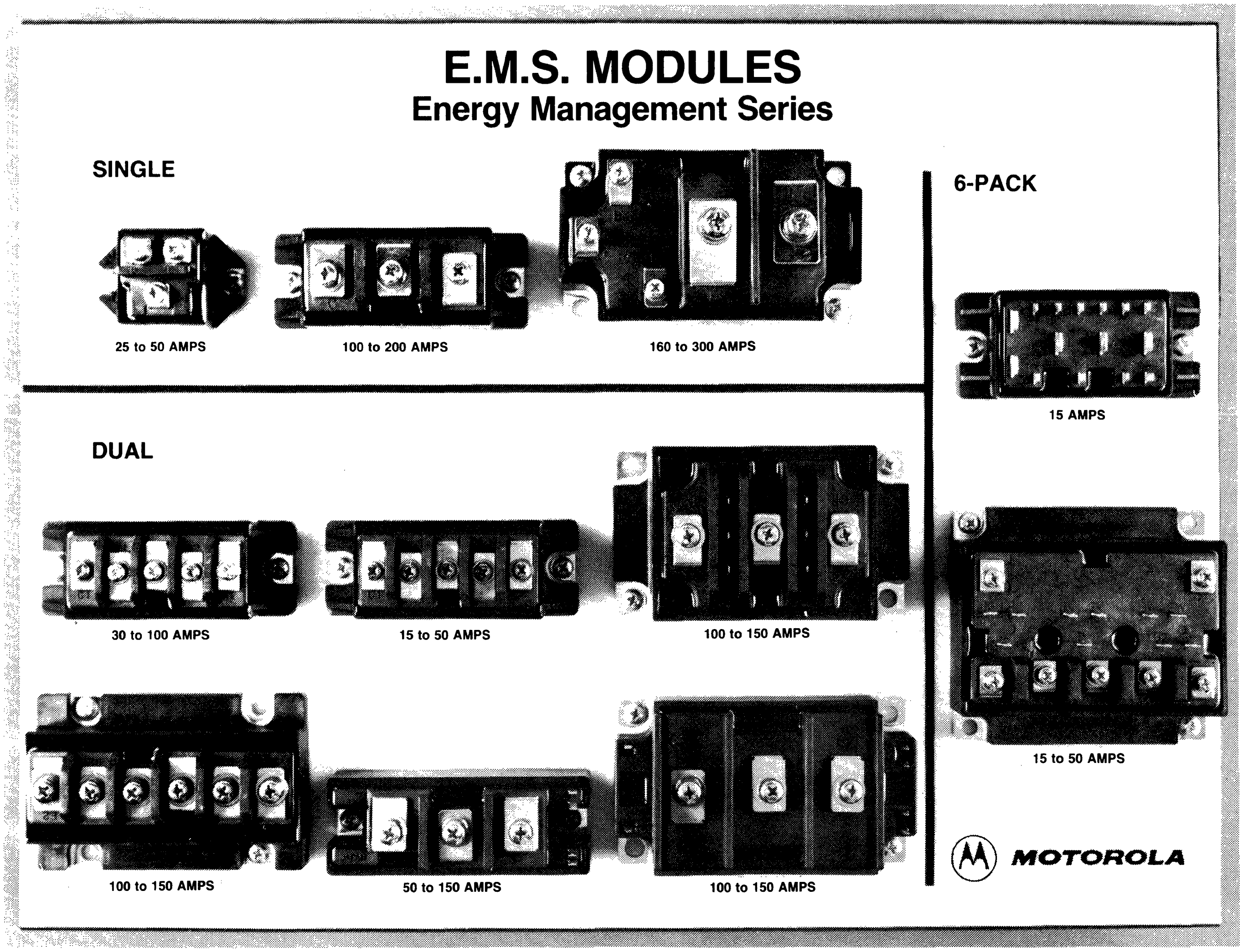
Military Specified Power Transistors (continued)

I_C Cont 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	Case JEDEC/MOT
15	400	2N6547J,/525 TX		12/60	5	4.7*		10	6	175	TO-204/1
		2N6675J,/537 TX, TXV**		8/20	10	2.5	0.5	10	15	175	TO-204AA/1
20	75	2N5039J,/439 TX, TXV		30/150	2	2*		10	60	140	TO-204/1
	80	2N5303J,/456A TX, TXV	2N5745J,433 TX, TXV	15/60	10	3*		10	2	200	TO-204/1
		2N6283J,/504 TX, TXV	2N6286J,/505 TX, TXV	1250/18k	10	10*		10	8	175	TO-204/1
	90	2N5038J/439 TX, TXV		50/200	2	2*		12	60	140	TO-204/1
	100	2N6284J,/504 TX, TXV	2N6287J,/505 TX, TXV	1250/18k	10	10*		10	8	175	TO-204/1
25	100		2N6437J,/508 TX, TXV	30/120	10	1		10	40	200	TO-204/1
	120		2N6438J,/509 TX, TXV	30/120	10	1		10	40	200	TO-204/1
30	60	2N5302J,/456A TX, TXV	2N4399J,/433 TX, TXV	15/60	15	3*		10	2	200	TO-204/1
50	60	2N5685J,/464 TX, TXV	2N5683J,/466 TX, TXV	15/60	25	3*		25	2	300	TO-204/197 MOD
	80	2N5686J,/464 TX, TXV	2N5684J,/466 TX, TXV	15/60	25	3*		25	2	300	TO-204/197 MOD
	100	2N6274J,/514 TX, TXV	2N6378J,/515 TX, TXV	30/120	20	1.05*		20	30	250	TO-204/197 MOD
	120		2N6379J,/515 TX, TXV	30/120	20	1.05*		20	30	250	TO-204/197 MOD
	150	2N6277J,/514 TX, TXV**		30/120	20	1.05*		20	30	250	TO-204/197

MIL-S-19500 Detailed Spec. shown by Device Type

* t_{off}

** Consult Factory for qualification status.



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

POWER BIPOLAR

Max I_C (cont) Amps	$V_{CEO(sus)}$ $V_{CEX(sus)}$* Volts	Device Type	Module Type	h_{FE} Min	Conditions V_{CE} Volts	Conditions I_C Amps	Max. Resistive Switching t_{on} μs	t_s μs	t_f μs	@ I_C(A)	P_D T_C = 25°C Watts	Case No.	Circuit Config.
15	450	MJ15FG45	Six-pack	100	5	15x6	1	12	2	15	100x6	809-01	G
	1100*	MJ15FL110	Six-pack	100	5	15x6	2	11	6	15	150x6		L
25	1000*	MJ25BX100	Dual	100	5	25x2	2	15	5	25	300x2	813-01	X
	1100*	MJ25FL110	Six-pack	100	5	25x6	2	14	6	25	300x6		L
50		MJ50AB45	Single	100	5	50	1	12	2	50	300		B
	450	MJ50BD45	Dual	100	5	50x2	1	12	2	50	300x2	807-01	D
		MJ50B2D45	Dual	100	5	50x2	1	12	2	50	300x2	813-01	2D
		MJ50FG45	Six-pack	100	5	50x6	1	12	2	50	300x6		G
		MJ50AC100	Single	100	5	50	2	20	5	50	350	373-01	C
	1000*	MJ50BK100	Dual	100	5	50x2	2	15	5	50	350x2	807-02	K
		MJ50BX100	Dual	100	5	50x2	2	15	5	50	350x2	813-01	X
	1200*	MJ50BX120	Dual	100	5	50x2	2	13	4	50	350x2	813-01	X
75	450	MJ75BD45	Dual	80	5	75	2	12	2	75	350x2		D
	500	MJ75B2D50	Dual	80	5	75x2	2	12	4	75	350x2	813-01	2D
	1000*	MJ75BX100	Dual	100	5	75x2	2	15	5	75	400x2	816-01	X
	1200*	MJ75BX120	Dual	100	5	75x2	3	15	5	75	400x2	816-01	X
100	450	MJ100AA45	Single	100	5	100	1	12	2	100	600	807A-01	A
		MJ100BD45	Dual	100	5	100x2	1	12	2	100	400x2	807-01	D
	550	MJ100BE55	Dual	100	5	100x2	2	12	4	100	400x2	819-01	E
	1000*	MJ100BK100	Dual	100	5	100x2	2	15	5	100	700x2	808-01	2K
		MJ100BX100	Dual	100	5	100x2	2	15	5	100	700x2	814-01	X
	1200*	MJ100BX120	Dual	100	5	100x2	2	14	3	100	700x2	814-01	X
150	550	MJ150B3D55	Dual	80	5	150x2	2	12	5	150	700x2	814A-01	3D
	1000*	MJ150BK100	Dual	100	5	150x2	2	15	5	150	800x2	808-01	2K
		MJ150BX100	Dual	100	5	150x2	2	15	5	150	800x2	814-01	X
	1200*	MJ150BX120	Dual	100	5	150x2	3	15	5	150	800x2	814-01	X
200	550	MJ200AA55	Single	80	5	200	2	12	4	200	800	807A-01	A
		MJ200AF55	Single	80	5	200	2	12	4	200	800		F
	1000*	MJ200AV100	Single	100	5	200	2	15	5	200	1400	812-01	V
	1200*	MJ200AV120	Single	100	5	200	2	14	3	200	1400	812-01	V
300	550	MJ300A2F55	Single	80	5	300	2	12	5	300	1400	812-01	2F
	1000*	MJ300AV100	Single	100	5	300	2	15	5	300	1600	812-01	V
	1200*	MJ300AV120	Single	100	5	300	4	12	5	300	1600	812-01	V

POWER MOSFET

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	15x6	10	0.6	2	0.5	15	10	125x6	809-01	R
50	450	MT50BY45	Dual	7	50	10	0.8	1.3	0.2	50	10	400x2	816-01	Y

POWER ISOLATED GATE BIPOLAR (IGBT)

Max I_C (cont) Amps	Max V_{CES} Volts	Device Type	Module Type	Max V_{CE} Volts	Conditions I_C Amps	Conditions V_{GE} Volts	Max. Resistive Switching t_{on} μs	t_s μs	t_f μs	Conditions I_C(A)	Conditions V_G(V)	P_D T_C = 25°C Watts	Case No.	Circuit Config.
25	1000	MG25BZ100	Dual	5	25	15	1	2	1	25	15	200x2	813-01	Z
50	1000	MG50BZ100	Dual	5	50	15	1	1.5	1	50	15	300x2	813-01	Z
100	1000	MG100BZ100	Dual	5	100	15	1	1.5	1	100	15	400x2	814B-01	Z

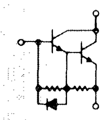
Not Introduced

UL RECOGNIZED

E.M.S. Circuits

Bipolar Transistors

B



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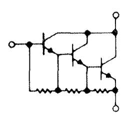
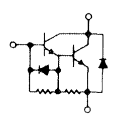


A



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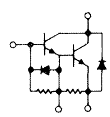

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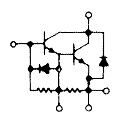

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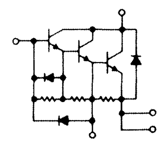

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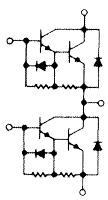

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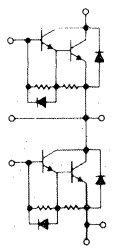

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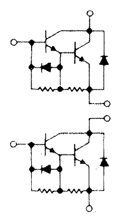

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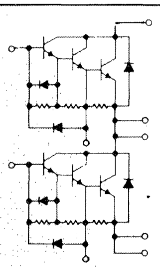

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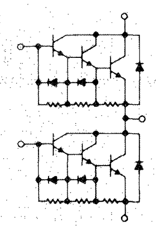
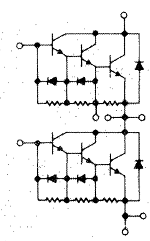


2K



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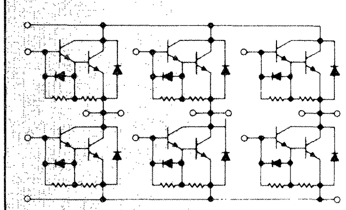

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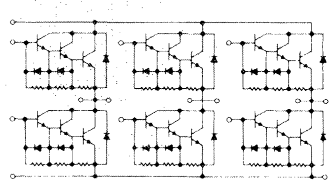
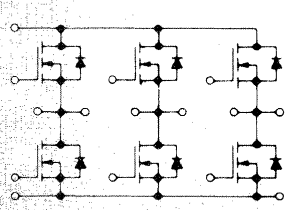
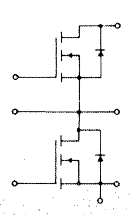


Power MOSFETs

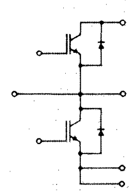
R



Y



Z

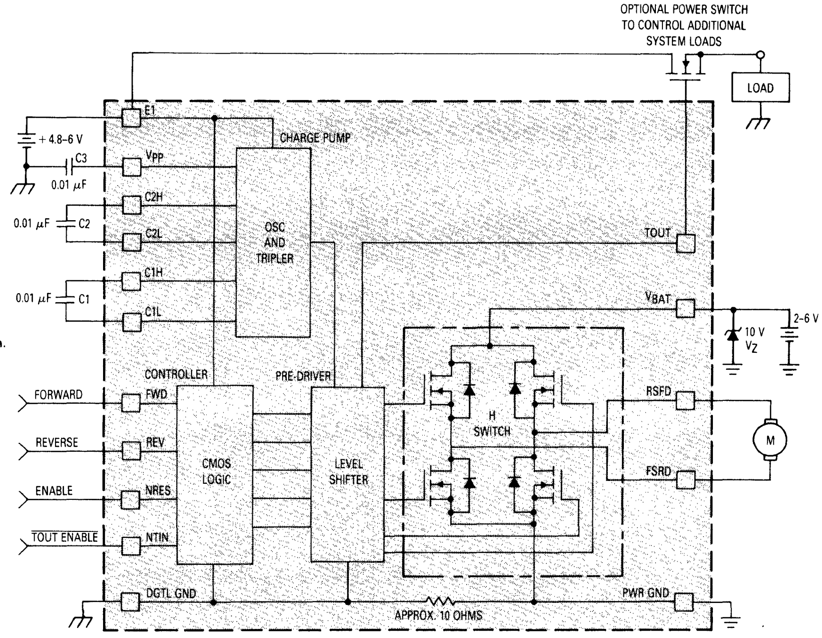


Smartpower (SMARTMOS™) Products

Smartpower — the term itself has been around for a number of years. Only recently, however, has there been a proliferation of products that prove the viability of the processes for implementing integrated-circuit control and discrete power capabilities on a single monolithic chip. The following Motorola smartpower products, trademarked SMARTMOS, represent the initial excursions into this new technology that promises a significant advance in system design simplification.

MPC1710A
Pin Definition

Pin 1	C2L	Second stage charge pump capacitor (Low potential).
Pin 2	C1H	First stage charge pump capacitor (High potential).
Pin 3	C1L	First stage charge pump capacitor (Low potential).
Pin 4	V_{BAT}	Motor (H-Bridge) voltage supply.
Pin 5	E1	Control logic voltage supply.
Pin 6, 7	FWD, REV	Logic inputs to control motor direction and braking.
Pin 8	NRES	Control circuit enable pin.
Pin 9	DGND	Control logic (Digital) ground.
Pin 10	NTIN	Enable control for TOUT. A logic "0" on this pin charge pump drives TOUT.
Pin 11, 13	FSRD, RSFD	H-Bridge outputs which control motor direction (See truth table).
Pin 12	PGND	H-Bridge power ground.
Pin 14	TOUT	Charge pumped output for driving an external MOSFET switch.
Pin 15	V_{PP}	Charge pump output.
Pin 16	C2H	Second stage charge pump capacitor (High potential).



Motor Controls

Bidirectional Motor Control
MPC1710A

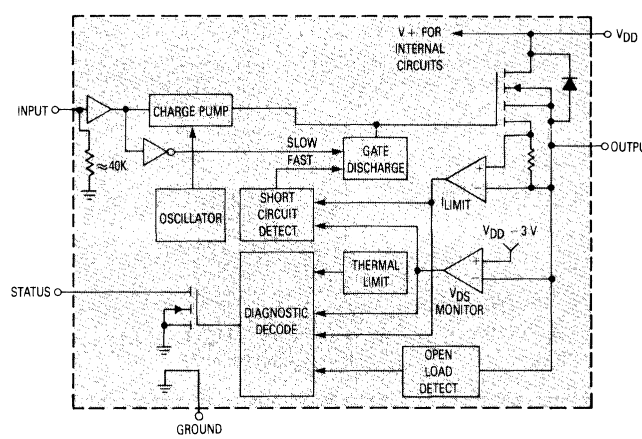
Designed for low-voltage portable applications. This motor controller can drive loads up to 3 A (peak) under direct MPU control without the need for interface devices. It consists of four lateral DMOS power devices connected in an H-bridge configuration that allows a motor to be operated in forward, reverse, brake and stop modes. Very low on-resistance keeps power dissipation low enough to permit installation in a tiny 10 x 8.3 mm surface-mount package. Voltage tripler provides proper operation even under low battery conditions and an under-voltage lockout circuit keeps the motor in the stop position at voltage below a 2.5 V threshold.

Power Switching

High Side Switch
MPC1510

Designed for automotive (and similar) applications, this electronic switching element is inserted between the high (+) side of the power source and a grounded load.

The circuit operates with a maximum steady state voltage of 35 V and an output current in excess of 20 A. It performs the logic-to-load switching function and incorporates internal feedback that permits detection of failure modes such as open or short circuits. Circuit protection includes over-temperature shutdown, current limiting and turnoff voltage transient protection.

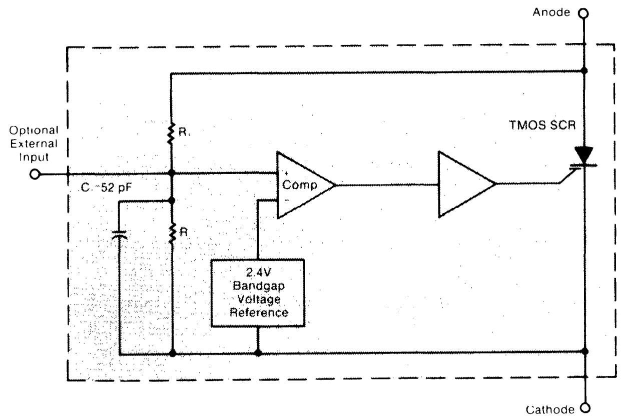


Power Supply Circuits

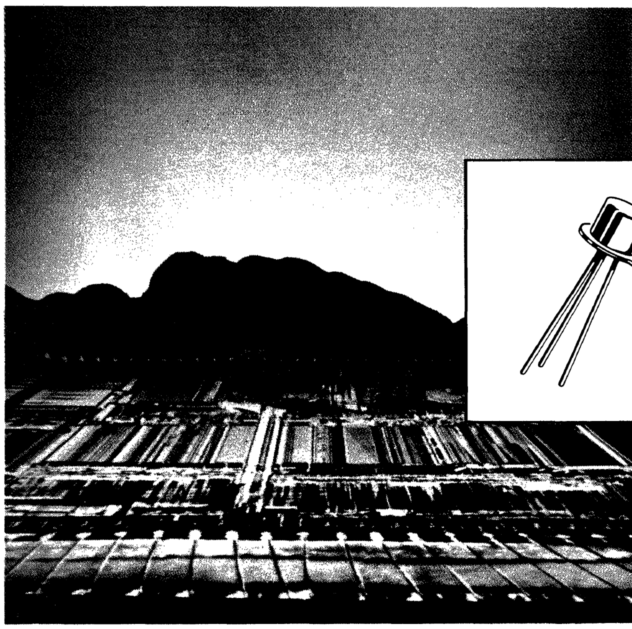
Over-voltage/Over-temperature Protection Circuits MPC2000 Series

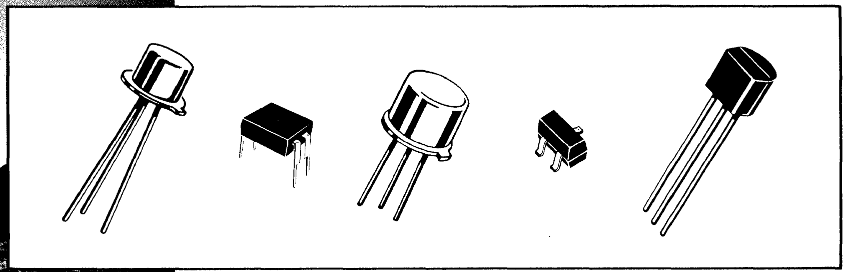
SMARTMOS technology can combine the best qualities of High-Speed CMOS logic and the high-current TMOS vertical power structure on a single chip. The circuits indicated here protect sensitive electronic equipment from over-voltage transients and from extreme temperature environments by quickly sensing a fault condition and forcing the power supply to a current-limit condition, or opening a fuse or circuit breaker.

The devices are available for 5-, 12-, and 15-volt bus voltages with continuous-current ratings of 7.5 and 15 amperes. Peak currents up to 350 amperes can be used to discharge capacitors. All devices are housed in a plastic TO-220 package.



Continuous Current (Amps)	Nominal Bus Voltage		
	5 V	12 V	15 V
7.5	MPC2004	MPC2011	MPC2014
15	MPC2005	MPC2012	MPC2015





Small-Signal Transistors and Diodes

In Brief . . .

Bipolar transistors and FETs;
Singles and multiples;
Switches and amplifiers;
From audio through UHF;
MIL and CECC qualification;
Plastic and metal packaging;
Surface-mount options . . .

No semiconductor product line offers the range of product line specifications available for the selection of small-signal transistors, and no manufacturer matches Motorola in production capacity. Military qualification to JAN, JANTX, JANTXV and JANS of a wide selection of devices attests to the inherent reliability of the small-signal product line. Choosing Motorola small-signal transistors, therefore, is synonymous with:

Lowest Off-The-Shelf Prices
Tailormade Specifications
Unexcelled Reliability

And In Addition —

In the unlikely event that no standard product will match your exacting requirements, Motorola will select devices to your special needs. Our normally large production runs make this selection quick, easy and inexpensive.

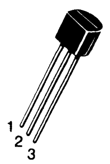
For designers wishing to replace TO-18 and TO-79 (formerly TO-5) metal transistors with plastic devices, lead-forming to fit these sockets is available.

As shipping options, all plastic packaged devices are available in radial or axial tape and reel format.

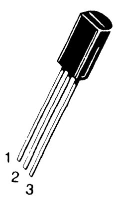
Small-Signal Diodes, Too

In the signal diode category, Motorola concentrates primarily on multiple diodes and arrays which provide cost effective solutions to special requirements. For such applications, Motorola diodes merit your attention.

Small-Signal Bipolar Transistors



CASE 29-04
TO-226AA
(TO-92)



CASE 29-03
TO-226AE
(1 WATT TO-92)

Plastic-Encapsulated

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.

General-Purpose Transistors

The 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.

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 Max dB
TO-226AA										
MPS8099	MPS8599	EBC	80	150	10	200	100	300	1	—
MPSA06	MPSA56	EBC	80	100	10	50	50	—	100	—
BC546	BC556	CBE	65	150	10	100	120	450	2	10
BC546A	BC556A	CBE	65	150	10	100	120	220	2	10
BC546B	BC556B	CBE	65	150	10	100	180	450	2	10
MPS8098	MPS8598	EBC	60	150	10	200	100	300	1	—
MPSA05	MPSA55	EBC	60	100	10	500	50	—	100	—
MPS651	MPS751	EBC	60	75	50	2000	40	—	2000	—
BC182	BC212	CBE	50	200	10	100	120	460	2	10
BC237	BC307	CBE	45	150	10	100	120	460	2	10
BC239	BC309	CBE	45	150	10	100	180	800	2	10
BC547	BC557	CBE	45	150	10	100	120	450	2	10
BC547A	BC557A	CBE	45	150	10	100	120	220	2	10
BC547B	BC557B	CBE	45	150	10	100	180	450	2	10
BC547C	BC557C	CBE	45	150	10	100	380	800	2	10
BC317	BC320	CBE	45	250	10	150	110	450	2	10
2N3904	2N3906	EBC	40	300	10	200	100	300	10	5
2N4401	2N4403	EBC	40	250	20	600	100	300	150	—
2N3903	2N3905	EBC	40	250	10	200	50	150	100	6
2N4400	2N4402	EBC	40	200	20	600	50	150	150	—
MPSA20	MPSA70	EBC	40	125	5	100	40	400	5	—
MPS650	MPS750	EBC	40	75	50	2000	40	—	2000	—
MPS6531	MPS6534	EBC	40	390*	50	600	10	120	100	—
MPS2222	MPS2907	EBC	30	250	20	600	100	300	150	—
2N4123	2N4125	EBC	30	250	10	200	50	150	2	—
MPS3704	MPS3702	EBC	30	100	50	600	100	300	50	—
MPS6513	MPS6517	EBC	30	330*	10	100	90	180	2	—
BC548	BC558	CBE	30	300*	10	100	120	300	2	10
BC548A	BC558A	CBE	30	300*	10	100	120	220	2	10
BC548B	BC558B	CBE	30	300*	10	100	180	450	2	10
BC548C	BC558C	CBE	30	300	10	100	380	800	2	10
2N4124	2N4126	EBC	25	300	10	200	120	360	2	—
MPS6514	MPS6518	EBC	25	480*	10	100	150	300	2	—
MPS6515	MPS6519	EBC	25	480	10	100	250	500	2	—
MPS5172		EBC	25	120*	5	100	100	500	10	—
MPS6560	MPS6562	EBC	25	60	10	500	50	200	600	—
MPS6601	MPS6551	EBC	25	100	50	1000	30	150	1000	—
BC238	BC308	CBE	25	150	10	100	120	800	2	10

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} Min	h_{FE} Max	I_C mA	V_T[1] mV Typ	NF[2] dB Max	f_T Typ MHz
TO-226AA									
—	MPS4249	EBC	60	100	—	10	—	3	100
—	2N5087	EBC	60	250	—	10	—	2	40
—	MPS425A	EBC	60	250	—	10	—	2	250
—	2N5086	EBC	50	150	—	10	—	3	40
BC239	BC309	CBE	45	120	800	2	9.5	2	240
BC414	BC416	CBE	45	180	800	2	8	2.5	250
BC550	BC560	CBE	45	180	800	2	8	2.5	250
BC550B	BC560B	CBE	45	180	460	2	8	2.5	250
BC550C	BC560C	CBE	45	380	800	2	8	2.5	250
BC651	—	EBC	45	380	1400	2	—	—	300
MPSA18	—	EBC	45	500	—	2	7	—	160
—	MPS4250	EBC	40	250	—	10	—	2	250
BC413	BC415	CBE	30	180	800	2	8	2.5	250
BC549	BC559	CBE	30	180	800	2	8	2.5	250
BC549B	BC559B	CBE	30	180	800	2	8	2.5	250
BC459C	BC459C	CBE	30	380	800	2	8	2.5	250
BC650	—	EBC	30	380	1400	2	—	—	300
2N4123	2N4125	EBC	30	50	150	2	—	6	300
2N5088	—	EBC	30	350	—	2	—	3	150
2N4124	2N4126	EBC	25	120	360	2	—	5	350
2N5089	—	EBC	25	450	—	2	—	2	150
—	MPS6523	EBC	25	300	—	2	—	3	340*

[1] V_T: Total Input Noise Voltage (see BC413/BC414 and BC415/BC416 Data Sheets) at $R_S = 2\ k\Omega$, $I_C = 200\ \mu A$, $V_{CE} = 5$ Volts.
[2] N_F: Noise Figure at $R_S = 2\ k$, $I_C = 200\ \mu A$, $V_{CE} = 5$ Volts. f = 30 Hz to 15 kHz.
* "S" version.

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} Min	h_{FE} Max	I_C mA	$V_{CE(sat)}$ Volts Max	$V_{CE(sat)}$ I_C mA	I_B mA	f_T Min	I_C
TO-226AA												
MPSA29	—	EBC	100	500	10K	—	100	1.4	100	0.1	125	10
BC372	—	EBC	100	1000	25K	160K	100	1	250	0.25	100	100
MPSA28	—	EBC	80	500	10K	—	100	1.4	100	0.1	125	10
BC373	—	EBC	80	1000	25K	160K	100	1	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
MPSA26	MPSA76	EBC	50	500	10K	—	100	1.5	100	0.1	125	10
MPSA25	MPSA75	EBC	40	500	10K	—	100	1.5	100	0.1	125	10
BC617	—	CBE	40	1000	20K	70K	200	1.1	200	0.2	150	500
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	100	0.1	125	10
—	MPSD54	EBC	25	300	1K	—	100	1	100	0.1	100	10
MPSA12	MPSA62	EBC	20	500	20K	—	10	1	10	0.01	125	10
TO-226AE (1 WATT)												
MPSW6725	—	EBC	50	1000	25K	—	200	1.5	1000	2	100	200
MPSW6724	—	EBC	40	1000	25K	—	200	1.5	1000	2	100	200
MPSW45	—	EBC	40	1000	25K	—	200	1.5	1000	2	100	200
MPSW14	MPSW64	EBC	30	1000	20K	—	100	1.5	100	0.1	125	10
MPSW13	MPSW63	EBC	30	1000	10K	—	100	1.5	100	0.1	125	10

SMALL-SIGNAL BIPOLAR DEVICES — PLASTIC-ENCAPSULATED (continued)

High-Current Transistors

TO-226AA — P_D = 625 mW

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts	P_D mW 25°C Amb	I_C (mA) Cont	h_{FE} Min	h_{FE} Max	@ I_C mA	V_{CE} (Volts)	f_T Typical (MHz)
BC337	BC327	CBE	45	625	800	100	600	100	1	210
BC338	BC328	CBE	25	625	800	100	600	100	1	210
BC445	BC446	CBE	60	625	300	70	—	10	5	250/200[1]
BC447	BC448	CBE	80	625	300	70	—	10	5	250/200[1]
BC449	BC450	CBE	100	625	300	70	—	10	5	250/200[1]
BC485	BC486	CBE	45	625	1000	60	400	100	2	200/150[1]
BC487	BC488	CBE	60	625	1000	60	400	100	2	200/150[1]
BC489	BC490	CBE	80	625	1000	60	400	100	2	200/150[1]
MPSA05	MPSA55	EBC	60	625	500	50	—	100	1	150/175[1]
MPSA06	MPSA56	EBC	80	625	500	50	—	100	1	150/175[1]
MPS8099	MPS8599	EBC	80	625	500	75	—	100	5	200[1]
2N4409	—	EBC	50	625	250	60	400	10	1	200
2N4410	—	EBC	80	625	250	60	400	10	1	200
MPS650	MPS750	EBC	40	625	2000	75	—	1000	2	100
						40	—	2000	2	

[1]Relevant to PNP.

TO-226AA — P_D = 800 mW

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Cont	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	@ I_B mA	f_T MHz Min	@ I_C mA
BF420	BF421	ECB	300	0.1	40	25	2	20	2	60	10
BF422	BF423	ECB	250	0.1	50	25	2	20	2	60	10
BC639	BC640	ECB	80	1	40	150	0.5	500	50	60	10
BC637	BC639	ECB	60	1	40	150	0.5	500	50	60	10
BC635	BC636	ECB	45	1	40	150	0.5	500	50	60	10
BC368	BC369	ECB	20	1	60	1000	0.5	1000	100	65	10

TO-226AE — P_D = 1 W

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	MHz f_T Min	@ I_C mA	I_C Max A	h_{FE} Min	h_{FE} Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	@ I_B mA
BDB01D	BDB02D	EBC	100	50	200	1.5	40	400	100	0.7	1000	100
BDC01D	BDC02D	ECB	100	50	200	1.5	40	400	100	0.7	1000	100
BDB01C	BDB02C	EBC	80	50	200	1.5	40	400	100	0.7	1000	100
BDC01C	BDC02C	ECB	80	50	200	1.5	40	400	100	0.7	1000	100
MPS6717	MPS6729	EBC	80	50	200	0.5	80	—	50	0.5	250	10
MPSW06	—	EBC	80	50	200	0.5	50	—	50	0.4	250	10
BDB01B	BDB02B	EBC	60	50	200	1.5	40	400	100	0.7	1000	100
BDC01B	BDC02B	ECB	60	50	200	1.5	40	400	100	0.7	1000	100
MPSW05	MPS6728	EBC	60	50	200	0.5	80	—	50	0.4	250	10
MPS6716	MPSW55	EBC	60	50	200	0.5	80	—	50	0.5	250	10
BDB01A	BDB02A	EBC	45	50	200	1.5	40	400	100	0.7	1000	100
BDC01A	BDC02A	ECB	45	50	200	1.5	40	400	100	0.7	1000	100
MPS6715	MPS6727	EBC	40	50	50	1	50	—	1000	0.5	1000	100
MPSW01A	MPSW51A	EBC	40	50	50	1	50	—	1000	0.5	1000	100
MPS6714	MPS6726	EBC	30	50	50	1	50	—	1000	0.5	1000	100
MPSW01	MPSW51	EBC	30	50	50	1	50	—	1000	0.5	1000	100

High-Voltage Amplifier Transistors

These high-voltage transistors are designed for driving neon bulbs and Nixie® 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 ($V_{(BR)CEO}$).

NPN Transistors

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Max	h_{FE} Min	@ I_C mA	V_F Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
TO-226AA										
BF844	EBC	400	0.5	40	30	0.5	10	1	50	10
MPSA44	EBC	400	0.3	40	100	0.75	50	5	20	10
BF845	EBC	350	0.5	40	30	0.5	10	1	50	10
MPSA45	EBC	350	0.3	50	100	0.75	50	5	20	10
2N6516	EBC	350	0..5	30	30	0.2	10	1	40	10
BF393	EBC	300	0.5	40	10	0.2	20	2	50	10
MPSA42	EBC	300	0.5	40	30	0.5	20	2	50	10
2N6517	EBC	300	0.5	45	30	0.3	10	1	40	10
BF392	EBC	250	0.5	40	10	0.2	20	2	50	10
2N6515	EBC	250	0.5	50	30	0.3	10	1	40	10
BF391	EBC	200	0.5	40	10	0.2	20	2	50	10
MPSA43	EBC	200	0.5	40	10	0.4	20	2	50	10
2N5551	EBC	160	0.6	80	10	0.15	10	1	100	10
2N5550	EBC	140	0.6	60	10	0.15	10	1	100	10
MPSL01	EBC	100	0.15	20	30	0.2	10	1	40	10
TO-226AE (1 WATT)										
BDC05	ECB	300	0.5	40	25	2	20	2	60	10
MPS6735	EBC	300	0.3	40	10	2	20	2	50	10
MPSW10	EBC	300	0.3	40	30	0.75	30	3	45	10
MPSW42	EBC	300	0.3	40	30	0.5	20	2	50	10
BDC07	ECB	250	0.5	200	50	2	20	2	60	10
MPS6734	EBC	250	0.3	40	10	2	20	2	50	10
MPSW43	EBC	200	0.3	50	30	0.4	20	2	50	10
MPS6733	EBC	200	0.3	40	10	2	20	2	50	10

PNP Transistors

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Max	h_{FE} Min	@ I_C mA	V_F Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
TO-226AA										
BF493S	EBC	350	0.5	40	10	20	20	2	50	10
2N6520	EBC	350	0.5	30	30	3	10	1	40	10
BF493	EBC	350	0.5	40	10	0.2	20	2	50	10
MPSA92	EBC	300	0.5	40	10	0.5	20	2	50	10
2N6519	EBC	300	0.5	45	30	0.3	10	1	40	10
BF492	EBC	250	0.5	40	10	0.2	20	2	50	10
BF491	EBC	200	0.5	40	10	0.2	20	2	50	10
MPSA93	EBC	200	0.5	40	10	0.4	20	2	50	10
2N5401	EBC	150	0.6	60	10	0.2	10	1	100	10
2N5400	EBC	120	0.6	40	10	0.2	10	1	100	10
MPSL51	EBC	100	0.6	40	50	0.25	10	1	50	10
TO-226AE (1 WATT)										
BDC06	ECB	300	0.5	40	25	2	20	2	60	10
MPSW60	EBC	300	0.5	25	30	0.75	20	2	60	10
MPSW92	EBC	300	0.3	25	30	0.5	20	2	50	10
BDC08	ECB	250	0.5	40	25	2	20	2	60	10
MPSW93	EBC	200	0.3	25	30	0.5	20	2	50	10

SMALL-SIGNAL BIPOLAR DEVICES — PLASTIC-ENCAPSULATED (continued)

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. Several types are AGC characterized.

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Max mA	h_{FE} Min	I_C mA	V_{CE} V	f_T Typ MHz	CRE/CRB pF Max	NF Typ dB	f MHz
NPN — TO-226AA										
BF373	BEC	45	100	38	7	10	720	0.32	—	—
BF241	CEB	40	25	35	1	10	470	0.34	2.5	100
BF240	CEB	40	25	65	1	10	600	0.34	2.5	100
BF224	CEB	30	50	30	7	10	600	0.28	2.5	100
MPSH32	BEC	30	30	27	4	5	300*	—	3.3*	45
MPSH24	BEC	30	100	30	8	10	400*	0.36	—	—
MPSH20	BEC	30	100	25	4	10	400*	—	—	—
MPSH07	EBC	30	25	20	3	10	400*	0.3	—	—
MPS3866	EBC	30	400	10	50	5	500*	—	—	—
BF371	BEC	30	100	38	7	10	720	0.23	—	—
MPSH11	BEC	25	25	60	4	10	660*	—	—	—
MPSH10	BEC	25	100	60	4	10	1500	0.7	—	—
BF375	BEC	25	100	35	1	10	800	0.6	4	100
BF374	BEC	25	100	70	1	10	800	0.6	4	100
BF199	CEB	25	100	40	7	10	750	0.35	2.5	35
MPSH30	BEC	20	50	20	4	5	300*	—	6*	100
BF959	CEB	20	100	40	20	10	800	0.65	3	200
BF254	CEB	20	100	65	1	10	260	0.9	1.7	1
MPSH17	BEC	15	100	25	5	10	1600	0.9	6*	200
MPS918	EBC	15	50	20	8	10	800	1.7	6*	60
MPS5179	EBC	12	50	25	3	1	2000	—	4.5*	200
MPS3563	EBC	12	50	20	8	10	800	1.7	6*	60
MPSH04	EBC	10	30	30	1.5	10	80*	—	2*	1
PNP — TO-226AA										
MPSH55	BEC	80	100	30	1.5	10	80	—	—	—
BF506	CBE	35	50	20	3	10	600	0.25	4	200
2N5208	BEC	25	50	20	2	10	300*	—	3*	100
MPSH81	BEC	20	50	60	5	10	700	0.85	—	—

* Max

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 pF). The transistors are listed in order of decreasing turn-on time (t_{on}).

Device Type	t_{on} ns Max &	t_{off} ns Max @	I_C mA	$V_{(BR)CEO}$ Volts Min	h_{FE} Min @	I_C mA	$V_{CEO(sat)}$ Volts Max @	I_C mA &	I_B mA	f_T MHz Min @	I_C mA
NPN — TO-226AA											
2N3904	70	250	10	40	100	10	0.2	10	1	300	10
2N3903	70	225	10	40	50	10	0.2	10	1	250	10
2N4400	35	255	150	40	50	150	0.4	150	15	200	20
2N4264	25	35	10	15	40	10	0.22	10	1	300	10
2N4265	25	35	10	12	100	10	0.22	10	1	300	10
MPS3646	18	28	300	15	30	30	0.2	30	3	350	30
MPS2369	12	18	10	15	40	10	0.25	10	1	500	10
PNP — TO-226AA											
MPS404A	223*	835*	10	25[1]	30	12	0.2	24	1	—	—
2N3906	70	250	10	40	100	10	0.25	10	1	250	10
2N3905	70	225	10	40	100	10	0.25	10	1	200	10
2N4402	35	255	150	40	50	150	0.4	150	15	150	20
MPS3640	25	35	50	12	30	10	0.2	10	1	500	10
MPS4258	15	20	10	12	30	50	0.15	10	1	700	10
2N5771	15	20	10	15	50	10	0.18	10	1	850	10

[1] $V_{(BR)EBO}$
* Typ

Choppers

Devices are listed in decreasing ($V_{(BR)EBO}$)

Device Type	Pin Out	$V_{(BR)EBO}$ Volts Min	I_C Amp* Max	h_{FE} Min @	I_C mA	$V_{CE(sat)}$ @ Volts Max	I_C mA &	I_B mA	f_T @ MHz Min	I_C mA
NPN — TO-226AA										
MPSA17	EBC	15	100	200	5	0.25	10	1	100	5
MPSA16	EBC	12	100	200	5	0.25	10	1	80	5
PNP — TO-226AA										
MPS404A	EBC	25	150	30	12	0.2	24	1	—	—
MPS404	EBC	12	150	30	12	0.2	24	1	—	—

Industrial Transistors

These devices are special products ranges intended for use in applications which require well specified high performing devices like high quality amplifier differential input, driver stage.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ (Volts)	I_C (mA) Cont	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (Volts)	f_T Typ (MHz)	Typ (dB)	t_{on} ns Typ	t_{off} ns Typ
TO-226AA												
—	MPS2907A	EBC	60	600	100	—	10	10	200*	—	45	100
BCX59	BCX79	CBE	45	200	120	630	2	5	250	2	75	600/350
MPS2222A	—	EBC	40	600	75	—	10	10	300*	—	30	270
—	MPS2907	EBC	40	600	75	—	10	10	200*	—	45	100
MPS6531	MPS6534	EBC	40	600	90	270	100	1	250	—	30	250
BCX58	BCX78	CBE	32	200	120	630	2	5	250	2	75	600/350
MPS2222	—	EBC	30	600	75	—	10	10	250*	—	30	270
MPS6532	MPS6535	EBC	30	600	30	—	100	1	250	—	30	250

* f_T Min

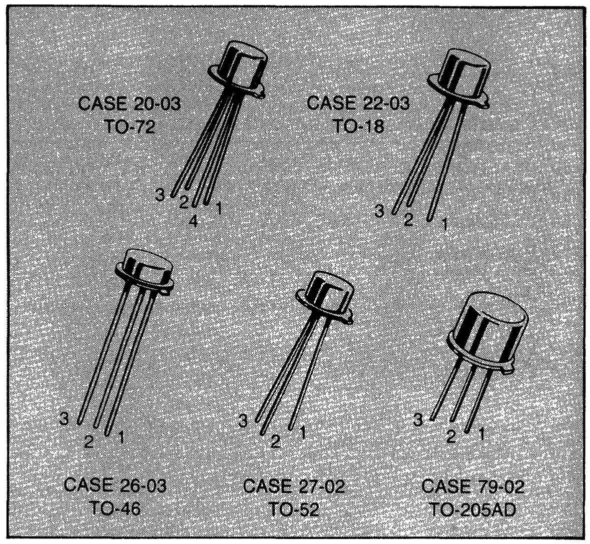
Telecom Transistors

These devices are special product ranges intended for use in Telecom application which require an excellent long term reliability.

Device Type	Pin Out	$V_{(BR)CEO}$ Volts	P_D mW 25°C Amb	I_C (mA) Cont	h_{FE} Min	h_{FE} Max	h_{FE} I_C (mA)	h_{FE} V_{CE} (V)	f_T Min MHz
NPN — TO-226AA									
P2N2222	CBE	30	625	600	75	—	10	10	250
P2N2222A	CBE	40	625	600	75	—	10	10	300
(1)PBF259,S	EBC	300	625	500	25	—	1	10	40
(1)PBF259R,RS	CBE	300	625	500	25	—	1	10	40
PNP — TO-226AA									
P2N2907	CBE	40	625	600	75	—	10	10	200
P2N2907A	CBE	60	625	600	100	—	10	10	200
(2)PBF493,S	EBC	300	625	500	40	—	1	10	40
(2)PBF493R,RS	CBE	300	625	500	40	—	1	10	40

(1) "S" version, h_{FE} Min 60 @ I_C = 20 mA, V_{CE} = 10 V.
(2) "S" version, h_{FE} Min 40 @ I_C = 0.1 mA, V_{CE} = 1 V.

Small-Signal Metal Packaged Transistors



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.

Package	Device Type	$V_{(BR)CEO}$ Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
NPN								
TO-18	2N2896	90	120	50	1000	60	200	150
	2N3700#	80	80	1.0	1000	50	—	500
	2N2895	65	120	50	1000	40	120	150
	2N2484#	60	15	0.05	50	100	500	0.01
	2N956	50	70	50	—	40	120	150
	2N2897	45	100	50	1000	50	200	150
	2N930	45	30	0.5	30	100	300	0.01
	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
	BC107C	45	150	10	200	420	800	2.0
	BCY59	45	125	10	200	120	630	2.0
	BCY59-IX	45	125	10	200	250	460	2.0
	BCY59-VII	45	125	10	200	120	220	2.0
	BCY59-VIII	45	125	10	200	180	310	2.0
	BCY59-X	45	125	10	200	380	630	2.0
	2N2218#	40	250	20	800	40	120	150
	2N2221A#	40	250	20	800	40	120	150
	2N2222A#	40	300	20	800	100	300	150
	2N3946	40	300	10	200	50	150	10
	2N3947	40	300	10	200	100	300	10
	2N718	40	50	50	—	40	120	150
	BCY58	32	125	10	200	120	630	2.0
	BCY58-IX	32	125	10	200	250	460	2.0
	BCY58-VII	32	125	10	200	120	220	2.0
	BCY58-VIII	32	125	10	200	180	310	2.0
	BCY58-X	32	125	10	200	380	630	2.0
	2N2222#	30	250	20	800	100	300	150
	2N3302	30	250	50	500	100	300	150
	2N916*	25	300	10	—	50	200	10
	BC108	25	150	10	100	110	800	2.0
	BC108A	25	150	10	100	110	220	2.0
	BC108B	25	150	10	100	200	450	2.0
	BC108C	25	150	10	100	420	800	2.0
	BC109	25	150	10	100	200	800	2.0
	BC109A	25	150	10	100	110	220	2.0
	BC109B	25	150	10	100	200	450	2.0
	BC109C	25	150	10	100	420	800	2.0
	BSX51	25	150	10	200	75	225	2.0

#JAN/JANTX/JANTXV available

General-Purpose Transistors (continued)

Package	Device Type	$V_{(BR)CEO}$ Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
NPN (continued)								
TO-205AD	2N1711	80	70	50	—	100	300	150
	2N3019#	80	100	50	1000	100	300	150
	2N3020	80	80	50	1000	40	120	150
	BSX47-10	80	50	20	1000	63	160	100
	BSX47-16	80	50	20	1000	100	250	100
	BSX47-6	80	50	20	1000	40	100	100
	BC141	60	50	50	1000	40	400	100
	BC141-10	60	50	50	1000	63	160	100
	BC141-16	60	50	50	1000	100	250	100
	BC141-6	60	50	50	1000	40	100	100
	BSX46-10	60	50	20	1000	63	160	100
	BSX46-16	60	50	20	1000	100	250	100
	BSX46-6	60	50	20	1000	40	100	100
	2N1613#	50	60	50	500	40	120	150
	2N2270	45	100	50	1000	50	200	150
	2N2219A#	40	300	20	800	100	300	150
	2N3053	40	100	50	700	50	250	150
	2N697	40	—	—	200	40	120	150
	BC140	40	50	50	1000	40	400	100
	BC140-10	40	50	50	1000	63	160	100
	BC140-16	40	50	50	1000	100	250	100
	BC140-6	40	50	50	1000	40	100	100
	BSX45-10	40	50	20	1000	63	160	100
	BSX45-16	40	50	20	1000	100	250	100
	BSX45-6	40	50	20	1000	40	100	100
	BFY50	35	60	50	1000	30	—	150
	2N2218#	30	250	20	800	40	120	150
	2N2219#	30	250	20	800	100	300	150
	2N3300	30	250	50	500	100	300	150
	BFY51	30	50	50	1000	40	—	150
	BFY52	20	50	50	1000	50	—	150
TO-46	2N5581**	40	250	20	800	40	120	150
	2N5582**	40	300	20	800	100	300	150
TO-52	MM3903	40	250	10	200	50	150	10
	MM3904	40	300	10	200	100	300	10
PNP								
TO-18	2N3963	80	40	0.5	200	100	450	1.0
	2N4026	80	100	50	1000	15	—	100
	2N4027	80	100	50	1000	10	—	100
	2N4028	80	150	50	1000	40	—	100
	2N4029	80	150	50	1000	25	—	100
	2N2906A#	60	200	50	600	40	120	150
	2N2907A	60	200	50	600	100	300	150
	2N3250A#	60	250	10	200	50	150	10
	2N3251A#	60	300	10	200	100	300	10
	2N3799	60	30	0.5	50	300	900	0.5
	2N3964	45	50	0.5	200	250	600	1.0
	BC177	45	200	10	200	120	460	2.0
	BC177A	45	200	10	200	120	220	2.0
	BC177B	45	200	10	200	180	460	2.0
	BC177C	45	200	10	200	380	800	2.0
	BC177VI	45	200	10	200	70	140	2.0
	BCY71	45	10	200	200	100	600	10
	BCY79-IX	45	180	10	200	250	460	2.0
	BCY79-VII	45	180	10	200	120	220	2.0
	BCY79-VIII	45	180	10	200	180	310	2.0
	BCY79-X	45	180	10	200	380	630	2.0
	2N2906#	40	200	50	600	40	120	150
	2N2907#	40	200	50	600	100	300	150
	2N3250	40	250	10	200	50	150	10
	2N3251	40	300	10	200	100	300	10
	BCY70	40	250	10	200	50	—	10

**JAN/JANTX available #JAN/JANTX/JANTXV available

SMALL-SIGNAL BIPOLAR TRANSISTORS — METAL (continued)

General-Purpose Transistors (continued)

Package	Device Type	$V_{(BR)CEO}$ Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
PNP (continued)								
TO-18	BCY78-IX	32	180	10	200	250	460	2.0
	BCY78-VII	32	180	10	200	120	220	2.0
	BCY78-VIII	32	180	10	200	180	310	2.0
	BCY78-X	32	180	10	200	380	630	2.0
	BC178	25	200	10	200	120	800	2.0
	BC178A	25	200	10	200	120	220	2.0
	BC178B	25	200	10	200	180	460	2.0
	BC178C	25	200	10	200	380	800	2.0
	BC178VI	25	200	10	200	70	140	2.0
	BCY72	25	250	10	200	50	—	10
	BC179	20	200	10	200	180	800	2.0
	BC179-VI	20	200	10	200	70	140	2.0
	BC179A	20	200	10	200	120	220	2.0
	BC179B	20	200	10	200	180	460	2.0
	BC179C	20	200	10	200	380	800	2.0
	2N869A	18	400	10	120	40	120	30
TO-205AD	MM5007	100	30	50	2000	50	250	250
	2N4031	80	100	50	1000	10	—	100
	2N4033#	80	150	50	1000	25	—	100
	2N4404	80	200	50	1000	40	120	150
	2N4405**	80	200	50	1000	100	300	150
	BSV17-10	80	50	50	1000	63	160	100
	BSV17-6	80	50	50	1000	40	100	100
	MM5006	80	30	50	2000	50	250	200
	BFX40	75	100	50	1000	85	—	100
	BFX41	75	100	50	1000	40	—	100
	2N4036	65	60	50	1000	40	140	150
	2N4037	65	60	50	1000	40	—	150
	MM4036	65	60	50	1000	20	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
	BC161	60	50	50	1000	40	400	100
	BC161-10	60	50	50	1000	63	160	100
	BC161-16	60	50	50	1000	100	250	100
	BC161-6	60	50	50	1000	40	100	100
	BSV16-10	60	50	50	1000	63	160	100
	BSV16-16	60	50	50	1000	100	250	100
	BSV16-6	60	50	50	1000	40	100	100
	MM5005	60	30	50	2000	50	250	150
	2N1131A	40	50	50	600	30	90	150
	2N1132A	40	60	50	600	30	90	150
	2N2904#	40	200	50	600	40	120	150
	2N2905#	40	200	50	600	100	300	150
	BC160	40	50	50	1000	40	400	100
	BC160-10	40	50	50	1000	63	160	100
	BC160-16	40	50	50	1000	100	250	100
	BC160-6	40	50	50	1000	40	100	100
	BSV15-10	40	50	50	1000	63	160	100
	BSV15-16	40	50	50	1000	100	250	100
	BSV15-6	40	50	50	1000	40	100	100
	MM4037	40	60	50	1000	50	250	150
	2N1132	35	60	50	600	30	90	150
TO-46	2N3485A**	60	200	50	600	40	120	150
	2N3486A**	60	200	50	600	100	300	150
	2N3673	50	200	50	600	75	225	150
	2N3486	40	200	50	600	100	300	150
TO-52	MM3906	40	250	10	200	100	300	10
	MM3905	40	200	10	200	50	150	10

*JAN available **JAN/JANTX available #JAN/JANTX/JANTXV available

High-Gain/Low-Noise Transistors

These transistors are characterized for high-gain and low-noise applications. Devices are listed in decreasing order of NF.

Package	Device Type	NF Wideband Typ* Max dB	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C μA mA*	f_T MHz Min	@ I_C mA
NPN									
TO-18	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
PNP									
TO-18	2N3962	10	60	200	100	450	1.0*	40	0.5
	2N3963	10	80	200	100	450	1.0*	40	0.5
	2N3965	8.0	60	200	250	600	1.0*	50	0.5
	2N3964	4.0	45	200	250	600	1.0*	50	0.5
	2N3798	3.5	60	50	150	450	500	30	0.5
	2N3799	2.5	60	50	300	900	500	30	0.5
TO-46	2N2605#	4.0	45	30	100	300	10	30	0.5

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.

Package	Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN										
TO-18	2N6431	300	50	50	30	0.5	20	2.0	50	10
	BSS73	300	500	40	30	0.5	50	5.0	100	20
	BSS72	250	500	40	30	0.5	50	5.0	100	20
	2N6430	200	50	50	30	0.5	20	2.0	50	10
	BSS71	200	500	40	30	0.5	50	5.0	100	20
	BC394	180	500	30	10	0.3	10	1.0	50	20
TO-205AD	2N3439#	350	1000	40	20	0.5	50	4.0	15	10
	2N5058	300	150	35	30	1.0	30	3.0	30	10
	BF259	300	100	25	30	1.0	30	6.0	110	30
	2N3440#	250	1000	40	20	0.5	50	4.0	15	10
	2N4927	250	50	20	30	2.0	30	3.0	30	10
	2N5059	250	150	30	30	1.0	30	3.0	30	10
	MM3003	250	50	20	10	—	—	—	150	10
	BF258	250	100	25	30	1.0	30	6.0	110	30
	BSS78	250	500	40	30	0.4	30	3.0	70	20
	2N4926	200	50	20	30	2.0	30	3.0	30	10
	BUY49S	200	3000	40	500	0.2	500	50	—	—
	MM3002	200	50	20	10	—	—	—	150	10
	BSS77	200	500	40	30	0.4	30	3.0	70	20
	MM3009	180	400	40	10	—	—	—	50	20
	BF357	160	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
	2N3114	150	200	30	30	1.0	50	5.0	40	30
	BSW68A	150	2000	30	500	1.0	500	150	—	—
	2N5682	120	1000	40	250	0.6	250	25	30	100
	BSW67A	120	2000	30	500	1.0	500	150	—	—
	2N3498#	100	500	40	150	0.6	300	30	150	20
	2N3499#	100	500	100	150	0.6	300	30	150	20
	2N5681	100	1000	40	250	0.6	250	25	30	100
	2N657	100	—	300	200	4.0	200	40	—	—
	MM3007	100	2500	50	250	0.35	150	15	50	50
	2N4239	80	3000	30	250	0.3	500	50	2.0	100
	MM3006	80	2500	50	200	0.35	150	15	50	50

JAN/JANTX/JANTXV available ** JAN/JTX

SMALL-SIGNAL BIPOLAR TRANSISTORS — METAL (continued)

High-Voltage/High-Current Transistors (continued)

Package	Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN (continued)										
TO-205AD	2N4238	60	3000	30	250	0.3	500	50	2.0	100
	MM3005	60	2500	50	150	0.35	150	15	50	50
	2N4237	40	3000	30	250	0.3	500	50	2.0	100
PNP										
TO-18	2N6433	300	500	30	30	0.5	20	20	50	10
	BSS76	300	500	35	30	0.5	50	5.0	100	20
	BSS75	250	500	35	30	0.5	50	5.0	100	20
	2N6432	200	1000	30	30	0.5	20	2.0	50	10
	BSS74	200	500	35	30	0.5	50	5.0	100	20
	BC393	180	500	50	10	0.3	10	1.0	50	20
	2N3497	120	100	40	10	0.35	10	1.0	150	20
	2N3496	80	100	40	10	0.3	10	1.0	200	20
TO-205AD	2N3494	80	100	40	10	0.3	10	1.0	200	20
	2N3495	120	100	40	10	0.35	10	1.0	150	20
	2N3635#	140	1000	100	50	0.5	50	5.0	200	30
	2N3636#	175	1000	50	50	0.5	50	5.0	150	30
	2N3637#	175	1000	100	50	0.5	50	5.0	200	30
	2N3743#	300	50	25	30	8.0	30	3.0	30	10
	2N4036	65	1000	40	150	0.65	150	15	60	50
	2N4234	40	3000	30	250	0.6	1000	125	3.0	100
	2N4235	60	3000	30	250	0.6	1000	125	3.0	100
	2N4236	80	3000	30	250	0.6	1000	125	3.0	100
	2N4928	100	100	25	10	0.5	10	1.0	100	20
	2N4929	150	500	25	10	0.5	10	1.0	100	20
	2N4930#	200	500	20	20	5.0	10	1.0	20	20
	2N4931#	250	500	20	20	5.0	10	1.0	20	20
	2N5415#	200	1000	30	50	2.5	50	5.0	15	10
	2N5416#	300	1000	30	50	2.5	50	5.0	15	10
	2N5679	100	1000	40	250	0.6	250	25	30	100
	2N5680	120	1000	40	250	0.6	250	25	30	100
	2N3634#	140	1000	50	50	0.5	50	5.0	150	30
	MM4000	100	100	20	20	0.6	10	1.0	—	—
	MM4001	150	500	20	10	0.6	10	1.0	—	—
	MM4002	200	500	20	10	5.0	10	1.0	—	—
	MM4003	250	500	20	10	5.0	10	1.0	—	—
	MM5005	60	2000	50	150	0.5	150	15	30	50
	MM5006	80	2000	50	200	0.5	150	15	30	50
	MM5007	100	2000	50	250	0.5	150	15	30	50

#JAN/JANTX/JANTXV available

High-Frequency Amplifiers/Oscillators

The transistors shown are designed for use as both oscillators and amplifiers at UHF and VHF frequencies. Devices are listed in decreasing order of $V_{(BR)CEO}$ with each line.

Package	Device Type	$V_{(BR)CEO}$ Volts Min	h_{FE} Min	@ I_C mA	G_{pe} dB Min	NF dB Max	@ f MHz	f_T MHz Min	@ I_C mA	C_{obo} pF Max
NPN										
TO-18	MM1941	20	25	10	7.0	—	—	600	10	2.5
TO-72	2N918†	15	20	3.0	15	6.0	60	600	4.0	1.7
PNP										
TO-18	2N3307	35	40	2.0	17	4.5	200	300	2.0	1.3
TO-72	2N4261#	15	30	10	—	—	—	1600	10	2.5
	2N4260	15	30	10	—	—	—	2000	10	2.5

†JAN/JANTX/JANTXV/JANS available #JAN/JANTX/JANTXV available

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}).

Package	Device Type	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	@ I_B mA	f_T MHz Min	I_C mA
NPN													
TO-18	2N2540	40	40	150	30	—	100	150	0.45	150	15	250	20
	2N914**	40	40	200	15	150	12	10	0.7	200	20	300	20
	2N4014	35	60	500	50	1000	35	500	0.52	500	50	300	50
	2N4013	35	60	500	30	1000	35	500	0.42	500	50	300	50
	2N2501	15	25	300	20	—	10	500	0.3	50	5.0	350	10
	2N2369	12	18	100	15	500	20	100	0.25	10	1.0	500	10
	2N2369A†	12	18	10	15	200	40	10	0.2	10	1.0	500	10
	2N3227	12	18	100	20	50	30	100	0.25	10	1.0	500	10
	BSX20	7.0	18	100	15	500	20	10	0.25	10	1.0	400	10
TO-205AD	2N3444**	50	70	500	50	—	20	500	0.6	500	50	175	50
	2N3253**	50	70	500	40	—	25	500	0.6	500	50	175	50
	2N3735#	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
	2N3734	48	60	1000	50	1500	30	1000	0.5	500	50	250	50
	2N3252	45	70	500	30	—	30	500	0.5	500	50	200	50
	2N3506#	45	90	1500	40	3000	40	1500	1.0	1500	150	60	100
	2N3507#	45	90	1500	50	3000	30	1500	1.0	1500	150	60	100
	BSX60	40	70	500	30	1000	30	500	0.5	500	50	—	—
	2N3725	35	60	500	50	2000	35	500	0.52	500	50	300	50
	2N3725A	35	60	500	30	1200	35	500	0.52	500	50	300	50
	2N3724	35	60	500	30	2000	35	500	0.42	500	50	300	50
	2N3724A	35	60	500	30	1200	35	500	0.42	500	50	300	50
	BSX59	35	60	500	45	1000	25	500	0.5	500	50	—	—
	MM5262	30	60	1000	50	2000	25	1000	0.8	1000	100	350(typ)	50
	2N5861	25	60	500	50	2000	25	500	0.5	500	50	200	50
	2N3303	15	25	1000	—	1000	20	10	0.7	1000	100	450	100
TO-46	2N3737#	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
	2N3648	16	18	150	15	500	30	150	0.4	150	15	450	15
TO-52	MM1748A	10	15	10	—	150	20	10	—	—	—	600	5.0
PNP													
TO-18	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
	2N4208	15	20	10	12	200	30	10	0.15	10	1.0	700	10
	MM4258	15	20	10	12	200	30	10	0.15	10	1.0	700	10
	2N4209	15	20	10	15	200	50	10	0.6	50	5.0	850	10
TO-205AD	2N3634#	400	600	50	140	1000	50	50	0.5	50	5.0	150	30
	2N3635#	400	600	50	140	1000	100	50	0.5	50	5.0	200	30
	2N3636#	400	600	50	175	1000	50	50	0.5	50	5.0	150	30
	2N4036	110	700	150	65	1000	40	150	0.65	150	15	60	50
	2N4030	100	240(typ)	500	60	1000	15	1000	1.0	1000	100	100	50
	2N4031	100	240(typ)	500	80	1000	10	1000	0.5	500	50	100	50
	2N4032	100	240(typ)	500	60	1000	40	1000	1.0	1000	100	150	50
	2N4033#	100	240(typ)	500	80	1000	25	1000	0.5	500	50	150	50
	2N4406	75	225	1000	80	1500	20	1000	0.7	1000	100	150	50
	2N4407	75	225	1000	80	1500	30	1000	0.7	1000	100	150	50
	2N3245	55	165	500	50	1000	30	500	0.6	500	50	150	50
	2N3244	50	185	500	40	1000	50	500	0.5	500	50	175	50
	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#	43	115	1000	40	1500	30	1000	0.9	1000	100	180	50
	2N3763#	43	115	1000	60	1500	20	1000	0.9	1000	100	150	50
	2N4404	40	210	500	80	1000	30	500	0.5	500	50	200	50
	2N4405**	40	210	500	80	1000	50	500	0.5	500	50	200	50
	2N5022	40	90	500	—	500	25	1000	0.8	1000	100	170	50
	2N5023	40	90	500	—	500	40	1000	0.7	1000	100	200	50

** JAN/JANTX available # JAN/JANTX/JANTXV available † JAN/JANTX/JANTXV/JANS available

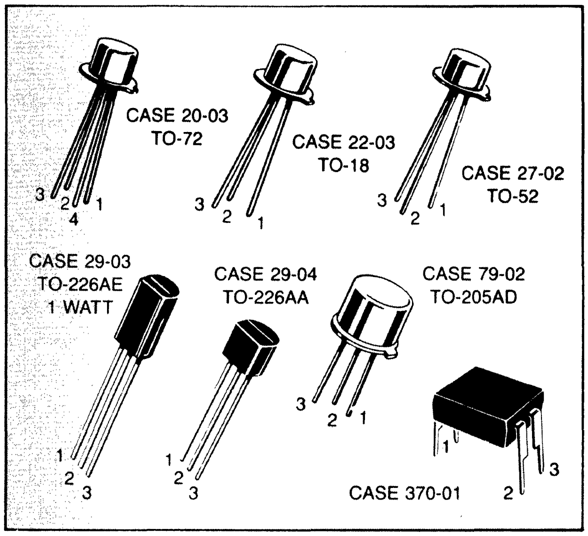
Choppers

Devices are listed in decreasing $V_{(BR)EBO}$.

PNP

Package	Device	$V_{(BR)EBO}$ Min	$V_{(BR)ECO}$	$h_{FE(inv)}$ Min	Offset Voltage $V_{EC(ofs)}$ Max (mV)	On-State Resistance $r_{ec(on)}$ Max (Ω)
TO-46	2N2946A	40	35	20	2.0	8.0
	2N5230	30	20	15	0.5	8.0
	2N2945A	25	20	30	1.0	6.0
	2N2945	25	20	4.0	1.0	35

Small-Signal Field-Effect Transistors



JFETs

JFETs operate in the depletion mode. They are available in both P- and N-channel and are offered in both metal and plastic 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.

Low-Frequency/Low-Noise

P-Channel JFETs

Package TO-	Device	$R_e \lvert Y_{fs} \rvert$ (mmho) Min	$R_e \lvert Y_{os} \rvert$ (µmho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
72	2N3909	1.0	100	32	16	20	0.3	7.9	0.3	15
92	MPF2608	1.0	—	17	—	30	1.0	4.0	0.9	4.5
92	2N5460	1.0	50	7.0	2.0	40	0.75	6.0	1.0	5.0
92	2N5463	1.0	75	7.0	2.0	60	0.5	4.0	1.0	5.0
72	2N3330	1.5	40	20	—	20	—	6.0	2.0	6.0
92	MPF3330	1.5	40	20	—	20	—	6.0	2.0	6.0
92	2N5461	1.5	50	7.0	2.0	40	1.0	7.5	2.0	9.0
92	2N5464	1.5	75	7.0	2.0	60	0.8	4.5	2.0	9.0
92	2N5462	2.0	50	7.0	2.0	40	1.8	9.0	4.0	16
92	2N5465	2.0	75	7.0	2.0	60	1.5	6.0	4.0	16
72	2N3909A	2.2	100	9.0	3.0	20	0.3	7.9	1.0	15

N-Channel JFETs

Package TO-	Device	$R_e \lvert Y_{fs} \rvert$ (mmho) Min	$R_e \lvert Y_{fs} \rvert$ @ f (MHz)	$R_e \lvert Y_{os} \rvert$ (µmho) Max	$R_e \lvert Y_{os} \rvert$ @ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
18	2N3370	0.3	30	15	30	20	3.0	40	—	3.2	0.1	0.6
92	J201	0.5	20	1.0†	20	5.0†	2.0†	40	0.3	1.5	0.2	1.0
18	2N3369	0.6	30	30	30	20	3.0	40	—	6.5	0.5	2.5
18	2N4339	0.8	15	15	15	7.0	3.0	50	0.6	1.8	0.5	1.5
92	MPF4339	0.8	15	15	15	7.0	3.0	50	0.6	1.8	0.5	1.5
18	2N3460	0.8	20	5.0	30	18	6.0	50	—	1.8	0.2	1.0
18	2N3438	0.8	20	5.0	30	18	6.0	50	—	2.3	0.2	1.0
72	2N4220	1.0	15	10	15	6.0	2.0	30	—	4.0	0.5	3.0
72	2N4220A	1.0	15	10	15	6.0	2.0	30	—	4.0	0.5	3.0

† = typical

SMALL-SIGNAL FIELD-EFFECT TRANSISTORS (continued)

Low-Frequency/Low-Noise (continued)

N-Channel JFETs (continued)

Package TO-	Device	$R_e \lvert Y_{fs} \rvert$ (mmho) Min	@ f (MHz)	$R_e \lvert Y_{os} \rvert$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
92	J202	1.0	20	3.5^t	20	5.0^t	2.0^t	40	0.8	4.0	0.9	4.5
18	2N3368	1.0	30	80	30	20	3.0	40	—	11.5	2.0	12
72	2N5359	1.2	15	10	15	6.0	2.0	40	0.8	4.0	0.6	1.6
18	2N4340	1.3	15	30	15	7.0	3.0	50	1.0	3.0	1.2	3.6
72	2N5360	1.4	15	20	15	6.0	2.0	40	0.8	4.0	0.5	2.5
92	2N5458	1.5	15	50	15	7.0	3.0	25	1.0	7.0	2.0	9.0
72	2N5361	1.5	15	20	15	6.0	2.0	40	1.0	6.0	2.5	5.0
92	J203	1.5	20	10^t	20	5.0^t	2.0^t	40	2.0	10	4.0	20
18	2N3459	1.5	20	20	30	18	6.0	50	—	3.4	0.8	4.0
72	2N3821	1.5	15	10	15	6.0	3.0	50	—	4.0	0.5	2.5
92	MPF3821	1.5	15	10	15	6.0	3.0	50	—	4.0	0.5	2.5
18	2N3437	1.5	20	20	30	18	6.0	50	—	4.8	0.8	4.0
92	2N5457	2.0	15	50	15	7.0	3.0	25	0.5	6.0	1.0	5.0
92	2N5459	2.0	15	50	15	7.0	3.0	25	2.0	8.0	4.0	16
72	2N4221	2.0	15	20	15	6.0	2.0	30	—	6.0	2.0	6.0
92	MPF4221	2.0	15	20	15	6.0	2.0	30	—	6.0	2.0	6.0
72	2N4221A	2.0	15	20	15	6.0	2.0	30	—	6.0	2.0	6.0
72	2N3822	2.0	15	20	15	6.0	3.0	50	—	6.0	2.0	10
92	MPF3822	2.0	15	20	15	6.0	3.0	50	—	6.0	2.0	10
18	2N4341	2.0	15	60	15	7.0	3.0	50	2.0	6.0	3.0	9.0
72	2N4222	2.5	15	40	15	6.0	2.0	30	—	8.0	5.0	15
72	2N4222A	2.5	15	40	15	6.0	2.0	30	—	8.0	5.0	15
92	MPF4222A	2.5	15	40	15	6.0	2.0	30	—	8.0	5.0	15
92	2N5670	3.0	15	75	15	7.0	3.0	25	2.0	8.0	8.0	20
18	2N4398	12^t	0.001	—	—	14	3.5	40	0.5	3.0	5.0	30
72	2N4118	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240
92	MPF4118	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240
72	2N4118A	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240
92	MPF4118A	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240

t = typical

High-Frequency Amplifiers

N-Channel JFETs

Package TO-	Device	$R_e \lvert Y_{fs} \rvert$ (mmho) Min	@ f (MHz)	$R_e \lvert Y_{os} \rvert$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	NF @ RG = 1K f (MHz)	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
92	2N5669	1.6	100	100	100	7.0	3.0	2.5	100	25	1.0	6.0	4.0	10
92	MPF102	1.6	100	200	100	7.0	3.0	—	—	25	—	8.0	2.0	20
92	2N3819	1.6	100	—	—	8.0	4.0	—	—	25	—	8.0	2.0	20
92	2N5668	1.0	100	50	100	7.0	3.0	2.5	100	25	0.2	4.0	1.0	5.0
92	MPF4224	1.7	200	200	200	6.0	2.0	—	—	30	0.1	8.0	2.0	20
92	2N5484	2.5	100	75	100	5.0	1.0	3.0	100	25	0.3	3.0	1.0	5.0
92	2N5670	2.5	100	150	100	7.0	3.0	2.5	100	25	2.0	8.0	8.0	20

High-Frequency Amplifiers (continued)

N-Channel JFETs (continued)

Package TO-	Device	$R_e \lvert Y_{fs} \rvert$ (mmho) Min	@ f (MHz)	$R_e \lvert Y_{os} \rvert$ (µmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	NF @ RG = 1K f (MHz)	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
92	2N5246	2.5	400	100	400	4.5	1.0	—	—	30	0.5	4.0	1.5	7.0
92	MPF4223	2.7	200	200	200	6.0	2.0	5.0	200	30	0.1	8.0	3.0	18
92	2N5485	3.0	400	100	400	5.0	1.0	4.0	400	25	1.0	4.0	4.0	10
92	J305	3.0[t]	400	80[t]	100	3.0[t]	0.8[t]	4.0[t]	400	30	0.5	3.0	1.0	8.0
72	2N3823	3.2	200	200	200	6.0	2.0	2.5	100	30	—	8.0	4.0	20
92	2N5486	3.5	400	100	400	5.0	1.0	4.0	400	25	2.0	6.0	8.0	20
72	2N4416	40	400	100	400	4.0	0.8	4.0	400	30	2.0	6.0	5.0	15
72	2N4416A	4.0	400	100	400	4.0	0.8	4.0	400	30	2.0	6.0	5.0	15
92	2N5245	4.0	400	100	400	4.5	1.0	4.0	400	30	1.0	6.0	5.0	15
92	2N5247	4.0	400	150	400	4.5	1.0	4.0	400	30	1.5	8.0	8.0	24
92	J304	4.2[t]	400	80[t]	100	3.0[t]	0.8[t]	4.0[t]	400	30	2.0	6.0	5.0	15
52	U308	10	0.001	150	100	5.0	2.5	3.0[t]	450	25	1.0	6.0	12	60
52	U309	10	0.001	150	100	5.0	2.5	3.0[t]	450	25	1.0	4.0	12	30
52	U310	10	0.001	150	100	5.0	2.5	3.0[t]	450	25	2.5	6.0	24	60
92	J308	12[t]	100	250[t]	100	7.5	2.5	1.5[t]	100	25	1.0	6.5	12	60
92	J309	12[t]	100	250[t]	100	7.5	2.5	1.5[t]	100	25	1.0	4.0	12	30
92	J310	12[t]	100	250[t]	100	7.5	2.5	1.5[t]	100	25	2.0	6.5	24	60

t typical

Switches and Choppers

P-Channel JFETs

Package TO-	Device	$r_{ds(on)}$ (Ω) Max	@ I_D (µA)	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) 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
92	MPF970	100	1.0	5.0	12	15	100	30	12	5.0	8.0	25
92	MPF971	250	1.0	1.0	7.0	2.0	80	30	12	5.0	10	120
72	2N3993	150	—	4.0	9.5	10	—	25	16	4.5	—	—
72	2N3994	300	—	1.0	5.5	2.0	—	25	16	4.5	—	—

N-Channel JFETs

Package TO-	Device	$r_{ds(on)}$ (Ω) Max	@ I_D (µA)	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) 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
18	MFE2012	10	—	3.0	10	100	—	25	50	20	16	37
18	MFE2011	15	1.0	1.0	10	40	—	25	50	20	10	20
18	2N4859A	25	—	2.0	6.0	50	—	30	10	4.0	8.0	20
92	MPF4859A	25	—	2.0	6.0	50	—	30	10	4.0	8.0	20
18	2N4856A	25	—	4.0	10	50	—	40	10	4.0	8.0	20
92	MPF4856A	25	—	4.0	10	50	—	40	10	4.0	8.0	20
18	2N4856	26	—	4.0	10	50	—	40	10	8.0	9.0	25
92	MPF4856	25	—	4.0	10	50	—	40	10	8.0	9.0	25
18	2N4859	25	—	4.0	10	50	—	30	18	8.0	9.0	25
92	MPF4859	25	—	4.0	10	50	—	30	18	8.0	9.0	25
18	MFE2010	25	1.0	0.5	10	15	—	25	50	20	10	35
18	2N4391	30	1.0	4.0	10	50	150	40	14	3.5	15	20
92	MPF4391	30	1.0	4.0	10	60	130	20	10	3.5	15	20
92	2N5638	30	1.0	—	(12)	50	—	30	10	4.0	9.0	15
18	2N4091	30	1.0	5.0	10	30	—	40	16	5.0	25	40

SMALL-SIGNAL FIELD-EFFECT TRANSISTORS (continued)

Switches and Choppers (continued)

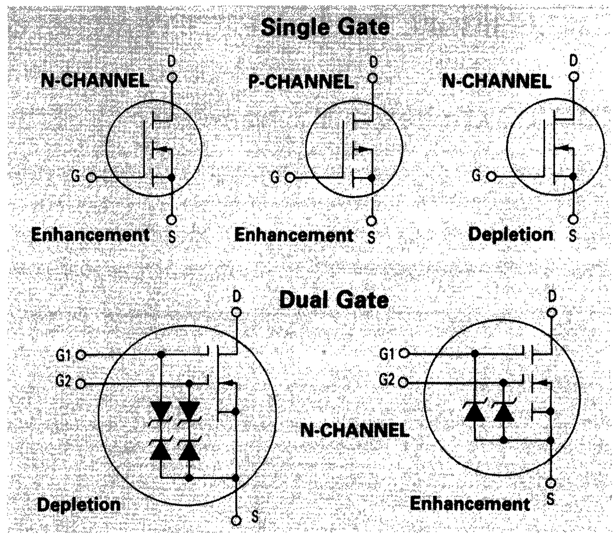
N-Channel JFETs (continued)

Package TO-	Device	$r_{ds(on)}$ (Ω) Max	@ I_D (µA)	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) 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
92	MPF4091	30	1.0	5.0	10	30	—	40	16	5.0	25	40
92	J111	30	1.0	3.0	10	20	—	35	10^{t}	5.0^{t}	13	35
18	MFE2006	30	1.0	−5.0	−10	30	—	−30	16	5.0	20	40
18	2N3970	30	1.0	4.0	10	50	150	40	25	6.0	20	30
92	MPF3970	30	1.0	4.0	10	50	150	40	25	6.0	20	30
18	2N5857A	40	—	2.0	6.0	20	100	40	10	3.5	10	40
92	MPF4857A	40	—	2.0	6.0	20	100	40	10	3.5	10	40
18	2N4860A	40	—	2.0	6.0	20	100	30	10	3.5	10	40
92	MPF4860A	40	—	2.0	6.0	20	100	30	10	3.5	10	40
18	2N4857	40	—	2.0	6.0	20	100	40	18	8.0	10	50
92	MPF4857	40	—	2.0	6.0	20	100	40	18	8.0	10	50
18	2N4860	40	—	2.0	6.0	20	100	30	18	8.0	10	50
92	MPF4860	40	—	2.0	6.0	20	100	30	18	8.0	10	50
18	2N4092	50	1.0	2.0	7.0	15	—	40	16	5.0	35	60
92	J112	50	1.0	1.0	5.0	5.0	—	35	10^{t}	5.0^{t}	13^{t}	35^{t}
18	MFE2005	50	1.0	−2.0	−8.0	15	—	−30	16	5.0	35	60
18	2N4392	60	1.0	2.0	5.0	25	75	40	14	3.5	15	35
92	MPF4392	60	1.0	2.0	5.0	25	75	20	10	3.5	15	35
18	2N4858A	60	1.0	0.8	4.0	8.0	80	40	10	3.5	16	80
92	MPF4858A	60	1.0	0.8	4.0	8.0	80	40	10	3.5	16	80
18	2N4861A	60	—	0.8	4.0	8.0	80	30	10	3.5	16	80
92	MPF4861A	60	—	0.8	4.0	8.0	80	30	10	3.5	16	80
92	2N5639	60	1.0	—	$(8.0)^{t}$	25	—	30	10	4.0	14	30
18	2N3971	60	1.0	2.0	5.0	25	75	40	25	6.0	30	60
18	2N4858	60	—	0.8	4.0	8.0	80	40	18	8.0	20	100
92	MPF4858	60	—	0.8	4.0	8.0	80	40	18	8.0	20	100
18	2N4861	60	—	0.8	4.0	8.0	80	30	18	8.0	20	100
92	MPF4861	60	—	0.8	4.0	8.0	80	30	18	8.0	20	100
18	2N4093	80	1.0	1.0	5.0	80	—	40	16	5.0	60	80
18	MFE2004	80	1.0	−1.0	−6.0	8.0	—	−30	16	5.0	60	80
18	2N4393	100	1.0	0.5	3.0	5.0	30	40	14	3.5	15	50
92	MPF4393	100	1.0	0.5	3.0	5.0	30	20	10	3.5	15	55
92	2N5640	100	1.0	—	(6.0)	5.0	—	30	10	4.0	18	45
18	2N3972	100	1.0	0.5	3.0	5.0	30	40	25	6.0	80	100
92	MPF3972	100	1.0	0.5	3.0	5.0	30	40	25	6.0	80	100
92	J113	100	1.0	0.5	3.0	2.0	—	35	10^{t}	5.0^{t}	13^{t}	35^{t}
92	BF246	—	—	0.5	14	10	300	25	—	—	—	—
92	BF246A	35^{t}	1.0	1.5	4.0	30	80	25	—	—	—	—
92	BF246B	50^{t}	1.0	3.0	7.0	60	140	25	—	—	—	—
92	BF246C	65^{t}	1.0	5.5	12	110	250	25	—	—	—	—
92	J107	8.0	—	0.5	4.5	100	—	25	—	—	—	—
92	J108	8.0	—	3.0	10	80	—	25	—	—	—	—
92	J109	12	—	2.0	6.0	40	—	25	—	—	—	—
92	J110	18	—	0.5	4.0	10	—	25	—	—	—	—

t = typical

MOSFETs

MOSFETs are available in either depletion/enhancement or enhancement mode (in general, depletion/enhancement devices are operated in the depletion mode and are referred to as depletion devices). They are available in both N- and P-channel, and both single gate and dual gate construction. Some MOSFETs are also offered with input diode protection which reduces the chance of damage from static charge in handling.



Dual Gate

These devices are especially suited for RF amplifier and mixer applications in TV tuners, radio, etc. The Dual Gate construction also allows easy AGC control with very low power.

N-Channel MOSFETs

Package TO-	Device	$R_e \vert Y_{fs} \vert$ (mmho) Min	@ f (MHz)	$R_e \vert Y_{os} \vert$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	@ RG = 1K f (MHz)	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
72	MFE521	10	0.001	—	—	4.0	0.02	3.5	200	10	0.5	2.0	5.0	20
72	MFE211	17	0.001	—	—	—	0.05	3.5	200	±6.0	−0.2	−5.5	6.0	40
72	MFE203	7.0	0.001	—	—	4.3[t]	0.03	4.5	200	±6.0	−0.2	−5.0	3.0	11
72	MFE201	8.0	0.001	—	—	4.5[t]	0.03	4.5	200	±6.0	−0.2	−5.0	6.0	30
72	MFE202	8.0	0.001	—	—	4.3[t]	0.03	4.5	200	±6.0	−0.2	−5.0	6.0	30
72	MFE121	10	0.001	—	—	6.0	0.02	5.0	60	±7.0	—	−4.0	5.0	30
72	MFE131	8.0	0.001	—	—	7.0	0.05	5.0	200	±7.0	—	−4.0	3.0	30
72	MFE204	10	0.001	—	—	—	0.03	5.0	400	25	−0.2	−4.0	6.0	30
72	MFE205	10	0.001	—	—	—	0.03	5.0	400	25	−0.2	−4.0	6.0	30
72	MFE209	10	0.001	—	—	7.0	0.03	6.0	500	±7.0	−0.1	−4.0	5.0	30

t = typical

Low-Frequency/Low-Noise

P-Channel MOSFETs

Package TO-	Device	$R_e \vert Y_{fs} \vert$ (mmho) Min	$R_e \vert Y_{fs} \vert$ (μmho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)DSS}$ (V) Min	$V_{GS(th)}$ (V) Min	$V_{GS(th)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
72	3N155	1.0	60	5.0	1.3	−35	−1.5	−3.2	—	−1.0
72	3N156	1.0	60	5.0	1.3	−35	−3.0	−5.0	—	−1.0
72	3N157	1.0	60	5.0	1.3	−35	−1.5	−3.2	—	−1.0
72	3N158	1.0	60	5.0	1.3	−35	−3.0	−5.0	—	−1.0
72	3N158A	1.0	60	5.0	1.3	−25	−2.0	−6.0	—	−20
18	MFE823	1.0	—	6.0	1.5	−50	−3.0	−5.0	—	−0.25

N-Channel MOSFETs

Package TO-	Device	$R_e \vert Y_{fs} \vert$ (mmho) Min	$R_e \vert Y_{fs} \vert$ (μmho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)DSS}$ (V) Min	$V_{GS(th)}$ (V) Min	$V_{GS(th)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
18	2N3796	0.4	1.8	7.0	0.8	25	—	−7.0	2.0	6.0
18	MFE825	0.5	—	4.0	0.7	20	—	—	1.0	25
72	2N4351	1.0	—	5.0	1.3	25	1.0	5.0	—	10
72	3N169	1.0	—	5.0	1.3	25	0.5	1.5	—	10
72	3N170	1.0	—	5.0	1.3	25	1.0	2.0	—	10
72	3N171	1.0	—	5.0	1.3	25	1.5	3.0	—	10
18	2N3797	1.5	—	8.0	0.8	25	—	−7.0	2.0	6.0

TMOS Switches and Choppers

TO-226AA
N-CHANNEL

Device	$r_{DS(on)}$ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
VN0300L	1.2	1.0	0.8	2.5	30	100	25	30	30
2N7000	5.0	0.5	0.8	3.0	60	60	5.0	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
VN1706L	6.0	0.5	0.8	2.0	170	125	20	16	30
VN2406L	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
MPF9200	6.4	0.25	1.0	4.0	200	90	10	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
BS108	8.5	0.1	0.3	2.0	200	90	8.0	8.0 Typ	10 Typ
VN1710L	10	0.5	0.8	2.0	170	125	20	16	50
VN2410L	10	0.5	0.8	2.0	240	125	20	16	50
MPF4150†	12	0.1	1.0	6.0	150	125	15	—	—
BS107	14	0.2	1.0	3.0	200	70 Typ	6.0 Typ	15	15
MPF350	35	0.1	1.0	4.0	350	125	20	20	20
2N7007	45	0.05	1.0	2.5	240	30	10	30	30
MPF500	50	0.1	1.0	4.0	500	125	20	20	20
MPF480	80	0.01	0.5	3.0	80	8.0	7.0	20	20
MPF481	140	0.01	0.5	3.0	180	8.0	7.0	20	20
P-CHANNEL									
VP0300L	2.5	1.0	2.0	4.5	30	150	60	30	30
BS170P	5.0	0.2	1.0	3.5	60	110	25	15	15
BS250	14	0.2	1.0	3.5	45	150	25	10	10
TO-226AE (1 WATT) 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
MPF89	6.4	0.25	1.0	2.7	200	90	3.5	15	15
P-CHANNEL									
MPF930P	1.4	1.0	1.0	3.5	35	150	50	30	30
MPF960P	1.7	1.0	1.0	3.5	60	150	50	30	30
MPF990P	2.0	1.0	1.0	3.5	90	150	50	30	30

CASE 370-01 (FET DIP)
N-CHANNEL

Device	$r_{DS(on)}$ Ω Max	@ mA	$V_{(BR)DSS}$ Volt Min	$I_{D(on)}$ $V_{GS} = 10$ V $V_{DS} = 5.0$ V Amp	G_{fs} mhos Min	@ 5.0 V Amp	C_{iss} @ 25 V pF Max	C_{oss} @ 25 V pF Max	C_{rss} @ 25 V pF Max	$t_{d(on)}$ ns Max	t_r ns Max	$t_{d(off)}$ ns Max	t_f ns Max
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
IRFD220	0.8	400	200	0.8	0.5	0.4	600	300	80	40	60	100	60
IRFD223	1.2	400	150	0.7	0.5	0.4	600	300	80	40	60	100	60
IRFD210	1.5	600	200	0.6	0.3	0.5	150	80	25	15	25	15	15
IRFD213	2.4	300	150	0.45	0.3	0.5	150	80	25	15	25	15	15
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

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
IRFD9110	1.2	300	100	0.7	0.6	0.3	250	100	35	30	60	40	40
IRFD9112	1.2	300	100	0.6	0.6	0.3	250	100	35	30	60	40	40

TO-205AD
N-CHANNEL

Device	$r_{DS(on)}$ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
VN0300B	1.2	1.0	0.8	2.5	30	100	25	30	30
MFE930	1.4	1.0	1.0	3.5	35	70	18	15	15
MFE960	1.7	1.0	1.0	3.5	60	70	18	15	15
2N6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
MFE990	2.0	1.0	1.0	3.5	90	70	18	15	15
2N6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
2N6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
MFE910	5.0	0.5	0.8	2.5	60	50	10	10	10
VN1706B	6.0	0.5	0.8	2.0	170	125	20	16	30
VN2406B	6.0	0.5	0.8	2.0	240	125	20	16	30
MFE9200††	6.4	0.25	1.0	4.0	200	90	10	15	15
VN1710B	10	0.5	0.8	2.0	170	125	20	16	57
VN2410B	10	0.5	0.8	2.0	240	125	20	16	57
MFE4150†	12	0.1	1.0	6.0	150	125	15	—	—
MFE350	35	0.1	1.0	4.0	350	125	20	20	20
MFE500	50	0.1	1.0	4.0	500	125	20	20	20

P-CHANNEL

MFE930P	1.4	1.0	1.0	3.5	35	150	50	30	30
MFE960P	1.7	1.0	1.0	3.5	60	150	50	30	30
MFE990P	2.0	1.0	1.0	3.5	90	150	50	30	30
VP0300B	2.5	1.0	2.0	4.5	30	150	60	30	30

†Depletion Mode
††TO-18 — Case Style 12

SMALL-SIGNAL FIELD-EFFECT TRANSISTORS (continued)

TMOS Switches and Choppers (continued)

TO-205AF
N-CHANNEL

Device	$r_{DS(on)}$ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
2N6796	0.18	8.0	2.0	4.0	100	900	150	105	85
IRFF130	0.18	8.0	2.0	4.0	100	800	150	200	250
IRFF133	0.25	7.0	2.0	4.0	60	800	150	200	250
IRFF120	0.3	6.0	2.0	4.0	100	600	100	110	170
2N6798	0.4	5.5	2.0	4.0	200	900	150	80	90
IRFF123	0.4	5.0	2.0	4.0	60	600	100	110	170
IRFF230	0.4	5.5	2.0	4.0	200	150	150	80	90
2N6782	0.6	3.5	2.0	4.0	100	200	25	40	45
IRFF110	0.6	3.5	2.0	4.0	100	200	25	45	45
IRFF233	0.6	4.5	2.0	4.0	150	800	150	80	90
2N6790	0.8	3.5	2.0	4.0	200	600	80	90	100
IRFF113	0.8	3.0	2.0	4.0	60	200	25	45	45
IRFF220	0.8	3.5	2.0	4.0	200	600	80	100	160
2N6800	1.0	3.0	2.0	4.0	400	900	80	65	90
IRFF330	1.0	3.5	2.0	4.0	400	900	80	65	90
IRFF223	1.2	3.0	2.0	4.0	150	600	80	100	160
MFE930	1.4	1.0	1.0	3.5	35	70	18	15	15
2N6784	1.5	2.25	2.0	4.0	200	200	25	35	50
2N6802	1.5	3.5	2.0	4.0	500	900	60	60	85
IRFF210	1.5	2.2	2.0	4.0	200	150	25	40	30
IRFF333	1.5	3.0	2.0	4.0	350	900	80	65	90
IRFF430	1.5	2.75	2.0	4.0	500	800	60	60	85
IRFF313	1.5	1.15	2.0	4.0	350	150	15	30	25
MFE960	1.7	1.0	1.0	3.5	60	70	18	15	15
2N6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
IRFF433	2.0	2.25	2.0	4.0	450	800	60	60	85
MFE990	2.0	1.0	1.0	3.5	90	70	18	15	15
IRFF213	2.4	1.8	2.0	4.0	150	150	25	40	30
2N6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
2N6786*	3.6	1.25	2.0	4.0	400	200	15	35	65
IRFF310	3.6	1.35	2.0	4.0	400	150	15	30	25
2N6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0

P-CHANNEL

Device	$r_{DS(on)}$ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
IRFF9120	0.6	−4.0	2.0	4.0	−100	450	100	150	200
IRFF9123	0.8	−3.5	2.0	4.0	−60	450	100	151	200

Small-Signal Surface Mount Devices

CASE 318
TO-236AA
TO-236AB
SOT-23

SO-16

Bipolar Transistors — SOT-23

General-Purpose Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending breakdown voltage.

Device	Marking	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	@ I_C (mA)	f_T Min (MHz)
NPN						
BC846A	1A	65	110	220	2	100
BC846B	1B	65	200	450	2	100
BSS82B	CH	60	40	120	150	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
BCX70K	AK	45	100	—	50	125
BCX70J	AJ	45	90	—	50	125
BCW72	K2	45	200	450	2	—
BCX70H	AH	45	70	—	50	125
BCX70G	AG	45	60	220	50	125
MMBT930	1X	45	150	—	0.5	30
BCW71	K1	45	110	220	2	—
BCX19	U1	45	40	—	500	200
MMBC1623L7	L7	40	300	600	1	200
MMBC1623L6	L6	40	200	400	1	200
MMBC1623L5	L5	40	135	270	1	200
BSS79C	CF	40	100	300	150	250
MMBT2222A	1P	40	40	—	500	200
MMBT3904	1A	40	30	—	100	200
MMBT4401	2X	40	40	—	500	250
MMBC1623L4	L4	40	90	180	1	200
MMBC1623L3	L3	40	60	120	1	200
MMBT3903	1Y	40	15	—	100	250
BSS79B	CE	40	40	120	150	250
MMBTA20	1C	40	40	400	5	125
MMBT4123	5B	30	25	—	50	250
MMBC1622D8	D8	35	450	900	0.5	100
MMBC1622D7	D7	35	300	600	0.5	100
MMBC1622D6	D6	35	200	400	0.5	100
BCW60A	AA	32	60	—	50	125
BCW60D	AD	32	100	—	50	125
BCW65A	EA	32	100	250	100	100
BCW60C	AC	32	90	—	50	125
BCW65C	EC	32	100	—	500	100
BCW60B	AB	32	70	—	50	125
BCW65B	EB	32	60	—	500	100
BC848A	1J	30	110	220	2	100
BC848B	1K	30	200	450	2	100
BC848C	1L	30	420	800	2	100
MMBT2222	1B	30	30	—	500	250
MMBC1009F1	F1	25	30	60	0.5	150
MMBC1009F3	F3	25	60	120	0.5	150
BC818-16	6E	25	100	250	100	200
BC818-25	6F	25	160	400	100	200
BC818-40	6G	25	250	600	100	200
BCX20	U2	25	100	600	100	—
BCW33	D3	20	420	—	2	—
BCW31	D1	20	110	220	2	—

SURFACE MOUNT BIPOLAR DEVICES (continued)

General-Purpose Transistors (continued)

Device	Marking	$V_{(BR)CEO}$	h_{FE} Min	Max	@ I_C (mA)	f_T Min (MHz)
PNP						
MMBT8599	2W	80	75	—	100	150
BC856A	3A	65	125	250	2	100
BC856B	3B	65	220	475	2	100
MMBT8598	2K	60	75	—	100	150
BSS82C	CM	60	100	300	150	100
MMBT2907A	2F	60	50	—	500	200
MMBA811C8	C8	45	450	900	5	50
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
BCX71K	BK	45	100	—	50	—
MMBA811C7	C7	45	300	600	5	50
BCX71J	BJ	45	100	—	50	—
BCW70	H2	45	215	500	2	—
MMBA811C6	C6	45	200	400	5	50
BCW68G	DG	45	60	—	500	100
MMBA811C5	C5	45	135	270	5	50
BCW69	H1	45	120	260	2	—
BCX71G	BG	45	60	—	50	—
BCW68F	DF	45	35	—	500	100
BCX17	T1	45	100	600	100	100
MMBA813S4	S4	45	100	200	50	100
MMBA813S3	S3	45	75	150	50	100
MMBA813S2	S2	45	50	100	50	100
MMBA812M7	M7	40	300	600	1	150
MMBA812M6	M6	40	200	400	1	150
MMBA812M5	M5	40	135	270	1	150
MMBT2907	2B	40	30	—	500	200
MMBT3906	2A	40	100	300	10	250
MMBT4403	2T	40	100	300	150	200
MMBA812M4	M4	40	90	180	1	150
MMBA812M3	M3	40	60	120	1	150
BSS80B	CH	40	40	120	150	200
BSS80C	CJ	40	100	30	150	200
MMBTA70	2C	40	40	400	5	125
BCW61D	BD	32	110	—	50	—
BCW61C	BC	32	100	—	50	—
BCW67C	EC	32	100	—	500	100
BCW61B	BB	32	80	—	50	—
BCW67B	DB	32	60	—	500	100
BCW61A	BA	32	60	—	50	—
BCW67A	DA	32	35	—	500	100
BC808-16	5E	25	100	250	100	200
BC808-25	5F	25	160	400	100	200
BC808-40	5G	25	250	600	100	200
BC858A	3J	30	125	250	2	100
BC858B	3K	30	220	475	2	100
BC858C	3L	30	420	800	2	100
MMBT4125	ZD	30	25	—	50	200
BCX18	T2	25	40	—	500	—
MMBTA55	AL	25	30	—	500	100
BCW30	C2	20	215	500	2	—
BCW29	C1	20	120	260	2	—

Switching Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	Switching Time (ns) t_{on}	Switching Time (ns) t_{off}	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)	f_T Min (MHz)
NPN								
MMBT2369	1J	12	18	15	20	—	100	—
BSV52	B2	12	18	12	40	120	10	400
MMBT2222	1B	35	385	30	30	—	500	250
MMBT2222A	1P	35	385	40	40	—	500	200
MMBT4401	2X	35	255	40	40	—	500	250
MMBT3903	1Y	70	225	40	15	—	100	250
MMBT3904	1A	70	250	40	30	—	100	200
PNP								
MMBT3638A	BN	75	170	25	20	—	300	—
MMBT3638	AM	75	170	25	20	—	300	—
MMBT3640	2J	25	35	12	20	—	50	500
MMBT4403	2T	35	225	40	90	180	1	150
MMBT2907	2B	45	100	40	30	—	500	200
MMBT2907A	2F	45	100	60	50	—	500	200
MMBT3906	2A	70	300	40	100	300	10	250

VHF/UHF Amplifiers, Mixers, Oscillators

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)CEO}$	C_{ob} Max (pF)	f_T Min (GHz)	f_T @ I_C (mA)
NPN					
MMBT3960A	1T	8	2	1.6	30
MMBT3960	15	3	2	1.6	30
MMBTH10	3E	25	0.7	0.65	4
MMBC1321Q3	Q3	25	1.8	0.6	2
MMBC1321Q4	Q4	25	1.8	0.6	2
MMBC1321Q5	Q5	25	1.8	0.6	2
MMBT918	3B	15	1.7	0.6	4
MMBTH24	3A	30	0.36	0.4	8
PNP					
MMBTH81	3D	20	0.85	0.6	5

Choppers

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)EBO}$	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)
PNP						
MMBT404	2M	12	24	30	400	12
MMBT404A	2N	25	35	30	400	12

SURFACE MOUNT BIPOLAR DEVICES (continued)

Darlingtons

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending h_{FE}.

Device	Marking	$V_{(BR)CEO}$	$V_{CE(sat)}$ Max (V)	h_{FE} Min	Max	@ I_C (mA)
NPN						
MMBTA14	1N	30	1.5	20K	—	100
MMBT6427	1V	40	1.5	14K	140K	500
MMBTA13	1M	30	1.5	10K	—	100
PNP						
MMBTA64	2V	30	1.5	20K	—	100
MMBTA63	2U	30	1.5	10K	—	100

Low-Noise Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of ascending NF.

Device	Marking	NF Typ (dB)	$V_{(BR)CEO}$	h_{FE} Min	Max	@ I_C (mA)	f_T Min (MHz)
NPN							
MMBT5088	1Q	1	30	300	—	10	50
MMBT5089	1R	1	30	400	—	10	50
MMBT2484	1U	3	60	—	800	10	15
MMBT6428	1K	3	50	250	—	10	100
MMBT6429	1L	3	45	500	—	10	100
PNP							
MMBT5086	2P	1	50	150	—	10	40
MMBT5087	2Q	1	50	250	—	10	40
BC849B	2B	4*	30	200	450	2	100
BC849C	2C	4*	30	420	800	2	100
BC850B	2F	4*	45	200	450	2	100
BC850C	2G	4*	45	420	800	2	100
BC859A	4A	4*	30	100	220	2	100
BC859B	4B	4*	30	200	450	2	100
BC859C	4C	4*	30	420	800	2	100
BC860A	4E	4*	45	100	220	2	100
BC860B	4F	4*	45	200	450	2	100
BC860C	4G	4*	45	420	800	2	100

*Max

High-Voltage Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending breakdown voltage.

Device	Marking	$V_{(BR)CEO}$	h_{FE} Min	Max	@ I_C (mA)	f_T Min (MHz)
NPN						
MMBT6517	1Z	350	15	—	100	40
MMBTA42	1D	300	40	—	30	50
MMBTA43	1E	200	40	—	30	50
MMBC1654N5	N5	160	50	130	15	120
MMBC1654N6	N6	160	100	220	15	120
MMBC1654N7	N7	160	150	330	15	120
MMBT5550	1F	160	30	—	50	100
MMBT5551	G1	160	30	—	50	100
PNP						
MMBT6520	2Z	350	15	—	100	40
MMBTA92	2D	300	25	—	30	50
MMBTA93	2E	200	25	—	30	50
MMBT5401	2L	150	50	—	50	100

Drivers

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)	f_T Min (MHz)
NPN						
MMBTA06	1G	80	50	—	100	100
BSS64	AM	80	20	80	4	50
MMBTA05	1H	60	50	—	100	100
PNP						
BSS63	BM	100	30	—	25	50
MMBTA55	2H	60	50	—	100	50
MMBTA56	2G	80	50	—	100	50

RF Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

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)	MAG Typ (dB)	MAG @ I_C (mA)	MAG V_{CE} (V)	f (MHz)
NPN											
MMBR571	7X	8	50	10	2	5	6	16.5*	5	6	500
MMBR911	7P	6	30	10	2	10	10	17*	10	5	500
MMBR930	7C	5.5	30	5	1.9	2	5	11	30	5	500
BFR92	P1	3	14	10	3	3	1.5	—	—	—	500
BFR93	R1	3	30	5	2.5	2	5	—	—	—	30
MMBR931	7D	3.5	1	1	4.3	0.5	1	10	1	1	1000
MMBR2060	7E	2.5	20	1	2	1.5	10	13	20	10	450
MMBR5179	7H	1.5	5	6	4	1.5	6	11	5	6	450
MMBR920	7B	4.5	14	10	2.4	2	10	15	2	10	500
MMBR901	7A	4	15	10	1.9	5	6	16	5	6	1000
MMBR941	7Y	8	15	6	1.7	5	6	12.5	5	6	2000
MMBR951	7Z	7.5	30	6	1.7	5	6	12.5	5	6	2000
MMBR5031	7G	2	5	6	1.9	1	6	17	1	6	450
MMBR2857	7K	1.2	4	10	3	1.5	6	12.5	1.5	6	450
BFS17	E1	1	2	5	5	2	5	—	—	—	30
PNP											
MMBR536	7R	5.5	20	5	4.5	10	5	—	—	—	500
MMBR4957	7F	2	2	10	3	2	10	17	2	10	450

*GNF

Bipolar Quad Transistors — SO-16

Device	$V_{(BR)CEO}$	$V_{(BR)CBO}$	h_{FE} Min	h_{FE} @ I_C mA	f_T MHz Min	f_T @ I_C (mA)	Package
MMPQ2222	40	60	30	300	350*	20	SO-16
MMPQ2222A	40	75	40	500	350*	20	SO-16
MMPQ2907	40	40	30	300	350*	50	SO-16
MMPQ2907A	50	60	50	500	350*	50	SO-16
MMPQ3467	40	40	20	500	125	50	SO-16
MMPQ3725	40	60	25	500	250	50	SO-16
MMPQ3725A	50	70	30	500	200	50	SO-16
MMPQ3762	40	40	20	1000	150	50	SO-16

*Typ

Field-Effect Transistors — SOT-23

RF JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	NF Typ (dB)	NF f (MHz)	Y_{fs} Min (mmhos)	Y_{fs} Max (mmhos)	V_{DS} (V)	$V_{(BR)GSS}$
N-CHANNEL							
MMBFU310	6C	1.5	1	10	18	10	−25
MMBF102	—	3**	—	2	7.5	15	−25
MMBF108	—	3**	100	2	7.5	15	−25
MMBF112	TV	3**	—	1	7.5	10	−25
MMBF5484	6B	2	100	3	6	15	−25
MMBF5485	—	2	100	3.5	7	15	−25
MMBF5486	6H	2	100	4	8	15	−25
MMBF4416	6A	2	100	4.5	7.5	15	−30
MMBFJ310	6T	4	450	8	18	10	−25

**Max

General-Purpose JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	$V_{(BR)GSS}$	Y_{fs} Min (mmhos)	Y_{fs} Max (mmhos)	V_{DS} (V)	I_{DSS} Min (mA)	I_{DSS} Max (mA)
N-CHANNEL							
MMBF5457	6D	25	1	5	15	1	5
MMBF5459	6L	25	2	6	15	4	16
P-CHANNEL							
MMBF5460	6E	−40	1	4	−15	1	5

Choppers/Switches, JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

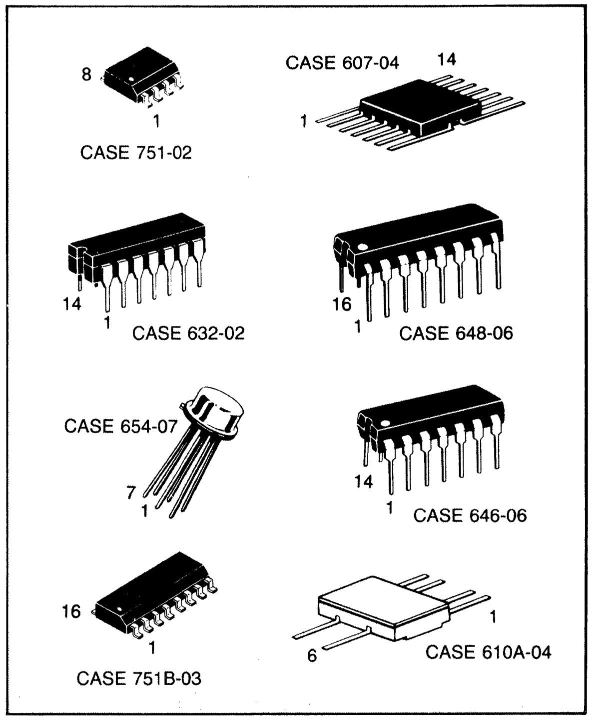
Device	Marking	$r_{DS(on)}$ Max (Ohms)	t_{off} Max (ns)	$V_{(BR)GSS}$	$V_{GS(off)}$ Min (V)	$V_{GS(off)}$ Max (V)	I_{DSS} Min (mA)	I_{DSS} Max (mA)
N-CHANNEL								
MMBF4391	6J	30	20	30	−4	−10	50	150
BSR56	M4	25	25	40	−4	−10	50	—
MMBF4860	6F	40	50	30	−2	−6	20	100
BSR57	M5	40	50	40	−2	−6	20	100
MMBF4392	6K	60	35	30	−2	−5	25	75
BSR58	M6	60	100	40	−0.8	−4	8	80
MMBF4393	6G	100	50	30	−0.5	−3	5	30
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

TMOS FETs

Pinout: 1-Gate, 2-Source, 3-Drain

Device	Marking	$r_{DS(on)}$ Ohm	$r_{DS(on)}$ mA	V_{DSS}	$V_{GS(th)}$ Min (V)	$V_{GS(th)}$ Max (V)	Switching Time t_{on} ns	Switching Time t_{off} ns
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

Multiple Devices



Bipolar Transistors

The trend in electronic system design is toward the use of integrated circuits — to reduce component cost, assembly cost, and equipment cost. But ICs still aren't all things to all people, and for those circuit designs where ICs are not available, there is a noticeable swing towards the use of multiple devices.*

Motorola is reacting to this expanding market requirement by making available a large selection of quad and dual transistors, for off-the-shelf delivery. The chips used in the Quad and Dual transistors are those that have emerged as the most popular ones for discrete transistor applications. But even beyond that, Motorola offers its entire vast repertoire of discrete small-signal transistors for multiple-device packaging. For special applications where the devices in these tables might not quite fit the design requirements, special configurations can be supplied with quick turnaround time and at low premiums.

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 Bipolar Quad and Dual Transistor tables only.

KEY

TYPE NO.	ID	P_D Watts One Die Only	Ref. Point	V_{CE} Volts	Subscript	I_C Amp Max	h_{FE} @ I_C Min	Unit	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** @ *I_C & I_C I_B*	**f**	Unit	PACKAGE TO-No.	Case No.

Alphanumeric listing type numbers

Identification Code
1st Letter: Polarity
C — both types in multiple device
N — NPN
P — PNP
2nd Letter: Use
A — General Purpose Amplifier
E — Low Noise Audio Amplifier
F — Low Noise RF Amplifier
G — General Purpose Amplifier and Switch
H — Tuned RF IF Amplifier
M — Differential Amplifier
S — High Speed Switch

Power Dissipation specified at 25°C. Single die rating.
Ref. Point: A — Ambient temperature
C — Case temperature

Rated Minimum Collector-Emitter Voltage
Subscript letter identifies base termination listed below in order of preference.
SUBSCRIPT:
0 — V_{CEO}, open

Continuous (DC) Collector Current

Common-emitter DC Current Gain.
Units for test current:
A — ampere
m — mA
u — μA

Current-Gain-Bandwidth Product.

Output Capacitance, common-base. Shown without distinction:
C_{cb} — Collector-Base Capacitance
C_{re} — Common-Emitter Reverse Transfer Capacitance

h_{FE1}/h_{FE2} — Current Gain Ratio
V_{BE} — Differential Base Voltage $|V_{BE1} - V_{BE2}|$.
Differential Amplifiers
t_{on} — turn-on time
t_{off} — turn-off time

G_p — Power Gain
NF — Noise Figure
f — Test Frequency
AUD — 10–15 kHz
Frequency Units:
H — Hertz
K — kHz
M — MHz
G — GHz
$V_{CE(sat)}$ — Collector-Emitter Saturation Voltage
I_C — Test Current
Current Units: u — μA
m — mA
A — Amp

JEDEC Outline/ Motorola Package Outline.

MULTIPLE DEVICES (continued)

Bipolar Transistors — Quads

TYPE NO.	I_D	P_D Watts One Die Only	Ref. Point	V_{CE} Volts	Subscript	I_C Amp Max	h_{FE} Min	@ I_C	Unit	f_T MHz Min Typ*	C_{ob} pF Max Typ*	h_{FE1}/h_{FE2} / _t_{on} ns Max Typ*_	**ΔV_{BE} mV Max** / _t_{off} ns Max Typ*_	**G_p dB Min** / _$V_{CE(sat)}$ @ Volts Max_	**NF dB Max Typ*** @ / _I_C/I_B_	**f** / _& I_C_	Unit	PACKAGE TO- No.	Case No.
MHQ2369	NS	0.5	A	15	O	0.5	40	10	m	450	4.0	_9.0*_	_15*_	_0.25_	_10_	_10_	_m_	116	632
MHQ2906	PG	0.65	A	40	O	0.6	40	150	m	200	8.0	_30*_	_100*_	_0.4_	_10_	_150_	_m_	116	632
MHQ2907†	PG	0.65	A	40	O	0.6	100	150	m	200	8.0	_30*_	_100*_	_0.4_	_10_	_150_	_m_	116	632
MHQ3467†	PS	0.9	A	40	O	1.0	20	500	m	125	25	_40_	_90_	_0.5_	_10_	_500_	_m_	116	632
MHQ3546	PS	0.5	A	12	O	0.2	30	10	m	600	6.0	_0.15*_	_25*_	_0.25_	_10_	_10_	_m_	116	632
MHQ3798	PA	0.5	A	40	O	0.05	150	0.1	m	60	4.0				**3.0***	**AUD**		116	632
MHQ4002A	NS	0.75	A	45	O	1.5	30	500	m	200	10	_40_	_75_	_0.52_	_10_	_500_	_m_	116	632
MHQ4013††	NS	0.75	A	40	O	1.5	35	500	m	200	10	_35_	_60_	_0.52_	_10_	_500_	_m_	116	632
MHQ4014	NS	0.75	A	45	O	1.5	35	500	m	200	10	_35_	_60_	_0.52_	_10_	_500_	_m_	116	632
MHQ6002	CA	0.65	A	30	O	0.5	100	150	m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150_	_m_	116	632
MPQ1000	NA	0.65	A	20	O	0.5	50	10	m	175	8.0			_0.5_	_10_	_150_	_m_		646
MPQ2221	NA	0.65	A	30	O	0.5	40	150	m	200	8.0	_25*_	_250*_	_0.4_	_10_	_150_	_m_		646
MPQ2221A	NA	0.65	A	30	O	0.5	40	150	m	200	8.0	_25*_	_250*_	_0.4_	_10_	_150_	_m_		646
MPQ2222	NA	0.65	A	30	O	0.5	100	150	m	200	8.0	_25*_	_250*_	_0.4_	_10_	_150_	_m_		646
MPQ2222A	NA	0.65	A	30	O	0.5	100	150	m	200	8.0	_25*_	_250*_	_0.4_	_10_	_150_	_m_		646
MPQ2369	NS	0.5	A	15	O	0.5	40	10	m	450	4.0	_9.0*_	_15*_	_0.25_	_10_	_10_	_m_		646
MPQ2483	NA	0.625	A	40	O	0.05	150	1.0	m	50					**3.0***	**AUD**			646
MPQ2484	NA	0.625	A	40	O	0.05	300	1.0	m	50					**2.0***	**AUD**			646
MPQ2906	PA	0.65	A	40	O	0.6	40	150	m	200	8.0	_30*_	_100*_	_0.4_	_10_	_150_	_m_		646
MPQ2906A	PA	0.65	A	60	O	0.6	40	150	m	200	8.0	_30*_	_100*_	_0.4_	_10_	_150_	_m_		646
MPQ2907	PA	0.65	A	40	O	0.6	100	150	m	200	8.0	_30*_	_100*_	_0.4_	_10_	_150_	_m_		646
MPQ2907A	PA	0.65	A	60	O	0.6	100	150	m	200	8.0	_30*_	_100*_	_0.4_	_10_	_150_	_m_		646
MPQ3467	PS	0.75	A	40	O	1.0	20	500	m	125	25	_40_	_90_	_0.5_	_10_	_500_	_m_		646
MPQ3546	PA	0.5	A	12	O	0.2	30	10	m	600	6.0	_15*_	_25*_	_0.25_	_10_	_10_	_m_		646
MPQ3725†	NS	1.0	A	40	O	1.0	25	500	m	250	10	_35_	_60_	_0.45_	_10_	_500_	_m_		646
MPQ3725A	NS	1.0	A	50	O	1.0	30	500	m	200	10	_3.5_	_60_	_0.45_		_500_	_m_		646
MPQ3762	PS	0.75	A	40	O	1.5	35	150	m	150	15	_50_	_120_	_0.55_	_10_	_500_	_m_		646
MPQ3798	PA	0.625	A	40	O	0.05	150	0.1	m	60	4.0				**3.0***	**AUD**			646
MPQ3799	PA	0.625	A	60	O	0.05	300	0.1	m	60	4.0				**2.0***	**AUD**			646
MPQ3904	NG	0.5	A	40	O	0.2	75	10	m	250	4.0	_37*_	_136*_	_0.2_	_10_	_10_	_m_		646
MPQ3906	PG	0.5	A	40	O	0.2	75	10	m	200	4.5	_43*_	_155*_	_0.25_	_10_	_10_	_m_		646
MPQ6001	CG	0.65	A	30	O	0.5	40	150	m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150_	_m_		646
MPQ6002	CG	0.65	A	30	O	0.5	100	150	m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150_	_m_		646
MPQ6100	CA	0.5	A	40	O	0.05	75	1.0	m	50	4.0				**4.0***	**AUD**			646
MPQ6100A	CA	0.5	A	45	O	0.05	150	1.0	m	50	4.0				**4.0***	**AUD**			646
MPQ6501	CG	0.65	A	30	O	0.5	40	150	m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150_	_m_		646
MPQ6502	CG	0.65	A	30	O	0.5	100	150	m	200	8.0	_30*_	_225*_	_0.4_	_10_	_150_	_m_		646
MPQ6600	CA	0.5	A	40	O	0.05	75	1.0	m	50	4.0				**4.0***	**AUD**			646
MPQ6600A	CA	0.5	A	45	O	0.05	150	1.0	m	50	4.0			_0.25_	_4.0_	_1.0_	_m_		646
MPQ6700	CA	0.5	A	40	O	0.2	70	10	m	200	4.5			_0.25_	_4.0_	_1.0_	_m_		646
MPQ6842	CA	0.75	A	40	O	0.5	70	10	m	300	4.5	_45_	_150_	_0.15_	_10_	_0.5_	_m_		646
MPQ7041	NA	0.75	A	150	O	0.5	25	1.0	m	50	5.0			_0.5_	_10_	_20_	_m_		646
MPQ7042	NA	0.75	A	200	O	0.5	25	1.0	m	50	5.0			_0.5_	_10_	_20_	_m_		646
MPQ7043	NA	0.75	A	250	O	0.5	25	1.0	m	50	5.0			_0.5_	_10_	_20_	_m_		646
MPQ7091	PA	0.75	A	150	O	0.5	25	1.0	m	50	5.0			_0.5_	_10_	_20_	_m_		646
MPQ7092	PA	0.75	A	200	O	0.5	25	1.0	m	50	5.0			_0.5_	_10_	_20_	_m_		646
MPQ7093	PA	0.75	A	250	O	0.5	35	10	m	50	5.0			_0.5_	_10_	_20_	_m_		646
MQ918	NA	0.55	A	15	O	0.05	50	3.0	m	600	1.7				**6.0**	**60**	**M**		607
MQ930	NA	0.4	A	45	O	0.03	150	1.0	m	260*	6.0								607
MQ982	PA	0.4	A	50	O	0.6	40	150	m	200	8.0			_0.5_	_10_	_150_	_m_		607

†H, HX, and HXV Suffixes also available.
††MHQ4013 is electrically equivalent to MHQ3725.
Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Bipolar Transistors — Quads (continued)

TYPE NO.	I_D	P_D Watts One Die Only	Ref. Point	V_{CE}- Volts	Subscript	I_C Amp Max	h_{FE} Min	@ I_C	Unit	f_T MHz Min Typ*	C_{ob} pF Max Typ*	**h_{FE1}/h_{FE2}** / *t_{on} ns Max Typ**	**ΔV_{BE} mV Max** / *t_{off} ns Max Typ**	**G_p dB Min** / *V_{CE} (sat) @ Volts Max*	**NF dB Max Typ* @** / *I_C/I_B*	**f** / & *I_C*	Unit	PACKAGE TO- No.	PACKAGE Case No.
MQ1120	PA	0.4	A	30	O	0.5	50	10	m	200	8.0			*0.1*	*10*	*10*	*m*		607
MQ1129	NA	0.4	A	30	O	0.5	100	10	m	200	8.0			*0.15*	*10*	*10*	*m*		607
MQ2218	NA	0.4	A	30	O	0.5	40	150	m	200	8.0			*0.4*	*10*	*150*	*m*		607
MQ2218A	NA	0.6	A	40	O	0.5	40	150	m	200	8.0			*0.4*	*10*	*150*	*m*		607
MQ2219	NA	0.6	A	30	O	0.5	100	150	m	200	8.0			*0.3*	*10*	*150*	*m*		607
MQ2219A	NA	0.4	A	30	O	0.5	100	150	m	200	8.0			*0.3*	*10*	*150*	*m*		607
MQ2369	NS	0.4	A	15	O	0.5	40	10	m	500	4.0	*15*	*20*	*0.25*	*10*	*10*	*m*		607
MQ2484	NE	0.4	A	60	O	0.03	100	10	u	260*	6.0				**3.0**	**AUD**			607
MQ2905A	PG	0.4	A	60	O	0.6	100	150	m	300	8.0	*42*	*130*	*0.4*	*10*	*150*	*m*		607
MQ3251	PA	0.4	A	40	O	0.05	100	10	m	300	6.0			*0.25*	*10*	*10*	*m*		607
MQ3467	PS	0.4	A	40	O	1.0	20	500	m	150	20	*40*	*110*	*0.5*	*10*	*500*	*m*		607
MQ3725	NS	0.4	A	40	O	1.0	50	100	m	200	10	*45*	*75*	*0.26*	*10*	*100*	*m*		607
MQ3762	PS	0.4	A	40	O	1.5	20	1.0	A	150	20	*40*	*110*	*1.0*	*10*	*1.0*	*A*		607
MQ3798	PA	0.4	A	60	O	0.05	150	100	u	450*	4.0			*0.2*	*10*	*1.0*	*m*		607
MQ6001	CG	0.4	A	30	O	0.5	40	150	m	200	8.0	*60*	*350*	*0.4*	*10*	*150*	*m*		607
MQ7001	PA	0.4	A	30	O	0.6	70	1.0	m	200	8.0			*0.4*	*10*	*150*	*m*		607
MQ7003	NA	0.4	A	40	O	0.05	50	10	m	200	6.0			*0.35*	*10*	*1.0*	*m*		607
MQ7004	NA	0.4	A	13	O	0.2	30	10	m	675*	4.0			*0.4*	*10*	*10*	*m*		607
MQ7007	PA	0.4	A	40	O	0.2	30	1.0	m	300	8.0			*1.0*	*10*	*50*	*m*		607
MQ7021	CG	0.4	A	40	O	0.05	50	10	m	200	6.0	*28**	*72**	*0.35*	*10*	*10*	*m*		607
2N5146	PA	0.4	A	40	O	1.5	20	1.0	A	150	20	*40*	*110*	*1.0*	*10*	*1.0*	*A*		607

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Bipolar Transistors — Duals

TYPE NO.	I_D	P_D Watts One Die Only	Ref. Point	V_{CE}- Volts	Subscript	I_C Amp Max	h_{FE} Min	@ I_C	Unit	f_T MHz Min Typ*	C_{ob} pF Max Typ*	**h_{FE1}/h_{FE2}** / *t_{on} ns Max Typ**	**ΔV_{BE} mV Max** / *t_{off} ns Max Typ**	**G_p dB Min** / *V_{CE} (sat) @ Volts Max*	**NF dB Max Typ* @** / *I_C/I_B*	**f** / & *I_C*	Unit	PACKAGE TO- No.	PACKAGE Case No.
BFX11	PM	0.4	A	45	O	0.05	80	50	m	130	8.0	0.8	5.0	0.25	20	50	m	78	654
BFX15	NM	0.5	A	40	O	0.5	60	100	u	50	15	0.9	5.0	1.0	10	1.0	m	78	654
BFX36	PM	0.4	A	60	O	0.05	100	10	u	40	6.0	0.9	3.0	0.25	20	10	m	78	654
BFY81	NM	0.4	A	45	O	0.03	100	100	u	60	6.0	0.8	10	0.35	10	1.0	m	78	654
MD708	NG	0.55	A	15	O	0.2	40	10	m	300	5.0	*35*	*75*	*0.2*	*10*	*10*	*m*		654
MD708A	NM	0.55	A	15	O	0.2	40	10	m	300	5.0	**0.9**	**5.0**	*0.2*	*10*	*10*	*m*		654
MD708B	NM	0.55	A	15	O	0.2	40	10	m	300	5.0	**0.8**	**10**	*0.2*	*10*	*10*	*m*		654
MD918A	NM	0.55	A	15	O	0.05	50	3.0	m	600	1.7	**0.9**	**5.0**		**6.0**	**60**	**M**		654
MD918AF	NM	0.35	A	15	O	0.05	50	3.0	m	600	1.7	**0.9**	**5.0**		**6.0**	**60**	**M**		610A
MD918B	NM	0.55	A	15	O	0.05	50	3.0	m	600	1.7	**0.8**	**10**		**6.0**	**60**	**M**		654
MD982,F	PA	0.4	A	50	O	0.6	40	150	m	200	8.0			*0.5*	*10*	*150*	*m*		610A
MD984	PA	0.575	A	20	O	0.2	25	10	m	250				*0.5*	*10*	*50*	*m*		654
MD985	CA	0.575	A	30	O	0.5	40	150	m	200	8.0			*0.5*	*10*	*150*	*m*		654
MD1121	NM	0.575	A	30	O	0.5	50	10	m	200	8.0	**0.9**	**10**	*0.1*	*10*	*10*	*m*		654
MD1121F	NM	0.35	A	30	O	0.5	50	10	m	200	8.0	**0.9**	**10**	*0.1*	*10*	*10*	*m*		654
MD1122F	NM	0.35	A	30	O	0.5	50	20	m	200	8.0	**0.9**	**5.0**	*0.1*	*10*	*10*	*m*		654
MD1132	NM	0.3	A	15	O	0.05	50	1.0	m	600	1.7	**0.9**	**5.0**	*0.4*	*10*	*10*	*m*		654
MD2060F	NM	0.35	A	60	O	0.5	30	0.1	m	100	15	**0.9**	**5.0**	*0.1*	*8.0*	*10*	*m*		610A

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

MULTIPLE DEVICES (continued)

Bipolar Transistors — Duals (continued)

TYPE NO.	I_D	P_D Watts One Die Only (Ref. Point)	V_{CE-} Volts (Subscript)	I_C Amp Max	h_{FE} Min	@ I_C (Unit)	f_T MHz Min Typ*	C_{ob} pF Max Typ*	h_{FE1}/h_{FE2} / *t_{on} ns Max Typ**	ΔV_{BE} mV Max / *t_{off} ns Max Typ**	G_p dB Min / *V_{CE} (sat) @ Volts Max*	NF @ f dB Max Typ* / *I_C/I_B*	& I_C (Unit)	PACKAGE TO-No.	PACKAGE Case No.
MD2218	NG	0.575 A	30 O	0.5	40	150 m	200	8.0	*60*	*350*	*0.4*	*10*	*150 m*		654
MD2218A	NG	0.575 A	30 O	0.5	40	150 m	200	8.0	*45*	*310*	*0.3*	*10*	*150 m*		654
MD2218AF	NG	0.35 A	30 O	0.5	40	150 m	200	8.0	*45*	*310*	*0.3*	*10*	*150 m*		610A
MD2219A	NG	0.575 A	30 O	0.5	100	150 m	200	8.0	*45*	*310*	*0.3*	*10*	*150 m*		654
MD2219AF	NG	0.35 A	30 O	0.5	100	150 m	200	8.0	*45*	*310*	*0.3*	*10*	*150 m*		610A
MD2369	NS	0.55 A	15 O	0.5	40	10 m	500	4.0	*15*	*20*	*0.25*	*10*	*10 m*		654
MD2369A	NM	0.55 A	15 O	0.5	40	10 m	500	4.0	**0.9**	**5.0**	*0.25*	*10*	*10 m*		654
MD2369AF	NM	0.35 A	15 O	0.5	40	10 m	500	4.0	**0.9**	**5.0**	*0.25*	*10*	*10 m*		610A
MD2369B	NM	0.55 A	15 O	0.5	40	10 m	500	4.0	**0.8**	**10**	*0.25*	*10*	*10 m*		654
MD2369BF	NM	0.35 A	15 O	0.5	40	10 m	500	4.0	**0.8**	**10**	*0.25*	*10*	*10 m*		610A
MD2904	PG	0.575 A	40 O	0.6	40	150 m	200	8.0	*45*	*130*	*0.4*	*10*	*150 m*		654
MD2904A	PG	0.575 A	60 O	0.6	40	150 m	200	8.0	*45*	*130*	*0.4*	*10*	*150 m*		654
MD2904AF	PG	0.35 A	60 O	0.6	40	150 m	200	8.0	*45*	*130*	*0.4*	*10*	*150 m*		610A
MD2905	PG	0.575 A	40 O	0.6	100	150 m	200	8.0	*45*	*130*	*0.4*	*10*	*150 m*		654
MD2905A	PG	0.575 A	60 O	0.6	100	150 m	200	8.0	*45*	*130*	*0.4*	*10*	*150 m*		654
MD2905AF	PG	0.35 A	60 O	0.6	100	150 m	200	8.0	*45*	*130*	*0.4*	*10*	*150 m*		610A
MD3250	PA	0.575 A	40 O	0.2	50	1.0 m	200	6.0			*0.25*	*10*	*10 m*		654
MD3250A	PM	0.575 A	40 O	0.2	50	1.0 m	200	6.0	**0.9**	**5.0**	*0.25*	*10*	*10 m*		654
MD3250AF	PM	0.35 A	40 O	0.2	50	1.0 m	200	6.0	**0.9**	**5.0**	*0.25*	*10*	*10 m*		610A
MD3251	PA	0.575 A	40 O	0.2	100	1.0 m	250	6.0			*0.25*	*10*	*10 m*		654
MD3251A	PM	0.575 A	40 O	0.2	100	1.0 m	250	6.0	**0.9**	**5.0**	*0.25*	*10*	*10 m*		654
MD3251AF	PM	0.35 A	40 O	0.2	100	1.0 m	250	6.0	**0.9**	**5.0**	*0.25*	*10*	*10 m*		610A
MD3409	NM	0.575 A	30 O	0.5	50	10 m	200	8.0	**0.8**	**10**	*0.15*	*10*	*10 m*		654
MD3410	NM	0.575 A	30 O	0.5	50	10 m	200	8.0	**0.9**	**10**	*0.15*	*10*	*10 m*		654
MD3725	NS	0.6 A	40 O	1.0	50	100 m	200	10	*45*	*75*	*0.26*	*10*	*100 m*		654
MD3725F	NS	0.35 A	40 O	1.0	50	100 m	200	10	*45*	*75*	*0.26*	*10*	*100 m*		610A
MD3762	PS	0.6 A	40 O	1.5	20	1.0 A	150	20	*40*	*110*	*1.0*	*10*	*1.0 A*		654
MD3762F	PS	0.35 A	40 O	1.5	20	1.0 A	150	20	*40*	*110*	*1.0*	*10*	*1.0 A*		610A
MD5000	PH	0.3 A	15 O	0.05	20	3.0 m	600	1.7			**15**		**200 M**		654
MD5000A	PM	0.3 A	15 O	0.05	20	3.0 m	600	1.7	**0.9**	**5.0**	**15**		**200 M**		654
MD5000B	PM	0.3 A	15 O	0.05	20	3.0 m	600	1.7	**0.8**	**10**	**15**		**200 M**		654
MD6001	CG	0.575 A	30 O	0.5	40	150 m	200	8.0	*60*	*350*	*0.4*	*10*	*150 m*		654
MD6001F	CG	0.35 A	30 O	0.5	40	150 m	200	8.0	*60*	*350*	*0.4*	*10*	*150 m*		610A
MD6002	CG	0.575 A	30 O	0.5	100	150 m	200	8.0	*60*	*350*	*0.4*	*10*	*150 m*		654
MD6002F	CG	0.35 A	30 O	0.5	100	150 m	200	8.0	*60*	*350*	*0.4*	*10*	*150 m*		610A
MD6100	CA	0.5 A	45 O	0.05	100	0.1 m	30	4.0			*0.25*	*10*	*1.0 m*		654
MD6100F	CA	0.35 A	45 O	0.05	100	0.1 m	30	4.0			*0.25*	*10*	*10 m*		610A
MD7000	NA	0.575 A	30 O	0.5	70	150 m	200	8.0			*0.4*	*10*	*150 m*		654
MD7001	PA	0.6 A	30 O	0.6	70	150 m	200	8.0			*0.4*	*10*	*150 m*		654
MD7001F	PA	0.35 A	30 O	0.6	70	150 m	200	8.0			*0.4*	*10*	*150 m*		610A
MD7002	NA	0.575 A	40 O	0.03	40	100 u	200	6.0			*0.35*	*10*	*10 m*		654
MD7002A	NM	0.575 A	40 O	0.03	40	100 u	200	6.0	**0.75**	**25**	*0.35*	*10*	*10 m*		654
MD7002B	NM	0.575 A	40 O	0.03	40	100 u	200	6.0	**0.85**	**15**	*0.35*	*10*	*10 m*		654
MD7003	NA	0.55 A	40 O	0.05	50	10 m	200	6.0			*0.35*	*10*	*1.0 m*		654
MD7003A	NM	0.55 A	40 O	0.05	50	10 m	200	6.0	**0.75**	**25**	*0.35*	*10*	*1.0 m*		654
MD7003AF	NM	0.35 A	40 O	0.05	50	10 m	200	6.0	**0.75**	**25**	*0.35*	*10*	*1.0 m*		610A
MD7003B	NM	0.55 A	40 O	0.05	50	10 m	200	6.0	**0.85**	**15**	*0.35*	*10*	*1.0 m*		654

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Bipolar Transistors — Duals (continued)

TYPE NO.	I_D	P_D Watts One Die Only	Ref. Point	V_{CE}- Volts	Subscript	I_C Amp Max	h_{FE} Min	@ I_C	Unit	f_T MHz Min Typ*	C_{ob} pF Max Typ*	**h_{FE1}/h_{FE2}** / *t_{on} ns Max Typ**	**ΔV_{BE} mV Max** / *t_{off} ns Max Typ**	**G_p dB Min** / *V_{CE} (sat)@ Volts Max*	**NF dB Max Typ*** @ / *I_C/I_B* &	**f** / *I_C*	Unit	PACKAGE TO- No.	PACKAGE Case No.
MD7004	NA	0.55	A	13	O	0.2	30	10	m	675*	4.0			*0.4*	*10*	*10*	*m*		654
MD7005	PA	0.55	A	12	O	0.05	30	3.0	m	650	3.0			*0.4*	*10*	*10*	*m*		654
MD7007	PA	0.575	A	40	O	0.2	30	1.0	m	300	8.0			*1.0*	*10*	*50*	*m*		654
MD7007A	PM	0.575	A	50	O	0.2	30	1.0	m	300	8.0	**0.75**	**20**	*1.0*	*10*	*50*	*m*		654
MD7007B	PM	0.575	A	60	O	0.2	30	1.0	m	300	8.0	**0.85**	**10**	*1.0*	*10*	*50*	*m*		654
MD7007BF	PM	0.35	A	40	O	0.2	30	1.0	m	300	8.0	**0.85**	**10**	*1.0*	*10*	*50*	*m*		610A
MD7021	CG	0.55	A	40	O	0.05	50	10	m	200	6.0	*28**	*72**	*0.35*	*10*	*10*	*m*		654
MD7021F	CG	0.35	A	40	O	0.05	50	10	m	200	6.0	*28**	*72**	*0.35*	*10*	*10*	*m*		610A
MD8001	NM	0.575	A	40	O	0.03	100	1.0	m	260*	2.6*		**15**						654
MD8002	NM	0.575	A	40	O	0.03	100	1.0	m	260*	2.6*		**15**						654
MD8003	NM	0.575	A	40	O	0.03	100	1.0	m	260*	2.6*		**15**						654
2N2060	NM	0.5	A	60	O	0.5	30	100	u	60	15	**0.9**	**5.0**		**8.0**	**1000**	**H**	78	654
2N2223	NM	0.5	A	60	O	0.5	25	100	u	50	15	**0.8**	**15**	*1.2*	*10*	*50*	*m*	78	654
2N2223A	NM	0.5	A	60	O	0.5	25	100	u	50	15	**0.9**	**5.0**	*1.2*	*10*	*50*	*m*	78	654
2N2453	NM	0.5	A	30	O	0.05	80	10	u	60	8.0	**0.9**	**3.0**		**7.0**	**1000**	**H**	78	654
2N2453A	NM	0.5	A	50	O	0.05	80	10	u	60	8.0	**0.9**	**3.0**		**4.0**	**1000**	**H**	78	654
2N2480A	NM	0.3	A	40	O	0.5	50	1.0	m	50	18	**0.8**	**5.0**	*1.3*	*10*	*50*	*m*	78	654
2N2639	NM	0.3	A	45	O	0.03	50	10	u	80	8.0	**0.9**	**5.0**		**4.0**	**AUD**		78	654
2N2640	NM	0.3	A	45	O	0.03	50	10	u	80	8.0	**0.8**	**10**		**4.0**	**AUD**		78	654
2N2641	NE	0.3	A	45	O	0.03	50	10	u	80	8.0				**4.0**	**AUD**		78	654
2N2642	NM	0.3	A	45	O	0.03	100	10	u	80	8.0	**0.9**	**5.0**		**4.0**	**AUD**		78	654
2N2643	NM	0.3	A	45	O	0.03	100	10	u	80	8.0	**0.8**	**10**		**4.0**	**AUD**		78	654
2N2644	NE	0.3	A	45	O	0.03	100	10	u	80	8.0				**4.0**	**AUD**		78	654
2N2652	NM	0.3	A	60	O	0.5	50	1.0	m	60	15	**0.85**	**3.0**	*1.2*	*10*	*50*	*m*	78	654
2N2652A	NM	0.3	A	60	O	0.5	50	1.0	m	60	15	**0.9**	**3.0**		**8.0**	**1000**	**H**	78	654
2N2721	NM	0.3	A	60	O	0.04	30	0.1	m	80	6.0	**0.8**	**10**	*1.0*	*10*	*10*	*m*	78	654
2N2722	NM	0.3	A	45	O	0.04	50	1.0	u	100	6.0	**0.9**	**5.0**	*1.0*	*20*	*10*	*m*	78	654
2N2903	NM	0.6	C	30	O	0.05	125	1.0	m	60	8.0	**0.8**	**10**		**7.0**	**1000**	**H**	78	654
2N2913	NE	0.3	A	45	O	0.03	60	10	u	60	6.0				**4.0**	**AUD**			654
2N2914	NE	0.3	A	45	O	0.03	150	10	u	60	6.0				**3.0**	**AUD**			654
2N2915	NM	0.3	A	45	O	0.03	60	10	u	60	6.0	**0.9**	**5.0**		**4.0**	**AUD**			654
2N2916	NM	0.3	A	45	O	0.03	150	10	u	60	6.0	**0.9**	**5.0**		**3.0**	**AUD**			654
2N2917	NM	0.3	A	45	O	0.03	60	10	u	60	6.0	**0.8**	**10**		**4.0**	**AUD**			654
2N2918	NM	0.3	A	45	O	0.03	150	10	u	60	6.0	**0.8**	**10**		**3.0**	**AUD**			654
2N2919	NM	0.3	A	60	O	0.03	60	10	u	60	6.0	**0.9**	**5.0**		**4.0**	**AUD**			654
2N2920	NM	0.3	A	60	O	0.03	150	10	u	60	6.0	**0.9**	**5.0**		**3.0**	**AUD**			654
2N3043	NM	0.25	A	45	O	0.03	100	10	u	30	8.0	**0.9**	**5.0**		**5.0**	**AUD**			610A
2N3044	NM	0.25	A	45	O	0.03	100	10	u	30	8.0	**0.8**	**10**		**5.0**	**AUD**			610A
2N3045	NE	0.25	A	45	O	0.03	100	10	u	30	8.0				**5.0**	**AUD**			610A
2N3048	NE	0.25	A	45	O	0.03	50	10	u	30	8.0				**5.0**	**AUD**			610A
2N3425	NA	0.3		15		0.05	30	10	m	300	6.0								654
2N3726	PE	0.4	A	45	O	0.3	135	1.0	m	200	8.0	**0.9**	**5.0**		**4.0**	**1000**	**H**		654
2N3727	PE	0.4	A	45	O	0.3	135	1.0	m	200	8.0	**0.9**	**2.5**		**4.0**	**1000**	**H**		654
2N3806	PE	0.5	A	60	O	0.05	150	0.1	m	100	4.0				**7.0**	**100**	**H**		654
2N3807	PE	0.5	A	60	O	0.05	300	0.1	m	100	4.0				**4.0**	**100**	**H**		654
2N3808	PM	0.5	A	60	O	0.05	150	0.1	m	100	4.0	**0.8**	**5.0**		**7.0**	**100**	**H**		654
2N3809	PM	0.5	A	60	O	0.05	300	0.1	m	100	4.0	**0.8**	**5.0**		**4.0**	**100**	**H**		654
2N3810	PM	0.5	A	60	O	0.05	150	0.1	m	100	4.0	**0.9**	**3.0**		**7.0**	**100**	**H**		654
2N3810A	PM	0.5	A	60	O	0.05	150	0.1	m	100	4.0	**0.95**	**1.5**		**3.0**	**100**	**H**		654
2N3811	PM	0.5	A	60	O	0.05	300	0.1	m	100	4.0	**0.9**	**3.0**		**4.0**	**100**	**H**		654
2N3811A	PM	0.5	A	60	O	0.05	300	0.1	m	100	4.0	**0.95**	**1.5**		**1.5**	**100**	**H**		654
2N3813	PA	0.5	A	60	O	0.05	300	0.1	m	100	4.0				**2.5**	**AUD**			610A
2N3816A	PM	0.5	A	60	O	0.05	150	0.1	m	100	4.0	**0.95**	**1.5**		**7.0**	**100**	**H**		610A

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MULTIPLE DEVICES (continued)

Bipolar Transistors — Duals (continued)

TYPE NO.	I_D	P_D Watts One Die Only	Ref. Point	V_{CE-} Volts	Subscript	I_C Amp Max	h_{FE} Min	@ I_C	Unit	f_T MHz Min Typ*	C_{ob} pF Max Typ*	**h_{FE1}/h_{FE2}** / *t_{on} ns Max Typ**	**ΔV_{BE} mV Max** / *t_{off} ns Max Typ**	**G_p dB Min** / *V_{CE} (sat) @ Volts Max*	**NF dB Max Typ*** / *I_C/I_B*	**@ f** / *& I_C*	Unit	PACKAGE TO- No.	Case No.
2N3817	**PM**	0.5 A		60	O	0.05	300	0.1	m	100	4.0	**0.9**	**3.0**		**4.0**	**100**	**H**		610A
2N3838	**CE**	0.25 A		40	O	0.6	100	150	m	200	8.0	*50*	*340*		**8.0**	**1000**	**H**		610A
2N4015	**PM**	0.4 A		60	O	0.3	135	1.0	m	200	8.0	**0.9**	**5.0**		**4.0**	**1000**	**H**		654
2N4016	**PM**	0.4 A		60	O	0.3	135	1.0	m	200	8.0	**0.9**	**2.5**		**4.0**	**1000**	**H**		654
2N4854	**CE**	0.3 A		40	O	0.6	100	150	m	200	8.0	*60*	*350*		**8.0**	**1000**	**H**		654
2N4855	**CE**	0.3 A		40	O	0.6	40	150	m	200	8.0	*60*	*350*		**8.0**	**1000**	**H**		654
2N4937	**PM**	0.6 A		40	O	0.05	50	1.0	m	300	5.0	**0.9**	**3.0**		**4.0**	**AUD**			654
2N4938	**PM**	0.6 A		40	O	0.05	50	1.0	m	300	5.0	**0.8**	**5.0**		**4.0**	**AUD**			654
2N4939	**PE**	0.6 A		40	O	0.05	50	1.0	m	300	5.0				**40**	**AUD**			654
2N4941	**PM**	0.6 A		40	O	0.05	50	1.0	m	300	5.0	**0.9**	**3.0**		**4.0**	**AUD**			610A
2N5793	**NG**	0.5 A		40	O	0.6	40	150	m	200	8.0	*45*	*310*	*0.3*	*10*	*150*	*m*		654
2N5794	**NG**	0.5 A		40	O	0.6	100	150	m	200	8.0	*45*	*310*	*0.3*	*10*	*150*	*m*		654
2N5795	**NG**	0.5 A		60	O	0.6	40	150	m	200	8.0	*47*	*140*	*0.4*	*10*	*150*	*m*		654
2N5796	**NG**	0.5 A		60	O	0.6	100	150	m	200	8.0	*47*	*140*	*0.4*	*10*	*150*	*m*		654

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Surface Mount Multiples

Bipolar Quad Transistors — SO-16

Device	$V_{(BR)CEO}$	$V_{(BR)CBO}$	h_{FE} Min	h_{FE} @ I_C mA	f_T MHz Min	f_T @ I_C (mA)	Package
MMPQ2222	40	60	30	300	350*	20	SO-16
MMPQ2222A	40	75	40	500	350*	20	SO-16
MMPQ2907	40	40	30	300	350*	50	SO-16
MMPQ2907A	50	60	50	500	350*	50	SO-16
MMPQ3467	40	40	20	500	125	50	SO-16
MMPQ3725	40	60	25	500	250	50	SO-16
MMPQ3725A	50	70	30	500	200	50	SO-16
MMPQ3762	40	40	20	1000	150	50	SO-16

*Typ

TMOS FETs — Quads

N-CHANNEL TMOS QUAD — CASE 646-06 (14-PIN DIP)

Device	$r_{DS(on)}$ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
MFQ930P	1.4	1.0	1.0	3.5	35	70	18	15	15
MFQ960P	1.7	1.0	1.0	3.5	60	70	18	15	15
MFQ6659P	1.8	1.0	0.8	2.0	36	50	10	5.0	5.0
MFQ1000P	2.0	0.5	—	10	35	—	—	10	10
MFQ990P	2.0	1.0	1.0	3.5	90	70	18	15	15
MFQ6660P	3.0	1.0	0.8	2.0	35	50	10	5.0	5.0
MFQ6661P	4.0	1.0	0.8	2.4	90	50	16	5.0	5.0
MFQ170P	5.0	0.2	0.8	3.0	60	—	—	10	10
MFQ9200P	6.2	0.2	1.0	4.0	200	90	3.5	15	15
MFQ107AP	6.4	0.25	1.0	3.0	200	90	3.5	—	—
MFQ107P	14	0.2	1.0	3.0	200	90	3.5	—	—

N-CHANNEL TMOS QUAD — CASE 648-06 (16-PIN DIP)

Device	$r_{DS(on)}$ Ω Max	@ mA	$V_{(BR)DSS}$ Volt Min	$I_{D(on)}$ V_{GS} = 10 V V_{DS} = 5.0 V Amp	G_{fs} mhos Min	@ 5.0 V Amp	C_{iss} @ 25 V pF Max	C_{oss} @ 25 V pF Max	C_{rss} @ 25 V pF Max	$t_{d(on)}$ ns Max	t_r ns Max	$t_{d(off)}$ ns Max	t_f ns Max
IRFE110	0.6	800	100	1.0	0.8	0.8	200	100	25	20	25	25	20
IRFE113	0.8	800	60	0.8	0.8	0.8	200	100	25	20	25	25	20

P-CHANNEL TMOS QUAD — CASE 648-06 (16-PIN DIP)

IRFE9120	0.8	800	100	1.0	0.8	0.8	450	350	100	50	100	100	100
IRFE9123	0.6	800	60	0.8	0.8	0.8	450	350	100	50	100	100	100

Devices for Hi-Rel and Military Applications

JAN, JANTX, JANTXV, and JANS

Motorola offers over 650 devices listed in QPL-19500, and is certified to supply small-signal bipolar devices to ALL FOUR quality levels of MIL-S-19500.

The following tables list the Motorola discrete devices and slash-sheet number as they appear on the Qualified Products List.

Switching and High-Frequency Transistors (MIL-S-19500)

2N703 JAN	/153	2N2905 JAN,JTX,JTXV	/290	2N3506 JAN,JTX,JTXV	/349
2N706 JAN	/120	2N2905A JAN,JTX,JTXV	/290	2N3507 JAN,JTX,JTXV	/349
2N708 JAN,JTX	/312	2N2905AL JANS	/	2N3634 JAN,JTX,JTXV	/357
2N718A JAN,JTX,JTXV	/181	2N2906 JAN,JTX,JTXV	/291	2N3635 JAN,JTX,JTXV	/357
2N869A JAN,JTX	/283	2N2906A JAN,JTX,JTXV	/291	2N3636 JAN,JTX,JTXV	/357
2N914 JAN,JTX	/373	2N2907 JAN,JTX,JTXV	/291	2N3637 JAN,JTX,JTXV	/357
2N916 JAN	/271	2N2907A JAN,JTX,JTXV,JANS	/291	2N3700 JAN,JTX,JTXV	/391
2N918 JAN,JTX,JTXV,JANS	/301	2N2944A JAN,JTX,JTXV	/	2N3735 JAN,JTX,JTXV	/395
2N930 JAN,JTX	/253	2N2945A JAN,JTX,JTXV	/	2N3737 JAN,JTX,JTXV	/395
2N1132 JAN	/177	2N2946A JAN,JTX,JTXV	/	2N3743 JAN,JTX,JTXV	/397
2N1613 JAN,JTX,JTXV	/181	2N3013 JAN,JTX	/287	2N3762 JAN,JTX,JTXV	/396
2N2218 JAN,JTX,JTXV	/251	2N3019,S JAN,JTX,JTSV	/391	2N3763 JAN,JTX,JTXV	/396
2N2218A JAN,JTX,JTXV	/251	2N3250A JAN,JTX,JTXV	/323	2N3764 JAN,JTX,JTXV	/396
2N2219 JAN,JTX,JTXV	/251	2N3251A JAN,JTX,JTXV	/323	2N3765 JAN,JTX,JTXV	/396
2N2219A JAN,JTX,JTXV	/251	2N3253 JAN	/347	2N4033 JAN,JTX,JTXV	/511
2N22219AL JANS	/	2N3444 JAN,JTX	/347	2N4261 JAN,JTX,JTXV	/511
2N2221 JAN,JTX,JTXV	/255	2N3467 JAN,JTX,JTXV	/348	2N4405 JAN,JTX,JTXV	/488
2N2221A JAN,JTX,JTXV	/255	2N3468 JAN,JTX,JTXV	/348	2N4449 JAN,JTX,JTXV	/317
2N2222 JAN,JTX,JTXV	/255	2N3485A JAN,JTX	/392	2N4453 JAN,JTX	/283
2N2222A JAN,JTX,JTXV,JANS	/225	2N3486A JAN,JTX	/392	2N4930 JAN,JTX,JTXV	/397
2N2369A JAN,JTX,JTXV,JANS	/317	2N3498 JAN,JTX,JTXV	/366	2N4931 JAN,JTX,JTXV	/397
2N2481 JAN,JTX	/268	2N3499 JAN,JTX,JTXV	/366	2N5581 JAN,JTX	/423
2N2904 JAN,JTX,JTXV	/290	2N3500 JAN,JTX,JTXV	/366	2N5582 JAN,JTX	/423
2N2904A JAN,JTX,JTXV	/	2N3501 JAN,JTX,JTXV	/366		

Multiple Devices (MIL-S-19500)

2N2060 JAN,JTX,JTXV	/270	2N4854 JAN,JTX,JTXV	/421	2N5796 JAN,JTX,JTXV	/496
2N2919 JAN,JTX,JTXV	/355	2N5793 JAN,JTX,JTXV	/495	M558-01	/558
2N2920 JAN,JTX,JTXV	/355	2N5794 JAN,JTX,JTXV	/495	M558-02	/558
2N3810 JAN,JTX,JTXV	/336	2N5795 JAN,JTX,JTXV	/496	M559-01	/559
2N3811 JAN,JTX,JTXV	/336			M559-02	/559

Field-Effect Transistors (MIL-S-19500)

2N2608 JAN	/295	2N3823 JAN,JTX,JTXV	/375	2N4860 JAN,JTX,JTXV	/385
2N2609 JAN	/296	2N4856 JAN,JTX,JTXV	/385	2N4861 JAN,JTX,JTXV	/385
2N3330 JAN,JTX	/378	2N4857 JAN,JTX,JTXV	/385	2N4091 JAN,JTX,JTXV	/431
2N3821 JAN,JTX,JTXV	/375	2N4858 JAN,JTX,JTXV	/385	2N4092 JAN,JTX,JTXV	/431
2N3822 JAN,JTX,JTXV	/375	2N4859 JAN,JTX,JTXV	/385	2N4093 JAN,JTX,JTXV	/431

CECC

All CECC types are available to assessment levels E, F, L

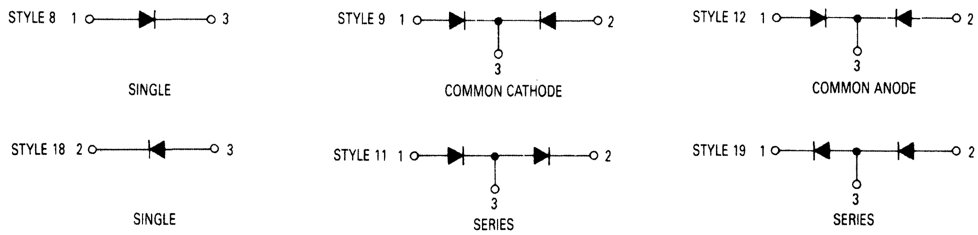
Qualified Types

2N1613	2N2219	2N2222A	2N3019	2N2906	2N3439	2N5416
2N1711	2N2219A	2N2368	2N2904	2N2906A	2N3440	BC107-108-109
2N1893	2N2221	2N2369	2N2904A	2N2907	2N3501	CV9507
2N2218	2N2221A	2N2369A	2N2905	2N2907A	2N4033	PO7726
2N2218A	2N2222	2N2484	2N2905A	2N2894	2N5415	

Qualified products to CECC 50,000

Signal and Switching Diodes

SOT-23 Surface Mount Diode Configurations



General-Purpose Diodes

Device	Marking	$V_{(BR)R}$ Min (V)	@ I_{BR} (μA)	I_R Max (μA)	@ V_R (V)	V_F Min (V)	V_F Max (V)	@ I_F (mA)	C_T Max (pF)	t_{rr} Max (ns)	Pin Out Case Style
SINGLES											
MMBD6050X	5AX	70	100	0.1	50	0.85	1.1	100	2.5	15	8
MMBD914X	5DX	100	100	5	75		1	10	4	15	8
MBAS16	A6X	75	100	1	75		1.3	100	2	15	8
MBAL99	TFX	70	10	2.5	70		1.1	50	1.5	15	18
DUALS											
MBAV70	A4X	70	100	5	70		1.1	50	1.5	15	9
MBAW56	A1X	70	100	2.5	70		1.1	50	1.5	15	12
MBAV99	A7X	70	100	2.5	70		1.1	50	1.5	15	11
MBAV74	JAX	50	5	0.1	50		1	100	2		9
MMBD2835X	A3X	35	100	0.1	30		1	10	4	15	12
MMBD2836X	A2X	75	100	0.1	50		1	10	4	15	12
MMBD2837X	A5X	35	100	0.1	30		1	10	4	15	9
MMBD2838X	A6X	75	100	0.1	50		1	10	4	15	9
MMBD6100	5B	70	100	0.1	50	0.85	1.1	100	2.5	15	9
MMBD7000	5C	100	100	0.3	50	0.75	1.1	100	1.5	15	11

Mixer and Detector Diodes

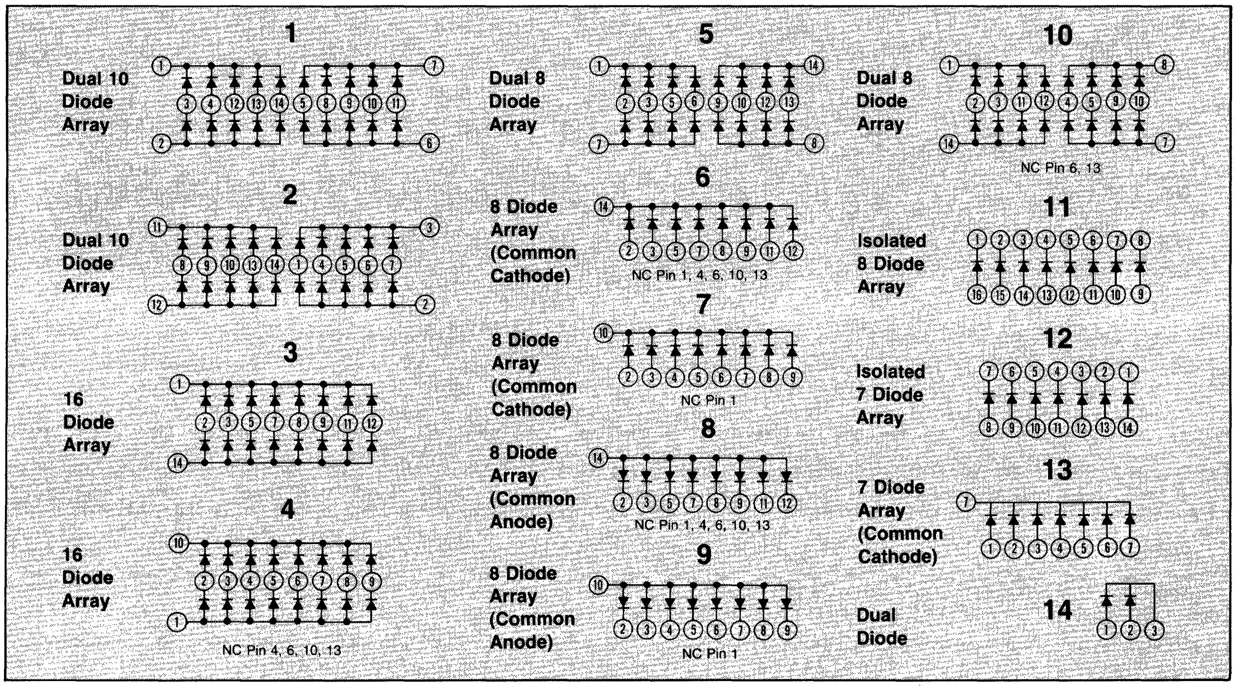
Pin Diodes are designed for VHF Band and General Purpose Switching. Hot Carrier Diodes are ideal for VHF, UHF applications.

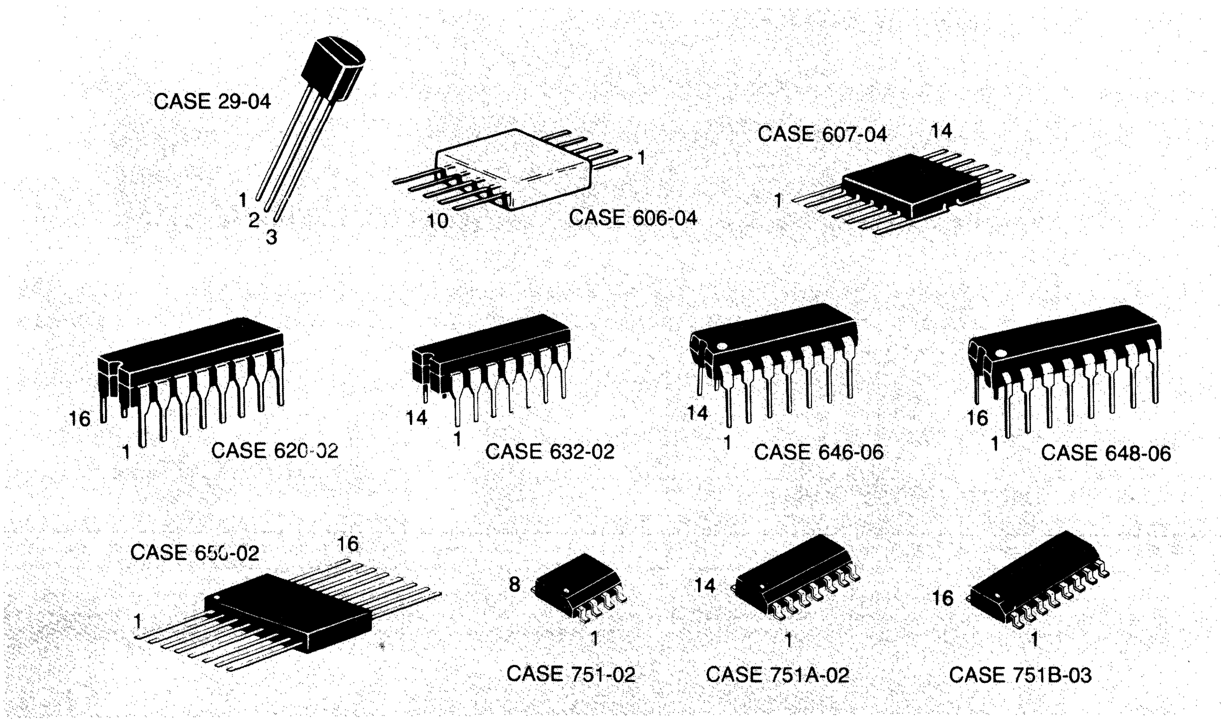
Device	Marking	$V_{(BR)R}$ Min (V)	@ I_R (μA)	C_T Max (pF)	@ V_R (V)	R_S Max (ohms)	V_F Max (V)	@ I_F (mA)	I_R Max (μA)	@ V_R (V)	Pin Out Case Style
PIN DIODES (SINGLES)											
MMBV3700	4R	200	10	1	20	1			0.1	150	8
MMBV3401	4D	35	10	1	20	0.7			0.1	25	8
HOT CARRIER SCHOTTKY DIODES (SINGLES)											
MMBD101	4M	4	10	1	0		0.6	10	0.25	3	8
MMBD201	4S	20	10	1.5	15		0.6	10	0.2	15	8
MMBD301	4T	30	10	1.5	15		0.6	10	0.2	25	8
MMBD501	5F	50	10	1	20		1.2	10	0.2	25	8
MMBD701	5H	70	10	1	20		1.2	10	0.2	35	8
HOT CARRIER SCHOTTKY DIODES (DUALS)											
MMBD352	5G	4	10	1	0		0.6	10	0.25	3	11
MMBD353	4F	4	10	1	0		0.6	10	0.25	3	19

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.

Diode Array Diagrams



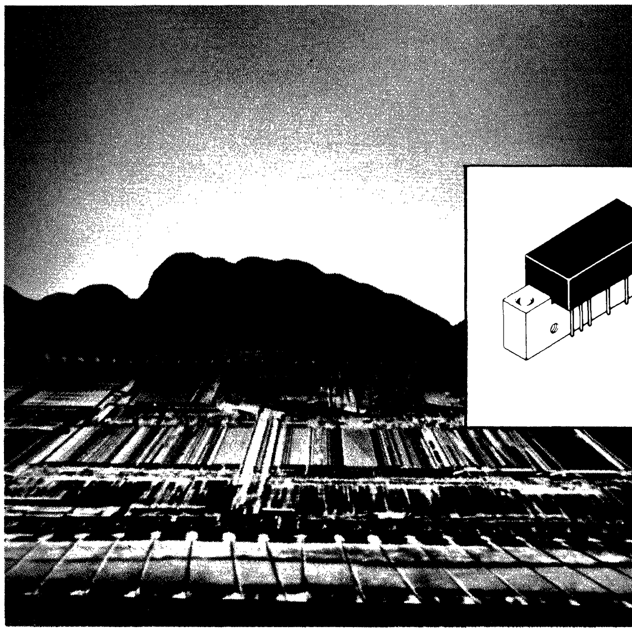


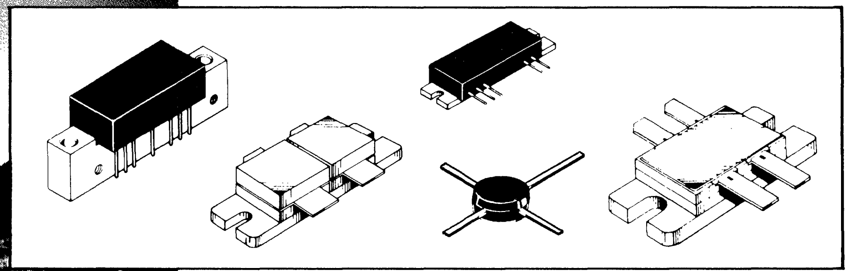
Dual Diodes

Device	$V_{(BR)}$ Volts Min	@ $I_{(BR)}$ A	I_R A Max	@ V_R Volts	V_F Volts Min/Max	@ I_F mA	C @V_R=0 pF (Max)	t_{rr} ns Max	Package	Diagram No.
MSD6100	100	100	0.1	50	0.67/0.82	10	1.5	4.0	TO-226AA	14
MSD6101	50	100	0.1	40	0.67/0.82	10	2.0	10		14
MSD6102	70	100	0.1	50	0.67/1.0	10	3.0	100		14
MSD6150	70	100	0.1	50	−/1.0	10	8.0	100		14

Diode Arrays

Device	Function	Pin Connections	
		Package	Diagram No.
MAD130C	Dual 10 Diode Array	632-02	1
MAD130P	Dual 10 Diode Array	646-06	1
MMAD130	Dual 10 Diode Array	751A-02	2
MAD1103C	16 Diode Array	632-02	3
MAD1103F	16 Diode Array	606-04	4
MAD1103P	16 Diode Array	646-06	3
MMAD1103	16 Diode Array	751A-02	3
MAD1104C	Dual 8 Diode Array	632-02	5
MAD1104F	Dual 8 Diode Array	607-04	5
MAD1104P	Dual 8 Diode Array	646-06	5
MMAD1104	Dual 8 Diode Array	751A-02	5
MAD1105C	8 Diode Common Cathode Array	632-02	6
MAD1105F	8 Diode Common Cathode Array	606-04	7
MAD1105P	8 Diode Common Cathode Array	646-06	6
MMAD1105	8 Diode Common Cathode Array	751A-02	6
MAD1106C	8 Diode Common Anode Array	632-02	8
MAD1106F	8 Diode Common Anode Array	606-04	9
MAD1106P	8 Diode Common Anode Array	646-06	8
MMAD1106	8 Diode Common Anode Array	751A-02	8
MAD1107C	Dual 8 Diode Array	632-02	10
MAD1107F	Dual 8 Diode Array	607-04	10
MAD1107P	Dual 8 Diode Array	646-06	10
MMAD1107	Dual 8 Diode Array	751A-02	10
MAD1108C	8 Isolated Diode Array	620-02	11
MAD1108F	8 Isolated Diode Array	650-02	11
MAD1108P	8 Isolated Diode Array	648-06	11
MMAD1108	8 Isolated Diode Array	751B-03	11
MAD1109C	7 Isolated Diode Array	632-02	12
MAD1109F	7 Isolated Diode Array	607-04	12
MAD1109P	7 Isolated Diode Array	646-06	12
MMAD1109	7 Isolated Diode Array	751A-02	12
MMAD1185	7 Diode Common Cathode Array	751-02	13





RF Products

In Brief . . .

While Motorola is considered to be the supermarket for semiconductor products, there is no 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.

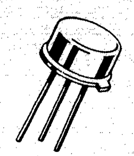
The immediate future will advance these Motorola objectives in two significant ways:

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 amplifier modules, and in broadband **UHF and microwave** devices. With continuing full-scale operation of these erstwhile TRW facilities, there will be no interruption of service for these components.

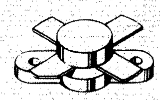
2. Recently patented process breakthroughs in the field of dielectric isolation will result in new monolithic integrated circuits with RF gain and power levels that substantially reduce the component count of VHF/UHF designs.

The selection tables on the subsequent pages include a number of 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.

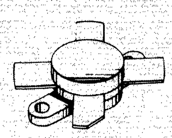
RF Power Transistors



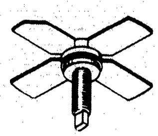
CASE 79-05
STYLE 7



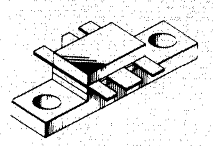
CASE 211-07
STYLE 2
(.380″ FLANGE)



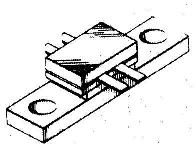
CASE 211-11
STYLE 2
(.500″ FLANGE)



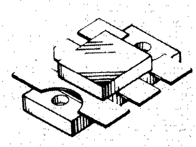
CASE 244-04
STYLE 3
(.280″ STUD)



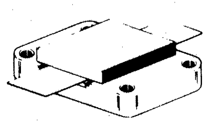
CASE 319-05
STYLE 3



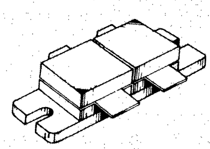
CASE 319B-01
STYLE 1



CASE 333-03
STYLE 1



CASE 368-01
STYLE 2
(HOG PAC)



CASE 375-01
STYLE 2

TMOS Power 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 FETs

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	Package/Style
V_{DD} = 28 Volts						
MRF138	30	0.6	17	−30	−60	211-07/2
MRF140	150	4.7	15	−30	−60	211-11/2
V_{DD} = 50 Volts						
MRF148	30	0.5	18	−35	−60	211-07/2
MRF150	150	2.9	17	−32	−60	211-11/2
MRF153	300	6	17	−25	—	368-01/2
MRF154	600	12	17	−25	—	368-01/2
MRF155 (1)	300	1.9	22	−25	—	368-01/2
MRF156 (1)	600	6	20	−25	—	368-01/2

TO 225 MHz VHF AM/FM FETs

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 %	Package/Style
V_{DD} = 28 Volts					
MRF134	5	0.2	14/150	55	211-07/2
MRF136	15	0.38	16/150	60	211-07/2
MRF136Y	30	1.2	14/150	54	319B-01/1
MRF137	30	0.75	16/150	60	211-07/2
MRF141 (1)	150	10	10/175	55	211-11/2
MRF141G (1)	300	13	10/175	55	375-01/2
MRF171	45	1.4	15/150	60	211-07/2
MRF172	80	4.7	12.3/150	60	211-11/2
MRF174	125	8.3	11.8/150	60	211-11/2
MRF175GV (1)	200	8	14/225	65	375-01/2
MRF175LV (1)	100	4	14/225	65	333-03/1
V_{DD} = 50 Volts					
MRF151 (1)	150	7.5	13/175	45	211-11/2
MRF151G (1)	300	7.5	16/175	55	375-01/2
MRF176GV (1)	200	4	17/225	55	375-01/2

TO 500 MHz UHF AM/FM FETs

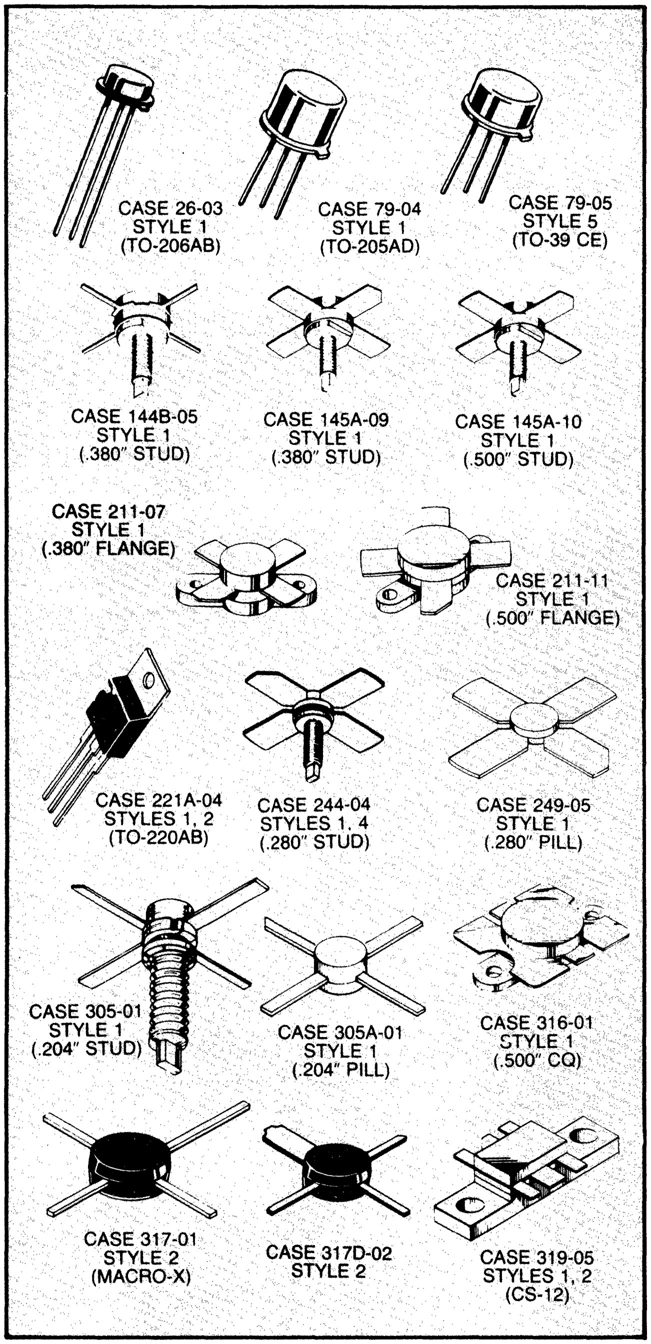
For VHF/UHF military and commercial aircraft radio transmitters.

V_{DD} = 28 Volts					
MRF158R (1)	2	0.02	20/400	55	79-05/7
MRF160R (1)	4	0.04	20/400	55	79-05/7
MRF161	5	0.4	13.5/400	45	244-04/3
MRF162	15	1.2	11/400	45	244-04/3
MRF163	25	2.5	10/400	45	244-04/3
MRF166C (1)	20	0.4	17/400	55	319-05/3
MRF175GU (1)	150	9.5	12/400	55	375-01/2
MRF175LU (1)	100	10	10/400	55	333-03/1
V_{DD} = 50 Volts					
MRF176GU (1)	150	9.5	12/400	45	375-01/2

(1) To be introduced

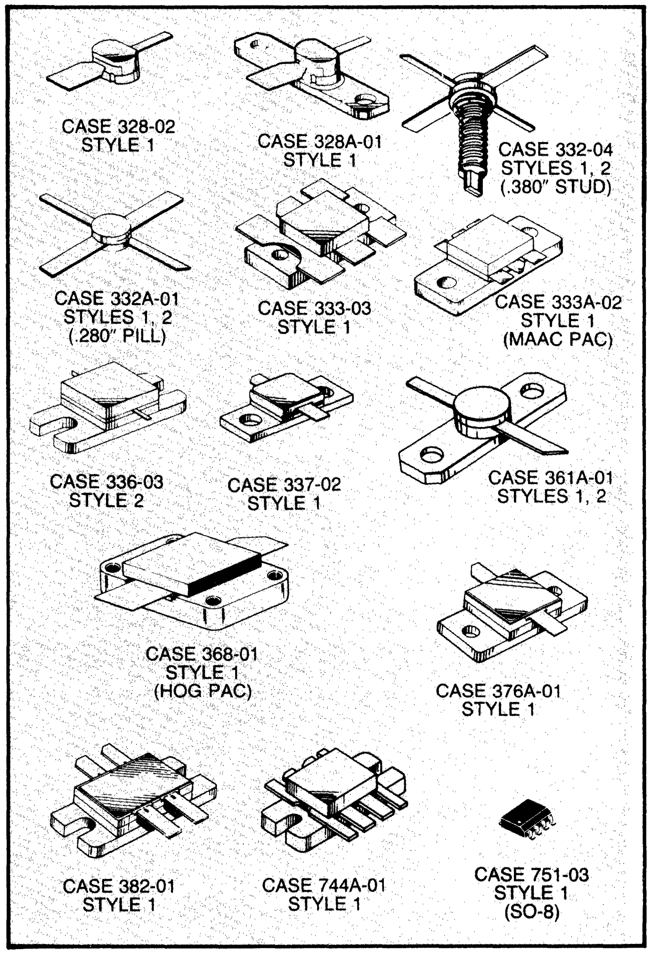
New introductions.

RF POWER TRANSISTORS (continued)



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. ***All devices are NPN polarity except where otherwise noted.***



HF Bipolar Power Transistors

1.5–30 MHz, HF/SSB TRANSISTORS

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	Package/Style
V_{CC} = 12.5 or 13.6 Volts				
MRF476	3 PEP/CW	0.1	15	221A-04/1
MRF475	12 PEP/CW	1.2	10	221A-04/1
MRF433	12.5 PEP/CW	0.125	20	211-07/1
MRF479	15 PEP/CW	0.95	12	221A-04/2
MRF406	20 PEP/CW	1.25	12	211-07/1
MRF460	40 PEP/CW	2.5	12	211-11/1
MRF477	40 PEP/CW	1.25	15	221A-04/2
MRF421	100 PEP/CW	10	10	211-11/1
V_{CC} = 28 Volts				
MRF410	10 PEP/CW	0.5	13	211-07/1
MRF485	15 PEP/CW	1.5	10	221A-04/1
MRF426	25 PEP/CW	0.16	22	211-07/1
MRF466	40 PEP/CW	1.25	15	211-09/1
MRF486	40 PEP/CW	1.25	15	221A-04/2
MRF464	80 PEP/CW	2.53	15	211-11/1
MRF464A	80 PEP/CW	2.53	15	145A-10/1
MRF422	150 PEP/CW	15	10	211-11/1
V_{CC} = 50 Volts				
MRF427	25 PEP/CW	0.4	18	211-11/1
MRF428	150 PEP/CW	7.5	13	211-11/1
MRF429	150 PEP/CW	7.5	13	211-11/1
MRF448	250 PEP/CW	15.7	12	211-11/1
MRF430	600 PEP/CW	60	10	368-01/1

14–30 MHz, CB/AMATEUR TRANSISTORS

These HF transistors are designed for economical, high-volume use in CW, AM and SSB applications.

Device	P_{out} Output Power Watts	P_{in} Input Power Watts (Max)	G_{PE} (Min) Power Gain dB @ 30 MHz	Package/Style
V_{CC} = 12.5 or 13.6 Volts				
MRF476	3	0.1	15	221A-04/1
MRF475	4	0.4	10	221A-04/1
MRF449A	30	1.9	12	145A-09/1
MRF450	50	4	11	211-07/1
MRF450A	50	4	11	145A-09/1
MRF455	60	3	13	211-07/1
MRF455A	60	3	13	145A-09/1
MRF454	80	5	12	211-11/1
MRF458	80	5	12	211-11/1

27–50 MHz, LOW-BAND FM TRANSISTORS

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	Package/Style
V_{CC} = 12.5 or 13.6 Volts				
MRF475	4	0.4	10	211A-04/1
MRF497	40	4	10	221A-04/2
MRF492	70	5.6	11	211-11/1
MRF492A	70	5.6	11	145A-10/1

VHF Transistors

30–200 MHz VHF AM/FM TRANSISTORS

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	Package/Style
V_{CC} = 28 Volts				
2N3553	2.5	0.25	10/175	79-04/1
2N5641	7	1	8.4/175	144B-05/1
MRF340	8	0.4	13/136	221A-04/2
2N5642	20	3	8.2/175	145A-09/1
MRF342	24	1.9	11/136	221A-04/2
MRF314	30	3	10/150	211-07/1
MRF314A	30	3	10/150	145A-09/1
2N5643	40	6.9	7.6/175	145A-09/1
MRF315	45	5.7	9/150	211-07/1
MRF315A	45	5.7	9/150	145A-09/1
MRF344	60	15	6/136	221A-04/2
MRF316 (1)	80	8	10/150	316-01/1
MRF317 (1)	100	12.5	9/150	316-01/1

66–88 MHz, MIDBAND FM TRANSISTORS

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 @ 90 MHz	Package/Style
V_{CC} = 12.5 Volts				
MRF229	1.5	0.15	10	79-05/5
MRF232	7.5	0.95	9	145A-09/1
MRF233	15	1.5	10	145A-09/1
MRF234	25	2.8	9.5	145A-09/1

(1) Internal Impedance Matched

136–174 MHz, HIGH-BAND/VHF FM TRANSISTORS

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	Package/Style
V_{CC} = 12.5 Volts				
2N4427	1	0.1	10	79-04/1
MRF604	1	0.1	10	26-03/1
MRF553	1.5	0.11	11.5	317D-02/2
MRF607	1.75	0.12	11.5	79-04/1
2N6080	4	0.25	12	145A-09/1
MRF220	4	0.25	12	211-07/1
MRF237	4	0.25	12	79-05/5
MRF260	5	0.5	10	221A-04/2
MRF212	10	1.25	9	145A-09/1
MRF261	10	3	5.2	221A-04/2
2N6081	15	3.5	6.3	145A-09/1
MRF221	15	3.5	6.3	211-07/1
MRF262	15	3.5	6.3	221A-04/2
MRF2628	15	0.95	12	244-04/1
2N6082	25	6	6.2	145A-09/1
2N6083	30	8.1	5.7	145A-09/1
MRF238	30	3.7	9	145A-09/1
MRF239	30	3	10	145A-09/1
MRF264	30	9.1	5.2	221A-04/2
MRF1946	30	3	10	211-07/1
MRF1946A	30	3	10	145A-09/1
2N6084	40	14.3	4.5	145A-09/1
MRF224	40	14.3	4.5	211-07/1
MRF240	40	5	9	145A-09/1
MRF4070 (1)	70	20	5	316-01/1
MRF247 (1)	75	15	7	316-01/1
MRF248 (1)	80	8	10	316-01/1

225 MHz, AMATEUR FM TRANSISTORS

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	Package/Style
V_{CC} = 12.5 Volts				
MRF207	1	0.15	8.2	79-04/1
MRF227	3	0.13	13.5	79-05/5
MRF208	10	0.1	10	145A-09/1
MRF226	13	1.6	9	145A-09/1

(1) Internal Impedance Matched

UHF Transistors

100–400 MHz, AM/FM TRANSISTORS

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	Package/Style
V_{CC} = 28 Volts				
MRF525	0.02	0.001	13	79-05/5
2N3866	1	0.1	10	79-04/1
2N5160 (1)	1	0.16	8	79-04/1
MRF5174	2	0.125	12	244-04/1
MRF325 (2)	30	4.3	8.5	316-01/1
MRF326 (2)	40	8	9	316-01/1
MRF309 (2)	50	10	7	316-01/1
2N6439 (2)	60	10	7.8	316-01/1
MRF390 (3)	60	6.8	7.5	744A-01/1
MRF327 (2)	80	14.9	7.3	316-01/1
MRF329 (2)	100	20	7	333-03/1
MRF392 (3)	125	19.8	8	744A-01/1
2N6985 (3)	125	19.8	8	382-01/1

100–500 MHz, AM/FM TRANSISTORS

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	Package/Style
V_{CC} = 28 V				
MRF313	1	0.03	15/400	305A-01/1
MRF321	10	0.62	12/400	244-04/1
MRF323	20	2	10/400	244-04/1
MRF338 (2)	80	15	7.3/470	333-03/1
MRF393 (3)	100	18	7.5/500	744A-01/1
2N6986 (3)	100	18	7.5/500	382-01/1

407–512 MHz, UHF FM TRANSISTORS

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) Power Gain dB @ 470 MHz	Package/Style
V_{CC} = 7.5 Volts				
MRF750	0.5	0.05	10	305A-01/1
MRF752	2.5	0.4	8	249-05/1
MRF754	8	2	6	249-05/1

(1) PNP
(2) Internal Impedance Matched.
(3) Internal Impedance Matched Push-Pull Transistors.

407–512 MHz, UHF FM TRANSISTORS (continued)

Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PE} (Min)/Freq. Power Gain dB/MHz	Package/Style
V_{CC} = 12.5 Volts				
MRF627	0.5	0.05	10/470	305A-01/1
MRF581 (1)	0.6	0.03	13/500	317-01/2
MRF515	0.75	0.12	8/470	79-04/1
MRF555	1.5	0.15	10/470	317D-02/2
2N5944	2	0.25	9/470	244-04/1
MRF629	2	0.32	8/470	79-05/5
MRF630	3	0.33	9.5/470	79-05/5
2N5945	4	0.64	8/470	244-04/1
MRF652	5	0.5	10/512	244-04/1
MRF660	7	2	5.4/470	221A-04/2
2N5946	10	2.5	6/470	244-04/1
MRF653	10	2	7/512	244-04/1
MRF641 (2)	15	2.5	7.8/470	316-01/1
MRF654 (2)	15	2.5	7.8/470	244-04/1
MRF644 (2)	25	5.9	6.2/470	316-01/1
MRF646 (2)	40	13.3	4.8/470	316-01/1
MRF648 (2)	60	22	4.4/470	316-01/1
MRF650 (2)	50	11.7	6.3/470	316-01/1

800 MHz Transistors

806–960 MHz, FM TRANSISTORS

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	Package/Style
V_{CC} = 12.5 Volts				
MRF559	0.5	0.08	8/870	317-01/2
MRF581	0.6	0.06	10/870	317-01/2
MRF837	0.75	0.11	8/870	317-01/1
MRF8372	0.75	0.11	8/870	751-03/1
MRF838	1	0.22	6.5/870	305A-01/1
MRF838A	1	0.22	6.5/870	305-01/1
MRF557	1.5	0.23	8/870	317D-02/2
MRF839	3	0.46	8/870	305A-01/1
MRF839F	3	0.46	8/870	319-05/2
MRF841F	5	0.7	8.5/870	319-05/1
MRF840 (2)	10	2.5	6/870	319-05/1
MRF843 (2)	15	3	7/870	244-04/4
MRF843F (2)	15	3	7/870	319-05/1
MRF873 (2)	15	3	7/870	319-05/1
MRF842 (2)	20	5	6/870	319-05/1
MRF844 (2)	30	9	5.2/870	319-05/1
MRF846 (2)	40	15	4.3/870	319-05/1
MRF847 (2)	45	16	4.5/870	319-05/1
MRF848 (2)	60	20	4.7/870	333A-02/1
V_{CC} = 24 Volts				
MRF890	2	0.25	9/900	305-01/1
MRF891	5	0.63	9/900	319-05/2
MRF892 (2)	14	2	8.5/900	319-05/1
MRF894 (2)	30	6	7/900	319-05/1
MRF898 (2)	60	12	7/900	333A-02/1

(1) Small signal gain. P_O is Typ.
(2) Internal impedance matched.

New introductions.

RF POWER BIPOLAR TRANSISTORS (continued)

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	Package/Style
V_{CC} = 18 Volts — Class A & AB Common Emitter				
MRF1000MA (1)	0.2	0.02	10	332-04/2
MRF1000MB (1)	0.2	0.02	10	332A-01/2
MRF1000MC (1)	0.2	0.02	10	361A-01/2
V_{CC} = 35 Volts — Class B & C Common Base				
MRF1002MA	2	0.2	10	332-04/1
MRF1002MB	2	0.2	10	332A-01/1
MRF1002MC	2	0.2	10	361A-01/1
MRF1004MA	4	0.4	10	332-04/1
MRF1004MB	4	0.4	10	332A-01/1
MRF1004MC	4	0.4	10	361A-01/1
MRF1008MA	8	0.8	10	332-04/1
MRF1008MB	8	0.8	10	332A-01/1
MRF1008MC	8	0.8	10	361A-01/1
V_{CC} = 50 Volts — Class C Common Base				
MRF1015MA	15	1.5	10	332-04/1
MRF1015MB	15	1.5	10	332A-01/1
MRF1015MC	15	1.5	10	361A-01/1
MRF1035MA	35	3.5	10	332-04/1
MRF1035MB	35	3.5	10	332A-01/1
MRF1035MC	35	3.5	10	361A-01/1
MRF1090MA	90	9	10	332-04/1
MRF1090MB	90	9	10	332A-01/1
MRF1090MC	90	9	10	361A-01/1
MRF1150M	150	25	7.8	336-03/2
MRF1150MA	150	25	7.8	332-04/1
MRF1150MB	150	25	7.8	332A-01/1
MRF1150MC	150	25	7.8	361A-01/1
MRF1250M	250	63	6	336-03/2
MRF1325M	325	81	6	336-03/2

(1) Class A, Common Emitter

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	Package/Style
V_{CC} = 28 Volts — Class C Common Base				
MRF10005	5	0.71	8.5	376A-01/1
V_{CC} = 36 Volts — Class C Common Base				
MRF10030	30	11.2	9.5	376A-01/1
MRF10120	120	19	8	376A-01/1

1.7–2.3 GHz BROADBAND CW

The MRF2000M Series of transistors has internal input impedance matching networks which facilitate broadband circuit designs in the 1.7 to 2.3 GHz telecommunications band.

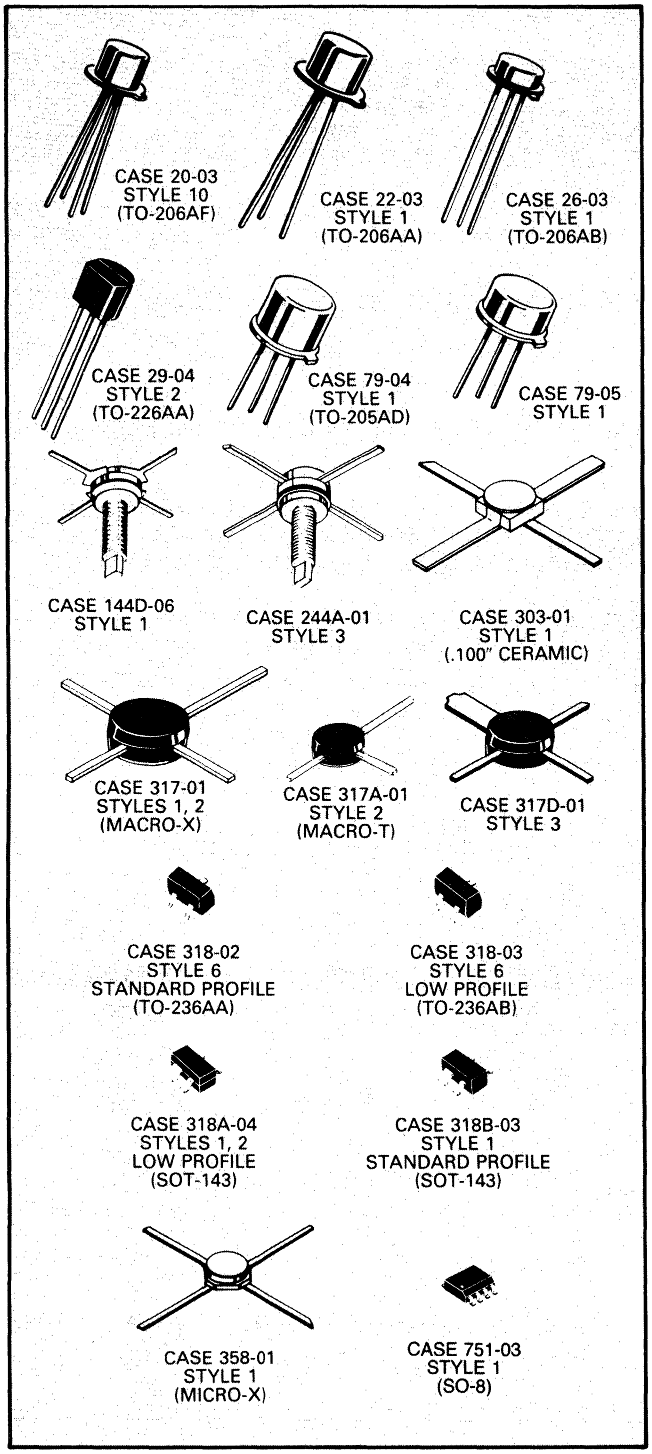
Device	P_{out} Output Power Watts	P_{in} Input Power Watts	G_{PB} (Min) Power Gain dB @ 2 GHz	Package/Style
V_{CC} = 24 Volts — Class B & C Common Base				
MRF2001M	1	0.14	8.5	337-02/1
MRF2003M	3	0.48	8	337-02/1
MRF2005M	5	0.89	7.5	337-02/1
MRF2010M	10	2	7	337-02/1
MRF2016M	16	3.6	6.5	337-02/1

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	Package/Style
V_{CC} = 28 Volts — Class B & C Common Base				
MRF2001	1	0.13	9	328A-01/1
MRF2001B	1	0.13	9	328-02/1
MRF2003	3	0.5	7.8	328A-01/1
MRF2003B	3	0.5	7.8	328-02/1
MRF2005	5	0.8	8	328A-01/1
MRF2005B	5	0.8	8	328-02/1
MRF2010	10	2.5	6	328A-01/1
MRF2010B	10	2.5	6	328-02/1

RF Small-Signal Transistors

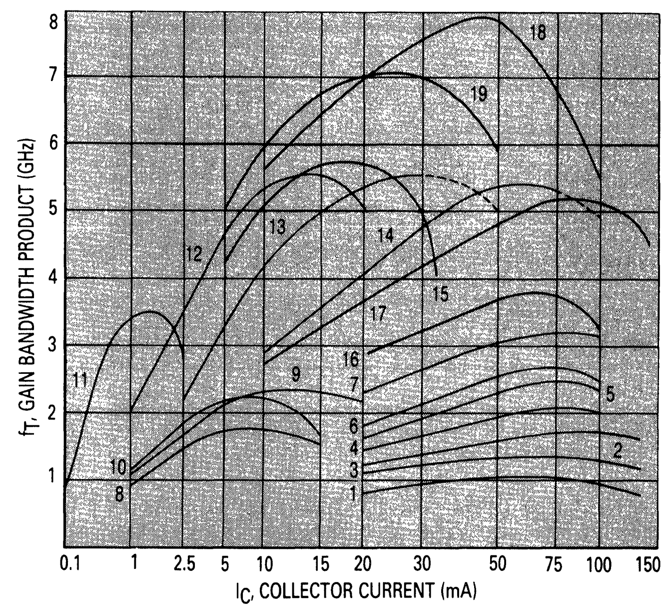


Motorola's broad line of RF Small-Signal Transistors includes NPN and PNP silicon Bipolar Transistors characterized for low noise amplifiers, mixers, oscillators, multipliers, non-saturated switches and low-power drivers.

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, QPL types with JAN, JTX and JTXV processing levels are available as well as Hi Rel processing to meet unique customer requirements.

RF Small Signal Transistor Gain Characteristics

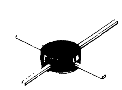
Curve numbers apply to transistors listed in the subsequent tables.



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 specific applications such as oscillators or switches are grouped in the appropriate succeeding tables. **These devices are NPN polarity unless otherwise designated.**

PLASTIC SOE CASE

	Gain-Bandwidth			Noise Figure		Gain		Maximum Ratings			
Device	f_T @ GHz Typ	I_C mA	Curve No. Page 5-89	NF @ dB Typ	f MHz	@ dB Typ	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
Case 317-01/2 — MACRO-X											
MRF521 (1)	4.2	50	—	2.8	1000	11	1000	10	70	750	
MRF536 (1)	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	2	500	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	—	
MRF951	7.5	30	—	1.7	2000	12.5	2000	10	100	—	
MRF961	4.5	50	14	2	500	15	500	15	100	500	
MRF2369	6	40	18	1.5	1000	12	1000	15	70	750	

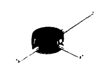
(1) PNP

(continued)

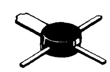
RF SMALL-SIGNAL TRANSISTORS BY PACKAGE (continued)

PLASTIC SOE CASE (continued)

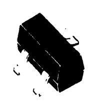
Case 317A-01/2 — MACRO-T

Device	Gain-Bandwidth f_T @ GHz Typ	Gain-Bandwidth I_C mA	Curve No. Page 5-89	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
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	

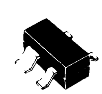
Case 317D-02/3

Device	f_T GHz Typ	I_C mA	Curve No.	NF dB Typ	f MHz	Gain dB Typ	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
MRF542 (2)	—	—	2	—	—	5.5	250	70	400	3000	
MRF543 (1) (2)	—	—	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 318-03/6, Case 318-02/6 — SOT-23

Device	f_T GHz Typ	I_C mA	Curve No.	NF dB Typ	f MHz	Gain dB Typ	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
BFR93	3	30	—	2.5	30	—	—	12	35	350	
MMBR536 (1)	5.5	20	19	4.5	500	14	500	10	30	350	
MMBR571	8	50	18	2	500	16.5	500	10	80	350	
MMBR901	4	15	12	1.9	1000	16	1000	15	30	350	
MMBR911	6	30	13	2	500	17	500	12	40	350	
MMBR920	4.5	14	—	2.4	500	15	500	15	35	350	
MMBR930	5.5	30	—	1.9	500	11	500	12	35	350	
MMBR941	8	15	—	1.7	2000	12.5	2000	10	50	—	
MMBR951	7.5	30	—	1.7	2000	12.5	2000	10	100	—	
MMBR931	3.5	1	11	4.3	1000	10	1000	5	5	350	
MMBR4957 (1)	2	2	10	3	450	17	450	30	30	350	
MMBR5031	2	5	—	1.9	450	17	450	10	20	350	
MMBR5179	1.5	5	8	4	450	11	450	12	50	350	

Case 318A-04/1, Case 318B-03/1 — SOT-143

Device	f_T GHz Typ	I_C mA	Curve No.	NF dB Typ	f MHz	Gain dB Typ	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
MRF0211	5.5	40	18	1.8	1000	13	1000	15	70	580	
MRF5211 (1)	4.2	50	—	2.8	1000	11	1000	10	70	580	
MRF5711	7.5	50	18	1.6	1000	13.5	1000	10	70	580	
MRF9011	3.8	15	12	2.3	1000	10.2	1000	15	30	300	
MRF9331	5	1	—	2.5	1000	12.5	1000	8	1	50	
MRF9411	8	15	—	1.7	2000	12.5	2000	10	50	—	
MRF9511	7.5	30	—	1.7	2000	12.5	2000	10	100	—	

(1) PNP (2) Common Base Configuration.

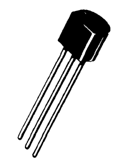
PLASTIC SOE CASE (continued)

Device	Gain-Bandwidth f_T @ GHz Typ	I_C mA	Curve No. Page 5-89	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 751-03/1 — SO-8

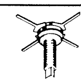
MRF3866	0.8	50	1	—	—	10.5	400	30	400	1000	
MRF4427	0.8	50	1	—	—	12	175	20	400	1000	
MRF5160 (1)	0.8	50	1	—	—	8	400	40	400	1000	
MRF5583 (1)	2.1	35	5	—	—	12.5	250	30	500	1000	
MRF5812	5	75	17	1.8	500	16	500	15	200	1500	
MRF5943	1.55	35	4	3.4	200	12	250	30	400	1000	
MRF8372	5	75	17	2	500	10	870	16	200	1500	
MRFQ17	2.2	50	5	—	—	12	500	25	300	1000	
MRFQ19	5.5	75	14	3.5	500	14.5	500	15	150	1000	

Case 29-04/2, TO-226AA

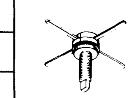
MPS536 (1)	5	20	19	4.5	500	14	500	10	30	625	
MPS571	6	50	18	2	500	14	500	10	80	625	
MPS901	4.5	15	12	2.5	900	12	900	15	30	625	
MPS911	7	30	13	1.7	500	16.5	500	12	40	625	
MPS3866	0.8	50	1	—	—	10	400	30	400	625	

CERAMIC SOE CASE

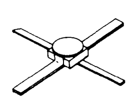
Case 144D-06/1

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-01/3

MRF546 (2)	—	—	—	—	—	6	250	70	600	9000	
MRF547 (2) (1)	—	—	—	—	—	5.5	250	70	600	9000	
MRF548 (2)	—	—	2	—	—	5.5	250	70	400	5000	
MRF549 (2) (1)	—	—	2	—	—	5.5	250	70	400	5000	
MRF587	5.5	90	17	3	500	13	500	17	200	5000	

Case 303-01/1

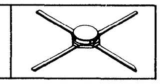
2N6603	5.5	15	12	2	1000	13	1000	15	30	400	
2N6604	5.5	30	13	2.7	1000	12	1000	15	50	500	
2N6618	—	—	—	2.2	2000	11	2000	20	20	300	
2N6679	($f_{1\ dB}$ is 18.5 dBm Typ @ 4 GHz)					9	4000	20	70	900	
MRF942	8	15	—	1.7	2000	12.5	2000	10	50	—	
MRF952	7.5	30	—	1.7	2000	12.5	2000	10	100	—	
MRF522 (1)	4.2	50	—	2.8	1000	11	1000	10	50	620	
MRF572	8	50	18	1.5	1000	12	1000	10	70	750	
MRF962	4.5	50	14	2	500	16.5	500	15	100	750	

(1) PNP (2) Common Base Configuration ☐ New introductions.

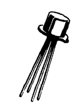
RF SMALL-SIGNAL TRANSISTORS (continued)

CERAMIC SOE CASE (continued)

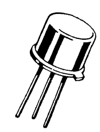
Case 358-01/1

Device	Gain-Bandwidth f_T @ GHz Typ	Gain-Bandwidth I_C mA	Curve No. Page 5-89	Noise Figure NF @ dB Max	Noise Figure f MHz	Gain @ dB Min	Gain f MHz	Maximum Ratings $V_{(BR)CEO}$ Volts	Maximum Ratings I_C mA	Maximum Ratings P_T mW	Package
MRF573	8	50	18	2	1000	10	1000	10	70	750	

TO-206AF METAL CAN (Case 20-03/10)

Device	f_T GHz Typ	I_C mA	Curve No. Page 5-89	NF dB Max	f MHz	Gain dB Min	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
BFR99 (1)	1.7	10	9	6	800	—	—	25	50	225	
2N2857	1.6	8	8	4.5	450	12.5	450	15	40	200	
2N4957 (1)	1.6	2	10	3	450	17	450	30	30	200	
2N4958 (1)	1.5	2	10	3.3	450	16	450	30	30	200	
2N4959 (1)	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	
BFX89	1.6	25	9	6.5	500	19	200	15	50	200	
BFY90	1.7	25	9	5	500	21 (2)	200	15	50	200	
MM4049 (1)	5	20	19	3 (2)	500	11.5	500	10	30	200	
MRF501	1	5	8	4.5 (2)	200	15 (2)	200	15	50	200	
MRF502	1.2	5	8	4 (2)	200	17 (2)	200	15	50	200	
MRF524 (1)	4.2	50	—	2.5	500	9	500	10	50	200	
MRF904	4	15	12	1.5 (2)	450	16 (2)	450	15	30	200	
MRF914	4.5	20	13	2 (2)	500	15 (2)	500	12	40	200	

TO-205AD METAL CAN (79-04/1)

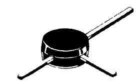
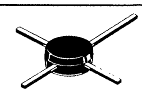
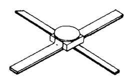
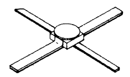
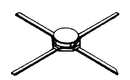
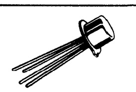
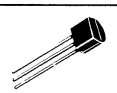
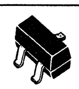
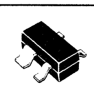
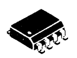
Device	f_T GHz Typ	I_C mA	Curve No. Page 5-89	NF dB Max	f MHz	Gain dB Min	f MHz	$V_{(BR)CEO}$ Volts	I_C mA	P_T mW	Package
2N5109	1.5	50	4	3 (2)	200	11	216	20	400	2500	
2N5583 (1)	1.5	100	5	—	—	—	—	30	500	5000	
2N5943	1.5	50	4	3.4 (2)	200	11.4 (2)	200	30	400	3500	
MM8000	0.8	50	1	2.7 (2)	200	11.4 (2)	200	30	400	3500	
MM8001	1	50	4	2.7 (2)	200	11.4 (2)	200	30	400	3500	
MRF517	2.7	60	7	7.5	300	10 (2)	300	20	150	2500	
MRF525 (TO-39CE)	3	50	7	4	400	13	400	20	150	2500	
MRF544	1.4	50	2	—	—	16.5 (2)	250	70	400	3500	
MRF545 (1)	1.2	50	2	—	—	15.5 (2)	250	70	400	3500	
MRF586	4.5	90	17	4	500	9	500	17	200	2500	

(1) PNP (2) Typical

New introductions.

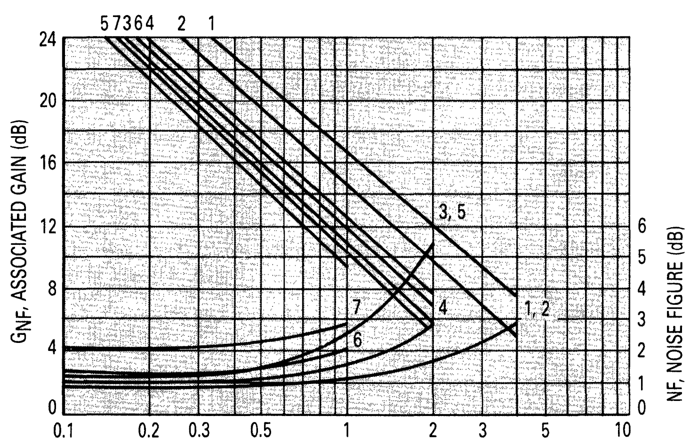
Low-Noise Amplifiers

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(1)	4	5	6	7
	MACRO-T	317A-01/2	—	—	—	—	MRF580	—	BFR91
	MACRO-X	317-01/2	—	MRF941 MRF951(3)	MRF521	MRF571 MRF2369(2)	MRF581	MRF901	MRF911
	.1″ Ceramic	303-01/1	2N6618	MRF942 MRF952(3)	MRF522	MRF572	—	2N6603	—
	.07″ Ceramic	303A-01	2N6617	—	—	—	—	—	—
	MICRO-X (To be introduced)	358-01/1	—	MRF943 MRF953(3)	MRF523	MRF573	—	—	—
	TO-206AF	20-03/10	—	—	MRF524	—	—	MRF904	MRF914
	TO-226AA	29-04/2	—	—	—	MPS571	—	MPS901	MPS911
	SOT-23	318-02/3/6	—	MMBR941 MMBR951(3)	—	MMBR571	—	MMBR901	MMBR911
	SOT-143	318A-04/1	—	MRF9411 MRF9511(3)	MRF5211	MRF5711 MRF0211(2)	—	MRF9011	—
	SO-8	751-03/1	—	—	—	—	MRF5812	—	—

(1) PNP
(2) Higher Voltage Version
(3) Higher Current Version

Gain and Noise Figure versus Frequency



RF SMALL-SIGNAL TRANSISTORS (continued)

CATV, MATV and Class A Linear Transistors

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				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					20-03/10
MRF502	6/5	1200	4/200					20-03/10
2N5179	6/10	1400	3.2/200					20-03/10
MMBR5179	6/5	1500	4/450					318-02/6
2N5109	15/50	1500	3/200					79-04/1
2N5943	15/50	1500	3.4/200	−50		−4	+50	79-04/1
2N5947	20/75	1500	3.8/200		−55	−60	+50	144D-06/1
MRF5943	15/50	1500	3.4/200					751-03/1
MRF5583 (1)	10/100	1500						751-03/1
BFX89	5/25	1600	2.5/500					20-03/10
BFY90	5/25	1700	2.5/500					20-03/10
2N6305	5/10	1800	4/450					20-03/10
2N6304	5/10	1800	3.2/450					20-03/10
MMBR4957 (1)	10/2	2000	3/450					318-02/6
MMBR5031	6/5	2000	1.9/450					318-02/6
MRF511	20/80	2100	7.3/200	−50	−65	−57	+50	144D-06/1
MRFQ17	12.5/50	2200						751-03/1
MRF517	15/60	2700	6.5/300	−60	−72	−57	+45	79-04/1
MMBR920	10/14	4500	2.4/500					318-02/6
BFW92A	10/10	4500	2.7/500					317A-01/2
MRF586	15/90	4500	3/500	−50	−72		+50	79-04/1
BFR96	10/50	4500	2/500					317A-01/2
MRF961	10/50	4500	2/500					317-01/2
MRF962	10/50	4500	2/500					303-01/1
MRF965	10/50	4500	2/500					26-03/1
BFR90	10/14	5000	2.4/500					317A-01/2
BFR91	5/30	5000	1.9/500					317A-01/2
MRF581	10/75	5000	2/500		−65		+50	317-01/2
MRF581A	10/75	5000	1.8/500		−65		+50	317-01/2
MRF5812	10/75	5000	1.8/500		−65		+50	751-03/1
MRF587	15/90	5500	3/500	−52	−72		+50	144D-06/1
2N6679	(Has $P_{1\ dB}$ of 18.5 dBm Typ @ 4 GHz)							303-01/1

(1) PNP

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 (2)	20-03/10
MM4049 (1)	20/5	4000	15	20-03/10
MRF914	20/10	4500 (2)	—	20-03/10
2N5583 (1)	50/10	1000	8 (2)	79-04/1
2N5836	50/6	2000	6 (2)	26-03/1
2N5943	50/15	1200	5.5 (2)	79-04/1
2N5837	100/3	1700	6 (2)	26-03/1

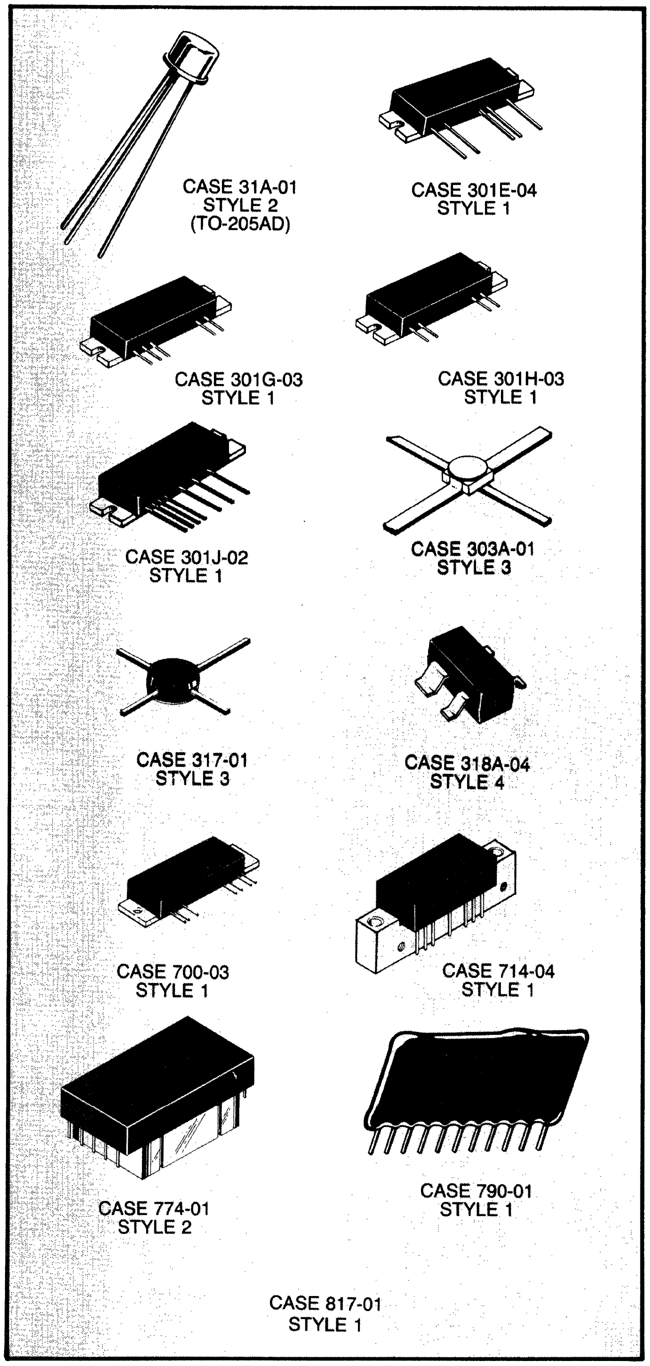
UHF and Microwave Oscillators

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 (2)	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	751-03/1

(1) PNP (2) Typical

RF Amplifier Modules



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 AMPLIFIER MODULES (continued)

Hybrid Land Mobile Power Amplifiers

The advantages of small size, reproducibility and overall lower cost become more pronounced with increasing frequency of operation. These modules offer a wide range in power levels and gain, with guaranteed performance specifications for bandwidth, stability and ruggedness.

400–512 MHz, UHF FM MODULES

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
MHW707-2*	7	0.001	440–470	38.4	7.5	301J-02/1
MHW709-1	7.5	0.1	400–440	18.8	12.5	700-03/1
MHW709-2	7.5	0.1	440–470	18.8	12.5	700-03/1
MHW709-3	7.5	0.1	470–512	18.8	12.5	700-03/1
MHW710-1	13	0.15	400–440	19.4	12.5	700-03/1
MHW710-2	13	0.15	440–470	19.4	12.5	700-03/1
MHW710-3	13	0.15	470–512	19.4	12.5	700-03/1
MHW720-1	20	0.15	400–440	21	12.5	700-03/1
MHW720-2	20	0.15	440–470	21	12.5	700-03/1
MHW720A1 (1)	20	0.15	400–440	21	12.5	700-03/1
MHW720A2 (1)	20	0.15	440–470	21	12.5	700-03/1

806–960 MHz, UHF FM MODULES

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
MHW806A1 (1)	6	0.03	820–850	23	12.5	301H-03/1
MHW806A2 (1)	6	0.03	806–870	23	12.5	301H-03/1
MHW806A3 (1)	6	0.03	890–915	23	12.5	301H-03/1
MHW806A4 (1)	6	0.03	870–960	23	12.5	301H-03/1
MHW812A1 (1)*	12	0.1	806–870	20.8	13	301H-03/1
MHW812A2 (1)*	12	0.1	806–890	20.8	13	301H-03/1
MHW812A3 (1)	12	0.1	870–950	20.8	13	301H-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
MHW820-3	18	0.35	870–950	17.1	12.5	301G-03/1

(1) Designed for Wide Range P_{out} Level Control
*To be introduced

New introductions.

CATV Distribution Hybrid Amplifiers

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 40 CHANNELS AND 330 MHz (Case 714-04/1)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test (1) dB	Composite Triple Beat dB		Cross Modulation dB		Noise Figure @ 330 MHz dB	
					35 CH	40 CH	35 CH	40 CH	Max	Typ
MHW1121	12	35	+50	−68	−51	—	−51	—	7	6
MHW1122	12	35	+50	−70	−56	—	−56	—	8	6.5
MHW3171	17	40	+50	−68	−56	−54	−55	−54	6	5.5
MHW3172	17	40	+50	−70	−59	−57	−58	−57	7	6
MHW3181	18	40	+50	−68	−54	−52	−55	−54	6	5.2
MHW3182	18	40	+50	−68	−57	−55	−58	−57	7	6
MHW3222	22	40	+50	−65	−57	−55	−55	−54	6.5	5
MHW3272A	27	40	+50	−70	—	−56	—	−55	6	5.5
MHW3342	34	40	+50	−68	−57	−55	−57	−55	5.5	4.5
MHW3382A	38	40	+50	−66	—	−53	—	−51	5.5	4.5

HYBRIDS UP TO 60 CHANNELS AND 450 MHz (Case 714-04/1)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test (2) dB	Composite Triple Beat dB		Cross Modulation dB		Noise Figure @ 450 MHz dB	
					53 CH	60 CH	53 CH	60 CH	Max	Typ
MHW5141A	14	60	+46	−72	−61	−56	−61	−56	7	—
MHW5142	14	60	+46	−70	−62	−58	−62	−58	8	7
MHW5142A	14	60	+46	−74	−63	−59	−63	−59	8	—
MHW5171	17	60	+46	−70	−57	−55	−58	−55	7	6.5
MHW5171A	17	60	+46	−72	−58	−56	−58	−56	7	6.5
MHW5172	17	60	+46	−70	−60	−58	−60	−58	8	6
MHW5172A	17	60	+46	−74	−61	−59	−61	−59	8	6
MHW5181	18	60	+46	−72	−58	−55	−57	−56	6.5	5.5
MHW5181A	18	60	+46	−72	−59	−57	−57	−56	6	—
MHW5182	18	60	+46	−72	−62	−59	−58	−58	7	6
MHW5182A	18	60	+46	−72	−63	−61	−59	−59	7	6
MHW5222	22	60	+46	−68	−57	—	−54	—	7	6
MHW5222A	22	60	+46	−72	−60	−58	−56	−55	8	6
MHW5272A	27	60	+46	−72	−62	−60	−62	−60	6	—
MHW5342	34	60	+46	−70	−61	−58	−61	−59	6	5
MHW5342A	34	60	+46	−72	−61	−59	−61	−59	5.5	5
MHW5382	38	60	+46	−68	−60	−57	−60	−58	6	5
MHW5382A	38	60	+46	−70	−61	−59	−61	−59	5.5	5

(1) Channels (2 and 13) @ R
(2) Channels (2 and M13) @ M22

RF AMPLIFIER MODULES (continued)

HYBRIDS UP TO 77 CHANNELS AND 550 MHz (Case 714-04/1)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test (1) dB	Composite Triple Beat dB 77 CH	Cross Modulation dB 77 CH	Noise Figure @ 550 MHz dB Max
MHW6141	14	77	+44	−72	−56	−59	7.5
MHW6142	14	77	+44	−72	−59	−62	8.5
MHW6171	17	77	+44	−68	−56	−59	6
MHW6172	17	77	+44	−70	−59	−62	6.5
MHW6181	18	77	+44	−70	−56	−59	7
MHW6182	18	77	+44	−72	−58	−62	8
MHW6222	22	77	+44	−64	−57	−57	7

REVERSE AMPLIFIER HYBRIDS (Case 714-04/1)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications						Noise Figure @ 175 MHz dB	
			Output Level dBmV	2nd Order Test dB (4)	Composite Triple Beat dB		Cross Modulation dB			
					22 CH	26 CH	22 CH	26 CH	Max	Typ
MHW1134	13	22	+50	−72	−73	−71 (2)	−65	−65 (2)	7	—
MHW1184	18	22	+50	−72	−72	−70 (2)	−64	−64 (2)	5.5	—
MHW1224	22	22	+50	−72	−71	−68 (2)	−62	−62 (2)	5.5	—
MHW1244	24	22	+50	−72	−70	−68 (2)	−61	−61 (2)	5	—

450/550 MHz POWER DOUBLING HYBRIDS (Case 714-04/1)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications						Noise Figure @ 450/550 MHz dB	
			Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB		Cross Modulation dB			
					60 CH	77 CH	60 CH	77 CH	Max	Typ
MHW5185	18	60	+46	−74 (3)	−65	—	−66	—	7	—
MHW6185	18	77	+46	−67 (1)	—	−58	—	−59	8	—

450/550 MHz FEEDFORWARD HYBRIDS (Case 774-01/2)

Device	Hybrid Gain (Nominal) dB	Channel Loading Capacity	Maximum Distortion Specifications						Noise Figure @ 450/550 MHz dB	
			Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB		Cross Modulation dB			
					60 CH	77 CH	60 CH	77 CH	Max	Typ
MHW4524F	24	60	+46	−84 (3)	−80	—	−75	—	8.5	8
MHW6246	24	77	+44	−80	—	−76	—	−76	9	—

(1) Channels (2 and M30) @ M39
(2) Typical
(3) Channels (2 and M13) @ M22
(4) Channels (2 and A) @ 7

General-Purpose Wideband Hybrid Amplifiers

50 Ω–100 Ω WIDEBAND AMPLIFIERS (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 TO-205AD (Case 31A-01/2)

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
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

50 Ω–75 Ω WIDEBAND AMPLIFIERS (Case 790-01/1)

The Case 790-01 amplifiers feature high gain with low noise, low input and output VSWR and excellent gain flatness to 1 GHz. Three amplifier stages are constructed using SOT-23 packaged devices mounted on thick film circuit substrates.

Device	Frequency Range MHz	Gain dB Min/Typ	Supply Voltage Vdc	Output Level 1 dB Compression dBm	Noise Figure @ 250 MHz dB
MWA5157	30–890	22/24	10–14	+6	5
MWA5121	30–890	25/27	18–22	+6	4

RF AMPLIFIER MODULES (continued)

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	817-01/1
MHW10001	54	56.75	249	8.5	817-01/1
MHW10002	54	62.75	255	8.5	817-01/1
MHW10003	54	50.75	243	8.5	817-01/1

50 Ω Monolithic Microwave Integrated Circuits

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	30–3000	11	25	7	6
MWA0304	30–3000	11.5	35	12	6
MWA0404	30–3000	8	50	12	6
Case 318A-04/4					
MWA0211	30–3000	11	25	7	6
MWA0311	30–3000	11.5	35	12	6
MWA0411	30–3000	8	50	12	6
Case 303A-01/3					
MWA0270	30–3000	11	25	7	6
MWA0370	30–3000	12	35	12	6
MWA0470	30–3000	8.5	50	12	6

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 non-standard product is $2500 **unless** otherwise stated at the time of quotation, order entry or acknowledgement.

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) — 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.

Wafer Pak (WP Suffix) — 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.

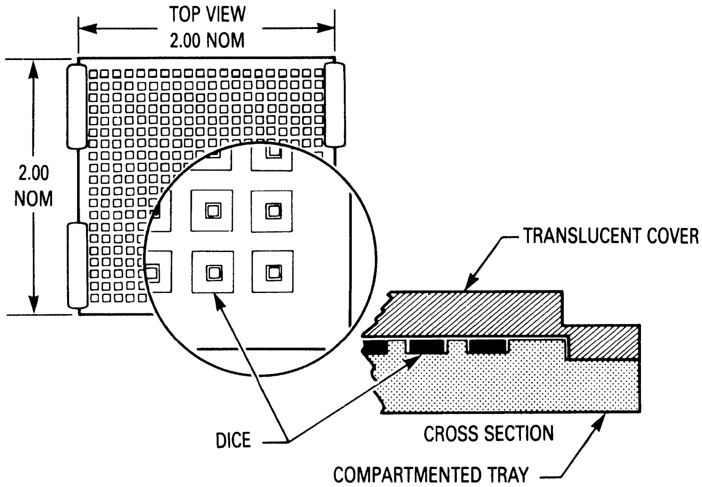


Figure 1. Multi-Pak (No Suffix)

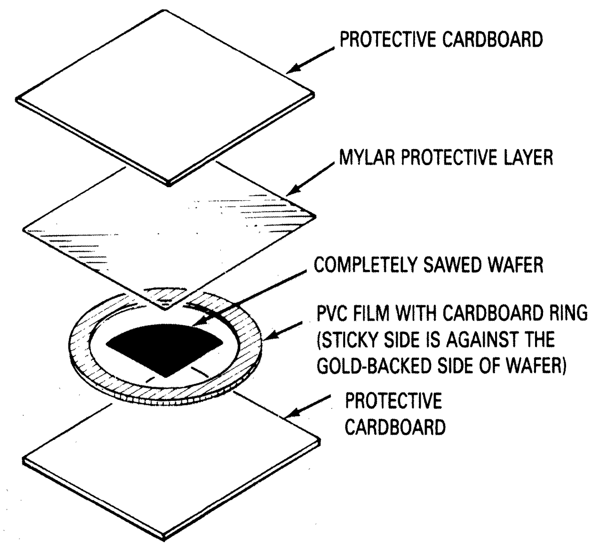


Figure 2. Circle Pak (CP Suffix)

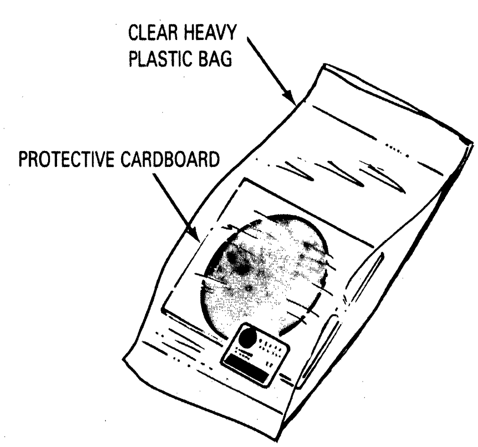
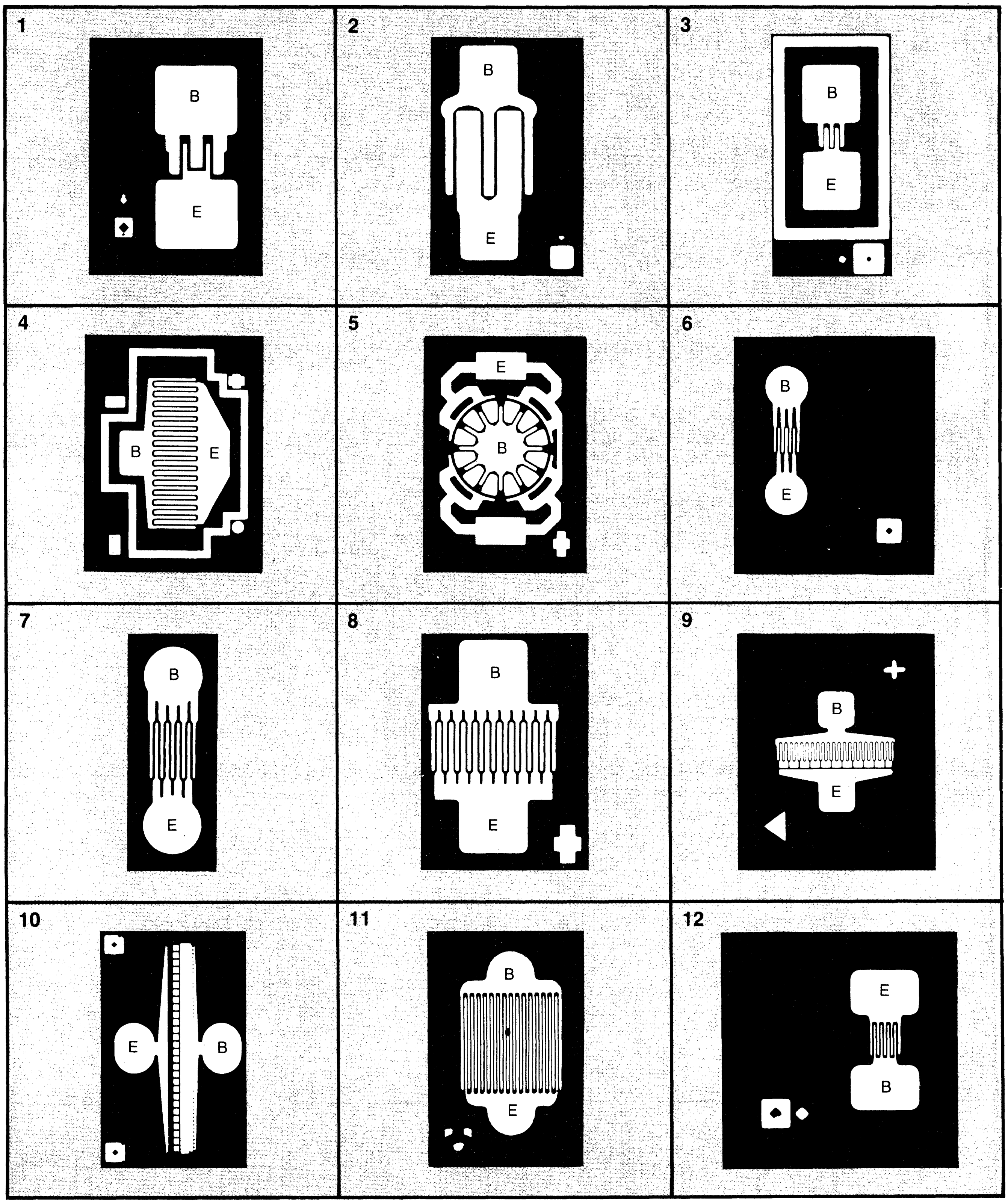


Figure 3. Wafer Pak (WP Suffix)

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		Metallization		Packaging		
					inches 1/1000 Base	inches 1/1000 Emitter	Front	Back	Multi (none)	Wafer (WP)	Circle (CP)
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	*	*	*
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

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.

Tuning and Switching Diodes

Tuning Diodes — A wide range of voltage-variable capacitance diodes for electronic tuning and control of RF circuits from HF through UHF.

Hot Carrier Diodes — For high-efficiency VHF and UHF switching and mixer applications.

PIN Diodes — Particularly useful for bandswitching and detector circuits in the VHF range.

Tuning Diodes — Abrupt Junction

General-Purpose

Glass

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. 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.

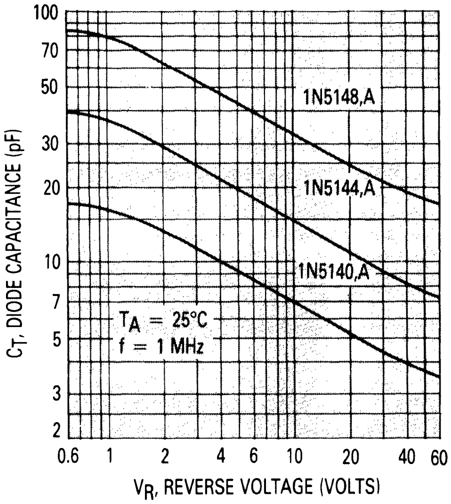
CASE 51-02
DO-204AA
(DO-7)

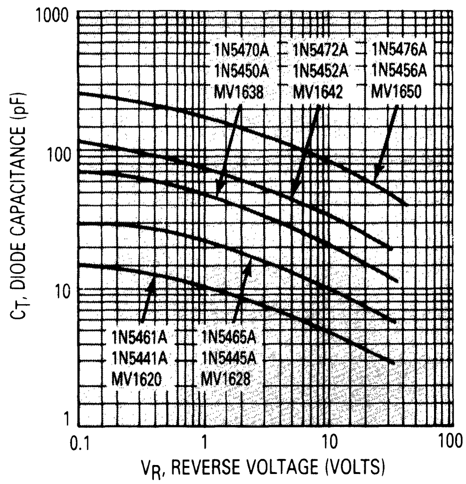
- High Q
- Capacitance TOL
  10% — No Suffix
  5% — Suffix A

	60 Volts		
C_T Nominal Capacitance pF ±10% @ V_R = 4 V f = 1 MHz	**Cap Ratio C4/C60 Min**	**Q @ 4 V 50 MHz Min**	**Device Type**
6.8	2.7	350	1N5139,A
8.2			
10	2.8	300	1N5140,A
12	2.8	300	1N5141,A
15	2.8	250	1N5142,A
18	2.8	250	1N5143,A
20			
22	3.2	200	1N5144,A
27	3.2	200	1N5145,A
33	3.2	200	1N5146,A
39	3.2	200	1N5147,A
47	3.2	200	1N5148,A
56			
68			
82			
100			

TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage

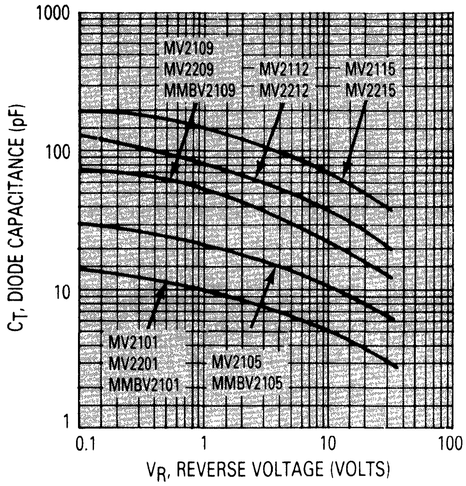


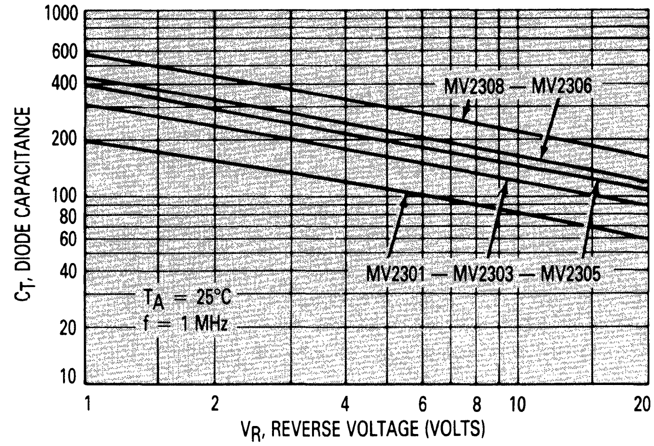


• Premium 30 V • Very High Q • Guaranteed High CR • Capacitance TOL 10% – A, 5% – B, 2% – C			• High Q • Controlled CR • Capacitance TOL 10% – A, 5% – B, 2% – C			• General-Purpose			
Maximum Working Voltage						Maximum Working Voltage			
30 Volts						20 Volts			
Cap Ratio C2/C30 Min	**Q @ 4 V 50 MHz Min**	**Device Type**	**Cap Ratio C2/C30 Min**	**Q @ 4 V 50 MHz Min**	**Device Type**	**Cap Ratio C2/C20 Min**	**Q @ 4 V 50 MHz Min**	**Device Type**	**C_T Nominal pF ±10% @ V_R = 4 V f = 1 MHz**
2.7	600	1N5461A	2.5	450	1N5441A	2	300	MV1620	**6.8**
2.8	600	1N5462A	2.5	450	1N5442A	2	300	MV1622	**8.2**
2.8	550	1N5463A	2.6	400	1N5443A	2	300	MV1624	**10**
2.8	550	1N5464A	2.6	400	1N5444A	2	300	MV1626	**12**
2.8	550	1N5465A	2.6	450	1N5445A	2	250	MV1628	**15**
2.9	500	1N5466A	2.6	350	1N5446A	2	250	MV1630	**18**
2.9	500	1N5467A	2.6	350	1N5447A	2	250	MV1632	**20**
2.9	500	1N5468A	2.6	350	1N5448A	2	250	MV1634	**22**
2.9	500	1N5469A	2.6	350	1N5449A	2	200	MV1636	**27**
2.9	500	1N5470A	2.6	350	1N5450A	2	200	MV1638	**33**
2.9	450	1N5471A	2.6	300	1N5451A	2	200	MV1640	**39**
2.9	400	1N5472A	2.6	250	1N5452A	2	200	MV1642	**47**
2.9	300	1N5473A	2.6	200	1N5453A	2	150	MV1644	**56**
2.9	250	1N5474A	2.7	175	1N5454A	2	150	MV1646	**68**
2.9	225	1N5475A	2.7	175	1N5455A	2	150	MV1648	**82**
2.9	200	1N5476A	2.7	175	1N5456A	2	150	MV1650	**100**

CASE 51-02
DO-204AA
(DO-7)

TYPICAL CHARACTERISTICS **Diode Capacitance versus Reverse Voltage**

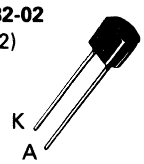




General-Purpose

Plastic

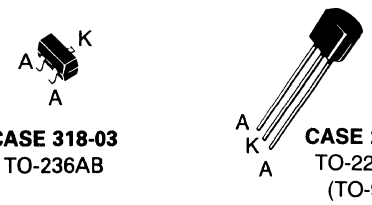
CASE 182-02
(TO-92)



CASE 318-02
(TO-236AA)

	• Low-Cost • High Volume			• Lower Cost • General-Purpose			• Low-Cost • High Volume		
	Maximum Working Voltage								
	30 Volts			25 Volts			30 Volts		
	CASE 182-02 2-Lead TO-92						CASE 318-02 TO-236AA		
C_T Nominal Capacitance pF ±10% @ V_R = 4 V f = 1 MHz	Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Min	Device Type	Cap Ratio C1/C10 Min	Q @ 4 V 50 MHz Min	Device Type C_T ±20%	Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Typ	Device Type
6.8	2.5	450	MV2101	1.9	300	MV2201	2.5	400	MMBV2101
8.2	2.5	450	MV2102				2.5	350	MMBV2102
10	2.5	400	MV2103	2	200	MV2203	2.5	350	MMBV2103
12	2.5	400	MV2104				2.5	350	MMBV2104
15	2.5	400	MV2105	2	200	MV2205	2.5	350	MMBV2105
18	2.5	350	MV2106				2.5	300	MMBV2106
22	2.5	350	MV2107	2	150	MV2207	2.5	300	MMBV2107
27	2.5	300	MV2108				2.5	250	MMBV2108
33	2.5	200	MV2109	2	150	MV2209	2.5	200	MMBV2109
39	2.5	150	MV2110						
47	2.5	150	MV2111	2	100	MV2211			
56	2.6	150	MV2112						
68	2.6	150	MV2113	2	100	MV2213			
82	2.6	100	MV2114						
100	2.6	100	MV2115	2	50	MV2215			

Dual Diodes



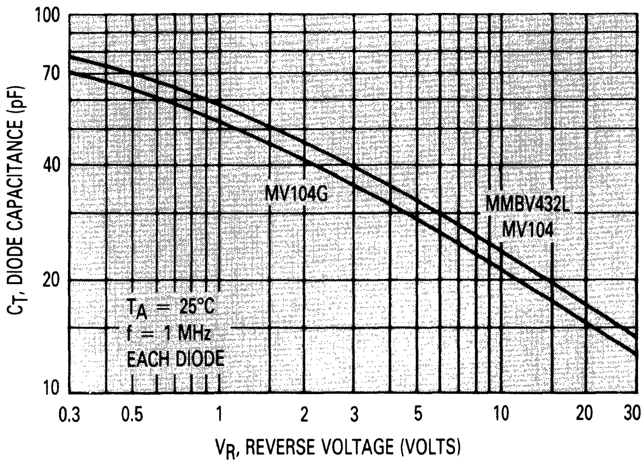
CASE 318-03
TO-236AB

CASE 29-04
TO-226AA
(TO-92)

• High Q • Guaranteed Capacitance Range • Monolithic Dual
Maximum Working Voltage
32 Volts

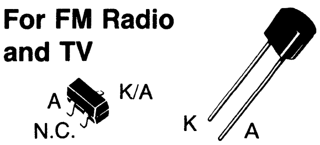
C_T Capacitance			Cap Ratio C3/C30	Q @ 3 V 50 MHz	Device Type
pF		@ V_R			
Min	Max	Volts	Min	Min	
34	39	3	2.5	100	MV104G(1)
37	42	3	2.5	100	MV104(1)
43	48.1	2	1.5*	100	MMBV432L(2)

(1) Case 29 (2) Case 318 *C2/C8



Tuning Diodes Hyper-Abrupt Junction

For FM Radio and TV



CASE 318-02 (TO-236AA) CASE 182-02 (TO-92)

- High Q
- Guaranteed Capacitance Range

Maximum Working Voltage

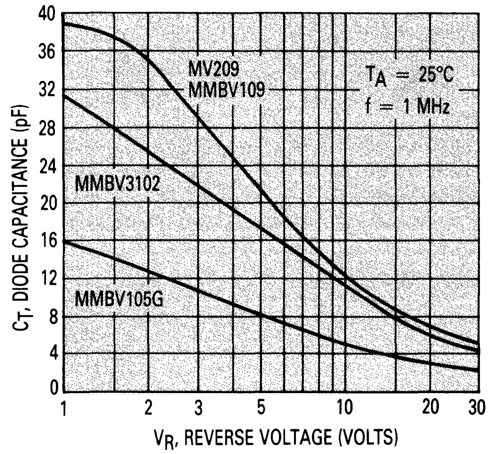
30 Volts

C_T Capacitance pF @ V_R			Cap Ratio C3/C25	Q @ 3 V 50 MHz	Device Type
Min	Max	Volts	Min	Typ	
1.8	2.8	25	4	350	MMBV105G*
20	25	3	4.5	300	MMBV3102*
26	32	3	5	250	MMBV109*
26	32	3	5	250	MV209**

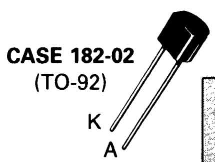
*Case 318 **Case 182

TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage

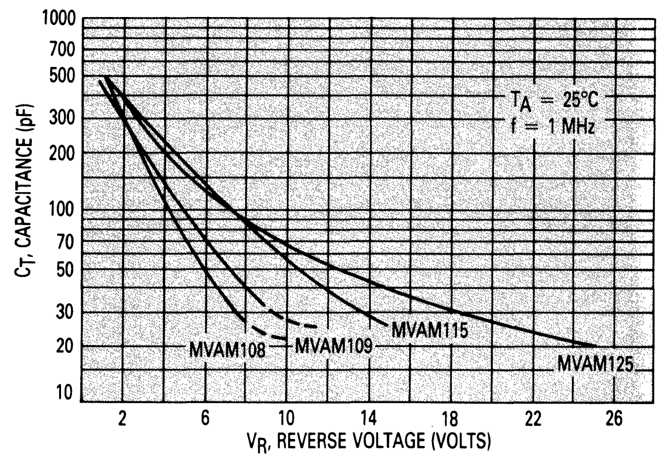


For AM Radio



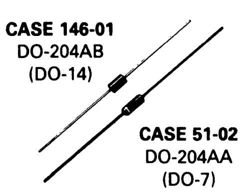
- High Capacitance Ratio
- Guaranteed Diode Capacitance
- Close Matching

C_T V_R=1 V, f=1 MHz pF		Q @ 1 Vdc, 1 MHz = 150 (Min)			
Min	Max	$V_{BR(R)}$ Min	Cap Ratio Min @	V_R Volts	Device Type
440	560	12	15	1/8	MVAM108
400	520	15	12	1/9	MVAM109
440	560	18	15	1/15	MVAM115
440	560	28	15	1/25	MVAM125



For High Capacitance and High Reliability Applications

100% Screening to High Rel electrical and environmental specifications, H suffix.



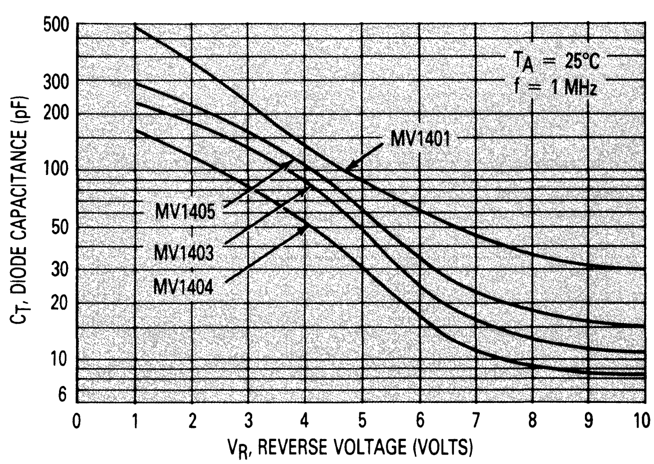
- Hyper-Abrupt
- High Tuning Ratio
- High Rel — Suffix H

Maximum Working Voltage

12 Volts

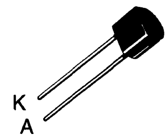
C_T, Nominal Capacitance pF @ V_R		Cap Ratio C2/C10	Q @ 2 V 1 MHz	Device Type	
Nom ± 20%	Volts	Min	Min	Case 51	Case 146
120	2	10	200	MV1404,H	
175	2	10	200	MV1403,H	
250	2	10	200	MV1405,H	
550*	1	14(1)	200		MV1401,H

*±15% (1)Cap Ratio @ C1/C10 V

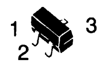


Hot-Carrier (Schottky) Diodes

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.



CASE 182-02



CASE 318-02

CASE 318-02

STYLE 8:
PIN 1. ANODE
2. N.C.
3. CATHODE

STYLE 11:
PIN 1. ANODE
2. CATHODE
3. CATHODE/ANODE

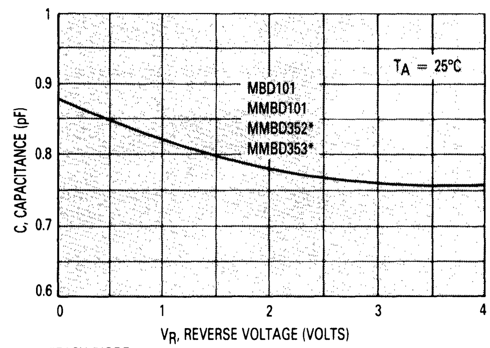
STYLE 19:
PIN 1. CATHODE
2. ANODE
3. CATHODE/ANODE

$V_{(BR)R}$ $I_R = 10\ \mu A$ Volts Min	C_T f = 1 MHz pF Max	V_R @ Volts	V_F $I_F = 10$ mA Volts Max	I_R nA Max	V_R @ Volts	Device Type
CASE 182, STYLE 1						
4	1	0	0.6	250	3	MBD101
20	1.5	15	0.6	200	15	MBD201
30	1.5	15	0.6	200	25	MBD301
50	1	20	1.2	200	25	MBD501
70	1	20	1.2	200	35	MBD701
CASE 318, STYLE 8						
4	1	0	0.6	250	3	MMBD101
20	1.5	15	0.6	200	15	MMBD201
30	1.5	15	0.6	200	25	MMBD301
50	1	20	1.2	200	25	MMBD501
70	1	20	1.2	200	35	MMBD701
DUAL DIODES, CASE 318						
4	1	0	0.6	250	3	MMBD352*
4	1	0	0.6	250	3	MMBD353**

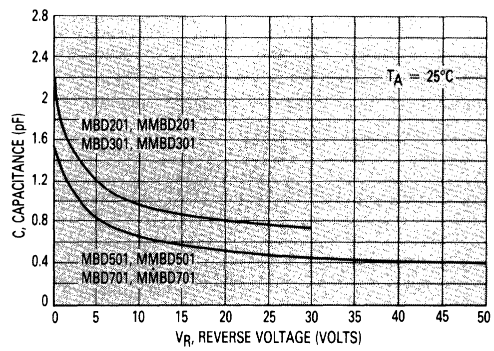
*Style 11 **Style 19

TYPICAL CHARACTERISTICS

Capacitance versus Reverse Voltage



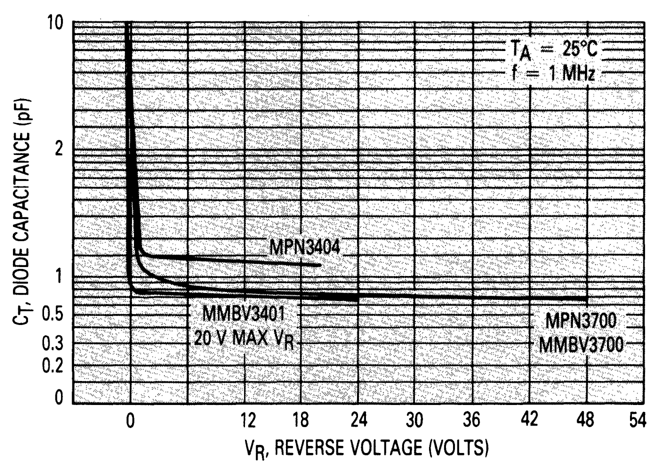
*EACH DIODE



PIN Switching Diodes

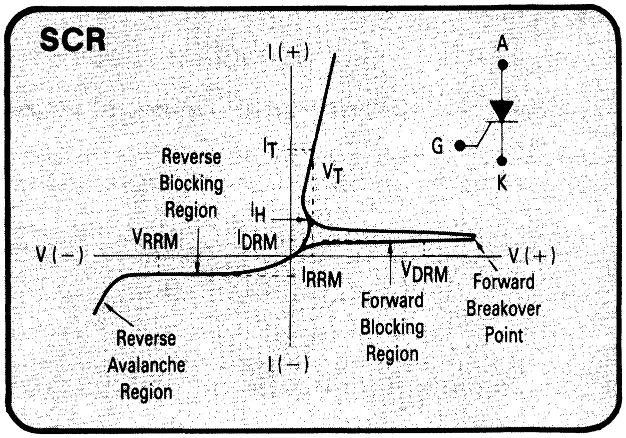
. . . designed for VHF band switching and general-purpose switching.

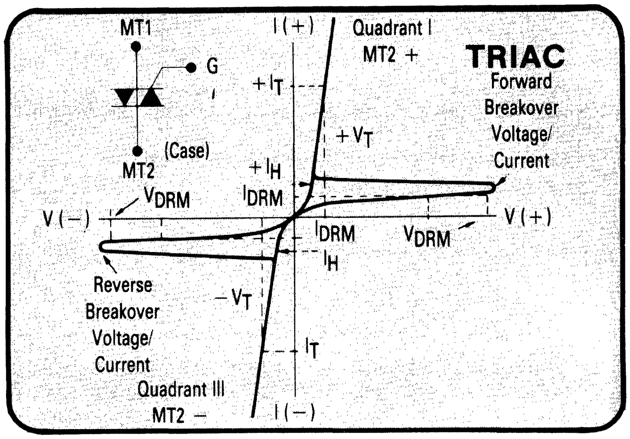
$V_{(BR)R}$ $I_R = 10\ \mu Adc$ Volts Min	R_S $I_F = 10$ mAdc f = 100 MHz Ohms Max	C_T $V_R = 20$ V f = 1 MHz pF Max	Device Type
CASE 182, STYLE 1			
20	0.85	2	MPN3404
200	1	1	MPN3700
CASE 318, STYLE 8			
35	0.7	1	MMBV3401
200	1	1	MMBV3700

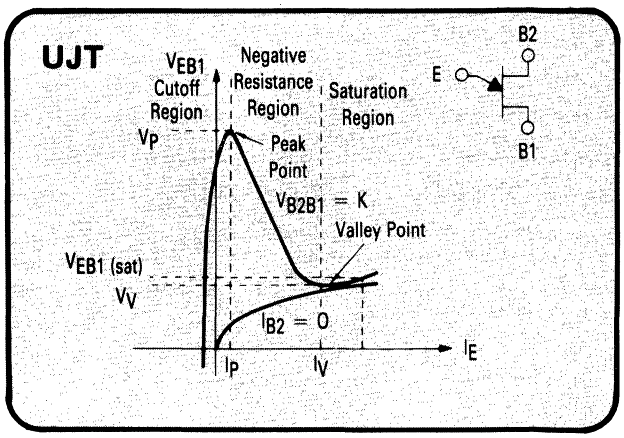


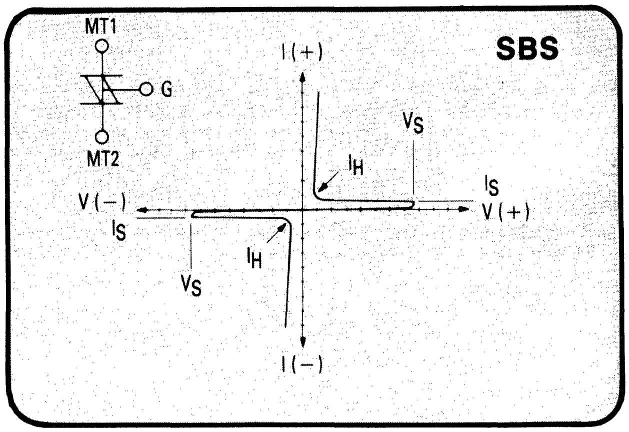
Thyristors and Triggers

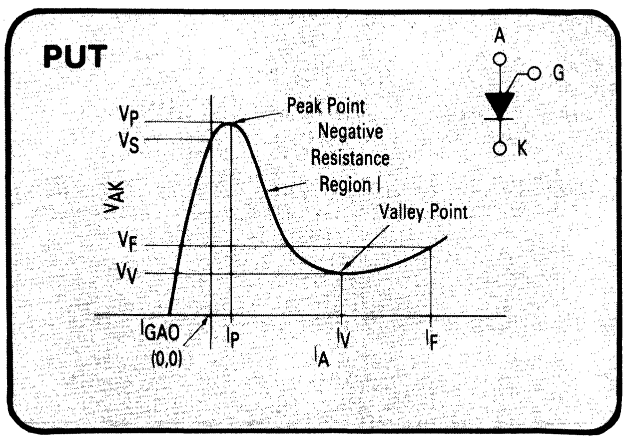
Characteristic Curves

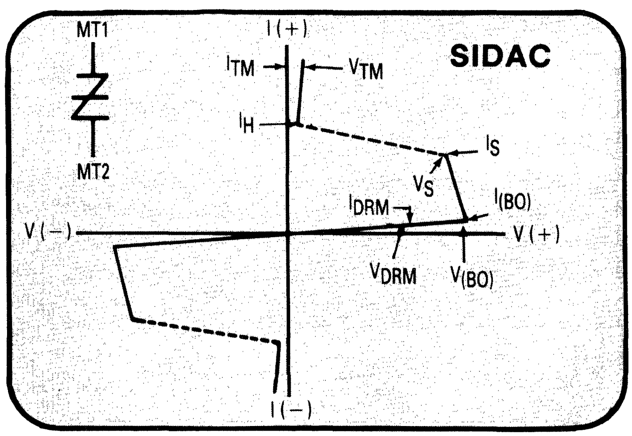


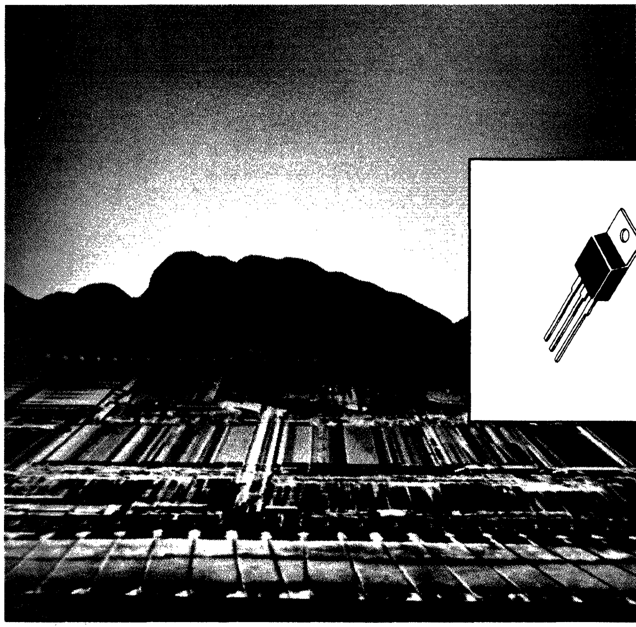


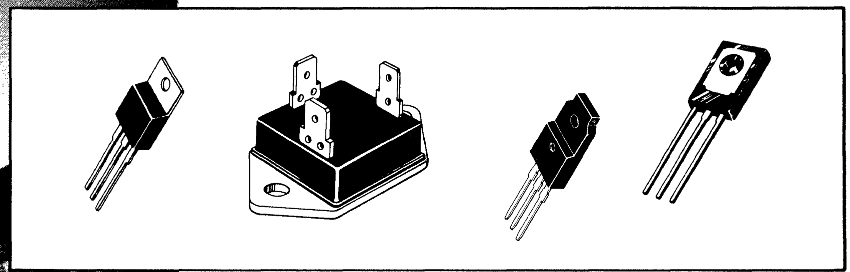












Thyristors and Triggers

In Brief . . .

Motorola's broad line of Thyristors include. . . .

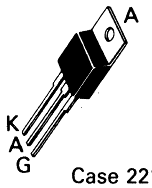
- A full line of TRIACs and SCRs covering a forward current range from 0.5 to 55 amperes and blocking voltages from 15 to 800 volts.
- Two basic package categories — plastic for lowest cost — including fully insulated plastic Case 221C-02 (TO-220 Full Pak); metal for hermetically-sealed requirements in high-reliability projects.
- An extensive line of trigger devices that includes UJTs, PUTs, SBS — even optically-coupled TRIAC drivers from Motorola's optoelectronic product line.

Then there are the special applications devices — for Radar Modulation and Crowbar applications; even specially packaged devices with quick-disconnect terminals for appliances and SOT 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 "gate-turnoff" (GTO) devices which facilitates the use of thyristors in dc power-switching applications.

GTOs

Gate Turn-Off Thyristors



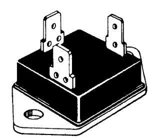
Case 221A-04

GTOs are thyristors that can be turned off as well as on by a gate signal. They are rugged, efficient high voltage switches that are particularly well suited for pulse width modulation circuits and in applications such as motor drives, switching power supplies, inverters and other functions requiring high surge-current capabilities and fast switching speeds.

Specification Max	Device Number	
	MGTO1000	MGTO1200
VDRXM (V)	1000	1200
I_{TSM} (A)	200	
I_{GTM} (mA)	300	
V_{GTM} (V)	1.5	
I_H (mA)	400	
V_{GRM} (V)	15	

ATTENTION:
PACKAGE INNOVATION

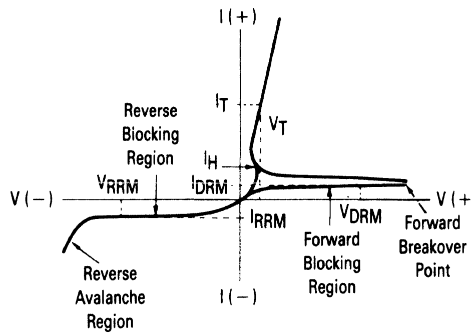
Isolated TRIAC Mold Type

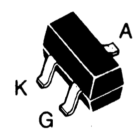


Features a TO-3 isolated mounting with a high isolation voltage of 2.5 kVrms min. This package also offers quick disconnect lead attachments, is plastic encapsulated to provide economical cost and is UL recognized. See pages 5-134 and 5-135 for the MAC625 and MAC635 series.

SCRs

Silicon Controlled Rectifiers

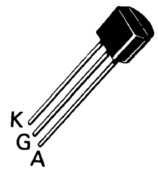
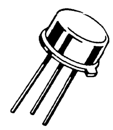


		On-State
		0.8 A
		$T_C = 67°C$
		
		Sensitive Gate
		Case 318-02 SOT-23
V_{DRM} V_{RRM}	25 V	MMBS5060
	50 V	MMBS5061
	100 V	MMBS5062
	200 V	
	400 V	
	500 V	
	600 V	
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps) 60 Hz	
	I_{GT} (mA)	0.2
	V_{GT} (V)	0.8
	T_J Operating Range (°C)	−25 to +150

Thyristors — SCR's

Metal/Plastic Packages

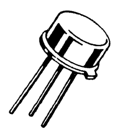
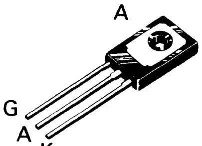
0.5 to 55 Amperes RMS
25–1000 Volts

On-State (RMS) Current						
0.5 AMP	**0.8 AMP**	**1.2 AMPS**	**1.5 AMPS**	**1.6 AMPS**		
T_C = 65°C	T_C = 58°C	T_C = 25°C	T_C = 50°C	T_C = 80°C		
						
Sensitive Gate						
Case 22-03 TO-206AA (TO-18) Style 6	**Case 29-04 TO-226AA (TO-92) Style 10**			**Case 79-04 TO-205AD (TO-39) Style 3**		
MCR202	MCR102 2N5060 BRX44/BRY55-30*	C205Y			**25 V**	
MCR203	MCR103 2N5061 BRX45/BRY55-60*	C205YY	MCR22-2	2N1595	**50 V**	
MCR204	MCR100-3 2N5062 BRX46/BRY55-100*	C205A	MCR22-3	2N1596	**100 V**	V_{DRM}
MCR206	MCR100-4 2N5064 BRX47/BRY55-200*	C205B	MCR22-4	2N1597	**200 V**	
	MCR100-6 BRX49/BRY55-400*	C205D	MCR22-6	2N1599	**400 V**	V_{RRM}
	BRY55-500*				**500 V**	
	MCR100-8 BRY55-600*		MCR22-8		**600 V**	
6	10		150(1)	15	**I_{TSM} (Amps) 60 Hz**	
0.2				10	**I_{GT} (mA)**	**MAXIMUM ELECTRICAL CHARACTERISTICS**
0.8				3	**V_{GT} (V)**	
−65 to +125	−65 to +110	−40 to +125°C	−40 to +125	−65 to +125	**T_J Operating Range (°C)**	

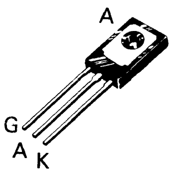
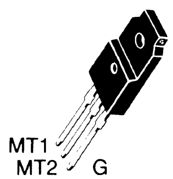
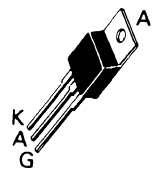
NOTE:
Industry Standards, with a variety of Custom Specifications and Leadforms available on Case 29-04 product.

(1) Exponential decay for 1 μs, 10 Hz pulse width (CD ignition).
* European Part Numbers. Package is Case 29 with Leadform 18.

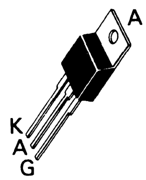
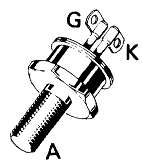
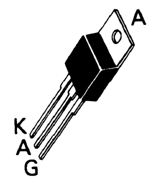
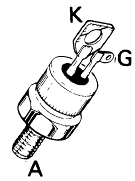
SCR's (continued)

		On-State (RMS) Current				
		1.6 AMPS			4 AMPS	
		$T_C = 85°C$		$T_C = 65°C$	$T_C = 93°C$	$T_C = 30°C$
						
		Sensitive Gate				
		Case 79-04 TO-205AD (TO-39) Style 3			Case 77-05 TO-126 Style 2	
V_{DRM} V_{RRM}	50 V	2N2323	2N4213	MCR1906-2	MCR106-2 2N6237	C106F
	100 V	2N2324	2N4214	MCR1906-3	MCR106-3 2N6238	C106A
	200 V	2N2326	2N4216	MCR1906-4	MCR106-4 2N6239	C106B
	400 V	2N2329	2N4219	MCR1906-6	MCR106-6 2N6240	C106D
	600 V			MCR1906-8	MCR106-8 2N6241	C106M
	800 V					
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps) 60 Hz	15			25	20 150(1)
	I_{GT} (mA)	0.2	0.1	1	0.2	
	V_{GT} (V)	0.8		1		0.8
	T_J Operating Range (°C)	−65 to +125		−65 to +110	−40 to +110	

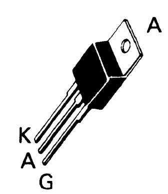
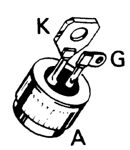
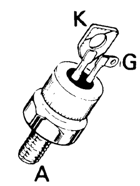
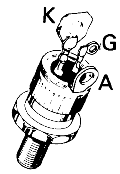
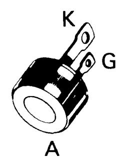
(1) Exponential decay for 1 μs, 10 Hz pulse width (CD ignition).

On-State (RMS) Current						
6 AMPS	**8 AMPS**					
T_C = 30°C	**T_C = 70°C**	**T_C = 75°C**		**T_C = 83°C**		
						
Sensitive Gate				**Sensitive Gate**		
Case 77-05 TO-126 Style 2	**Case 221C-02 Style 2**	**Case 221A-04 TO-220AB Style 3**				
MCR506-2	MCR218-2FP	MCR218-2	C122F S2800F	MCR72-2	**50 V**	**V_{DRM}**
MCR506-3		MCR218-3	C122A S2800A	MCR72-3	**100 V**	
MCR506-4	MCR218-4FP	MCR218-4	C122B S2800B	MCR72-4	**200 V**	
MCR506-6	MCR218-6FP	MCR218-6	C122D S2800D	MCR72-6	**400 V**	**V_{RRM}**
MCR506-8	MCR218-8FP	MCR218-8	C122M S2800M	MCR72-8	**600 V**	
	MCR218-10FP	MCR218-10	C122N S2800N		**800 V**	
40	80		C122/S2800 90/100	100	**I_{TSM} (Amps) 60 Hz**	**MAXIMUM ELECTRICAL CHARACTERISTICS**
0.2	30	25	C122/S2800 25/25	0.2	**I_{GT} (mA)**	
1	2.5	1.5			**V_{GT} (V)**	
−40 to +110	−40 to +125		−40 to +100		**T_J Operating Range (°C)**	

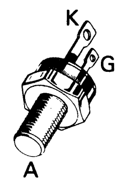
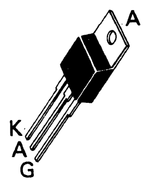
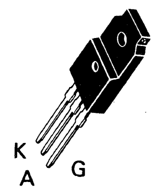
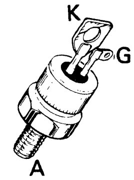
SCR's (continued)

	On-State (RMS) Current				
	10 AMPS	12 AMPS			16 AMPS
	T_C = 75°C	T_C = 85°C		T_C = 90°C	T_C = 35°C
	 Sensitive Gate				
	Case 221A-04 TO-220AB Style 3	Case 86-01 Style 1	Case 221A-04 TO-220AB Style 3		Case 263-04 Style 1
V_{DRM} / V_{RRM} 50 V	MCR310-2	MCR67-2	MCR68-2	2N6394	2N1843 2N1843A
100 V	MCR310-3	MCR67-3	MCR68-3	2N6395	2N1844 2N1844A
200 V	MCR310-4			2N6396	2N1846 2N1846A
400 V	MCR310-6	MCR67-6	MCR68-6	2N6397	2N1849 2N1849A
600 V	MCR310-8			2N6398	
800 V				2N6399	
MAXIMUM ELECTRICAL CHARACTERISTICS: I_{TSM} (Amps) 60 Hz	100	300(1)		100	125
I_{GT} (mA)	0.2	30			80
V_{GT} (V)	1.5				2
T_J Operating Range (°C)	−40 to +110	−40 to +125			−40 to +100

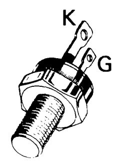
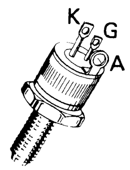
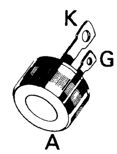
(1) Peak capacitor discharge current for t_w = 1 μs. t_w is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

On-State (RMS) Current						
16 AMPS	20 AMPS					
T_C = 90°C	T_C = 65°C					
			 Isolated			
Case 221A-04 TO-220AB Style 3	Case 310-02 Style 1	Case 263-04 Style 1	Case 311-02 Style 1	Case 174-04 TO-203AA Style 1		
2N6400	2N5164	2N5168		MCR3818-2	50 V	V_{DRM}
2N6401	S6200A	S6210A	2N6167 S6220A	MCR3818-3	100 V	
2N6402	2N5165 S6200B	2N5169 S6210B	2N6168 S6220B	MCR3818-4	200 V	
2N6403	2N5166 S6200D	2N5170 S6210D	2N6169 S6220D	MCR3818-6	400 V	V_{RRM}
2N6404	2N5167 S6200M	2N5171 S6210M	2N6170 S6220M	MCR3818-8	600 V	
2N6405				MCR3818-10	800 V	
160	240				I_{TSM} (Amps) 60 Hz	MAXIMUM ELECTRICAL CHARACTERISTICS
30	40				I_{GT} (mA)	
1.5					V_{GT} (V)	
−40 to +125	−40 to +100				T_J Operating Range (°C)	

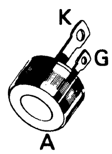
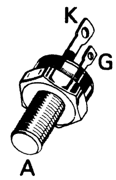
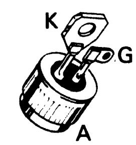
SCR's (continued)

		On-State (RMS) Current				
		20 AMPS	25 AMPS			
		T_C = 67°C	T_C = 85°C			T_C = 65°C
						
		Case 175-03 Style 1	Case 221A-04 TO-220AB Style 3		Case 221C-02 Style 3	Case 263-04 Style 1
V_{DRM} V_{RRM}	50 V	MCR3918-2	2N6504	MCR69-2	MCR225-2FP	2N682
	100 V	MCR3918-3	2N6505	MCR69-3		2N683
	200 V	MCR3918-4	2N6506		MCR225-4FP	2N685
	400 V	MCR3918-6	2N6507	MCR69-6	MCR225-6FP	2N688
	600 V	MCR3918-8	2N6508		MCR225-8FP	2N690
	800 V	MCR3918-10	2N6509		MCR225-10FP	2N692
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps) 60 Hz	240	300	750(1)	300	150
	I_{GT} (mA)	40		30	40	
	V_{GT} (V)	1.5				2
	T_J Operating Range (°C)	−40 to +100	−40 to +125			−65 to +125

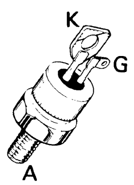
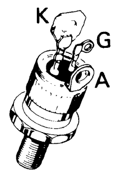
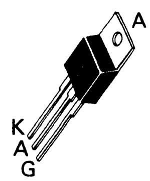
(1) Peak capacitor discharge current for t_W = 1 μs. t_W is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

On-State (RMS) Current						
25 AMPS						
T_C = 60°C		T_C = 65°C		T_C = 70°C		
		 Isolated				
Case 175-03 Style 1		Case 235-03 Style 1		Case 174-04 TO-203AA Style 1		
C230F	C231F	C230F3	C231F3	C232F	50 V	V_{DRM}
C230A	C231A	C230A3	C231A3	C232A	100 V	
C230B	C231B	C230B3	C231B3	C232B	200 V	
C230D	C231D	C230D3	C231D3	C232D	400 V	V_{RRM}
C230M	C231M	C230M3	C231M3	C232M	600 V	
					800 V	
250					I_{TSM} (Amps) 60 Hz	MAXIMUM ELECTRICAL CHARACTERISTICS
25	9	25	9	25	I_{GT} (mA)	
1.5					V_{GT} (V)	
−40 to +100					T_J Operating Range (°C)	

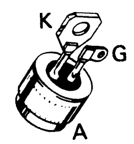
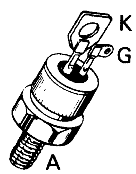
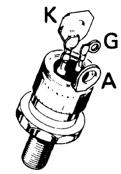
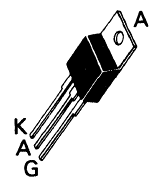
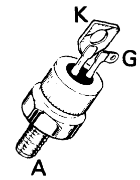
SCR's (continued)

		On-State (RMS) Current				
		25 AMPS		35 AMPS		
		$T_C = 70°C$		$T_C = 65°C$		
						
		Case 174-04 TO-203AA Style 1		Case 175-03 Style 1		Case 310-02 Style 1
V_{DRM}	50 V	C233F	MCR3835-2	MCR3935-2	MCR70-2	
V_{DRM}	100 V	C233A	2N3870	2N3896	MCR70-3	C229A
	200 V	C233B	2N3871	2N3897		C229B
V_{RRM}	400 V	C233D	2N3872	2N3898	MCR70-6	C229D
	600 V	C233M	2N3873 MCR3835-8	2N3899 MCR3935-8		C229M
	800 V		MCR3835-10	MCR3935-10		
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps) 60 Hz	250	350		850(1)	300
	I_{GT} (mA)	9	40		30	40
	V_{GT} (V)	1.5	1.6		1.5	2.5
	T_J Operating Range (°C)	−40 to +100			−40 to +125	

(1) Peak capacitor discharge current for $t_W = 1\ \mu s$. t_W is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

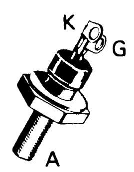
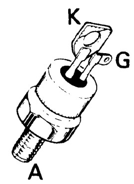
On-State (RMS) Current						
35 AMPS				40 AMPS		
T_C = 40°C	T_C = 65°C			T_C = 80°C		
		 Isolated				
Case 263-04 Style 1		Case 311-02 Style 1		Case 221A-04 TO-220AB Style 3		
C35F				MCR264-2	50 V	
C35A	C228A	2N6171	C228A3	MCR264-3	100 V	V_{DRM}
C35B	C228B	2N6172	C228B3	MCR264-4	200 V	
C35D	C228D	2N6173	C228D3	MCR264-6	400 V	V_{RRM}
C35M	C228M	2N6174	C228M3	MCR264-8	600 V	
C35N				MCR264-10	800 V	
225	300	350	300	400	I_{TSM} (Amps) 60 Hz	MAXIMUM ELECTRICAL CHARACTERISTICS
40				50	I_{GT} (mA)	
3	2.5	1.6	2.5	1.5	V_{GT} (V)	
−65 to +125	−40 to +125				T_J Operating Range (°C)	

SCR's (continued)

		On-State (RMS) Current				
		55 AMPS				
		T_C = 75°C		T_C = 70°C		T_C = 85°C
				 Isolated		
		Case 310-02 Style 1	Case 263-04 Style 1	Case 311-02 Style 1	Cases 221A-04 TO-220AB Style 3	Case 263-04 Style 1
V_{DRM} V_{RRM}	50 V	MCR63-2	MCR64-2	MCR65-2	MCR265-2	MCR71-2
	100 V	MCR63-3	MCR64-3	MCR65-3	MCR265-3	MCR71-3
	200 V	MCR63-4	MCR64-4	MCR65-4	MCR265-4	
	400 V	MCR63-6	MCR64-6	MCR65-6	MCR265-6	MCR71-6
	600 V	MCR63-8	MCR64-8	MCR65-8	MCR265-8	
	800 V	MCR63-10	MCR64-10	MCR65-10	MCR265-10	
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps) 60 Hz	550				1700(1)
	I_{GT} (mA)	40			50	30
	V_{GT} (V)	3			1.5	
	T_J Operating Range (°C)	−40 to +125				

(1) Peak capacitor discharge current for t_W = 1 μs. t_W is defined as five time constants of an exponentially decaying current pulse (crowbar applications).

Radar Modulators

On-State Pulsed Current				
100 AMPS		1000 AMPS		
T_C = 85°C		T_C = 65°C		
				
Case 63-03 TO-64 Style 1		Case 263-04 Style 1		
			50 V	V_{DRM} V_{RRM}
			100 V	
			200 V	
2N4199 2N4199JAN	MCR729-5	MCR1718-5	300 V	
2N4200 2N4200JAN	MCR729-6	MCR1718-6	400 V	
2N4201 2N4201JAN	MCR729-7	MCR1718-7	500 V	
2N4202 2N4202JAN	MCR729-8	MCR1718-8	600 V	
2N4203 2N4203JAN	MCR729-9		700 V	
2N4204 2N4204JAN	MCR729-10		800 V	
100*		1000*	I_{TSM} (Amps) 60 Hz	MAXIMUM ELECTRICAL CHARACTERISTICS
50			I_{GT} (mA)	
1.5			V_{GT} (V)	
−65 to +105		−65 to +125	T_J Operating Range (°C)	

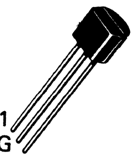
* Indicates pulse rating P_W = 3 μs duty cycle = 0.60%.

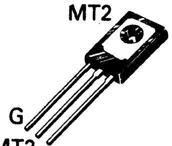
Thyristors — TRIACs

Metal/Plastic Packages

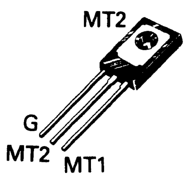
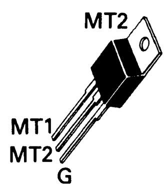
0.6 to 40 Amperes
25 to 800 Volts

NOTE:
Industry Standards, with a variety of Custom Specifications and Leadforms available.

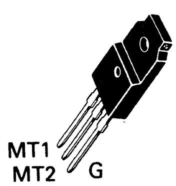
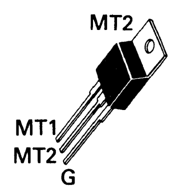
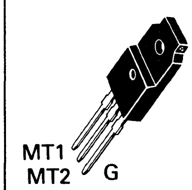




		On-State (RMS) Current				
		0.6 AMPS			2.5 AMPS	
		T_C = 50°C			T_C = 70°C	
		Sensitive Gate				
		Case 29-04 TO-226AA (TO-92) Style 12			Case 77-05 Style 5	
V_{DRM}	200 V	MAC97-4	MAC97A4	MAC97B4	T2322B	T2323B
	400 V	MAC97-6	MAC97A6	MAC97B6	T2322D	T2323D
	600 V	MAC97-8	MAC97A8	MAC97B8	T2322M	T2323M
	800 V					
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps)	8			25	
	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	10 10 10 10	5 5 5 7	3 3 3 5	10 10 10 10	25 40 25 40
	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	2 2 2 2.5			2.2 2.2 2.2 2.2	
	T_J Operating Range (°C)	−40 to +110				

On-State (RMS) Current						
4 AMPS			6 AMPS			
T_C = 85°C			T_C = 80°C			
						
	Sensitive Gate					
Case 77-05 Style 5			Case 221A-04 TO-220AB Style 4			
2N6071	2N6071A	2N6071B	T2500B	T2801B	200 V	V_{DRM}
2N6073	2N6073A	2N6073B	T2500D	T2801D	400 V	V_{DRM}
2N6075	2N6075A	2N6075B	T2500M	T2801M	600 V	V_{DRM}
			T2500N	T2801N	800 V	V_{DRM}
30			60	80	I_{TSM} (Amps)	MAXIMUM ELECTRICAL CHARACTERISTICS
					I_{GT} @ 25°C (mA)	
30	5	3	25	80	MT2(+)G(+)	
—	5	3	60	80	MT2(+)G(−)	
30	5	3	25	80	MT2(−)G(−)	
—	10	5	60	80	MT2(−)G(+)	
@ −40°C	@ −40°C				V_{GT} @ 25°C (V)	
2.5	2.5		2.5	4	MT2(+)G(+)	
—	2.5		2.5	4	MT2(+)G(−)	
2.5	2.5		2.5	4	MT2(−)G(−)	
—	2.5		2.5	4	MT2(−)G(+)	
−40 to +110					T_J Operating Range (°C)	

TRIACs (continued)

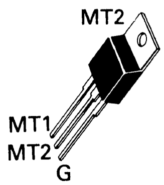
		On-State (RMS) Current				
		6 AMPS		8 AMPS		
		$T_C = 80°C$				
						
		Case 221C-02 Style 3	Case 221A-04 TO-220AB Style 4			Case 221C-02 Style 3
V_{DRM}	200 V	T2500BFP	SC141B	SC143B	MAC218-4 MAC218A4	MAC218-4FP MAC218A4FP
	400 V	T2500DFP	SC141D	SC143D	MAC218-6 MAC218A6	MAC218-6FP MAC218A6FP
	600 V	T2500MFP	SC141M	SC143M	MAC218-8 MAC218A8	MAC218-8FP MAC218A8FP
	800 V	T2500NFP	SC141N		MAC218-10 MAC218A10	MAC218-10FP MAC218A10FP
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps)	80		100		
	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	 80 80 80 80	 50 50 50 —		 50 50 50 75*	
	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	 4 4 4 4	 2.5 2.5 2.5 —		 2 2 2 2.5*	
	T_J Operating Range (°C)	−40 to +110			−40 to +125	

* Applies to A-version only.
Non A-version is not specified.

On-State (RMS) Current

8 AMPS

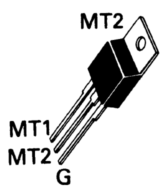
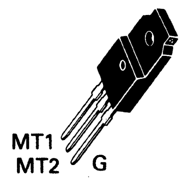
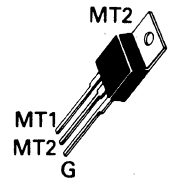
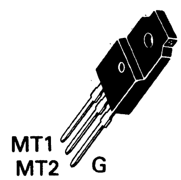
T_C = 80°C



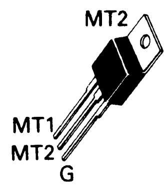
			Sensitive Gate			
Case 221A-04 TO-220AB Style 4						
2N6342 2N6346	T2800B	T2802B	MAC228-4 MAC228A4	MAC229-4 MAC229A4	**200 V**	V_{DRM}
2N6343 2N6347	T2800D	T2802D	MAC228-6 MAC228A6	MAC229-6 MAC229A6	**400 V**	
2N6344 2N6348	T2800M	T2802M	MAC228-8 MAC228A8	MAC229-8 MAC229A8	**600 V**	
2N6345 2N6349			MAC228-10 MAC228A10	MAC229-10 MAC229A10	**800 V**	
100			80		**I_{TSM} (Amps)**	**MAXIMUM ELECTRICAL CHARACTERISTICS**
50 75# 50 75#	25 60 25 60	50 — 50 —	5 5 5 10*	10 10 10 20	**I_{GT} @ 25°C (mA)** **MT2(+)G(+)** **MT2(+)G(−)** **MT2(−)G(−)** **MT2(−)G(+)**	
2 2.5# 2.5 2.5#	2.5 2.5 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 +125	−40 to +100		−40 to +110		**T_J Operating Range (°C)**	

# Denotes 2N6346-49 series only.
* Applies to A-version only.
Non A-version is not specified.

TRIACs (continued)

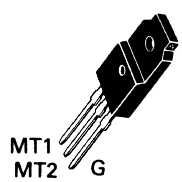
		On-State (RMS) Current				
		10 AMPS				12 AMPS
		$T_C = 70°C$	$T_C = 80°C$	$T_C = 70°C$	$T_C = 75°C$	$T_C = 85°C$
					 Sensitive Gate	
		Case 221A-04 TO-220AB Style 4		Case 221C-02 Style 3	Case 221A-04 TO-220AB Style 4	Case 221C-02 Style 3
V_{DRM}	200 V	MAC210-4 MAC210A4	SC146B	MAC210-4FP MAC210A4FP	MAC310-4 MAC310A4	MAC212-4FP MAC212A4FP
	400 V	MAC210-6 MAC210A6	SC146D	MAC210-6FP MAC210A6FP	MAC310-6 MAC310A6	MAC212-6FP MAC212A6FP
	600 V	MAC210-8 MAC210A8	SC146M	MAC210-8FP MAC210A8FP	MAC310-8 MAC310A8	MAC212-8FP MAC212A8FP
	800 V	MAC210-10 MAC210A10	SC146N	MAC210-10FP MAC210A10FP		MAC212-10FP MAC212A10FP
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps)	100				
	I_{GT} @ 25°C (mA)					
	MT2(+)G(+)	50	50	50	10	50
	MT2(+)G(−)	50	50	50	10	50
	MT2(−)G(−)	50	50	50	10	50
	MT2(−)G(+)	75*	—	75*	10	75*
	V_{GT} @ 25°C (V)					
	MT2(+)G(+)	2	2.5	2	2.5	2
	MT2(+)G(−)	2	2.5	2	2.5	2
	MT2(−)G(−)	2	2.5	2	2.5	2
	MT2(−)G(+)	2.5*	—	2.5*	2.5	2.5*
	T_J Operating Range (°C)	−40 to +125				

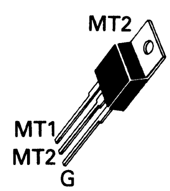
* Applies to A-version only.
Non A-version not specified.

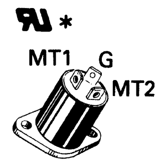
On-State (RMS) Current						
12 AMPS				15 AMPS		
T_C = 85°C	T_C = 80°C			T_C = 90°C		
						
		Case 221A-04 TO-220AB Style 4				
MAC212-4 MAC212A4	SC149B	2N6342A	2N6346A	MAC15-4 MAC15A4	200 V	V_{DRM}
MAC212-6 MAC212A6	SC149D	2N6343A	2N6347A	MAC15-6 MAC15A6	400 V	
MAC212-8 MAC212A8	SC149M	2N6344A	2N6348A	MAC15-8 MAC15A8	600 V	
MAC212-10 MAC212A10		2N6345A	2N6349A	MAC15-10 MAC15A10	800 V	
100	120			150	I_{TSM} (Amps)	MAXIMUM ELECTRICAL CHARACTERISTICS
50 50 50 75*	50 50 50 —	50 — 50 —	50 75 50 75	50 50 50 75*	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	
2 2 2 2.5*	2.5 2.5 2.5 —	2 — 2 —	2 2.5 2 2.5	2 2 2 2.5*	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	
−40 to +125					T_J Operating Range (°C)	

* Applies to A-version only.
Non A-version not specified.

TRIACs (continued)

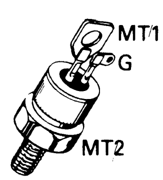
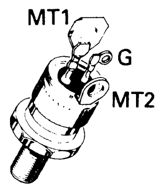
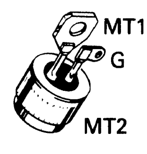
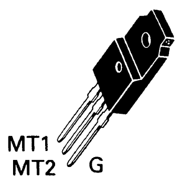
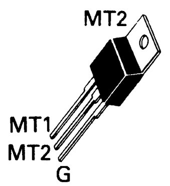






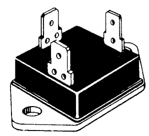
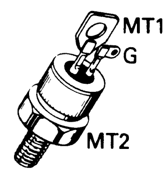
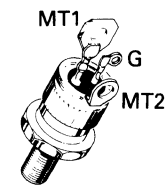
		On-State (RMS) Current			
		15 AMPS	20 AMPS		25 AMPS
		T_C = 90°C	T_C = 75°C		T_C = 90°C
					Hermetic and Isolated
		Case 221C-02 Style 3		Case 221A-04 TO-220AB Style 4	Case 326-01 Style 2
V_{DRM}	200 V	MAC15-4FP MAC15A4FP	MAC320-4FP MAC320A4FP	MAC320-4 MAC320A4	MAC25A4
	400 V	MAC15-6FP MAC15A6FP	MAC320-6FP MAC320A6FP	MAC320-6 MAC320A6	MAC25A6
	600 V	MAC15-8FP MAC15A8FP	MAC320-8FP MAC320A8FP	MAC320-8 MAC320A8	MAC25A8
	800 V	MAC15-10FP MAC15A10FP	MAC320-10FP MAC320A10FP	MAC320-10 MAC320A10	MAC25A10
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps)	150			250
	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	50 50 50 75*			70 70 70 100
	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 +125			−0 to +125

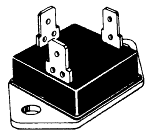
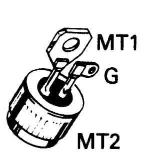
* Applies to A-version only.
Non A-version not specified.

On-State (RMS) Current						
25 AMPS						
T_C = 80°C	T_C = 75°C	T_C = 80°C				
	 Isolated					
Case 263-04 Style 2	Case 311-02 Style 2	Case 310-02 Style 2	Case 221C-02 Style 3	Case 221A-04 TO-220AB Style 4		
SC260B	SC260B3	SC261B	MAC223-4FP MAC223A4FP	MAC223-4 MAC223A4	200 V	V_{DRM}
SC260D	SC260D3	SC261D	MAC223-6FP MAC223A6FP	MAC223-6 MAC223A6	400 V	
SC260M	SC260M3	SC261M	MAC223-8FP MAC223A8FP	MAC223-8 MAC223A8	600 V	
			MAC223-10FP MAC223A10FP	MAC223-10 MAC223A10	800 V	
250					I_{TSM} (Amps)	MAXIMUM ELECTRICAL CHARACTERISTICS
50 50 50 —			50 50 50 75*		I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	
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 +115			−40 to +125		T_J Operating Range (°C)	

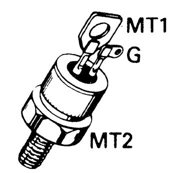
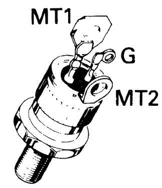
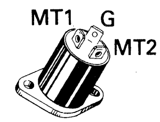
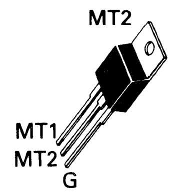
* Applies to A-version only.
Non A-version not specified.

TRIACs (continued)

	On-State (RMS) Current				
	25 AMPS	30 AMPS			
	T_C = 85°C		T_C = 60°C	T_C = 85°C	T_C = 55°C
				 Isolated	
	Case 383-01 Style 1	Case 263-04 Style 2		Case 311-02 Style 2	
V_{DRM} 200 V		2N6160	T6411B	2N6163	T6421B
V_{DRM} 400 V	MAC625-4	2N6161	T6411D	2N6164	T6421D
V_{DRM} 600 V	MAC625-6	2N6162	T6411M	2N6165	T6421M
V_{DRM} 800 V	MAC625-8		T6411N		T6421N
MAXIMUM ELECTRICAL CHARACTERISTICS: I_{TSM} (Amps)	250		300	250	300
I_{GT} @ 25°C (mA) MT2(+)G(+)	50	60	50	60	50
MT2(+)G(−)	50	70	80	70	80
MT2(−)G(−)	50	70	50	70	50
MT2(−)G(+)	—	100	80	100	80
V_{GT} @ 25°C (V) MT2(+)G(+)	3	2	2.5	2	2.5
MT2(+)G(−)	3	2.1	2.5	2.1	2.5
MT2(−)G(−)	3	2.1	2.5	2.1	2.5
MT2(−)G(+)	—	2.5	2.5	2.5	2.5
T_J Operating Range (°C)	−40 to +125	−65 to +125	−65 to +100	−40 to +100	−65 to +100

On-State (RMS) Current						
30 AMPS	35 AMPS	40 AMPS				
T_C = 85°C	T_C = 58°C	T_C = 65°C	T_C = 70°C			
						
Case 174-04 TO-203AA Style 3	Case 383-01 Style 1	Case 310-02 TO-203AB Style 2				
2N6157		T6401B	2N5441	T6400B	200 V	V_{DRM}
2N6158	MAC635-4	T6401D	2N5442	T6400D	400 V	V_{DRM}
2N6159	MAC635-6	T6401M	2N5443	T6400M	600 V	V_{DRM}
	MAC635-8	T6401N		T6400N	800 V	V_{DRM}
250	330	300			I_{TSM} (Amps)	MAXIMUM ELECTRICAL CHARACTERISTICS
					I_{GT} @ 25°C (mA)	
60	50	50	70	50	MT2(+)G(+)	
70	50	80	70	80	MT2(+)G(−)	
70	50	50	70	50	MT2(−)G(−)	
100	—	80	100	80	MT2(−)G(+)	
					V_{GT} @ 25°C (V)	
2	3	2.5	2	2.5	MT2(+)G(+)	
2.1	3	2.5	2	2.5	MT2(+)G(−)	
2.1	3	2.5	2	2.5	MT2(−)G(−)	
2.5	—	2.5	2.5	2.5	MT2(−)G(+)	
−65 to +125	−40 to +125	−65 to +100	−65 to +110		T_J Operating Range (°C)	

TRIACs (continued)

		On-State (RMS) Current				
		40 AMPS				
		$T_C = 65°C$		$T_C = 60°C$	$T_C = 70°C$	$T_C = 75°C$
				 Isolated	*  Hermetic and Isolated	
		Case 263-04 Style 2		Case 311-02 Style 2	Case 326-01 Style 2	Case 221A-04 TO-220AB Style 4
V_{DRM}	200 V	2N5444	T6410B	T6420B	MAC50A4	MAC224-4 MAC224A4
	400 V	2N5445	T6410D	T6420D	MAC50A6	MAC224-6 MAC224A6
	600 V	2N5446	T6410M	T6420M	MAC50A8	MAC224-8 MAC224A8
	800 V		T6410N	T6420N	MAC50A10	MAC224-10 MAC224A10
MAXIMUM ELECTRICAL CHARACTERISTICS	I_{TSM} (Amps)	300				350
	I_{GT} @ 25°C (mA) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	 70 70 70 100	 50 80 50 80		 70 70 70 100	 50 50 50 80*
	V_{GT} @ 25°C (V) MT2(+)G(+) MT2(+)G(−) MT2(−)G(−) MT2(−)G(+)	 2 2 2 2.5	 2.5 2.5 2.5 2.5		 2 2 2 2.5*	
	T_J Operating Range (°C)	−65 to +110			0 to +125	−40 to +125

* Indicates that device types are UL recognized, file #E69369.

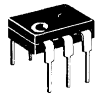
* Applies to A-version only.
  Non A-version not specified.

TRIACs

Optically Isolated

Triac Driver/Triac Combinations

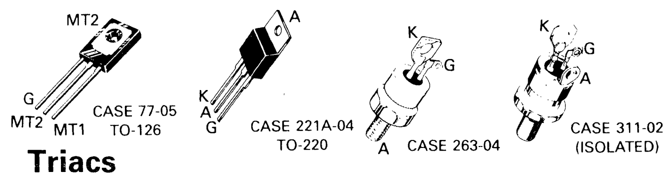
This series of Triac Drivers consists of infrared LEDs optically coupled to photodetectors with Triac output. 7500 V isolation between input and output allows safe, economical triggering of higher power triacs from logic sources with output as low as 3 volts, 10 mA. Associated voltage-compatible triacs 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	MOC3009
	15	3010
	10	3011
400	30	3020
	15	3021
For Zero Crossover Firing		
250	30	MOC3030*
	15	3031*
400	30	3040
	15	3031
600	30	3060
	15	3061

*Underwriters' Laboratories Recognition, File No. E54915.

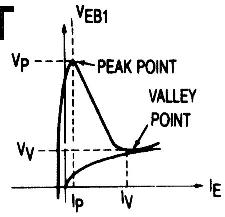


Triacs

Output Current I_{RMS} A, Max	Peak Blocking Voltage Volts			Case
	250	400	600	
4	MAC3010-4	MAC3020-4	—	77-05
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	77-05
8	-8	-8	-8	221A
15	-15	-15	-15	221A
25	-25	-25	-25	221A
40	-40	-40	-40	263
40	-40I	-40I	-40I	311

Thyristor Triggers

Unijunction Transistors — UJT

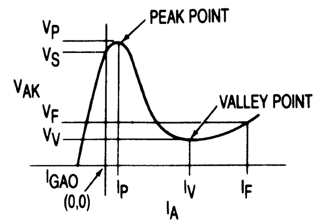


Highly stable devices for general-purpose trigger applications and as pulse generators (oscillators) and timing circuits. Useful at frequencies ranging (generally) from 1 Hz to 1 MHz.

Device Type	η Min	η Max	I_P μA Max	I_{EB20} μA Max	I_V mA Min
Plastic TO-92 (Case 29-04/9)					
MU10	0.5	0.85	5	1	1
2N4870	0.56	0.75	5	1	2
2N4871	0.7	0.85	5	1	4
MU4891	0.55	0.82	5	0.01	2
MU4892	0.51	0.69	2	0.01	2
MU4893	0.55	0.82	2	0.01	2
MU4894	0.74	0.86	1	0.01	2
Metal TO-18 (Case 22A-01/1)					
MU20	0.5	0.85	5	1	1
2N2646	0.56	0.75	5	12	4
2N2647	0.68	0.82	2	0.2	8
2N3980	0.68	0.82	2	0.01	1
2N4851	0.56	0.75	2	0.1	2
2N4852	0.7	0.85	2	0.1	4
2N4853	0.7	0.85	0.4	0.05	6
2N4948*	0.55	0.82	2	0.01	2
2N4949*	0.74	0.86	1	0.01	2
2N5431*	0.72	0.8	0.4	0.01	2

*Also available as JAN and JANTX devices.

Programmable Unijunction Transistors — PUT

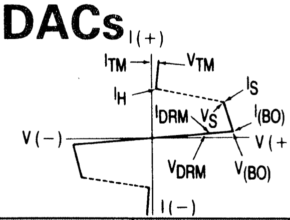


Similar to UJTs, except that I_V, I_P and intrinsic standoff voltage are programmable (adjustable) by means of external voltage divider. This stabilizes circuit performance for variations in device parameters. General operating frequency range is from 0.01 Hz to 10 kHz, making them suitable for long-duration timer circuits.

Device Type	I_P R_G = 10 kΩ μA Max	I_P R_G = 1 MΩ μA Max	I_{GAO} @ 40 V nA Max	I_V R_G = 10 kΩ μA Min	I_V R_G = 1 MΩ μA Max
Plastic TO-92 (Case 29-04/16)					
2N6027	5	2	10	70	50
2N6028	1	0.15	10	25	25
Metal TO-18 (Case 22-03/6)					
2N6116*	5	2	5	70	50
2N6117*	2	0.3	5	50	50
2N6118*	1	0.15	5	50	25
Surface Mount SOT-23 (Case 318-03/20)					
MMBP6027	5	2	10	70	50
MMBP6028	1	0.15	10	70	25

*Also available as JAN and JANTX devices.

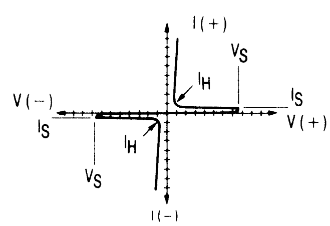
SIDACs



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.

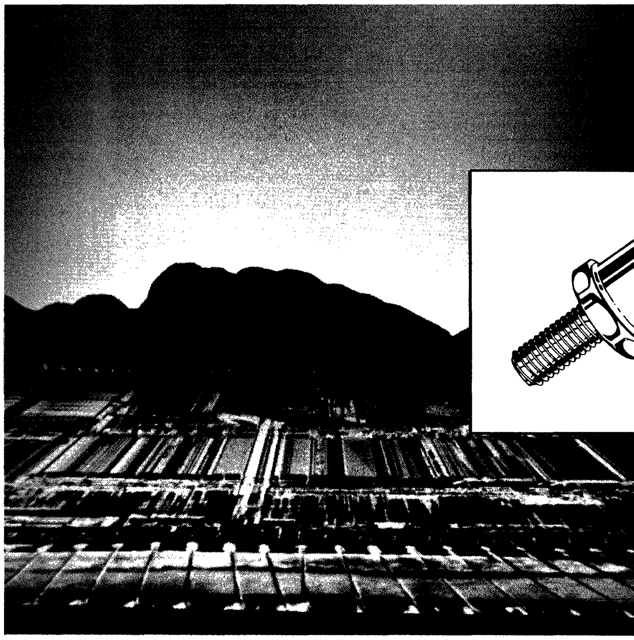
Device Type	I_{TSM} Amps	V_{BO} Volts Min	V_{BO} Volts Max
Case 267-03/1			
MK1V115	20	104	115
MK1V125	20	110	125
MK1V135	20	120	135
MK1V240	20	220	250
MK1V260	20	240	270
MK1V270	20	250	280
Case 59-04/1			
MKP9V120	4	110	125
MKP9V130	4	120	135
MKP9V240	4	220	250
MKP9V260	4	240	270
MKP9V270	4	250	280

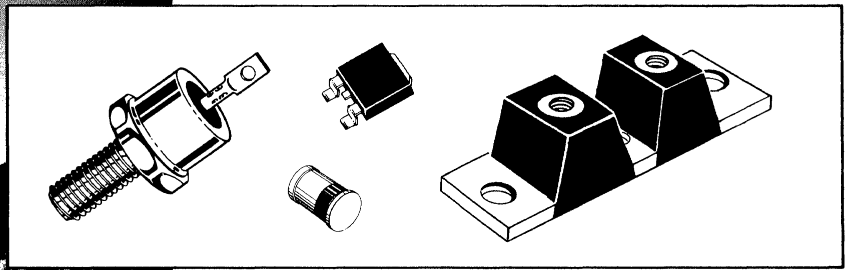
Silicon Bidirectional Switch (SBS)



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 μA dc for triggering.

Device Type	V_S Volts Min	V_S Volts Max	I_S μA Max	I_H mA Max
Plastic TO-92/TO-226AA				
MBS4991	6	10	500	1.5
MBS4992	7.5	9	120	0.5
MBS4993	7.5	9	250	0.75





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:

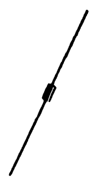
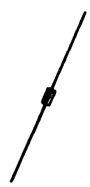
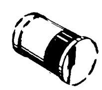
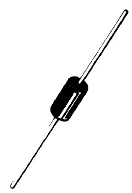
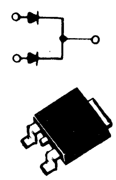
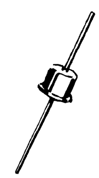
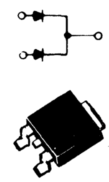
- A full line of low-cost General Purpose rectifiers with forward currents ranging from 1.0 to 50 amps and breakdown voltages from 50 to 1000 volts;
- Schottky rectifiers for low-voltage (to 100 V), high current (to 300 A) applications in high-frequency power supplies;
- Fast and ultrafast rectifiers with reverse recovery times as low as 25 ns to complement the Schottky offering for higher voltage requirements in high-frequency switches;
- A selection of bridge-rectifier assemblies that offer cost-effective space savings in single-phase applications.
- A wide variety of package options to match virtually any potential requirement.

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 less than 10 ns, and are offered in current ranges from 0.5 to 300 amperes, and reverse voltages to 60 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.

	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
	0.5	1		3			5	6
	299-02 (DO-204AH) Glass	59-04 Plastic	362B-01 MLL41 Glass Leadless	267-03 Plastic		369A-04 Plastic	60-01 Metal	369A-04 Plastic
V_{RRM} (Volts)								
15		MBR115P						
20		1N5817	MBRL120	1N5820	MBR320	MBRD320	1N5823	MBRD620CT
25								
30	MBR030	1N5818	MBRL130	1N5821	MBR330	MBRD330	1N5824	MBRD630CT
35								
40	MBR040	1N5819	MBRL140	1N5822	MBR340	MBRD340	1N5825	MBRD640CT
45								
50		MBR150††			MBR350	MBRD350		MBRD650CT
60		MBR160††			MBR360	MBRD360		MBRD660CT
70								
80								
90								
100								
I_{FSM} (Amps)	5	25	20	80	80	75	500	
†T_C @ Rated I_O (°C)						125		
†T_L @ Rated I_O (°C)	75	90	75	95			80	
T_J (Max) (°C)	150	125	150	125	150	150	125	
Max V_F @ $I_{FM} = I_O$	0.65 T_L = 25°C	*0.6 T_L = 25°C	*0.69 T_L = 25°C	*0.525 T_L = 25°C	***0.74 T_L = 25°C	0.45 T_C = 125°C	*0.38 T_C = 25°C	

▨ TX versions available.

* Values are for the 40 volt units. The lower voltage parts provide lower limits and higher voltage units provide slightly higher limits.

** I_O is total device output.

*** Values are for 60 volt units. The lower voltages parts ≤40 volts provide lower limits.

† Must be derated for reverse power dissipation. See data sheet.

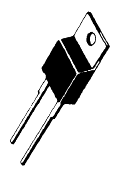
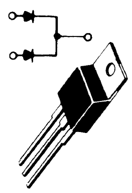
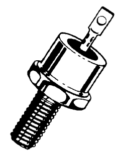
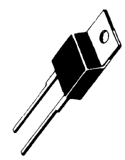
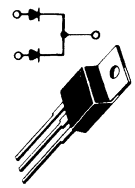
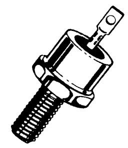
†† T_J (max) = 150°C

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.

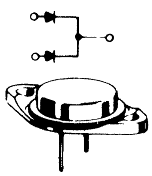
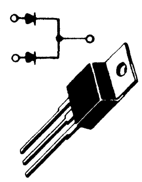
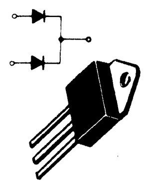
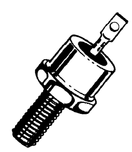
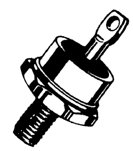
3. QUALITY CONTROL monitors all critical fabrication operations and performs selected stress tests to assure constant processes.

**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
7.5	**10**	**15**		**16**	**20**	**25**	
221B-01 (TO-220AC) Plastic		221A-04 (TO-220AB) Plastic	56-03 (DO-203AA) (DO-4) Metal	221B-01 (TO-220AC) Plastic	221A-04 (TO-220AB) Plastic	56-03 (DO-203AA) (DO-4) Metal	
							
			1N5826			1N5829	
			1N5827			1N5830	1N6095
MBR735	MBR1035	MBR1535CT		MBR1635	MBR2035CT		
			1N5828			1N5831	1N6096
MBR745	MBR1045	MBR1545CT		MBR1645	MBR2045CT		
	MBR1060				MBR2060CT		
	MBR1070				MBR2070CT		
	MBR1080				MBR2080CT		
	MBR1090				MBR2090CT		
	MBR10100				MBR20100CT		
150	150	150	500	150	150	800	400
105	135	105	85	125	135	85	70
150	150	150	125	150	150	125	125
0.57 $T_C = 125°C$	0.57 $T_C = 125°C$	0.72 @ 15 A $T_C = 125°C$	*0.5 $T_C = 25°C$	0.57 $T_C = 125°C$	0.72 @ 20 A $T_C = 125°C$	*0.48 $T_C = 25°C$	0.86 @ 78.5 A $T_C = 70°C$

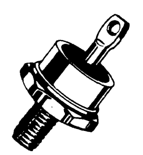
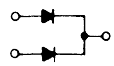
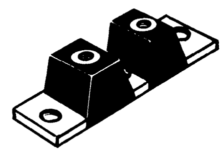
* Values are for the 40 volt units. The lower voltage parts provide lower limits.

** I_O is total device output.

SCHOTTKY RECTIFIERS (continued)

	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)					
	30			**35**	**40**	**50**
V_{RRM} (Volts)	11-03 (TO-204AA) Metal  (40 Mil Pins)	221A-04 (TO-220AB) Plastic 	340-02 (TO-218AC) Plastic 	56-03 (DO-203AA) Metal 	257-01 (DO-203AB) Metal 	
15						
20	MBR3020CT			MBR3520	1N5832	
25						
30					1N5833	1N6097
35	MBR3035CT	MBR2535CT	MBR3035PT	MBR3535		
40					1N5834	1N6098
45	SD241 MBR3045CT	MBR2545CT	MBR3045PT	SD41 MBR3545,H,H1***		
50						
60						
I_{FSM} (Amps)	400	300	400	600	800	800
†T_C @ Rated I_O (°C)	105	125	105	90	75	70
†T_L @ Rated I_O (°C)						
T_J (Max) (°C)	150	150	150	150	125	125
Max V_F @ $I_{FM} = I_O$	0.72 @ 30 A T_C = 125°C	0.73 @ 30 A T_C = 125°C	0.72 @ 30 A T_C = 125°C	0.55 T_C = 25°C	*0.59 T_C = 25°C	0.86 @ 157 A T_C = 70°C

* Values are for the 40 volt units. The lower voltage parts provide lower limits.
** I_O is total device output.
*** H & H1 versions are hi-rel processed parts (non JAN, JTX).
† Must be derated for reverse power dissipation. See data sheet.

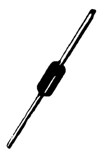
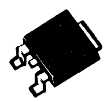
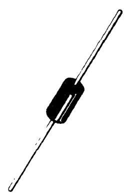
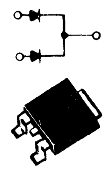
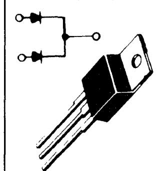
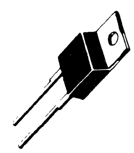
$^{**}I_O$, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)								
60		**65**	**75**	**80**	**120**	**200**		**300**
257-01 DO-203AB Metal 					357C-01 Plastic POWER TAP  			
	MBR6015L						MBR20015CTL	
	MBR6020L						MBR20020CTL	
	MBR6025L						MBR20025CTL	
	MBR6030L						MBR20030CTL	
MBR6035		MBR6535	MBR7535	MBR8035	MBR12035CT	MBR20035CT		MBR30035CT
			MBR7540					
SD51 MBR6045,H,H1***		MBR6545	MBR7545	MBR8045	MBR12045CT	MBR20045CT		MBR30045CT
					MBR12050CT	MBR20050CT		MBR30050CT
					MBR12060CT	MBR20060CT		MBR30060CT
800	1000	800	1000	1000	1500	1500	1500	2500
90	120	120	90	120	140	140	140	140
150	150	175	150	175	175	175	175	175
*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	0.68 T_C = 125°C	0.71 T_C = 125°C	0.48 @ T_C = 150°C	0.64 T_C = 125°C

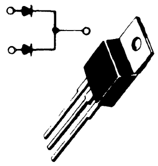
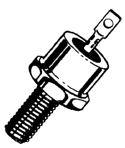
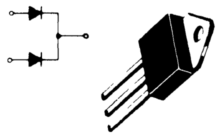
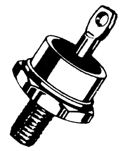
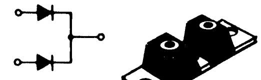
** I_O is total device output.
*** H & H1 versions are hi-rel processed parts (non JAN, JTX).

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. Additional package styles and operating current levels are planned.

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	4	6		8	15
V_{RRM} (Volts)	59-04 (DO-41) Plastic 	369A-04 Plastic 	267-03 Plastic 	369A-04 Plastic 	221A-04 (TO-220AB) Plastic 	221B-01 (TO-220AC) Plastic 	
50	MUR105	MURD305	MUR405	MURD605CT	MUR605CT	MUR805	MUR1505
100	MUR110	MURD310	MUR410	MURD610CT	MUR610CT	MUR810	MUR1510
150	MUR115	MURD315	MUR415	MURD615CT	MUR615CT	MUR815	MUR1515
200	MUR120	MURD320	MUR420	MURD620CT	MUR620CT	MUR820	MUR1520
300	MUR130		MUR430			MUR830	MUR1530
400	MUR140		MUR440			MUR840	MUR1540
500	MUR150		MUR450			MUR850	MUR1550
600	MUR160		MUR460			MUR860	MUR1560
700	MUR170		MUR470			MUR870	
800	MUR180		MUR480			MUR880	
900	MUR190		MUR490			MUR890	
1000	MUR1100		MUR4100			MUR8100	
I_{FSM} (Amps)	35	75	125	63	75	100	200
T_A @ Rated I_O (°C)	50		80				
T_C @ Rated I_O (°C)		158		145	130	150	150
T_J (Max) (°C)	175	175	175	175	175	175	175
t_{rr} ns	25/50/75	35	25/50/75	35	35	35/60/100	35/60

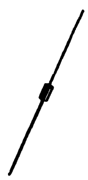
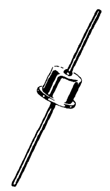
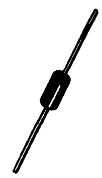
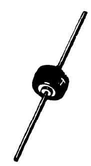
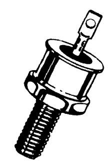
$^{**}I_O$, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
16	**25**	**30**		**50**	**70**	**100**	**200**
221A-04 (TO-220AB) Plastic	56-03 (DO-203AA)	340-02 (TO-218AC) Plastic		257-01 (DO-203AB) Metal		357C-01 Plastic POWER TAP	
							
MUR1605CT	MUR2505	R710XPT	MUR3005PT	MUR5005	MUR7005	MUR10005CT	MUR20005CT
MUR1610CT	MUR2510	R711XPT	MUR3010PT	MUR5010	MUR7010	MUR10010CT	MUR20010CT
MUR1615CT	MUR2515		MUR3015PT	MUR5015	MUR7015	MUR10015CT	MUR20015CT
MUR1620CT	MUR2520	R712XPT	MUR3020PT	MUR5020	MUR7020	MUR10020CT	MUR20020CT
MUR1630CT			MUR3030PT				MUR20030CT
MUR1640CT		R714XPT	MUR3040PT				MUR20040CT
MUR1650CT			MUR3050PT				
MUR1660CT			MUR3060PT				
100	500	150	400	600	1000	400	800
150	145	100	150	125	125	140	95
175	175	150	175	175	175	175	175
35	50	100	35	50	50	50	50

** I_O is total device output.

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.

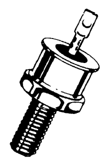
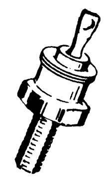
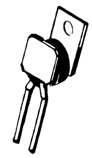
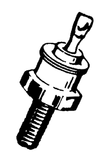
All devices are connected cathode to case or cathode to heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)					
	1		3		5	6
	59-04 Plastic		60-01 Metal	267-02 Plastic	194-04 Plastic	245A-02 (DO-203AA) Metal
						
50	†1N4933	MR810	MR830	MR850	MR820	1N3879
100	†1N4934	MR811	MR831	MR851	MR821	1N3880
200	†1N4935	MR812	MR832	MR852	MR822	1N3881
400	†1N4936	MR814	MR834	MR854	MR824	1N3883
600	†1N4937	MR816	MR836	MR856	MR826	MR1366
800		MR817				
1000		MR818				
I_{FSM} (Amps)	30	30	100	100	300	150
T_A @ Rated I_O (°C)	75	75		*90	*55	
T_C @ Rated I_O (°C)		100	100			100
T_J (Max) (°C)	150	150	150	175	175	150
t_{rr} (μs)	0.2	0.75	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.

V_{RRM} (Volts)	**I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)			
	12	**20**	**24**	**30**
	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.

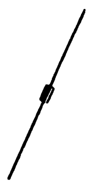
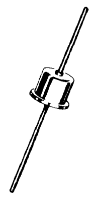
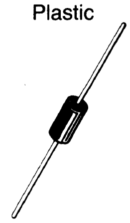
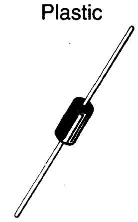
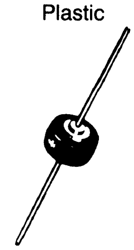
Note 1. Meets mounting configuration of TO-220 outline.

** I/O is total device output.

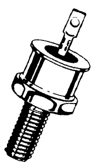
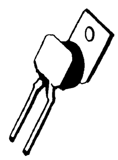
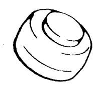
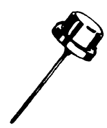
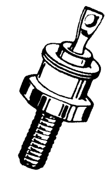
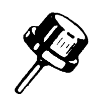
General-Purpose Rectifiers

Motorola offers 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	1.5	3			6
V_{RRM} (Volts)	59-03 (DO-41) Plastic 	59-04 Plastic 	60-01 Metal 	267-03 Plastic 	267-02 Plastic 	194-04 Plastic 
50	†1N4001	**1N5391	1N4719	**MR500	1N5400	MR750
100	†1N4002	**1N5392	1N4720	**MR501	1N5401	MR751
200	†1N4003	1N5393 *MR5059	1N4721	**MR502	1N5402	MR752
400	†1N4004	1N5395 *MR5060	1N4722	**MR504	1N5404	MR754
600	†1N4005	1N5397 *MR5061	1N4723	**MR506	1N5406	MR756
800	†1N4006	1N5398	1N4724	MR508		MR758
1000	†1N4007	1N5399	1N4725	MR510		MR760
I_{FSM} (Amps)	30	50	300	100	200	400
T_A @ Rated I_O (°C)	75	T_L = 70	75	95	T_L = 105	60
T_C @ Rated I_O (°C)						
T_J (Max) (°C)	175	175	175	175	175	175

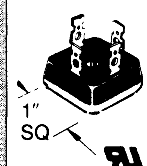
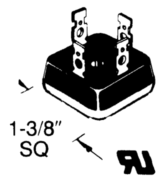
† Package Size: 0.120″ max diameter by 0.260″ max length.
* 1N5059 series equivalent avalanche rectifiers.
** Avalanche versions available, consult factory.

V_{RRM} (Volts)	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
	12	20	24	25	30		40	50
	245A-02 (DO-203AA) Metal 		339-02 Plastic Note 1 	193-04 Plastic Note 2 	43-02 (DO-21) Metal 		42A-01 (DO-203AB) Metal 	43-04 Metal 
50	MR1120 1N1199,A,B	MR2000	MR2400	MR2500	1N3491	1N3659	1N1183A	MR5005
100	MR1121 1N1200,A,B	MR2001	MR2401	MR2501	1N3492	1N3660	1N1184A	MR5010
200	MR1122 1N1202,A,B	MR2002	MR2402	MR2502	1N3493	1N3661	1N1186A	MR5020
400	MR1124 1N1204,A,B	MR2004	MR2404	MR2504	1N3495	1N3663	1N1188A	MR5040
600	MR1126 1N1206,A,B	MR2006	MR2406	MR2506		Note 3	1N1190A	Note 3
800	MR1128	MR2008		MR2508		Note 3	Note 3	Note 3
1000	MR1130	MR2010		MR2510		Note 3	Note 3	Note 3
I_{FSM} (Amps)	300	400	400	400	300	400	800	600
T_A @ Rated I_O (°C)								
T_C @ Rated I_O (°C)	150	150	125	150	130	100	150	150
T_J (Max) (°C)	190	175	175	175	175	175	190	195

Note 1. Meets mounting configuration of TO-220 outline.
Note 2. Request data sheet for mounting information.
Note 3. Available on special order.

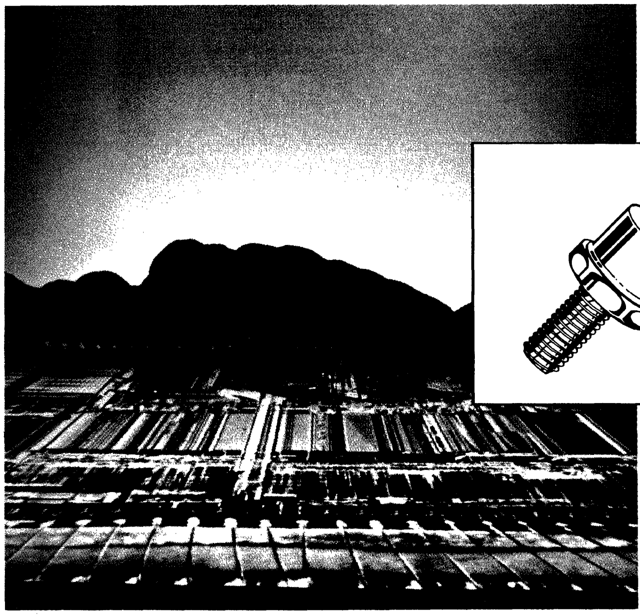
Rectifier Bridges

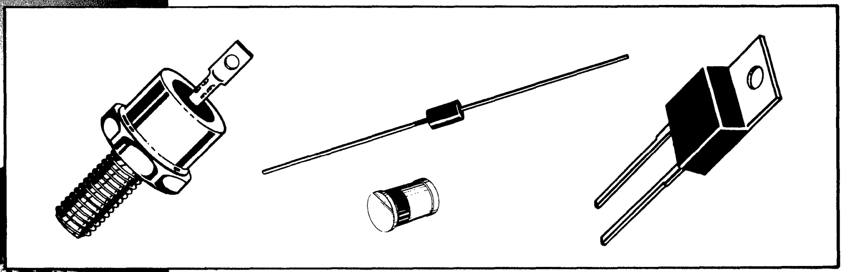
Motorola SUPERBRIDGES offer cost effectiveness and reliability in single phase applications. Assemblies combine pretested "button" rectifier cells for low assembly cost and high yields. Performance of four individual diodes is achieved with reliability of the whole assembly comparable to that of a single unit. Assemblies feature versatile slip-on/solder/wire wrap terminals.

	I_O, DC OUTPUT CURRENT (Amperes)		
	25	35	40
V_{RRM} (Volts)	309A-03  1" SQ	309A-02  1-3/8" SQ	
50	MDA2500	MDA3500	
100	MDA2501	MDA3501	
200	MDA2502	MDA3502	MDA4002
400	MDA2504	MDA3504	MDA4004
600	MDA2506	MDA3506	MDA4006
800	MDA2508	MDA3508	MDA4008
1000	MDA2510	MDA3510	
I_{FSM} (Amps)	400	400	800
T_A @ Rated I_O (°C)			
T_C @ Rated I_O (°C)	55	55	35
T_J (Max) (°C)	175	175	175

UL RECOGNIZED E61980

Dimensions given are nominal





Zener Regulator and Reference Diodes

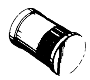
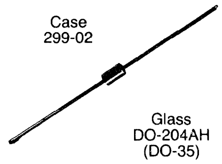
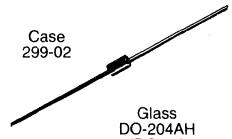
In Brief . . .

Motorola's standard Zeners and Avalanche Regulator 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
  - Metal for highest power
- Power ratings from 0.25 to 50 Watts
- Breakdown voltages from 1.8 to 200 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)
- JAN/JANTX(V) availability
- Special glass now used in DO-type packages is compatible with low temperature alloy processes, yielding sharper breakdown and low leakage.

Zener and Avalanche Regulator Diodes

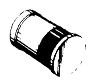
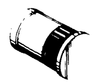
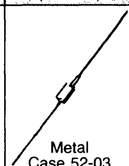
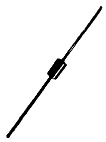
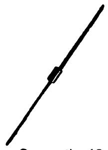
General-Purpose Regulator Diodes

Nominal Zener Voltage	250 mW Low Level Cathode = Polarity Mark	250 mW Low Noise Cathode = Polarity Mark	250 mW Low Level Cathode = Polarity Mark	250 mW Low Noise Cathode = Polarity Mark	350 mW Cathode = Polarity Mark	400 mW Low Noise Low Leakage Cathode = Polarity Mark	500 mW Cathode = Polarity Mark		
(*Note 1)	(*Notes 2,11)		(*Note 2)	(*Note 2)	(*Notes 5,13)	(*Note 3)	(*Note 4)	(*Note 8)	(*Note 9)
	 Glass Case 362-01		 Case 299-02 Glass DO-204AH (DO-35)		 Case 318-05 Style 8 SOT-23	 Case 299-02 Glass DO-204AH (DO-35)			
1.8	MLL4678	MLL4614	1N4678	1N4614					
2	MLL4679	MLL4615	1N4679	1N4615					
2.2	MLL4680	MLL4616	1N4680	1N4616					
2.4	MLL4681	MLL4617	1N4681	1N4617			1N4370	1N5221A	1N5985A
2.5									
2.7	MLL4682	MLL4618	1N4682	1N4618			1N4371	1N5223A	
2.8									1N5986A
3	MLL4683	MLL4619	1N4683	1N4619			1N4372	1N5225A	1N5987A
3.3	MLL4684	MLL4620	1N4684	1N4620	MMBZ5226B	1N5518A	1N746	1N5226A	1N5988A
3.6	MLL4685	MLL4621	1N4685	1N4621	MMBZ5227B	1N5519A	1N747	1N5227A	1N5989A
3.9	MLL4686	MLL4622	1N4686	1N4622	MMBZ5228B	1N5520A	1N748	1N5228A	1N5990A
4.3	MLL4687	MLL4623	1N4687	1N4623	MMBZ5229B	1N5221A	1N749	1N5229A	1N5991A
4.7	MLL4688	MLL4624	1N4688	1N4624	MMBZ5230B	1N5522A	1N750	1N5230A	1N5992A
5.1	MLL4689	MLL4625	1N4689	1N4625	MMBZ5231B	1N5523A	1N751	1N5231A	1N5993A
5.6	MLL4690	MLL4626	1N4690	1N4626	MMBZ5232B	1N5524A	1N752	1N5232A	1N5994A
6					MMBZ5233B				
6.2	MLL4691	MLL4627	1N4691	1N4627	MMBZ5234B	1N5525A	1N753	1N5234A	1N5995A
6.8	MLL4692	MLL4099	1N4692	1N4099	MMBZ5235B	1N5526A	1N754 1N957A	1N5235A	1N5996A
7.5	MLL4693	MLL4100	1N4693	1N4100	MMBZ5236B	1N5527A	1N755 1N958A	1N5236A	1N5997A
8.2	MLL4694	MLL4101	1N4694	1N4101	MMBZ5237B	1N5228A	1N756 1N959A	1N5237A	1N5998A
8.7	MLL4695	MLL4102	1N4695	1N4102	MMBZ5238B			1N5238A	
9.1	MLL4696	MLL4103	1N4696	1N4103	MMBZ5239B	1N5529A	1N757 1N960A	1N5239A	1N5999A
10	MLL4697	MLL4104	1N4697	1N4104	MMBZ5240B	1N5530A	1N758 1N961A	1N5240A	1N6000A
11	MLL4698	MLL4105	1N4698	1N4105	MMBZ5241B	1N5531A	1N962A	1N5241A	1N6001A
12	MLL4699	MLL4106	1N4699	1N4106	MMBZ5242B	1N5532A	1N759 1N963A	1N5242A	1N6002A
13	MLL4700	MLL4107	1N4700	1N4107	MMBZ5243B	1N5533A	1N964A	1N5243A	1N6003A
14	MLL4701	MLL4108	1N4701	1N4108	MMBZ5244B	1N5334A		1N5244A	
15	MLL4702	MLL4109	1N4702	1N4109	MMBZ5245B	1N5335A	1N965A	1N5245A	1N6004A
16	MLL4703	MLL4110	1N4703	1N4110	MMBZ5246B	1N5336A	1N966A	1N5246A	1N6005A
17	MLL4704	MLL4111	1N4704	1N4111	MMBZ5247B	1N5337A		1N5247A	
18	MLL4705	MLL4112	1N4705	1N4112	MMBZ5248B	1N5338A	1N967A	1N5248A	1N6006A
19	MLL4706	MLL4113	1N4706	1N4113	MMBZ5249B	1N5539A		1N5249A	
20	MLL4707	MLL4114	1N4707	1N4114	MMBZ5250B	1N5540A	1N968A	1N5250A	1N6007A
22	MLL4708	MLL4115	1N4708	1N4115	MMBZ5251B	1N5541A	1N969A	1N5251A	1N6008A
24	MLL4709	MLL4116	1N4709	1N4116	MMBZ5252B	1N5542A	1N970A	1N5252A	1N6009A
25	MLL4710	MLL4117	1N4710	1N4117	MMBZ5253B	1N5543A		1N5253A	
27	MLL4711	MLL4118	1N4711	1N4118	MMBZ5254B		1N971A	1N5254A	1N6010A
28	MLL4712	MLL4119	1N4712	1N4119	MMBZ5255B	1N5544A		1N5255A	
30	MLL4713	MLL4120	1N4713	1N4120	MMBZ5256B	1N5545A	1N972A	1N5256A	1N6011A
33	MLL4714	MLL4121	1N4714	1N4121	MMBZ5257B	1N5546A	1N973A	1N5257A	1N6012A
36	MLL4715	MLL4122	1N4715	1N4122			1N974A	1N5258A	1N6013A
39	MLL4716	MLL4123	1N4716	1N4123			1N975A	1N5259A	1N6014A
43	MLL4717	MLL4124	1N4717	1N4124			1N976A	1N5260A	1N6015A
47		MLL4125		1N4125			1N977A	1N5261A	1N6016A
51		MLL4126		1N4126			1N978A	1N5262A	1N6017A
56		MLL4127		1N4127			1N979A	1N5263A	1N6018A
60		MLL4128		1N4128				1N5264A	
62		MLL4129		1N4129			1N980A	1N5265A	1N6019A
68		MLL4130		1N4130			1N981A	1N5266A	1N6020A
75		MLL4131		1N4131			1N982A	1N5267A	1N6021A
82		MLL4132		1N4132			1N983A	1N5268A	1N6022A
87		MLL4133		1N4133				1N5269A	
91		MLL4134		1N4134			1N984A	1N5270A	1N6023A
100		MLL4135		1N4135			1N985A	1N5271A	1N6024A
110							1N986A	1N5272A	1N6025A
120							1N987A	†1N5273A	
130							1N988A	†1N5274A	
140								†1N5275A	
150							1N989A	†1N5276A	
160							1N990A	†1N5277A	
170								†1N5278A	
180							1N991A	†1N5279A	
200							1N992A	†1N5281A	

☐ JAN JANTX(V) available, ±5% only.

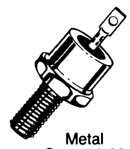
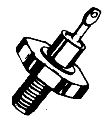
† 1N987A–1N992A & 1N5273A–1N5281A supplied in DO-7 glass package.

*See Notes — page 5-154.

Nominal Zener Voltage	500 mW Cathode = Polarity Mark		1 Watt Cathode = Polarity Mark		1 Watt Cathode to Case	1.5 Watt Cathode = Polarity Mark	5 Watt Cathode = Polarity Mark
(*Note 1)	(*Notes 4,11)	(*Notes 9,11)	(*Note 6)	(*Notes 6,12)	(*Note 7)	(*Note 8)	(*Note 8)
	 Glass Case 362-01		 Glass Case 59-04 (DO-41)	 Glass Case 362B-01	 Metal Case 52-03 (DO-13)	 Case 59-03 (DO-41)	 Surmetic 40 Case 17-02
1.8							
2							
2.2							
2.4	MLL4370	MLL5221A					
2.5		MLL5222A					
2.7	MLL4371	MLL5223A					
2.8		MLL5224A					
3	MLL4372	MLL4225A					
3.3	MLL746	MLL5226A	1N4728	MLL4728	1N3821	1N5913A	1N5333A
3.6	MLL747	MLL5227A	1N4729	MLL4729	1N3822	1N5914A	1N5334A
3.9	MLL748	MLL5228A	1N4730	MLL4730	1N3823	1N5915A	1N5335A
4.3	MLL749	MLL5229A	1N4731	MLL4731	1N3824	1N5916A	1N5336A
4.7	MLL750	MLL5230A	1N4732	MLL4732	1N3825	1N5917A	1N5337A
5.1	MLL751	MLL5231A	1N4733	MLL4733	1N3826	1N5918A	1N5338A
5.6	MLL752	MLL5232A	1N4734	MLL4734	1N3827	1N5919A	1N5339A
6		MLL5233A					
6.2	MLL753	MLL5234A	1N4735	MLL4735	1N3828	1N5920A	1N5341A
6.8	MLL754 MLL957A	MLL5235A	1N4736	MLL4736	1N3829 1N3016A	1N5921A	1N5342A
7.5	MLL755 MLL958A	MLL5236A	1N4737	MLL4737	1N3830 1N3017A	1N5922A	1N5343A
8.2	MLL756 MLL959A	MLL5237A	1N4738	MLL4738	1N3018A	1N5923A	1N5344A
8.7		MLL5238A					1N5345A
9.1	MLL757 MLL960A	MLL5239A	1N4739	MLL4739	1N3019A	1N5924A	1N5346A
10	MLL758 MLL961A	MLL5240A	1N4740	MLL4740	1N3020A	1N5925A	1N5347A
11	MLL962A	MLL5241A	1N4741	MLL4741	1N3021A	1N5926A	1N5348A
12	MLL759 MLL963A	MLL5242A	1N4742	MLL4742	1N3022A	1N5927A	1N5349A
13	MLL964A	MLL5243A	1N4743	MLL4743	1N3023A	1N5928A	1N5350A
14		MLL5244A					1N5351A
15	MLL965A	MLL5245A	1N4744	MLL4744	1N3024A	1N5929A	1N5352A
16	MLL966A	MLL5246A	1N4745	MLL4745	1N3025A	1N5930A	1N5353A
17		MLL5247A					1N5354A
18	MLL967A	MLL5248A	1N4746	MLL4746	1N3026A	1N5931A	1N5355A
19		MLL5249A					1N5356A
20	MLL968A	MLL5250A	1N4747	MLL4747	1N3027A	1N5932A	1N5357A
22	MLL969A	MLL5251A	1N4748	MLL4748	1N3028A	1N5933A	1N5358A
24	MLL970A	MLL5252A	1N4749	MLL4749	1N3029A	1N5934A	1N5359A
25		MLL5253A					1N5360A
27	MLL971A	MLL5254A	1N4750	MLL4750	1N3030A	1N5935A	1N5361A
28		MLL5255A					1N5362A
30	MLL972A	MLL5256A	1N4751	MLL4751	1N3031A	1N5936A	1N5363A
33	MLL973A	MLL5257A	1N4752	MLL4752	1N3032A	1N5937A	1N5364A
36	MLL974A	MLL5258A	1N4753	MLL4753	1N3033A	1N5938A	1N5365A
39	MLL975A	MLL5259A	1N4754	MLL4754	1N3034A	1N5939A	1N5366A
43	MLL976A	MLL5260A	1N4755	MLL4755	1N3035A	1N5940A	1N5367A
47	MLL977A	MLL5261A	1N4756	MLL4756	1N3036A	1N5941A	1N5368A
51	MLL978A	MLL5262A	1N4757	MLL4751	1N3037A	1N5942A	1N5369A
56	MLL979A	MLL5263A	1N4758	MLL4758	1N3038A	1N5943A	1N5370A
60		MLL5264A					1N5371A
62	MLL980A	MLL5265A	1N4759	MLL4759	1N3039A	1N5944A	1N5372A
68	MLL981A	MLL5266A	1N4760	MLL4760	1N3040A	1N5945A	1N5373A
75	MLL982A	MLL5267A	1N4761	MLL4761	1N3041A	1N5946A	1N5374A
82	MLL983A	MLL5268A	1N4762	MLL4762	1N3042A	1N5947A	1N5375A
87		MLL5269A					1N5376A
91	MLL984A	MLL5270A	1N4763	MLL4763	1N3043A	1N5958A	1N5377A
100	MLL985A		1N4764	MLL4764	1N3044A	1N5949A	1N5378A
110	MLL986A				1N3045A	1N5950A	1N5379A
120					1N3046A	1N5951A	1N5380A
130					1N3047A	1N5952A	1N5831A
150					1N3048A	1N5953A	1N5383A
160					1N3049A	1N5954A	1N5384A
170							1N5385A
175							
180					1N3050A	1N5955A	1N5386A
200					1N3051A	1N5956A	1N5388A

*See Notes — page 5-154.

General-Purpose Regulator Diodes (continued)

Nominal Zener Voltage (*Note 1)	10 Watt Cathode to Case = 1N3993 Series Anode to Case = 1N2970 Series (*Notes 9,10)	50 Watt Anode to Case (*Notes 9,10)
	 Metal Case 56-03 (DO-203AA)	 Metal Case 58-01 (DO-5 Type)
1.8		
2		
2.2		
2.4		
2.5		
2.7		
2.8		
3		
3.3		
3.6		
3.9	1N3993&R	1N4549A&RA
4.3	1N3994&R	1N4550A&RA
4.7	1N3995&R	1N4551A&RA
5.1	1N3996&R	1N4552A&RA
5.6	1N3997&R	1N4553A&RA
6		
6.2	1N3998&R	1N4554A&RA
6.8	1N3999&R 1N2970A&RA	1N4555A&RA 1N3305A&RA
7.5	1N4000&R 1N2971A&RA	1N4556A&RA 1N3306A&RA
8.2	1N2972A&RA	1N3307A&RA
8.7		
9.1	1N2973A&RA	1N3308A&RA
10	1N2974A&RA	1N3309A&RA
11	1N2975A&RA	1N3310A&RA
12	1N2976A&RA	1N3311A&RA
13	1N2977A&RA	1N3312A&RA
14	1N2878A&RA	1N3313A&RA
15	1N2979A&RA	1N3314A&RA
16	1N2980A&RA	1N3315A&RA
17		1N3316A&RA
18	1N2982A&RA	1N3317A&RA
19	1N2983A&RA	1N3318A&RA
20	1N2984A&RA	1N3319A&RA
22	1N2985A&RA	1N3320A&RA
24	1N2986A&RA	1N3321A&RA
25		1N3322A&RA
27	1N2988A&RA	1N3323A&RA
28		
30	1N2989A&RA	1N3324A&RA
33	1N2990A&RA	1N3325A&RA
36	1N2991A&RA	1N3326A&RA
39	1N2992A&RA	1N3327A&RA
43	1N2993A&RA	1N3328A&RA
47	1N2996A&RA	1N33330A&RA
50		
51	1N2997A&RA	1N3332A&RA
52		1N3334A&RA
56	1N2999A&RA	
60		1N3335A&RA
62	1N3000A&RA	1N3336A&RA
68	1N3001A&RA	
75	1N3002A&RA	1N3337A&RA
82	1N3003A&RA	1N3338A&RA
87		
91	1N3004A&RA	1N3339A&RA
100	1N3005A&RA	1N3340A&RA
105		
110	1N3007A&RA	1N3342A&RA
120	1N3008A&RA	1N3343A&RA
130	1N3009A&RA	1N3344A&RA
140		1N3345A&RA
150	1N3011A&RA	1N3346A&RA
160	1N3012A&RA	1N3347A&RA
170		
175		
180	1N3014A&RA	1N3349A&RA
200	1N3015A&RA	1N3350A&RA

▨ JAN JANTX (V) available, ±5% only.

*See Notes on this page.

NOTES

1. The zener voltage is measured at approximately 1/4 the rated power, with the following exceptions: the 1N4678–4717 is measured with I_{ZT} = 50 μAdc; the 1N4614/1N4099 is measured with I_{ZT} = 250 μAdc; the 1N4370/1N746 and the 1N5221–5242 are measured with I_{ZT} = 20 mAdc; the 1N5985A–6012A is measured with I_{ZT} = 5 mA; 1N6013A–6023A is measured with I_{ZT} = 2 mA; 1N6024–6025 is measured with I_{ZT} = 1 mA.

Tolerances

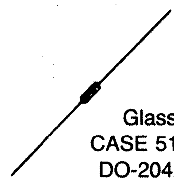
2. No suffix = ±5%
   C suffix = 2%
   D suffix = 1%
3. A Suffix = ±10% with guaranteed limits on V_Z, V_F, and I_R only
   B suffix = ±5%
   C suffix = ±2%
   D suffix = ±1%
4. MLL4370/1N4370/1N746 series:
   No suffix = ±10%
   A suffix = ±5%
   C suffix = 2%
   D suffix = 1%
   MLL957/1N957 series:
   A suffix = ±10%
   B suffix = ±5%
   C suffix = 2%
   D suffix = 1%

Military parts in 1N4370/746/962/4099/4614/5518 series supplied in DO-7. Military parts in 1N4370/746/962/4099/4614/5518 are also available in the cost effective DO-204AH (DO-35) package as the -1 version. This version can be ordered by inserting a 1 between the part number and the JAN, JTX or JTXV suffix, i.e. 1N746A1JAN. MIL-STD 19500/117 and 127 state the -1 version is a direct substitute for the non -1 version. The -1 versions appear on MIL-STD 701 as the preferred parts for new designs.

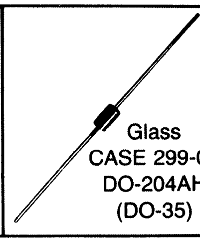
5. No suffix = ±10% with guaranteed limits on V_Z, V_F and I_R only.
   A suffix = ±10%
   B suffix = ±5%
6. No suffix = ±10%
   A suffix = ±5%
   C suffix = 2%
   D suffix = 1%
7. 1N3821 series: No suffix = ±10%, A suffix = ±5%
   1N3016 series: A suffix = ±10%, B suffix = ±5%
8. A suffix = ±10% C suffix = ±2%
   B suffix = ±5% D suffix = ±1%
9. A suffix = ±10%
   B suffix = ±5%
   Exception:
   1N3993–1N4000: No suffix = ±10%, A suffix = ±5%
10. RA and RB = reverse polarity types available
11. Available in 8 mm tape and reel
    T1 cathode facing sprocket holes
    T2 anode facing sprocket holes
12. Available in 12 mm tape and reel
    T1 cathode facing sprocket holes
    T2 anode facing sprocket holes
13. Available in 8 mm tape and reel, both T1 and T2 options.

Voltage Reference Diodes

Temperature Compensated Reference Devices



Glass
CASE 51-02
DO-204AA
(DO-7)



Glass
CASE 299-02
DO-204AH
(DO-35)

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. Includes JAN, JANTX and JTXV devices.

			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	Test Current mAdc	Test* Temp Points	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	Case
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	0.018	1N4566	0.024	1N4567	0.01	1N4568	0.005	1N4569	0.002	DO-204AH (DO-35)
	0.5	A	1N4565A	0.099	1N4566A	0.05	1N4567A	0.02	1N4568A	0.01	1N4569A	0.005	
	1	B	1N4570	0.048	1N4571	0.024	1N4572	0.01	1N4573	0.005	1N4574	0.002	
	1	A	1N4570A	0.099	1N4571A	0.05	1N4572A	0.02	1N4573A	0.01	1N4574A	0.005	
	2	B	1N4575	0.048	1N4576	0.024	1N4577	0.01	1N4578	0.005	1N4579	0.002	
	2	A	1N4575A	0.099	1N4576A	0.025	1N4577A	0.02	1N4578A	0.01	1N4579A	0.005	
	4	B	1N4580	0.048	1N4581	0.024	1N4582	0.01	1N4583	0.005	1N4584	0.002	
	4	A	1N4580A	0.099	1N4581A	0.05	1N4582A	0.02	1N4583A	0.01	1N4584A	0.005	

△1 Non-suffix — Z_{ZT} = 15, "A" Suffix — Z_{ZT} = 10
▨ -1 and non-1 JAN/JANTX(V) available, ±5% only, Military parts in the 1N821, -1 and 1N4565, -1 series and supplied in the DO-7 package.
***Test Temperature Points °C: A** = −55, 0, +25, +75, +100 **B** = 0, +25, +75 **C** = −55, 0, +25, +75, +100, +150

Precision Reference Diodes (CASE 51-02, DO-204AA)

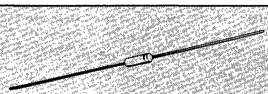
Designed, manufactured and tested for ultra-high stability of voltage with time and temperature change. Use of special measurement equipment and voltage standards provide calibration directly traceable to the National Bureau of Standards.

		Temperature Stability		CERTIFIED VOLTAGE TIME STABILITY OVER 1000 HOURS OF OPERATION (Parts/Million Change)							
				<5 PPM/1000 HR		<10 PPM/1000 HR		<20 PPM/1000 HR		<40 PPM/1000 HR	
Reference Voltage Volts	Test Current mA	ΔV_Z (mV)	OP Temp Range °C	Device Type	Change µV Max	Device Type	Change µV Max	Device Type	Change µV Max	Device Type	Change µV Max
6.2 ± 5%	7.5	2.5	25,75,100	MZ605	30	MZ610	60	MZ620	120	MZ640	240

Special Purpose Regulators

Field-Effect Current Regulator Diodes

High impedance diodes whose "constant current source" characteristic complements the "constant voltage" of the zener line. Currents are available from 0.22 to 4.7 mA, with usable voltage range from a minimum limit of 1 to 2.5 V, up to a voltage compliance of 100 V, for the 1N5283 series, or 70 V, for the MCL1300 series.

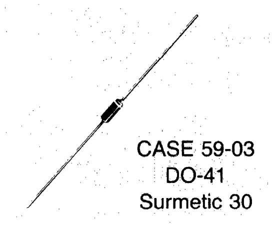


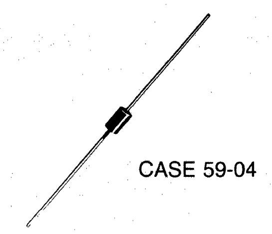
Glass Case 51-02 DO-204AA (DO-7)			
Reg. Current I_P @V_T = 25 V mA Nom	**Device Type**	**Knee Imp Z_K @V_K = 6.0 V MΩ Min**	**Limiting Voltage @I_L = 0.8 I_P Volts Max**
0.22	1N5283	2.75	1
0.24	1N5284	2.35	1
0.27	1N5285	1.95	1
0.3	1N5286	1.6	1
0.33	1N5287	1.35	1
0.39	1N5288	1	1.05
0.43	1N5289	0.87	1.05
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
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	3.35
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
0.5±.03	MCL1300	0.5	1
1±0.6	MCL1301	0.2	1.5
2±0.6	MCL1302	0.1	2
3±0.6	MCL1303	0.05	2
4±0.6	MCL1304	0.025	2.5

▢ JAN/JANTX (V) availability

Low-Voltage Regulators

High-conductance silicon diodes designed as stable forward-reference sources for transistor amplifier biasing and similar applications. Available in high reliability glass construction or economic plastic packaging.





ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted).

Forward Reference Voltage		I_F Test Current	Leakage Current I_R @ V_R		Device Type	Case
Min	Max	mA	μA	Volts		
0.63	0.71	10	10	5	MZ2360	59-04 Surmetic
1.24	1.38	10	10	5	MZ2361	59-03 Surmetic

Transient Suppressors

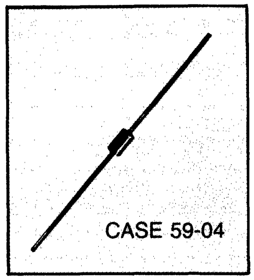
General-Purpose

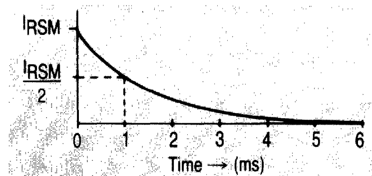
Transient suppressors are designed for applications requiring protection of voltage sensitive electronic devices in danger of destruction by high energy voltage transients. Select from standard factory available types or design the suppressor to meet specific needs by paralleling cells. For specific options, i.e., non-standard voltage, higher power capacity, and package configurations, consult factory.

PEAK POWER DISSIPATION @ 1 ms = 500 WATTS — CASE 59-04

Device	Breakdown Voltage V_{BR} Volts			I_{RSM} Max Reverse Surge Current Amps		V_{RSM} Max Reverse Voltage @ I_{RSM} Volts	
		Max					
	Min	Non "A"	"A"	Non "A"	"A"	Non "A"	"A"
SA5.0,A	6.4	7.3	7	52	54.3	9.6	9.2
SA6.0,A	6.67	8.15	7.37	43.9	48.5	11.4	10.3
SA6.5,A	7.22	8.82	7.98	40.7	44.7	12.3	11.2
SA7.0,A	7.78	9.51	8.6	37.8	41.7	13.3	12
SA7.5,A	8.33	10.2	9.21	35	38.8	14.3	12.9
SA8.0,A	8.89	10.9	9.3	33.3	36.7	15	13.6
SA8.5,A	9.44	11.5	10.4	31.4	34.7	15.9	14.4
SA9.0,A	10	12.2	11.1	29.5	32.5	16.9	15.4
SA10,A	11.1	13.6	12.3	26.6	29.4	18.8	17
SA11,A	12.2	14.9	13.5	24.9	27.4	20.1	18.2
SA12,A	13.3	16.3	14.7	22.7	25.1	22	19.9
SA13,A	14.4	17.6	15.9	21	23.2	23.8	21.5
SA14,A	15.6	19.1	17.2	19.4	21.5	25.8	23.2
SA15,A	16.7	20.4	18.5	18.8	20.6	26.9	24.4
SA16,A	17.8	21.8	19.7	17.6	19.2	28.8	26
SA17,A	18.9	23.1	20.9	16.4	18.1	30.5	27.6
SA18,A	20	24.4	22.1	15.5	17.2	32.2	29.2
SA20,A	22.2	27.1	24.5	13.9	15.4	35.8	32.4
SA22,A	24.4	29.8	26.9	12.7	14.1	39.4	35.5
SA24,A	26.7	32.6	29.5	11.6	12.8	43	38.9
SA26,A	28.9	35.3	31.9	10.7	11.9	26.6	42.1
SA28,A	31.1	38	34.4	9.9	11	50	45.4
SA30,A	33.3	40.7	36.8	9.3	10.3	53.5	48.4
SA33,A	36.7	44.9	40.6	8.5	9.4	59	53.3
SA36,A	40	48.9	44.2	7.8	8.6	64.3	58.1
SA40,A	44.4	54.3	49.1	7	7.8	71.4	64.5
SA43,A	47.8	58.4	52.8	6.5	7.2	76.7	69.4
SA45,A	50	61.1	55.3	6.2	6.9	80.3	72.7
SA48,A	53.3	65.1	58.9	5.8	6.5	85.5	77.4
SA51,A	56.7	69.3	62.7	5.5	6.1	91.1	82.4
SA54,A	60	73.3	66.3	5.2	5.7	96.3	87.1
SA60,A	66.7	81.5	73.7	4.7	5.2	107	96.8
SA64,A	71.1	86.9	78.6	4.4	4.9	114	103

(continued)





Surge Current Characteristics

PEAK POWER DISSIPATION @ 1 ms = 500 WATTS — CASE 59-04 (continued)

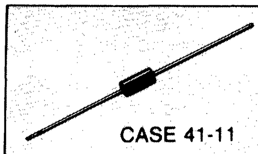
Device	Breakdown Voltage V_{BR} Volts Min	Max Non "A"	Max "A"	I_{RSM} Max Reverse Surge Current Amps Non "A"	"A"	V_{RSM} Max Reverse Voltage @ I_{RSM} Volts Non "A"	"A"
SA70,A	77.8	95.1	86	4	4.4	125	113
SA75,A	83.3	102	92.1	3.7	4.1	134	121
SA78,A	86.7	106	95.8	3.6	4	139	126
SA85,A	94.4	115	104	3.3	3.6	151	137
SA90,A	100	122	111	3.1	3.4	160	146
SA100,A	111	136	123	2.8	3.1	179	162
SA110,A	122	149	135	2.6	2.8	196	177
SA120,A	133	163	147	2.3	2.6	214	193
SA130,A	144	176	159	2.2	2.4	231	209
SA150,A	167	204	185	1.9	2.1	268	243
SA160,A	178	218	197	1.7	1.9	287	259
SA170,A	189	231	209	1.6	1.8	304	275

PEAK POWER DISSIPATION @ 1 ms = 600 WATTS

Breakdown Voltage $V_{(BR)}$ Volts Nom	@I_T mA	Device Type	I_{RSM} Maximum Reverse Surge Current Amp	V_{RSM} Maximum Reverse Voltage @ I_{RSM} Volts
6.8	10	P6KE6.8	56	10.8
7.5	10	P6KE7.5	51	11.7
8.2	10	P6KE8.2	48	12.5
9.1	1	P6KE9.1	44	13.8
10	1	P6KE10	40	15
11	1	P6KE11	37	16.2
12	1	P6KE12	35	17.3
13	1	P6KE13	32	19
15	1	P6KE15	27	22
16	1	P6KE16	26	23.5
18	1	P6KE18	23	26.5
20	1	P6KE20	21	29.1
22	1	P6KE22	19	31.9
24	1	P6KE24	17	34.7
27	1	P6KE27	15	39.1
30	1	P6KE30	14	43.5
33	1	P6KE33	12.6	47.7
36	1	P6KE36	11.6	52
39	1	P6KE39	10.6	56.4
43	1	P6KE43	9.6	61.9
47	1	P6KE47	8.9	67.8
51	1	P6KE51	8.2	73.5
56	1	P6KE56	7.4	80.5
62	1	P6KE62	6.8	89
68	1	P6KE68	6.1	98
75	1	P6KE75	5.5	108
82	1	P6KE82	5.1	118
91	1	P6KE91	4.8	131
100	1	P6KE100	4.2	144
110	1	P6KE110	3.8	158
120	1	P6KE120	3.5	173
130	1	P6KE130	3.2	187
150	1	P6KE150	2.8	215
160	1	P6KE160	2.6	230
170	1	P6KE170	2.5	244
180	1	P6KE180	2.3	258
200	1	P6KE200	2.1	287

CASE 17-02

Breakdown voltage for standard is ±10% tolerance; ±5% version is available by adding "A", i.e., P6KE6.8A. Clipper (back to back) versions are available by ordering with a "C" or "CA" suffix, i.e., P6KE6.8C or P6KE6.8CA.



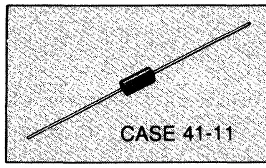
CASE 41-11

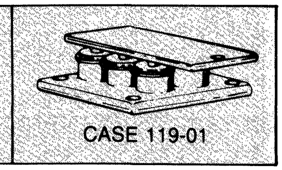
PEAK POWER DISSIPATION @ 1 ms = 1500 WATTS

Breakdown Voltage $V_{(BR)}$ Volts Nom	Breakdown Voltage @I_T mA	Device Type		I_{RSM} Maximum Reverse Surge Current Amp	V_{RSM} Maximum Reverse Voltage @ I_{RSM} Volts	Case
6	1	1N5908		120	8.5	41-11
6.8	10	1N6267	1.5KE6.8	139	10.8	
7.5	10	1N6268	1.5KE7.5	128	11.7	
8.2	10	1N6269	1.5KE8.2	120	12.5	
9.1	1	1N6270	1.5KE9.1	109	13.8	
10	1	1N6271	1.5KE10	100	15	
11	1	1N6272	1.5KE11	93	16.2	
12	1	1N6273	1.5KE12	87	17.3	
13	1	1N6274	1.5KE13	79	19	
15	1	1N6275	1.5KE15	68	22	
16	1	1N6276	1.5KE16	64	23.5	
18	1	1N6277	1.5KE18	56.5	26.5	
20	1	1N6278	1.5KE20	51.5	29.1	
22	1	1N6279	1.5KE22	47	31.9	
24	1	1N6280	1.5KE24	43	34.7	
27	1	1N6281	1.5KE27	38.5	39.1	
30	1	1N6282	1.5KE30	34.5	43.5	
33	1	1N6283	1.5KE33	31.5	47.7	
36	1	1N6284	1.5KE36	29	52	
39	1	1N6285	1.5KE39	26.5	56.4	
43	1	1N6286	1.5KE43	24	61.9	
47	1	1N6287	1.5KE47	22.2	67.8	
51	1	1N6288	1.5KE51	20.4	73.5	
56	1	1N6289	1.5KE56	18.6	80.5	
62	1	1N6290	1.5KE62	16.9	89	
68	1	1N6291	1.5KE68	15.3	98	
75	1	1N6292	1.5KE75	13.9	108	
82	1	1N6293	1.5KE82	12.7	118	
91	1	1N6294	1.5KE91	11.4	131	
100	1	1N6295	1.5KE100	10.4	144	
110	1	1N6296	1.5KE110	9.5	158	
120	1	1N6297	1.5KE120	8.7	173	
130	1	1N6298	1.5KE130	8	187	
150	1	1N6299	1.5KE150	7	215	
160	1	1N6300	1.5KE160	6.5	230	
170	1	1N6301	1.5KE170	6.2	244	
180	1	1N6302	1.5KE180	5.8	258	
200	1	1N6303	1.5KE200	5.2	287	
220	1		1.5KE220	4.3	344	
250	1		1.5KE250	5	360	

Breakdown voltage for standard is ±10% tolerance; ±5% version is available by adding "A", i.e., 1N6267A, 1.5KE6.8A. Clipper (back to back) versions are available by ordering the 1.5KE series with a "C" or "CA" suffix, i.e., 1.5KE6.8C or 1.5KE6.8CA.

TRANSIENT SUPPRESSORS (continued)


CASE 41-11


CASE 119-01

PEAK POWER DISSIPATION @ 1 ms = 1500 WATTS

V_{RWM} Working Peak Reverse Voltage (Blocking or Stand-Off Voltage)	Device Type	Clipper (Back To Back) Version	I_{RSM} Maximum Reverse Surge Current Amp	V_{RSM} Maximum Reverse Voltage @ I_{RSM} Volts	Case
5	1N6373 / ICTE-5 / MPTE-5	ICTE-5C	160	9.4	41-11
8	1N6374 / ICTE-8 / MPTE-8	1N6382	100	15	
10	1N6375 / ICTE-10 / MPTE-10	1N6383	90	16.7	
12	1N6376 / ICTE-12 / MPTE-12	1N6384	70	21.2	
15	1N6377 / ICTE-15 / MPTE-15	1N6385	60	25	
18	1N6378 / ICTE-18 / MPTE-18	1N6386	50	30	
22	1N6379 / ICTE-22 / MPTE-22	1N6387	40	37.5	
36	1N6380 / ICTE-36 / MPTE-36	1N6388	23	65.2	
45	1N6381 / ICTE-45 / MPTE-45	1N6389	19	78.9	

PEAK POWER DISSIPATION @ 1 ms = 8000 WATTS

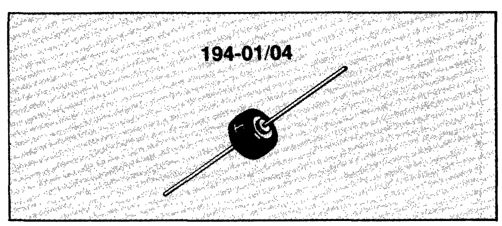
V_R Operating Voltage Nom Vdc	$V_{(RMS)}$	Device Type	I_R Reverse Current µA	ΔV_Z Breakdown Voltage Min Volts	@ I_{ZT} mA	V_C Clamping Voltage Max Volts	@ I_{PP} Amp	V_F Forward Voltage Volts	@ I_F Amp	Case
14	**10**	MPZ5-16A	50	16	0.4	24	200	1.5	10	119-01
14	**10**	MPZ5-16B		16	0.4	20	200			
28	**20**	MPZ5-32A		32	0.2	50	100			
28	**20**	MPZ5-32B		32	0.2	45	100			
28	**20**	MPZ5-32C		32	0.2	40	100			
165	**117**	MPZ5-180A		180	0.03	250	20			
165	**117**	MPZ5-180B		180	0.03	225	20			
165	**117**	MPZ5-180C		180	0.03	205	20			

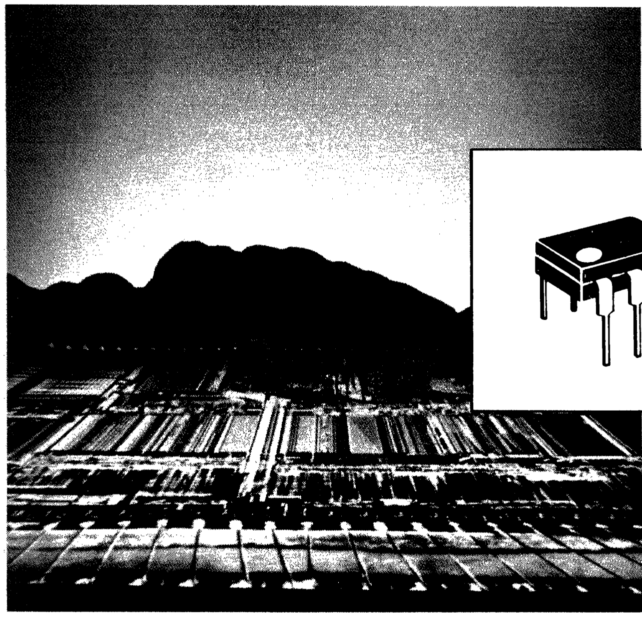
Automotive Transient Suppressors

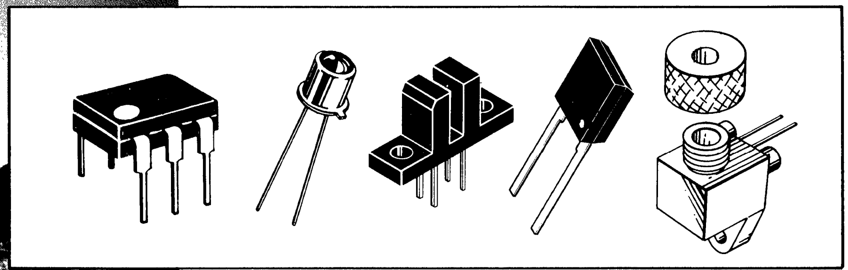
Automotive transient suppressors are designed for protection against over-voltage conditions in the auto electrical system including the "LOAD DUMP" phenomenon that occurs when the battery open circuits while the car is running.

AUTOMOTIVE TRANSIENT SUPPRESSOR	CASE 194-01 MR2535L	CASE 194-04 MR2540L
V_{RRM} (Volts)	20	20
I_O (Amp)	35	50
$V_{(BR)}$ (Volts)	24–32	24–32
I_{RSM}* (Amp)	110	150
T_C @ Rated I_O (°C)	150	150
T (°C)	175	175

* Time constant = 10 ms, duty cycle ≤ 1%, T_C = 25°C.







Optoelectronic Devices

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 applications 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 photo detectors 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 complements provide transmission up to several kilometers with bandwidths in excess of 100 MHz.

Chips

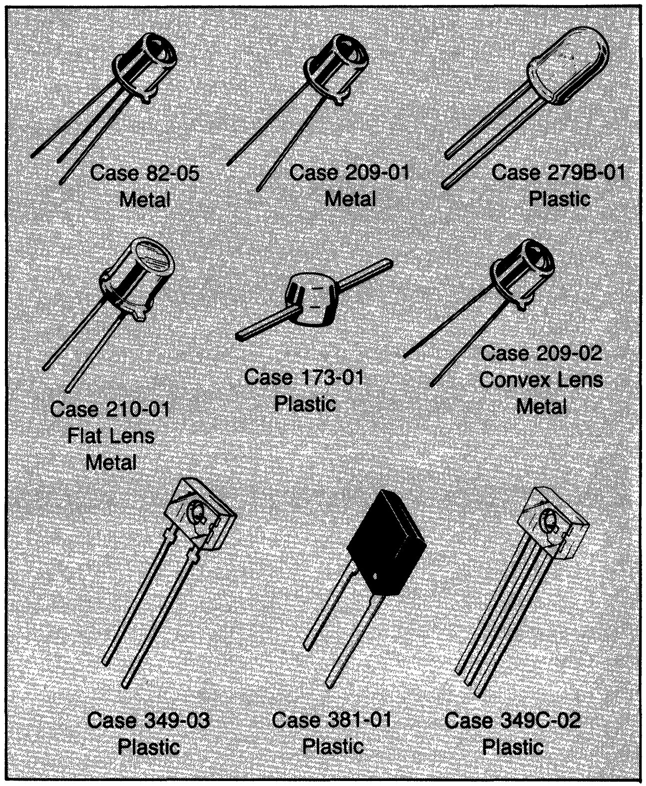
A number of LED and detector functions are available in chip form for hybrid system designs.

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 μW 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/cm² 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/cm² 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	3.5	50	2/2.5	82-05/1
MRD300	8	50	2/2.5	
MRD3050	0.1 Min	30	2/2.5	
MRD3051	0.2 Min	30	2/2.5	
MRD3054	0.5 Min	30	2/2.5	
MRD3055	1.5 Min	30	2/2.5	
MRD3056	2 Min	30	2/2.5	
			t_{on}/t_{off} @V_{CC}=5 V	
MRD701	0.5	30	10/60	349-03/2

Photodarlingtons

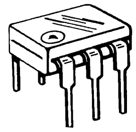
Device	Light Current @ V_{CC} = 5, H = 0.5 mW/cm² mA (Typ)	$V_{(BR)CEO}$ Volts (Min)	t_r/t_f @V_{CC}=5 V μs (Typ)	Case/ Style
MRD370	10	40	15/40	82-05/1
MRD360	20	40	15/65	
MRD711	25	60	125/150	349-03/2

Photothyristors — Triac Drivers

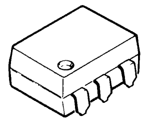
Device	H_{FT} mW/cm² Max	$I_{T(RMS)}$ mA Max	V_{DRM} Volts Peak Min	I_{DRM} nA Typ	Case/ Style
MRD3010	5	100	250	10	82-05/3
MRD3011	2	100	250	10	

Photo Schmitt Triggers

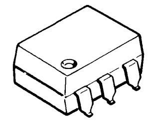
Device	Threshold Current mA ON Max	Threshold Current mA OFF Min	$\frac{I_{F(off)}}{I_{F(on)}}$ Typ	V_{CC} Volts	t_r/t_f μs Typ	Case/Style
MRD750	20	1.0	0.75	3–15	0.1	349C-02/3
MRD5009	20	1.0	0.75	3–15	0.1	82-05/1



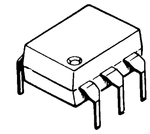
Case 730A



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

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

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.

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

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

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	$I_{F(off)}/I_{F(on)}$ Min	$I_{F(off)}/I_{F(on)}$ Max	V_{CC} Min	V_{CC} Max	t_r, t_f μs Typ	V_{ISO} Vac Pk
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.

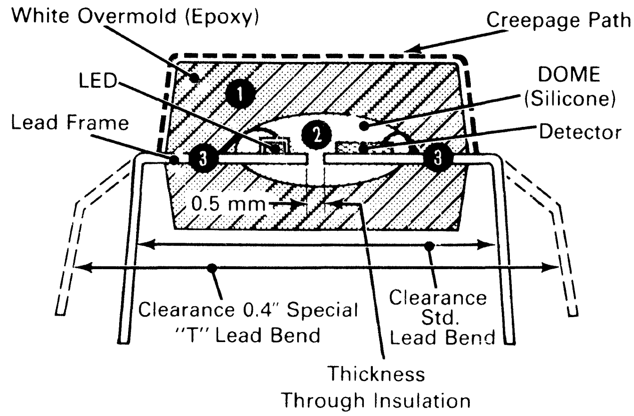


Figure 1. "DOME" Package

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 x 10^6
0805	435	Data Processing	8	8	—	3.75	7 x 10^6
0804	—	Telecommunication	8	8	—	2.50	2 x 10^6
0860	65	Electrical Household	6	6	0.4	3.0 (10)*	4 x 10^6
0113	204	Industrial Controls	8	8	—	2.5	1 x 10^6
0160	—	Power Installations with Electronic Equipment	8	8	—	2.70	1 x 10^6
0832	—	Traffic Light Controls	8	8	—	2.50	4 x 10^6
0883	—	Alarm Systems	8	8	—	2.50	2 x 10^6
0831	—	Electrical Signal System for Railroads	8	8	—	2.0	2 x 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 x 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.

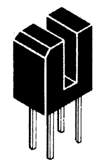
The various options are listed in the table below.

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.

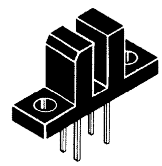
In accordance with this code, the sample Part Number at the bottom of the table (MOC75T2) represents a logic output interrupter in a flanged package with an LED trigger current of 15 mA. Parts that can be constructed within the above guidelines are readily available.

U
Unflanged



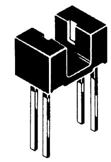
Case 354-02

T
Flanged



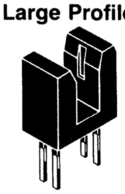
Case 354A-01

P
Wide Gap



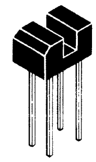
Case 354E-01

V
Large Profile



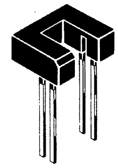
Case 354G-01

K
Low Profile



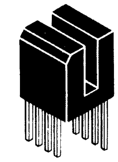
Case 365-01

H
Horizontal



Case 374-01

W
Dual-Channel



Case 792-01

These standard Interrupter packages can be supplemented with custom packages. For details consult your Motorola Sales Representative.

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 outline 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).

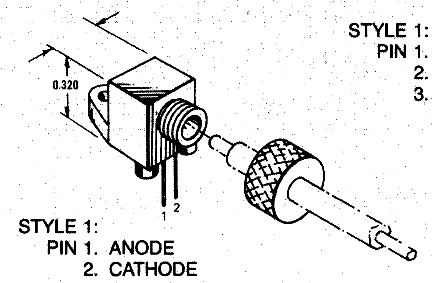
Detectors

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.

FLCS
Case 363B-01
(2-lead)

FLCS
Case 363C-01
(3-lead)

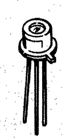


STYLE 1:
PIN 1. OUTPUT
2. GROUND
3. V_{CC}

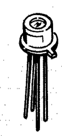
STYLE 1:
PIN 1. ANODE
2. CATHODE

STYLE 2:
PIN 1. EMITTER
2. COLLECTOR

STYLE 3:
PIN 1. CATHODE
2. ANODE



Case 210A-01
TO-206AC
(TO-52)



Case 210D-01
(TO-52 Type)

Case 366-01

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	

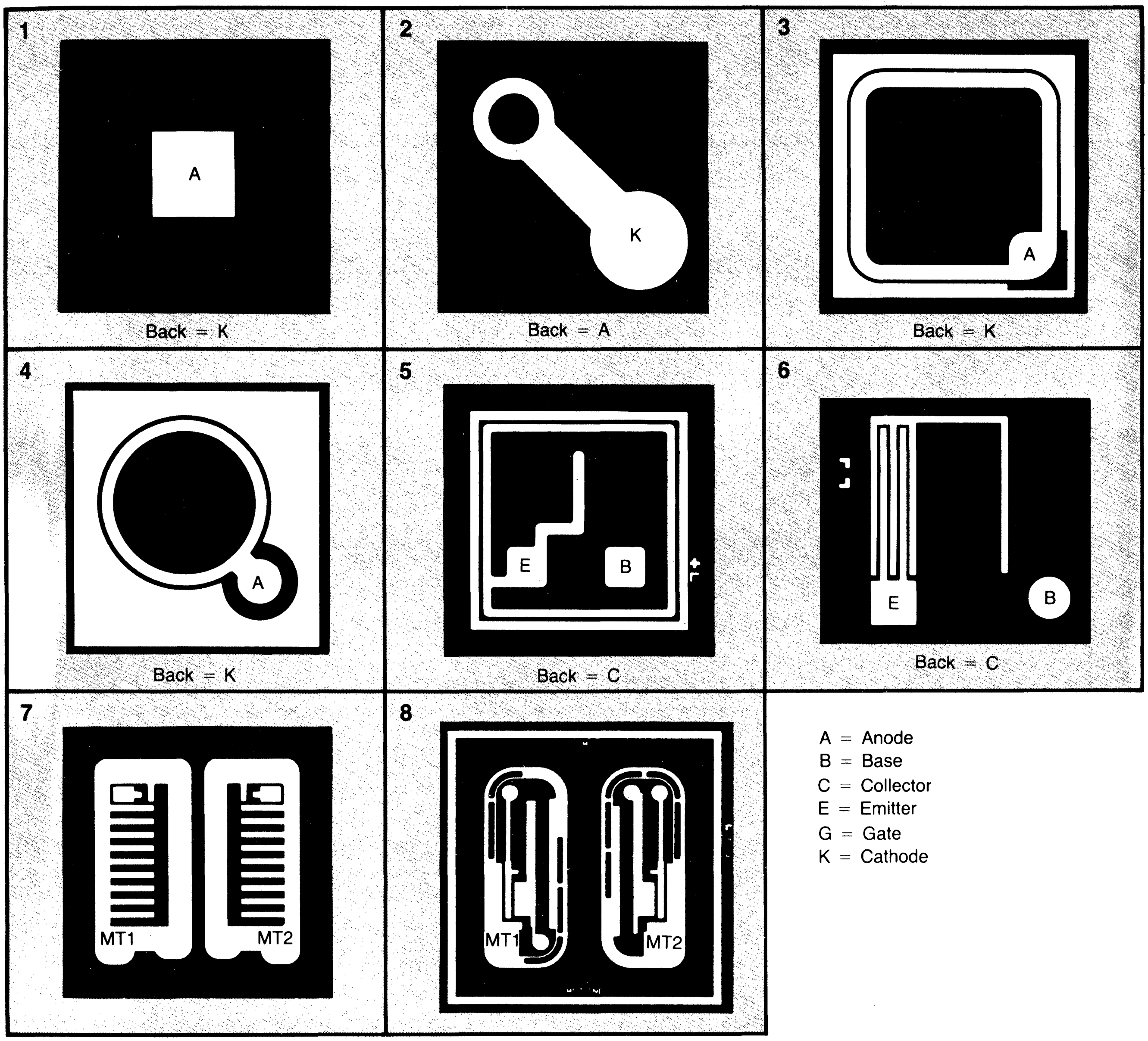
Photodetectors

Device	BWE MHz	Responsivity μA/μW 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/μW			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	*	*	*

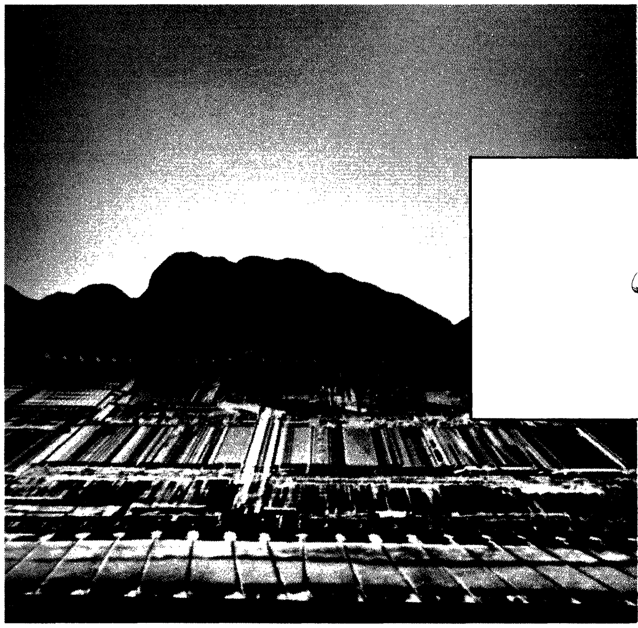
Samples available upon request, contact the Motorola Sales Office.

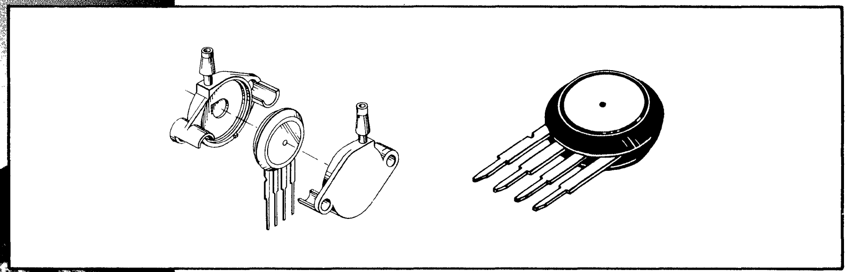
*Available Packaging

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit
MRDC100 Responsivity (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 conditioned, 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 ($\pm 2\%$ over a temperature range from $-40°$ to $+150°C$) at low cost.

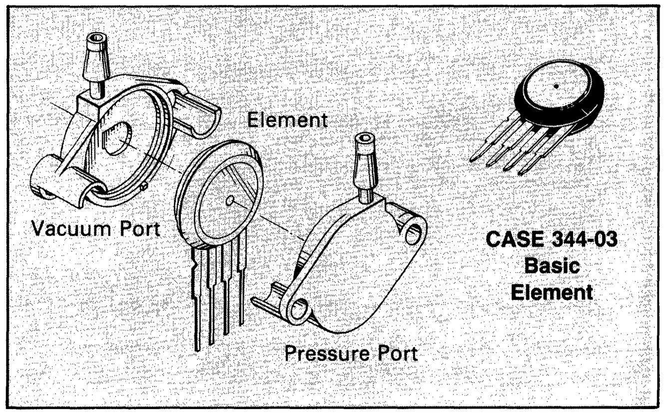
Pressure Sensors

Motorola pressure sensors combine advanced piezoresistive sensor architecture with IC technology to offer a range of pressure sensing devices for automotive, biomedical, consumer and industrial applications. Selection versatility includes choice of:

Pressure Ranges:
0 to 15, 1 to 7.5, 0 to 15, 0 to 30 PSI

Basic Measurements:
Differential, Absolute, Gage

Chip Options:
Uncompensated, Temperature Compensated/Calibrated Signal Conditioned (with on-chip amplifier)



Package Options:
Basic Element, Ported Elements for specific measurements

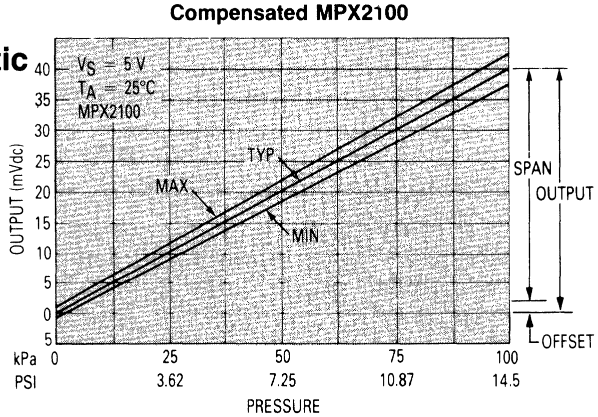
Electrical Characteristics

Device	Pressure Range PSI	Full Scale Span mV Typ	Offset mV Max	Sensitivity mV/PSI, Typ	Linearity % FS, Max
Signal Conditioned: V_S = 5 Vdc, T_A = 25°C					
MPX3100	0–15	2500	600	175	±2.0
On-Chip Compensated/Calibrated: V_S = 10 Vdc, T_A = 25°C					
MPX2050	0–7.5	40 ±1.5	±1	5.5	±0.25
MPX2051	0–7.5	40 ±1.5	±2	5.5	±0.5
MPX2100	0–15	40 ±1.5	±1	2.75	±0.25
MPX2101	0–15	40 ±2.5	±2	2.75	±0.5
MPX2200	0–30	40 ±1.5	±1	1.38	±0.25
MPX2201	0–30	40 ±2.5	±2	1.38	±0.5
Uncompensated: V_S = 3 Vdc, T_A = 25°C					
MPX10	0–1.5	20/50	35	24	±1.0
MPX11	0–1.5	20/60	35	34	0.5, +3
MPX1	0–1.5	20/70	35	38	0, +5
MPX50	0–7.5	45/90	35	8	±0.2
MPX51	0–7.5	30/60	35	6	0.2
MPX52	0–7.5	30/90	35	8	0.5
MPX100	0–15	45/90	35	4	0.2
MPX200	0–30	45/90	35	2	0.2
MPX201	0–30	45/90	35	2	0.5

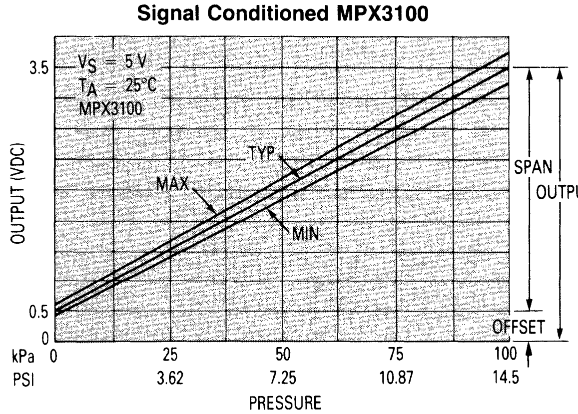
Typical Electrical Characteristic Curves

Output Voltage versus Pressure

Compensated MPX2100

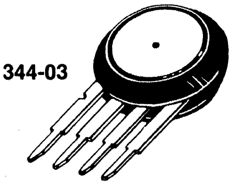


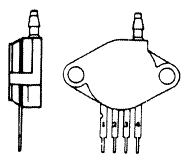
Signal Conditioned MPX3100



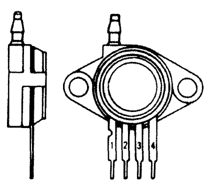
Ordering Information . . .

CASE 344-03

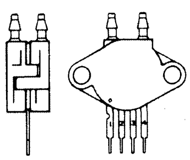




CASE 350-01
Sensing element with pressure side ported — for absolute and gage measurements



CASE 350-02
Sensing element with vacuum side ported — vacuum measurements



CASE 352-01
Sensing element with both sides ported — for differential measurements

MPX3100D Signal-Conditioned

Device Type	Measurement Options	Package Options	Pressure Range 0–15 PSI
Basic Element	Differential	Case 344-03	MPX3100D
Ported Element	Differential	Case 352-01	MPX3100DP
	Gage	Case 350-01	MPX3100GP
	Gage Vacuum	Case 350-02	MPX3100GVP

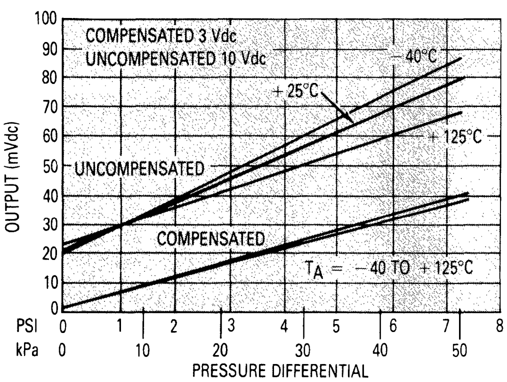
MPX2000 Series (Compensated)

Device Type	Measurement Options	Package Options	Pressure Range		
			0–7.5 PSI	0–15 PSI	0–30 PSI
Basic Element	Differential	Case 344-03	MPX2050D	MPX2100D	MPX2200D
Ported Element	Differential	Case 352-01	MPX2050DP	MPX2100DP	MPX2200DP
	Gage	Case 350-01	MPX2050GP	MPX2100GP	MPX2200GP
	Gage Vacuum	Case 350-02	MPX2050GVP	MPX2100GVP	MPX2200GVP

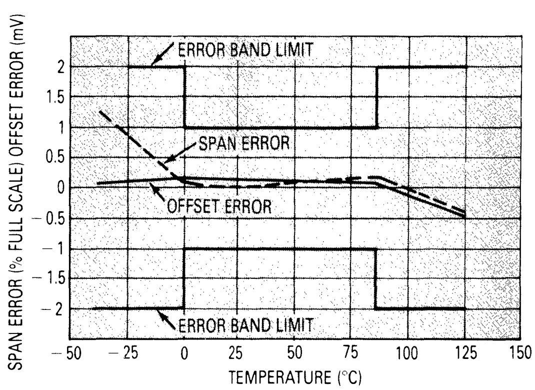
MPX10/50/100/200 Series (Noncompensated)

Device Type	Measurement Options	Package Options	Pressure Range			
			0–1.5 PSI	0–7.5 PSI	0–15 PSI	0–30 PSI
Basic Element	Absolute	Case 344-03	—	—	MPX100A	MPX200A
	Differential	Case 344-03	MPX10D	MPX50D	MPX100D	MPX200D
Ported Element	Absolute	Case 350-01	—	—	MPX100AP	MPX200AP
	Differential	Case 352-01	MPX10DP	MPX50DP	MPX100DP	MPX200DP
	Gage	Case 350-01	MPX10GP	MPX50GP	MPX100GP	MPX200GP
	Gage Vacuum	Case 350-02	MPX10GVP	MPX50GVP	MPX100GVP	MPX200GVP

Output Voltage versus Pressure and Temperature for Compensated and Uncompensated Devices

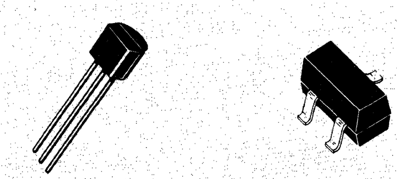


Temperature Error Band Limit and Typical Span and Offset Errors — Compensated Devices



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.

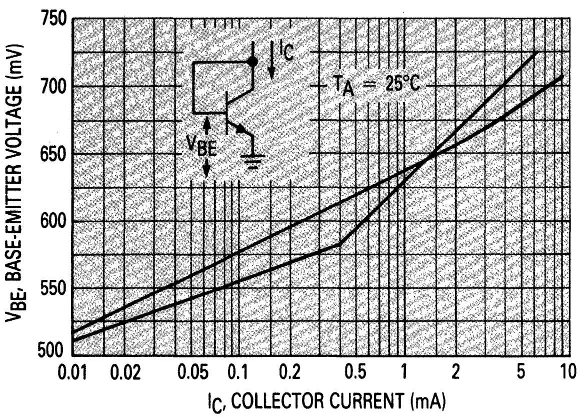


CASE 29-02 (TO-92)

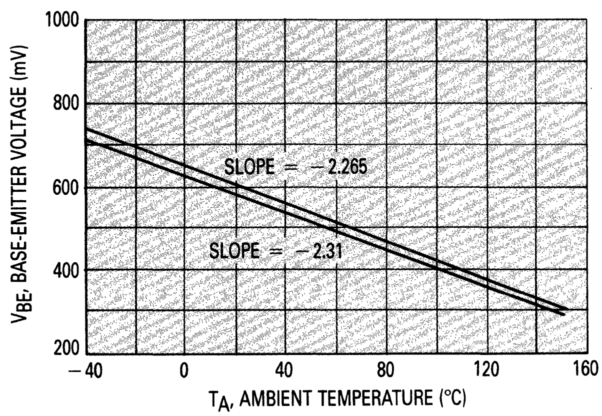
CASE 318 SOT-23

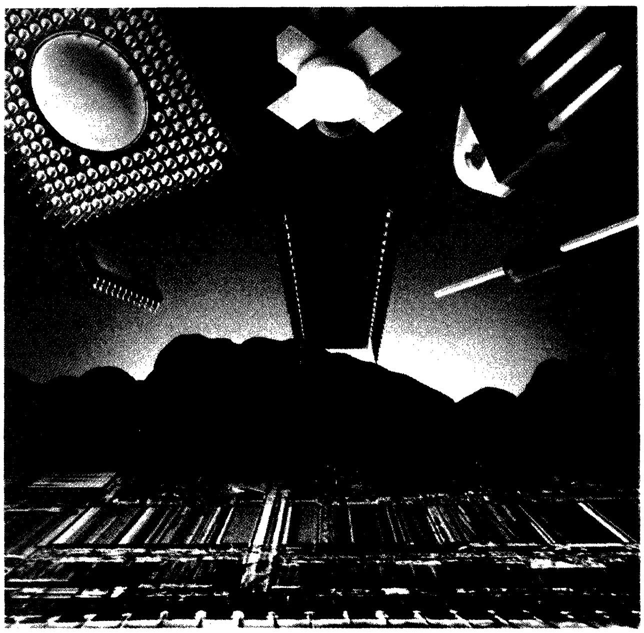
Device	V_{BE} @ I_C = 0.1 mA, T_A = 25°C Typ	Temperature Over −40°C to 150°C	Thermal Time Constant Liquid-to-Liquid	Thermal Time Constant Flowing Air	Case
MTS102		±2°C			29-02
MTS103	595 mV	±3°C	3 s	8 s	
MTS105		±5°C			

Typical V_{BE} versus Collector Current



Typical V_{BE} versus Ambient Temperature





MIL-Qualified Semiconductor Products

In Brief . . .

Motorola's Military Products Operation (MPO) produces and markets bipolar and MOS integrated circuits that perform both digital and analog functions, as well as a wide range of discrete components for standard military applications. The focus is primarily on high volume commodity devices which utilize proven standard technologies to provide low manufacturing costs, and on high-growth-potential products utilizing new technologies to gain a technological leadership position.

The MPO IC market scope is the OEM military end-use market, direct and through distribution, with emphasis on Data Processing, Communications, Radar Electronic Warfare and Guidance segments. Its charter is to provide a broad and balanced portfolio of defect-free, low-cost products to MIL-M-38510 and MIL-STD-883C specifications, delivered on time, with superior service to the customer.

In discrete products, Motorola's inventory covers a broad range of 1N— and 2N— products tested to JAN, JTX, JTXV and JAN S specifications.

The Military Products Operation, a segment of Motorola's Semiconductor Products Sector, is an operation which is totally dedicated to the manufacture and supply of standard military products, with its own engineering, manufacturing and administrative resources. Products are manufactured, screened and tested world wide, on lines certified per the requirements of the pertinent military specifications.

INTEGRATED CIRCUITS:

DISCRETE COMPONENTS:

Military Products Integrated Circuits

General Information

Over the years, the market for standard military integrated circuits has evolved into three basic programs:

- **MIL-STD-883C Program** (MIL-STD-883 Class B)
- **DESC Standard Military Drawing (SMD) Program** (MIL-STD-883 Class B)
- **JAN (38510) Program** (MIL-M-38510 Class B)

The semiconductor industry considers the MIL-STD-883C and the DESC SMD Programs to be equivalent. All products supplied by Motorola to these programs are processed to the applicable requirement of MIL-M-38510 and MIL-STD-883C.

Numbering Systems

The numbering systems associated with the products of the various programs are shown on the facing page. Suffix designations indicate Class of Flow, Case (package and pin number), and Lead Finish.

Class of Flow. The **Class B** flow has become the industry standard and there are no variations in this suffix designation.

Case. Motorola offers MIL qualified integrated circuits in five basic packages. The designated suffix indicator in the Numbering Systems describes both the case outline and the number of pins associated with the packages that house the various integrated circuits, as defined in the MIL-M-38510 Case Outlines Table. Packages not defined in this table are covered by Suffixes U, X, Y, and Z, defined in the associated JEDEC Case Outlines Table.

The code letters in the "Case Suffix" column of the subsequent Motorola MIL-STD-883C/SMD Product Guide indicate the packages available for each integrated circuit. The customer can select the desired package by replacing the dash (-) in the Suffix with the appropriate code letter.

Lead Finish. All Motorola military ICs are supplied with the standard Hot Solder Dip Kovar or Alloy 42 Lead Finish, Suffix Letter A. Devices in the chip carrier (LCC) package can also be ordered Co-Fired with Gold Plate, by replacing the standard A suffix with the Letter C.

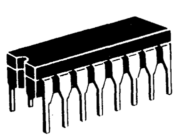
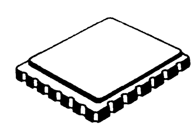
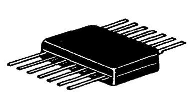
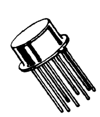
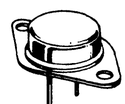
Standard Military Packages

Military integrated circuits are offered in five basic packages; ceramic dual-in-line package (known as CERDIP), solder seal dual-in-line package (known as sidebraze), ceramic flatpak package (CERFLAT), leadless ceramic chip carrier (LCC) and metal can package (CAN).

All of these packages are offered in a variety of pin patterns and lead finishes. Be sure to study the marking procedures to select the proper product codes when ordering.

The new leadless ceramic chip carriers offer considerable savings in board space (typically 6:1) and in weight savings (typically 10:1). They make ideal packages for space and airborne applications. MPO offers most of its military products in LCC packages.

Shown below are typical military integrated circuit packages:

- 16-PIN CERAMIC DUAL-IN-LINE  CERDIP
- LEADLESS CERAMIC CHIP CARRIER  LCCC
- 14-PIN CERAMIC FLATPAK  CERFLAT
- METAL CAN   CAN

TO-3

Military IC Numbering Systems

MIL-STD-883 — Example; 54LS00M/B2CJC

54LS00	M(1)	/B	X	X	JC
Device Number	LCC Package	Class B	Case	Lead Finish	JEDEC Marking

DESC STANDARD MILITARY DRAWING (SMD) — Example; 5962-8671001RA

5962(2)	XXXXX	01	X	X
DESC Desig.	Device Number	Device Detail	Case	Lead Finish

MIL-M-38510 (JAN) — Example; JM38510/30908BEA

JM38510	/XXX	XX	B	X	X
MIL Desig.	Device Number	Device Detail	Class B	Case	Lead Finish

Notes:

(1) Suffix M must be added to the Device Number when ordering a circuit in the Chip Carrier Package. For other packages, the M Suffix should be omitted.

(2) The DESC Designation number need not be used for ordering purposes since each device identification number uniquely associates the device with the DESC classification.

MIL-M-38510 Case Outlines

Letter	Description	Letter	Description
A	14-lead FP (1/4″ x 1/4″)	L	24-lead DIP (1/4″ x 1-1/4″)
B	14-lead FP (3/16″ x 1/4″)	M	12-lead Can
C	14-lead DIP (1/4″ x 3/4″)	P	8-lead DIP (1/4″ x 3/8″)
D	14-lead FP (1/4″ x 3/8″)	Q	40-lead DIP (9/16″ x 2-1/16″)
E	16-lead DIP (1/4″ x 7/8″)	R	20-lead DIP (1/4″ x 1-1/16″)
F	16-lead FP (1/4″ x 3/8″)	S	20-lead FP (1/4″ x 1/2″)
G	8-lead Can	V	18-lead DIP (1/4″ x 15/16″)
H	10-lead FP (1/4″ x 1/4″)	W	22-lead DIP (3/8″ x 1-1/8″)
I	10-lead Can	2	20-Terminal SQ. LCC (.350″ x .350″)
J	24-lead DIP (1/2″ x 1-1/4″)	3	28-Terminal SQ. LCC (.450″ x .450″)
K	24-lead FP (3/8″ x 5/8″)		

JEDEC Case Outlines

Undesignated package letters in the MIL-M-38510 Case Outlines Table (above) have the following definitions. Pin count is determined by circuit requirements.

U = Leadless Chip Carrier
X = DIP
Y = Flat Pack
Z = All other configurations

Standard Military Drawing (SMD/DESC) Flow

SCREEN	METHOD	REQUIREMENT
Internal Visual (Precap)	2010 Condition B and 38510	100%
Stabilization Bake	1008 24 hours min. Condition C or equivalent	100%
Temperature Cycling	1010 Condition C	100%
Constant Acceleration	2001 Condition E (min) in Y_1 Plane	100%
Seal Fine & Gross	1014, Conditions B & C	100%
Interim Electrical	Per SMD/DESC specification	Optional
Burn-In Test	1015 160 hours @ 125°C or equivalent	100%
Final Electrical Tests (A) Static Tests (1) 25°C (Subgroup 1, Table 1, 5005) (2) Max & min rated op temperature (Subgroups 2 & 3, Table 1, 5005) (B) Dynamic Test or Switching Tests 25°C (Subgroup 4 or 9, Table 1, 5005) (C) Functional Test 25°C (Subgroup 7, Table 1, 5005)	Standard military drawing specification	 100% 100% 100% 100%
Quality Conformance Inspection: Group A (A) Static (1) 25°C (Subgroup 1) (2) Temp. (Subgroup 2 & 3) (B) Dynamic & Switching Tests (1) 25°C (Subgroup 4 or 9) (2) Temp. (Subgroup 5 & 6 or 10 & 11) (C) Functional (1) 25°C (Subgroup 7)	5005 Class B	
Group B	5005 Class B	
Group C	5005 Class B	
Group D	5005 Class B	
External Visual	2009	100%

MIL-M-38510(JAN) Flow

SCREEN	METHOD	REQUIREMENT
Internal Visual (Precap)	2010 Condition B and 38510	100%
Stabilization Bake	1008 24 hours min. Condition C or equivalent	100%
Temperature Cycling	1010 Condition C	100%
Constant Acceleration	2001 Condition E (min) in Y_1 Plane	100%
Seal Fine & Gross	1014, Conditions B & C	100%
Interim Electrical	JAN slash sheet electrical specification	Optional
Burn-In Test	1015 160 hours @ 125°C or equivalent	100%
Final Electrical Tests (A) Static Tests (1) 25°C (Subgroup 1, Table 1, 5005) (2) Max & min rated op temperature (Subgroups 2 & 3, Table 1, 5005) (B) Dynamic Test or Switching Tests 25°C (Subgroup 4 or 9, Table 1, 5005) (C) Functional Test 25°C (Subgroup 7, Table 1, 5005)	JAN slash sheet electrical specifications	100% 100% 100% 100%
Quality Conformance Inspection: Group A (A) Static (1) 25°C (Subgroup 1) (2) Temp. (Subgroup 2 & 3) (B) Dynamic & Switching Tests (1) 25°C (Subgroup 4 or 9) (2) Temp. (Subgroup 5 & 6 or 10 & 11) (C) Functional (1) 25°C (Subgroup 7)	5005 Class B	
Group B	5005 Class B	
Group C	5005 Class B	26 wks. prod.
Group D	5005 Class B	38 wks. pkg. prod.
External Visual	2009	100%

MIL-STD-883 Flow

SCREEN	METHOD	REQUIREMENT
Internal Visual (Precap)	2010 Condition B and 38510	100%
Stabilization Bake	1008 24 hours min. Condition C or equivalent	100%
Temperature Cycling	1010 Condition C	100%
Constant Acceleration	2001 Condition E (min) in Y_1 Plane	100%
Seal Fine & Gross	1014, Conditions B & C	100%
Interim Electrical	Per applicable device specification	Optional
Burn-In Test	1015 160 hours @ 125°C or equivalent	100%
Final Electrical Tests (A) Static Tests (1) 25°C (Subgroup 1, Table 1, 5005) (2) Max & min rated op temperature (Subgroups 2 & 3, Table 1, 5005) (B) Dynamic Test or Switching Tests 25°C (Subgroup 4 or 9, Table 1, 5005) (C) Functional Test 25°C (Subgroup 7, Table 1, 5005)	Per applicable device specification	100% 100% 100% 100%
Quality Conformance Inspection: Group A (A) Static (1) 25°C (Subgroup 1) (2) Temp. (Subgroup 2 & 3) (B) Dynamic & Switching Tests (1) 25°C (Subgroup 4 or 9) (2) Temp. (Subgroup 5 & 6 or 10 & 11) (C) Functional (1) 25°C (Subgroup 7)	5005 Class B	
Group B	5005 Class B	
Group C	5005 Class B	
Group D	5005 Class B	
External Visual	2009	100%

STANDARD MILITARY PRODUCT MARKING

MINIMUM MARKING REQUIREMENT: All Motorola standard military product receives the following marking:

1. Motorola Symbol (logo): Example — Ⓜ
2. Seal Date Code (per MIL-M-38510): Example — 8511
3. ESD Identifier, Equilateral Triangle: Example — Δ
4. Device Part Number.
5. Index Point (defines starting point for numbering leads and/or mechanical orientation and shall consist of either a pin 1 dot, package notch or a dog-leg on pin 1 terminal).
6. Motorola's manufacturer's designating symbol CGG per NAV-SHIPS 0967-190-4010.*
7. If package material contains beryllium oxide, the part is marked with the designator "BeO."

*CGG not marked on can packages

ADDITIONAL MARKING:
JEDEC product also receives the following marking:

a. Multiple part numbers (when applicable) as defined below:
   — MOTOROLA JEDEC part number
   — DESC DRAWING part number (if applicable).
b. Country of Origin (marked on backside of CERDIP, CERFLAT, and LCCC package types and on the side or bottom of "Metal Can" packages).
   NOTE: A unique prefix code may be added to the Inspection Lot Identification Code (seal date) which identifies the country of origin for both assembly and test. See table below.
c. "883" MIL-STD-883 General Provisions paragraph 1.2.1 compliance marking.

LOCATOR CODES FOR ASSEMBLY OR TEST

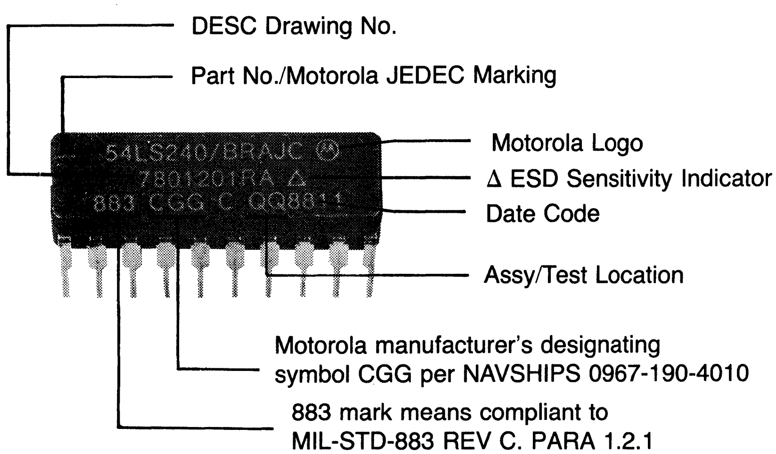
D — Austin, TX
E — Oakhill, TX
I — Anam, Korea (Contractor)
K — Seoul, Korea (MKL)
L — Hong Kong
M — Mesa, AZ
Q — Kuala Lumpur, Malaysia (KLM)
R — Seremban, Malaysia
T — France
W — Guadalajara, Mexico
Y — Tempe, AZ
Z — Scotland

The prefix letter closest to the date code is the Test Location Code. The letter to the left of the Test Location Code is the Assembly Location Code.

Example:

K Y 85XX B

- B — Lot Designator
- 85XX — Seal Date Code
- Y — Test Location — Tempe, Arizona
- K — Assembly Location — Seoul, Korea



Motorola MIL-STD-883C Program Components

The following table lists all current Motorola integrated circuits qualified to MIL-STD-883C specifications. Equivalent DESC SMD Drawings and JAN QPL products available from Motorola are also indicated. A numeric listing of Motorola DESC SMD products and JAN QPL products, cross-referenced to MIL-STD-883C type numbers, appears on pages 19 and 20, respectively.

The Case Suffix column in the subsequent table indicates the available packages for each of the devices. For proper parts identification, simply replace the dash (-) in the Suffix with the code for the desired package, as indicated in the column. The M shown at the end of the basic part number must be used if, and only if, the part is to be ordered in the LCC package defined by the Case Suffix Codes "2" and "U".

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Microprocessors and Peripherals

8-Bit

68HC11	Q	8-Bit Microcomputer (A0, A1, A2 — Non-ROM options)		
6800	Q	8-Bit Microprocessor		
6802	Q	8-Bit Microprocessor with Clock and Optional RAM		
6809	Q	8-Bit Microprocessor with Clock		
6810	Q	128 x 8-Bit Static RAM		
6821	Q	Peripheral Interface Adapter		
6840	X	Programmable Timer		
6844	Q	8-Bit Microprocessor		
6845	Q	CRT Controller		
68488	Q	8-Bit Microprocessor, GPIA		
6850	J	Asynchronous Communication Interface Adapter		
6852	J	Synchronous Serial Data Adapter		
6854	X	Data Link Controller		

16/32-Bit

68000-10	X, U, Z	16-Bit External/32-Bit Internal MPU (10 MHz)	8202103	
68000-10T	U	16-Bit External/32-Bit Internal MPU (10 MHz) with Thermal Pad Option	8202103	
68000-8	X, U, Z	16-Bit External/32-Bit Internal MPU (8 MHz)	8202102	
68000-8T	U	16-Bit External/32-Bit Internal MPU (8 MHz) with Thermal Pad Option	8202102	
68020-16	U, Z	32-Bit External & Internal HCMOS Virtual Memory MPU	8603202	
68020-20	U, Z	32-Bit External & Internal HCMOS Virtual Memory MPU	8603203	
68030	**	Enhanced 32-Bit MPU		
68230	**	Parallel Interface Timer		
68881-16	U, Z	Floating Point Co-Processor	8602102	
68881-20	U, Z	Floating Point Co-Processor	8602103	
68901	**	Multifunction Peripheral (Mostek Design)		

Logic

Advanced Low Power Schottky (54ALSXX)

54ALS00(M)	C, D, 2	Quad 2-Input NAND Gate	8683301	
54ALS04(M)	C, D, 2	Hex Inverter	8684301	
54ALS08(M)	C, D, 2	Quad 2-Input AND Gate		
54ALS138(M)	E, F, 2	1-to-8 Decoder/Multiplexer		
54ALS139(M)	E, F, 2	Dual 1-of-4 Decoder/Demultiplexer	8768301	
54ALS161(M)	E, F, 2	4-Bit Binary Counter, Asynchronous	8302201	
54ALS163(M)	E, F, 2	4-Bit Binary Counter, Synchronous Reset	8302202	
54ALS32(M)	C, D, 2	Quad 2-Input OR Gate		
54ALS573(M)	R, S, 2	Octal Transparent Latch, 3-State	8401201	
54ALS574(M)	R, S, 2	Octal D Flip-Flop, 3-State	8400101	

**Pending

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

FAST (54FXX)

54F00(M)	C, D, 2	Quad 2-Input NAND Gate		33001
54F02(M)	C, D, 2	Quad 2-Input NOR Gate		33301
54F04(M)	C, D, 2	Hex Inverter		33002
54F08(M)	C, D, 2	Quad 2-Input AND Gate		34001
54F10(M)	C, D, 2	Triple 3-Input NAND Gate		33003
54F109(M)	E, F, 2	Dual JK Flip-Flop with Preset		34102
54F11(M)	C, D, 2	Triple 3-Input AND Gate		34002
54F112	**	Dual J-K Flip-Flop		
54F113	**	Dual J-K Flip-Flop		
54F114	**	Dual J-K Flip-Flop		
54F125(M)	C, D, 2	Quad Buffer, 3-State, Enable-LO		
54F126(M)	C, D, 2	Quad Buffer, 3-State, Enable-HI		
54F13(M)	C, D, 2	Dual 4-Input NAND Schmitt Trigger		
54F132(M)	C, D, 2	Quad 2-Input NAND Schmitt Trigger		
54F138(M)	E, F, 2	1-of-8 Decoder/Demultiplexer		33701
54F139(M)	E, F, 2	Dual 1-of-4 Decoder/Demultiplexer		33702
54F148(M)	**	8-Line to 3-Line Priority Encoder		
54F151(M)	E, F, 2	8-Input Multiplexer		33901
54F153(M)	E, F, 2	Dual 4-Input Multiplexer		33902
54F157A(M)	E, F, 2	Quad 2-Input Multiplexer		33903
54F158A(M)	E, F, 2	Quad 2-Input Multiplexer, Inverting		
54F160A(M)	D, F, 2	BCD Decade Counter, Asynchronous Reset		
54F161A(M)	D, F, 2	4-Bit Binary Counter, Asychronous Reset		
54F162A(M)	D, F, 2	BCD Decade Counter, Synchronous Reset		
54F163A(M)	D, F, 2	4-Bit Binary Counter, Synchronous Reset		34302
54F164	C, D	8-Bit Serial-In Parallel-Out Shift Register		
54F168(M)	E, F, 2	Up/Down Decade Counter		
54F169(M)	E, F, 2	Up/Down Binary Counter		
54F174(M)	E, F, 2	Hex D Flip-Flop		34107
54F175(M)	E, F, 2	Quad D Flip-Flop		34104
54F181	E, F	4-Bit ALU		
54F182(M)	E, F, 2	Look-Ahead Carry Generator		33802
54F190	**	Up/Down Decade Counter		
54F191	**	Up/Down Binary Counter		
54F192	**	Up/Down Decade Counter w/Clear		
54F193	**	Up/Down Binary Counter w/Clear		
54F194	**	Universal Shift Register		33601
54F195	**	4-Bit Shift Register		
54F20(M)	C, D, 2	Dual 4-Input NAND Gate		33004
54F21	**	Dual 4-Input AND Gate		
54F219A	**	64-Bit RAM/3-State		
54F240(M)	R, S, 2	Octal Buffer/Line Driver/Inverting/3-State		33201
54F241(M)	R, S, 2	Octal Buffer/Line Driver, 3-State	8687401	33202
54F242(M)	C, D, 2	Quad Bus Transceiver/Inverting/3-State		
54F243(M)	C, D, 2	Quad Bus Transceiver/Non-Inverting/3-State	8683401	34802
54F244(M)	R, S, 2	Quad Buffer Driver/Non-Inverting/3-State		33203
54F245(M)	R, S, 2	Octal Bus Transceiver	8551101	34803
54F251(M)	E, F, 2	8-Input Multiplexer/3-State		33905
54F253(M)	E, F, 2	Dual 4-Input Multiplexer/3-State		33908
54F256	**	Dual 4-Bit Addressable Latch		
54F257(M)	E, F, 2	Quad 2-Input Multiplexer/3-State		
54F257A(M)	E, F, 2	Quad 2-Input Multiplexer/3-State		33906
54F258(M)	E, F, 2	Quad 2-Input Multiplexer/Inverting/3-State		
54F258A(M)	E, F, 2	Quad 2-Input Multiplexer/Inverting/3-State		33907
54F259	**	8-Bit Addressable Latch		

**Pending

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

FAST (54XX) (Continued)

54F260	**	Dual 5-Input NOR Gate		
54F269	**	8-Bit Bi-Directional Binary Counter		
54F27	**	Triple 3-Input NOR Gate		
54F273	**	Octal D-Type Flip-Flop w/Clear		
54F280(M)	C, D, 2	9-Bit Odd/Even Parity Generator/Checker		34901
54F283(M)	E, F, 2	4-Bit Full Adder		34201
54F289	**	64-Bit RAM, Open-Controller		
54F299	**	8-Bit Shift/Store Register		
54F30	**	8-Input NAND Gate		
54F32(M)	C, D, 2	Quad 2-Input OR Gate		33501
54F323	**	8-Bit Universal Shift/Storage Register		
54F350	**	4-Bit Shifter/3-State		
54F352(M)	E, F, 2	Dual 4-Input Multiplexer		33909
54F353(M)	E, F, 2	Dual 4-Input Multiplexer/3-State		33910
54F365(M)	E, F, 2	Hex 3-State Buffer, 2-Bit/4-Bit		
54F366(M)	E, F, 2	Hex 3-State Inverter Buffer, 2-Bit/4-Bit		
54F367(M)	E, F, 2	Hex 3-State Buffer		
54F368(M)	E, F, 2	Hex 3-State Inverter Buffer		
54F373(M)	R, S, 2	Octal Transparent Latch/3-State		34601
54F374(M)	R, S, 2	Octal D Flip-Flop/3-State		34105
54F377	**	Octal D-Type Flip-Flop w/Enable		
54F378(M)	E, F, 2	Hex Parallel D Register with Enable		34108
54F379(M)	E, F, 2	Quad Parallel Register with Enable		34109
54F38	**	NAND Buffer (O/C)		
54F381(M)	R, S, 2	4-Bit ALU	8671001	33803
54F382(M)	R, S, 2	4-Bit ALU		33804
54F398(M)	R, S, 2	Quad 2-Port Register		
54F399(M)	E, F, 2	Quad 2-Port Register		35002
54F51	**	Dual 2-Wide, 2-Input/3-Input AOI Gate		
54F521(M)	R, S, 2	Octal Comparator		
54F524	**	8-Bit Register Comparator		
54F533(M)	R, S, 2	Octal Transparent Latch/3-State		34602
54F534(M)	R, S, 2	Octal D Flip-Flop/3-State		34106
54F568(M)	R, S, 2	Decade Up/Down Counter/3-State		
54F569(M)	R, S, 2	Binary Up/Down Counter/3-State		
54F573	**	Octal Transparent Latch, 3-State		
54F574	**	Octal D-Type Flip-Flop, 3-State		
54F64(M)	C, D, 2	4-2-3-2 Input AND-OR-INVERT Gate		33401
54F74(M)	C, D, 2	Dual D Flip-Flop		34101
54F85	**	4-Bit Magnitude Comparator		
54F86(M)	C, D, 2	Quad EX/OR Gate		34501

Low Power Schottky (54LSXX)

54LS00(M)	C, D, 2	Quad 2-Input NAND Gate		33001
54LS01(M)	C, D, 2	Quad 2-Input NAND Gate, Open-Collector		
54LS02(M)	C, D, 2	Quad 2-Input NOR Gate		30301
54LS03(M)	C, D, 2	Quad 2-Input NAND Gate, Open-Collector		30002
54LS04(M)	C, D, 2	Hex Inverter		30003
54LS05(M)	C, D, 2	Hex Inverter, Open Collector		30004
54LS08(M)	C, D, 2	Quad 2-Input AND Gate		31004
54LS09(M)	C, D, 2	Quad 2-Input AND Gate, Open Collector	8001901	31005
54LS10(M)	C, D, 2	Triple 3-Input NAND Gate		30005
54LS107A(M)	C, D, 2	Dual JK Flip-Flop with Clear		30108
54LS109A(M)	C, D, 2	Dual JK Flip-Flop with Preset		30109
54LS11(M)	C, D, 2	Triple 3-Input AND Gate		31001

**Pending

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

Low Power Schottky (54LSXX) (Continued)

54LS112A(M)	E, F, 2	Dual JK Edge-Triggered Flip-Flop		30103
54LS113A(M)	C, D, 2	Dual JK Edge-Triggered Flip-Flop		30104
54LS114A(M)	C, D, 2	Dual JK Edge-Triggered Flip-Flop		30105
54LS12(M)	C, 2	Triple 3-Input NAND Gate, Open-Collector		30006
54LS122(M)	C, D, 2	Retriggerable Monostable Multivibrator	7600301	31403
54LS123(M)	E, F, 2	Dual Retriggerable Monostable Multivibrator	7603901	31401
54LS125A(M)	C, D, 2	Quad Buffer, Low Enable, 3-State		32301
54LS126A(M)	C, D, 2	Quad Buffer, High Enable, 3-State		32302
54LS13(M)	C, 2	Dual 4-Input Schmitt Trigger		31301
54LS132(M)	C, 2	Quad 2-Input Schmitt Trigger	7600401	31303
54LS133(M)	E, F, 2	13-Input NAND Gate		
54LS136	C	Quad Exclusive OR Gate, Open-Collector		
54LS138(M)	E, F, 2	1-of-8 Decoder/Multiplexer	7600501	30701
54LS139(M)	E, F, 2	Dual 1-of-4 Decoder/Multiplexer	7600701	30702
54LS14(M)	C, D, 2	Hex Schmitt Trigger		31302
54LS151(M)	E, F, 2	8-Input Multiplexer	7601001	30901
54LS153(M)	E, F, 2	Dual Input Multiplexer	7601101	30902
54LS155(M)	E, F, 2	Dual 1-to-4 Decoder		32601
54LS156(M)	E, F, 2	Dual 1-to-4 Decoder, Open-Collector		32602
54LS157(M)	E, F, 2	Quad 2-Input Multiplexer, Noninverting	7600201	30903
54LS158(M)	E, F, 2	Quad 2-Input Multiplexer, Inverting	7603301	30904
54LS160A(M)	E, F, 2	BCD Decade Counter, Asynchronous Reset (9310 Type)	7700901	31503
54LS161A(M)	E, F, 2	4-Bit Binary Counter, Asynchronous Reset (9316 Type)	7600801	31504
54LS162A(M)	E, F, 2	BCD Decade Counter, Synchronous Reset		31511
54LS163A(M)	E, F, 2	4-Bit Binary Counter, Synchronous Reset	7603401	31512
54LS164(M)	C, D, 2	8-Bit Serial-In/Parallel-Out Shift Register		30605
54LS165A(M)	E, F, 2	8-Bit Parallel-In/Serial-Out Shift Register	7700601	30608
54LS166A(M)	E, F, 2	8-Bit Parallel-In/Serial-Out Shift Register	8001701	30609
54LS168	E	Up/Down Decade Counter		31505
54LS169(M)	E, F, 2	Up/Down Binary Counter		
54LS170(M)	E, F, 2	4 x 4 Register File, Open Collector	8002501	
54LS173(M)	E, 2	4-Bit D Register, 3-State		
54LS174(M)	E, F, 2	Hex D Flip-Flop with Clear		30106
54LS175(M)	E, F, 2	Quad D Flip-Flop with Clear		30107
54LS181	J, K	4-Bit ALU		30801
54LS190(M)	E, F, 2	Up/Down Decade Counter	7603501	31513
54LS191(M)	E, F, 2	Up/Down Binary Counter	7600901	31509
54LS192(M)	E, F, 2	Up/Down Decode Counter with Clear	7603601	31507
54LS193(M)	E, F, 2	Up/Down Binary Counter with Clear	7600601	31508
54LS194A(M)	E, F, 2	4-Bit Right/Left Shift Register		30601
54LS195A(M)	E, F, 2	4-Bit Shift Register (9300 Type)		30602
54LS196	C	Decade Counter, Asynchronously Presettable		
54LS197	C	4-Bit Binary Counter, Asynchronously Presettable		
54LS20(M)	C, D, 2	Dual 4-Input NAND Gate		30007
54LS21(M)	C, D, 2	Dual 4-Input AND Gate		31003
54LS22	C	Dual 4-Input NAND Gate, Open Collector		30008
54LS221(M)	E, F, 2	Dual One-Shot (Very Stable)	7604201	31402
54LS240(M)	R, S, 2	Octal Bus/Line Driver, Inverting 3-State	7801201	32401
54LS241(M)	R, S, 2	Octal Bus/Line Driver, 3-State		32402
54LS242	C	Quad Bus Transceiver, Inverting, 3-State	8002001	32801
54LS243	C	Quad Bus Transceiver, Non-Inverting, 3-State	8002002	32802
54LS244(M)	R, S, 2	Octal Driver, Noninverting, 3-State	7705701	32403
54LS245(M)	R, S, 2	Octal Bus Transceiver, Noninverting, 3-State	8002101	32803
54LS251	E, F	8-Input Multiplexer, 3-State	7601601	30905
54LS253	E, F	Dual 4-Input Multiplexer, 3-State	7601701	30908

Logic

Low Power Schottky (54LSXX) (Continued)

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
54LS256	E	Dual 4-Bit Addressable Latch		
54LS257A(M)	E, F, 2	Quad 2-Input Multiplexer, Noninverting, 3-State	7603701	30906
54LS258A(M)	E, F, 2	Quad 2-Input Multiplexer, Inverting, 3-State	7603801	30907
54LS259(M)	E, F, 2	8-Bit Addressable Latch (9334)		31603
54LS26(M)	C, E, 2	Quad 2-Input NAND, High Voltage	7602001	32102
54LS266(M)	C, D, 2	Quad Exclusive NOR Gate, Open-Collector		30303
54LS27(M)	C, D, 2	Triple 3-Input NOR Gate		30302
54LS273(M)	R, S, 2	Octal D Flip-Flop with Clear	7801001	32501
54LS279(M)	E, F, 2	Quad Set/Reset Latch	7601801	31602
54LS28(M)	C, 2	Quad 2-Input NOR Buffer		30204
54LS280(M)	C, D, 2	9-Bit Odd/Even Parity Generator/Checker		32901
54LS283(M)	E, F, 2	4-Bit Full Adder (Rotated LS83A)	7604301	31202
54LS290(M)	C, D, 2	Decade Counter (Divide by 2 and 5)		32003
54LS293(M)	C, D, 2	4-Bit Binary Counter		32004
54LS295B(M)	C, D, 2	4-Bit Shift Register, 3-State		
54LS298(M)	E, F, 2	Quad 2-Multiplexer, with Output Register	7601901	30909
54LS30(M)	C, D, 2	8-Input NAND Gate		30009
54LS32(M)	C, D, 2	Quad 2-Input OR Gate		30501
54LS33(M)	C, D, 2	Quad 2-Input NOR Buffer, Open Collector		
54LS365A(M)	E, F, 2	Hex Buffer, Common Enable, 3-State		32201
54LS366A(M)	E, F, 2	Hex Inverter, Common Enable, 3-State		32202
54LS367A(M)	E, F, 2	Hex Buffer, 4-Bit and 2-Bit, 3-State		32203
54LS368A(M)	E, F, 2	Hex Inverter, 4-Bit and 2-Bit, 3-State		32204
54LS37(M)	C, D, 2	Quad 2-Input NAND Buffer		30202
54LS373(M)	R, S, 2	Octal Transparent Latch, 3-State		32502
54LS374(M)	R, S, 2	Octal D Flip-Flop	7801101	32503
54LS375(M)	E, 2	Quad Latch		31604
54LS377(M)	R, S, 2	Octal D Flip-Flop with Enable		32504
54LS378(M)	C, F, 2	Hex D Flip-Flop with Enable		
54LS38(M)	C, D, 2	Dual 4-Input NAND Buffer		30203
54LS390(M)	C, D, 2	Dual Decade Counter	7802601	
54LS393(M)	C, D, 2	Dual 4-Bit Binary Counter		32702
54LS398	R	Quad 2-Input Multiplexer with Output Register		
54LS399(M)	E, F, 2	Quad 2-Input Multiplexer with Output Register	8415401	
54LS40(M)	C, 2	Dual 4-Input NAND Buffer		30201
54LS42(M)	E, F, 2	1-of-10 Decoder	7603101	30703
54LS47(M)	E, F, 2	BCD to 7-Segment Decoder/Driver, Open Collector	7604501	30704
54LS51(M)	C, D, 2	Dual AND-OR-INVERT Gate		30401
54LS54(M)	C, D, 2	3-2-2-3 Input AND-OR-INVERT Gate		30402
54LS55	C	2-Wide 4-Input AND-OR-INVERT Gate		
54LS569(M)	R, S, 2	Binary Up/Down Conter, 3-State		
54LS645(M)	R, S, 2	Octal Bus Transceiver, Noninverting, 3-State		
54LS670(M)	E, F, 2	4 x 4 Register File, 3-State	7704201	31901
54LS716(M)	E, F, 2	Programmable Modulo-N Counter		
54LS718(M)	E, F, 2	Programmable Modulo-N Counter		
54LS719(M)	E, F, 2	Programmable Modulo-N Counter		
54LS73A(M)	C, D, 2	Dual JK Flip-Flop		30101
54LS74A(M)	C, D, 2	Dual D Flip-Flop		30102
54LS75(M)	E, F, 2	4-Bit Bi-Stable Latch with Q and Q	7601201	31601
54LS76A(M)	E, F, 2	Dual JK Flip-Flop	7601301	30110
54LS77	C	4-Bit Bi-Stable Latch		
54LS78A	C	Dual JK Flip-Flop with Reset		
54LS83A(M)	E, F, 2	4-Bit Full Adder	7601401	31201
54LS85(M)	E, F, 2	4-Bit Magnitude Comparator		31101
54LS86(M)	C, D, 2	Quad Exclusive OR Gate		30502

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

Low Power Schottky (54LSXX) (Continued)

54LS90(M)	C, D, 2	Decade Counter	7603201	31501
54LS92(M)	C, D, 2	Divide-by-12 Counter		31510
54LS93(M)	C, D, 2	4-Bit Binary Counter	7700101	31502
54LS95B(M)	C, D, 2	4-Bit Shift Register		30603

MECL 10KH (10HXXX)

10H416(M)	E, F, 2	Binary Counter	8759001	
10H500(M)	E, F, 2	Quad 2-Input NOR Gate with Strobe		
10H501(M)	E, F, 2	Quad OR/NOR	8750301	
10H502(M)	E, F, 2	Quad 2-Input NOR Gate	8755701	
10H503(M)	E, F, 2	Quad 2-Input OR Gate	8756501	
10H504(M)	E, F, 2	Quad AND Gate	8750401	
10H505(M)	E, F, 2	Triple 2-3-2 Input OR/NOR Gate	8750701	
10H506(M)	E, F, 2	Triple 4-3-3 Input NOR Gate	8756401	
10H507(M)	E, F, 2	Triple Exclusive OR/NOR Gate	8772701	
10H509(M)	E, F, 2	Dual 4-5 Input OR/NOR Gate		
10H513(M)	E, F, 2	Quad Exclusive OR Gate	8755801	
10H514	**	Triple Line Receiver		
10H515(M)	E, F, 2	Quad Line Receiver	8750101	
10H516(M)	E, F, 2	Triple Line Receiver	8750201	
10H517(M)	E, F, 2	Dual 2-Wide OR-AND/OR-AND INVERT		
10H518(M)	E, F, 2	Dual 2-Wide 3-Input OR/AND Gate	8755901	
10H519(M)	E, F, 2	4-Wide 4-3-3-3 Input OR-AND Gate	8772801	
10H521(M)	E, F, 2	4-Wide OR-AND/OR-AND INVERT Gate	8773001	
10H523	**	Quad TTL-to-MECL Translator		
10H524(M)	E, F, 2	Quad TTL-to-MECL Translator	8756001	
10H525(M)	E, F, 2	Quad MECL-to-TTL Translator	8750801	
10H530(M)	E, F, 2	Dual D Latch		
10H531(M)	E, F, 2	Dual D Master Slave Flip-Flop	8756101	
10H535(M)	E, F, 2	Dual J-K Master Slave Flip-Flop	8750501	
10H536(M)	E, F, 2	Universal Hexadecimal Counter	8700101	
10H541(M)	E, F, 2	4-Bit Universal Shift Register	8751101	
10H545	**	16 x 4 Register File		
10H555	**	8 x 2 Bit Content Addressable Memory		
10H558(M)	E, F, 2	Quad 2-Input Multiplexer (Noninverting)	8756601	
10H559(M)	E, F, 2	Quad 2-Input Multiplexer (Inverting)		
10H560(M)	E, F, 2	12-Bit Parity Generator-Checker	8756201	
10H561(M)	E, F, 2	Binary to 1-8 Line Decoder (Low)	8756701	
10H562	**	Binary to 1-8 Line Decoder (High)		
10H564(M)	E, F, 2	8-Line Multiplexer	8772901	
10H571(M)	E, F, 2	Dual 4-Line Decoder (Low)	8756801	
10H573	**	Quad 2-Input Multiplexer Latch		
10H574(M)	E, F, 2	Dual 4-1 Multiplexer	8750601	
10H575	**	Quint Latch		
10H576(M)	E, F, 2	Hex D Flip-Flop	8751201	
10H579(M)	E, F, 2	Look Ahead Carry Block		
10H580(M)	E, F, 2	Dual High Speed Adder/Subtractor		
10H581	J, K	4-Bit ALU		
10H586A(M)	E, F, 2	Hex D Flip-Flop with Enable	8756301	
10H588	E	Hex Buffer with Enable	8750901	
10H589(M)	E, F, 2	Hex Inverter with Enable	8751001	
10H609(M)	E, F, 2	Dual 4-5 Input OR/NOR Gate	8756901	
10H610(M)	E, F, 2	Dual 3-Input 3-Output OR Gate	8754101	
10H616(M)	E, R, 2	High Speed Triple Line Receiver		
10H624	**	Quad TTL-to-MECL Translator (ECL Strobe)		

**Pending

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

MECL 10KH (10HXXX) (Continued)

10H630	**	Quad Bus Driver/Receiver w/2-to-1 Output MUX		
10H632	**	Dual Bus Driver/Receiver w/4-to-1 Output MUX		
10H634	**	Quad Bus Driver/Receiver w/Transmit and RCVP Latches		
10H650	**	Quad MECL-to-TTL Translator Single Power Sup. (−5.2 V or +5.0 V)		
10H701	**	2-4 & 1-2 Input Exclusive OR Gates		
10H702	**	2-4 OR 1-6 & 1-4 Input Exclusive OR Gates		
10H703	**	2-5 Input Exclusive OR Gates		
10H704	**	1-8 OR 2-4 Input Exclusive OR Gates		
10H730	**	Quad Bus Transceiver w/2-1 Output MUX		
10H734	**	Quad Bus X-ceiver w/X-MIT & Rec Latches		
10H750(M)	E, F, 2	ECL-to-TTL Translator (Quad)		
10H751	**	Octal Translator		
10H823	**	Triple 3-Input Bus Driver w/Enable		
10H824(M)	E, F, 2	Quad TTL-to-MECL Translator		

MECL 10K (105XX & 106XX)

10500(M)	E, F, 2	Quad NOR Gate with Strobe		
10501(M)	E, F, 2	Quad OR/NOR Gate		06001
10502(M)	E, F, 2	Quad NOR Gate		06002
10503(M)	E, F, 2	Quad 2-Input OR Gate		
10504(M)	E, F, 2	Quad AND Gate		06201
10505(M)	E, F, 2	Triple 2-3-2 OR/NOR Gate		06003
10506(M)	E, F, 2	Triple 4-3-3 NOR Gate		06004
10507(M)	E, F, 2	Triple Exclusive OR/NOR Gate		06005
10509(M)	E, F, 2	Dual 4-5 Input OR/NOR Gate		06006
10513(M)	E, F, 2	Quad Exclusive OR Gate		
10514(M)	E, F, 2	Triple Line Receiver		
10515(M)	E, F, 2	Quad Line Receiver		
10516(M)	E, F, 2	Triple Line Reciever	7800901	
10517(M)	E, F, 2	Dual 2-Wide OR-AND/OR-AND-INVERT Gate		
10518(M)	E, F, 2	Dual 2-Wide 3-Input OR-AND Gate		
10519(M)	E, F, 2	4-Wide 4-3-3-3-Input OR-AND Gate		
10521(M)	E, F, 2	4-Wide OR-AND/OR-AND-INVERT Gate		
10523(M)	E, F, 2	Triple 4-4-3 Input Bus Driver		
10524(M)	E, F, 2	Quad TTL-to-MECL Translator		06301
10525(M)	E, F, 2	Quad MECL-to-TTL Translator		06302
10530(M)	E, F, 2	Dual D Latch		
10531(M)	E, F, 2	Dual D Flip-Flop		06101
10533(M)	E, F, 2	Quad Latch		
10535(M)	E, F, 2	Dual J-K Master-Slave Flip-Flop		06104
10536(M)	E, F, 2	Universal Binary Counter		
10537(M)	E, F, 2	Universal Decade Counter		
10538(M)	E, F, 2	Bi-Quinary Counter		
10539(M)	E, F, 2	32 x 8 Bit PROM		
10541(M)	E, F, 2	4-Bit Universal Shift Register		
10545(M)	E, F, 2	64-Bit Register File (RAM)		
10549(M)	E, F, 2	1024 Bit PROM		
10552(M)	E, F, 2	256 x 1 Bit RAM		
10553(M)	E, F, 2	Quad Latch (Negative Clock)		
10558(M)	E, F, 2	Quad 2-Input Multiplexer (Noninverting Output)		
10559(M)	E, F, 2	Quad 2-Input Multiplexer (Inverting Output)		
10560(M)	E, F, 2	12-Bit Party Generator/Checker		
10561(M)	E, F, 2	Binary to 1-8 Line Decoder (Low)		

**Pending

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

MECL 10K (105XX & 106XX) (Continued)

10562(M)	E, F, 2	Binary to 1-8 Line Decoder (High)		
10563(M)	E, F, 2	Error Detection/Correction Ckt. (IBM Pattern)		
10564(M)	E, F, 2	8-Line Multiplexer		
10565(M)	E, F, 2	Priority Encoder		
10566(M)	E, F, 2	5-Bit Comparator		
10568(M)	E, F, 2	Quad Latch (Common Clock)		
10570(M)	E, F, 2	9 + 2-Bit Parity Checker		
10571(M)	E, F, 2	Dual 4-Line Decoder (Low)		
10572(M)	E, F, 2	Dual 4-Line Decoder (High)		
10573(M)	E, F, 2	Quad 2-Input MUX/Latch		
10574(M)	E, F, 2	Dual 4-to-1 Multiplexer		
10575(M)	E, F, 2	Quint Latch		
10576(M)	E, F, 2	Hex D Flip-Flop		06103
10578(M)	E, F, 2	Binary Counter		
10579(M)	E, F, 2	Look Ahead Carry Block		
10580(M)	E, F, 2	Dual High-Speed Adder/Subtractor		
10581	J, K	4-Bit Arithmetic Logic Unit		
10582(M)	E, F, 2	16-Pin 2-Bit ALU		
10586(M)	E, F, 2	Hex D Flip-Flop with Common Reset		
10590(M)	E, F, 2	Quad IBM-toMECL Translator		
10591(M)	E, F, 2	Hex MECL-to-IBM Translator		
10592	**	Quad Bus Driver		
10593(M)	E, F, 2	Error Detection/Correction Ckt. (Motorola Pattern)		
10594(M)	E, F, 2	Dual Simultaneous Bus Transceiver		
10595(M)	E, F, 2	Hex Inverter/Buffer		
10597(M)	E, F, 2	Hex AND Gate		06202
10598(M)	E, F, 2	Monostable Multivibrator		
10610(M)	E, F, 2	High Speed Dual 3-Input/3-Output OR Gate		
10611(M)	E, F, 2	High Speed Dual 3-Input/3-Output NOR Gate		
10612(M)	E, F, 2	High Speed Dual 2-NOR/1-OR Gate		
10616(M)	E, F, 2	High Speed Dual Triple Line Receiver		
10631(M)	E, F, 2	High Speed Dual D Flip-Flop		06102
10687(M)	E, F, 2	High Speed 2-Bit Multiplier		

MECL III (16XX) (T_A = −30°C to +85°C)

1648(M)	C, A, 2	Voltage Controlled Oscillator (−55°C to +125°C)		
1650	E, F	Dual A/D Converter		
1651	E, F	Dual A/D Converter		
1654	E, F	Binary Counter		
1660	E, F	Dual 4-Input Gate		
1662	E, F	Quad 2-Input NOR Gate		
1664	E, F	Quad 2-Input OR Gate		
1668	E, F	Dual Clocked Latch		
1670	E, F	Master-Slave Flip-Flop		
1672	E, F	Triple 2-Input Exclusive OR Gate		
1674	E, F	Triple 2-Input Exclusive-NOR Gate		
1690	E, F	UHF Prescaler D Flip-Flop		
1692	E, F	Quad Line Receiver		

Proprietary TTL (43XX)

4319	E, F	(See 54LS719)		
4324	C, A	Dual Voltage-Controlled Multivibrator		
4344	C, A	Phase-Frequency Detector		

**Pending

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

Metal Gate CMOS (14XXXX)

14000A	C	Dual 3-Input NOR Gate Plus Inverter		
14001A	C	Quad 2-Input NOR Gate		
14001B	C	Quad 2-Input NOR Gate		
14002A	C	Dual 4-Input NOR Gate		
14002B	C	Dual 4-Input NOR Gate		
14006B	C	18-Bit Static Shift Register		
14007B	C	Dual Complementary Pair plus Inverter		
14008B	E	4-Bit Full Adder		
14011A	C	Quad 2-Input NAND Gate		
14011B	C	Quad 2-Input NAND Gate		
14012A	C	Dual 4-Input NAND Gate		
14012B	C	Dual 4-Input NAND Gate		
14013B	C	Dual D Flip-Flop		
14014B	E	8-Bit Static Shift Register		
14015B	E	Dual 4-Bit Static Shift Register		
14016B	C	Quad Analog Switch/Quad Multiplexer		
14017B	E	Decade Counter/Divider		
14018B	E	Presettable Divide-by-N Counter		
14020B	E	14-Bit Binary Counter		
14021B	E	8-Bit Static Shift Register		
14022B	E	Octal Counter/Divider		
14023A	C	Triple 3-Input NAND Gate		
14023B	C	Triple 3-Input NAND Gate	7901301	
14024A	C	7-Stage Ripple Counter		
14025A	C	Triple 3-Input NOR Gate		
14025B	C	Triple 3-Input NOR Gate		
14027B	E	Dual JK Flip-Flop		
14028B	E	BCD-to-Decimal Decoder		
14029B	E	4-Bit Presettable Up/Down Counter		
14032B	E	Triple Serial Adder (Positive Logic)		
14034B	J	8-Bit Universal Bus Register		
14035B	E	4-Bit Shift Register		
14038B	E	Triple Serial Adder (Negative Logic)		
14040B	E	12-Bit Binary Counter		
14042B	E	Quad Latch		
14043B	E	Quad NOR R-S Latch		
14044B	E	Quad NOR R-S Latch		
14046B	E	Phased-Locked Loop		
14049A	E	Hex Inverter/Buffer		
14050B	E	Hex Buffer		
14051B	E	8-Channel Analog Multiplexer		
14053B	E	Triple 2-Channel Analog Multiplexer		
14066B	C	Quad Analog Switch		
10468B	C	8-Input NAND Gate		
14069A	C	Hex Inverter		
14070B	C	Quad Exclusive OR Gate		
14071B	C	Quad 2-Input OR Gate		
14072B	C	Dual 4-Input OR Gate	7706001	
14073B	C	Triple 3-Input AND Gate	7705101	
14075B	C	Triple 3-Input OR Gate		
14076B	E	Quad D Register		
14077B	C	Quad Exclusive NOR Gate		
14078B	C	8-Input NOR Gate		
14081B	C	Quad 2-Input AND Gate	7702401	
14082B	C	Dual 4-Input AND Gate	7705901	

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

Metal Gate CMOS (14XXXX) (Continued)

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
14093B	C	Quad 2-Input NAND Schmitt Trigger		
14094B	E	8-Bit Bus Compatible Shift/Store/Latch		
14099B	E	8-Bit Addressable Latch		
14160B	E	Decade Counter, Asynchronous Clear		
14161B	E	Binary Counter, Asynchronous Clear		
14162B	E	Decade Counter, Synchronous Clear		
14163B	E	Binary Counter, Synchronous Clear		
14174B	E	Hex D Flip-Flop		
14175B	E	Quad D Flip-Flop		
14194B	E	4-Bit Universal Shift Register		
14490A	E	Hex Contact Bounce Eliminator		
14501A	E	Triple Gate		
14502A	E	Strobe Hex Inverter/Buffer	7702001	
14503B	E	Hex 3-State Buffer		
14504B	E	Triple TTL or CMOS-to-COMOS Level Shifter		
14506A	E	Dual Expandable AOI Gate		
14508B	J	Dual 4-Bit Latch		
14510B	E	BCD Up/Down Counter		
14511B	E	BCD-to-7 Segment Latch/Decoder/Driver		
14512B	E	8-Channel Data Selector		
14514B	J	4-Bit Latch/4-to-16 Line Decoder (High)	7703501	
14515B	J	4-Bit Latch/4-to-16 Line Decoder (Low)		
14516B	E	Binary Up/Down Counter		
14517B	E	Dual 64-Bit Static Shift Register		
14518B	E	Dual BCD Up Counter		
14519B	E	4-Bit AND/OR Selector		
14520B	E	Dual Binary Up Counter		
14522B	E	Programmable BCD Divide-by-N Counter		
14526B	E	Programmable Binary Divide-by-N Controller		
14529B	E	Dual 4-Channel Analog Data Selector		
14530B	E	Dual 5-Input Majority Logic Gate		
14531B	E	12-Bit Parity Tree		
14532B	E	8-Bit Priority Encoder		
14536B	E	Programmable Timer		
14538B	E	Dual Precision Monostable Multivibrator		
14539B	E	Dual 4-Channel Data Selector/Multiplexer		
14541B	C	Programmable Oscillator-Timer		
14543B	E	BCD-to-7 Segment Latch/Decoder/Driver		
14549B	E	Successive Approximation Register		
14551B	E	Quad 2-Channel Analog MUX		
14553B	E	3-Digit BCD Counter		
14555B	E	Dual Binary to 1-to-4 Decoder		
14556B	E	Dual Binary to 1-to-4 Decoder, Inverting		
14557B	E	1-to-64-Bit Variable Length Shift Register	7901601	
14559B	E	Successive Approximation Register		
14560B	E	NBCD Adder		
14561B	C	9's Complementer		
14562B	C	128-Bit Static Shift Register		
14566B	E	Industrial Time Base Generator		
14572A	E	Hex Gate		
14583B	E	Dual Schmitt Trigger		
14584B	C	Hex Schmitt Trigger	8550102	
14585B	E	4-Bit Magnitude Comparator		

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

Silicon Gate CMOS (54HCXX)

54HCT240(M)	R, 2	Octal Buffer/Line Driver/Line Receiver, 3-State, Inverting Output, TTL		
54HCT241(M)	R, 2	Octal Buffer/Line Driver/Line Receiver, 3-State TTL		
54HCT244(M)	R, 2	Octal Buffer/Line Driver/Line Receiver, 3-State TTL	8513001	
54HCT373(M)	R, 2	Octal 3-State Noninverting D-Type Transparent Latch	8686701	
54HCU04(M)	C, 2	Hex Unbuffered Inverter	8601001	
54HC00(M)	C, 2	Quad 2-Input NAND Gate	8403701	
54HC02(M)	C, 2	Quad 2-Input NOR Gate	8404101	
54HC03(M)	C, 2	Quad 2-Input NAND, Open Drains	8764701	
54HC04(M)	C, 2	Hex Inverter	8409801	
54HC08(M)	C, 2	Quad 2-Input AND Gate	8404701	
54HC10(M)	C, 2	Triple 3-Input NAND Gate	8403801	
54HC107(M)	C, 2	Dual JK Flip-Flop with Reset	8515401	
54HC109(M)	E, 2	Dual JK Flip-Flop with Set/Reset Positive Edge Triggered	8415001	
54HC11(M)	C, 2	Triple 3-Input AND Gate	8404801	
54HC112(M)	E, 2	Dual JK Flip-Flop, with Set/Reset Negative Edge Triggered	8408801	
54HC113(M)	C, 2	Dual JK Flip-Flop with Set Negative Edge Triggered		
54HC132(M)	E, 2	Quad 2-Input Schmitt-Trigger NAND		
54HC133(M)	E, 2	13-Input NAND Gate	8772301	
54HC138(M)	E, 2	1-of-8 Decoder/Demultiplexer	8406201	
54HC139(M)	E, 2	Dual 1-of-4 Decoder (Active Low Out)	8409201	
54HC14(M)	C, 2	Hex Schmitt-Trigger Inverter	8409101	
54HC151(M)	E, 2	8-Channel Digital Multiplexer	8412801	
54HC153(M)	E, 2	Dual 4-Channel Digital Multiplexer	8409301	
54HC154(M)	L, 2	4-to-16 Decoder	8682201	
54HC157(M)	E, 2	Quad 2-Input Data Selector/Multiplexer	8606101	
54HC158(M)	E, 2	Quad 2-Input Inverter Data Selector Multiplexer	8682301	
54HC160(M)	E, 2	Programmable Decade Counter with Asynchronous Clear	8682401	
54HC161(M)	E, 2	Programmable 4-Bit Binary Counter, Asynchronous Clear	8407501	
54HC162(M)	E, 2	Programmable Decade Counter with Synchronous Clear	8409401	
54HC163(M)	E, 2	Programmable 4-Bit Binary Counter, Synchronous Clear	8607601	
54HC164(M)	C, 2	8-Bit Serial-In/Parallel-Out Shift Register	8416201	
54HC165(M)	E, 2	8-Bit Serial-In or Parallel-In/Serial-Out Register with Reset	8409501	
54HC166(M)	E, 2	8-Bit Serial or Parallel-In/Serial-Out Shift Register with Reset		
54HC173(M)	E, 2	4-Bit D Register, 3-State	8682501	
54HC174(M)	E, 2	Hex D Flip-Flop with Common Clock and Reset	8407301	
54HC175(M)	E, 2	Quad D Flip-Flop	8408901	
54HC194(M)	E, 2	4-Bit Bidirectional Universal Shift Register	8682601	
54HC195(M)	E, 2	4-Bit Universal Shift Register	8682701	
54HC20(M)	C, 2	Dual 4-Input NAND Gate	8403901	
54HC240(M)	R, 2	Octal Buffer/Line Driver/Line Receiver, 3-State	8407401	
54HC241(M)	R, 2	Octal Buffer/Line Driver/Line Receiver, 3-State		
54HC243(M)	C, 2	Quad 3-State Bus Transceiver	8409001	
54HC244(M)	E, 2	Quad Buffer/Line Driver/Line Receiver, 3-State	8409601	
54HC251(M)	E, 2	8-Input Multiplexer, 3-State	8512501	
54HC253(M)	E, 2	Dual 4-Input Multiplexer, 3-State		
54HC257(M)	E, 2	Quad 2-Input Data Selector/Multiplexer, 3-State	8512401	
54HC266(M)	C, 2	Quad 2-Input EX-NOR (Non-Open Drain)	8404301	
54HC27(M)	C, 2	Triple 3-Input NOR Gate	8404201	
54HC273(M)	R, 2	Octal D-type Flip-Flop with Common Clock/Reset	8409901	
54HC280(M)	C, 2	9-Bit Odd/Even Parity Gen/Checker	8607701	
54HC30(M)	C, 2	8-Input NAND Gate	8404001	
54HC32(M)	C, 2	Quad 2-Input OR Gate	8404501	
54HC365(M)	E, 2	Hex 3-State Bus Driver with Common 2-Input NOR Enable	8500101	
54HC366(M)	E, 2	Hex 3-State Bus Driver with Common 2-Input NOR Enable, Inverting Output	8682801	

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Logic

Silicon Gate CMOS (54HCXX) (Continued)

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
54HC367(M)	E, 2	Hex 3-State Bus Driver w/Separate 2-Bit and 4-Bit Sections	8500201	
54HC368(M)	E, 2	Hex 3-State Bus Driver with Separate 2-Bit and 4-Bit Sections, Inverting Output	8681201	
54HC373(M)	R, 2	Octal D Transparent Latch, 3-State	8407201	
54HC374(M)	R, 2	Octal D Flip-Flop, 3-State	8407101	
54HC390(M)	E, 2	Dual Decade Counter	8600901	
54HC393(M)	C, 2	Dual 4-Bit Binary Counter	8410001	
54HC4017(M)	E, 2	Decade Counter/Divider	8601101	
54HC4020(M)	E, 2	14-Stage Binary Ripple Counter	8500301	
54HC4024(M)	C, 2	7-Stage Binary Ripple Counter	8601201	
54HC4040(M)	E, 2	12-Stage Binary Ripple Counter	8500401	
54HC4060(M)	E, 2	14-Stage Binary Ripple Counter with Oscillator	8768001	
54HC4075(M)	C, 2	Triple 3-Input OR Gate	8772201	
54HC4078(M)	C, 2	8-Input OR Gate	8857401	
54HC42(M)	E, 2	BCD to 1-of-10 Decoder	8682101	
54HC4511(M)	E, 2	BCD-to-7 Segment Latch/Decoder/Driver	8773301	
54HC4514(M)	L, 2	4-Bit Latch/4-to-16 Line Decoder		
54HC4538(M)	E, 2	Dual Precision Retriggerable/Resettable Monostable Multivibrator		
54HC4543(M)	E, 2	BCD-to-7 Segment Latch/Decoder/Driver for Liquid Crystal Displays		
54HC51(M)	C, 2	2-Wide 2-Input/2-Wide 3-Input AOI		
54HC58(M)	C, 2	2-Wide 2-Input/2-Wide 3-Input AO		
54HC595(M)	E, 2	8-Bit Serial-to-Parallel Shift Register, 3-State	8681601	
54HC73(M)	C, 2	Dual JK Flip-Flop with Reset	8515301	
54HC74(M)	C, 2	Dual D Flip-Flop with Set/Reset Positive Edge Triggered	8405601	
54HC75(M)	E, 2	4-Bit D Latch	8407001	
54HC76(M)	E, 2	Dual JK Flip-Flop with Set/Reset		
54HC85(M)	E, 2	4-Bit Magnitude Comparator	8601301	
54HC86(M)	C, 2	Quad 2-Input EX-OR Gate	8404601	

ASICs

HCMOS Macrocell Arrays

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
62A06	◇	Gate Equivalent 648		
62A10	◇	Gate Equivalent 957		
62A17	◇	Gate Equivalent 1638		
62A25	◇	Gate Equivalent 2448		
62A36	◇	Gate Equivalent 3600		
62A50	◇	Gate Equivalent 4968		
62A67	◇	Gate Equivalent 6708		
62A85	◇	Gate Equivalent 8568		

Phase Locked-Loop (12XXX)

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
12015	P	Two-Modulus ÷32/÷33, 225 MHz Typ (T_A = −55°C to +85°C)		
12502	C	Analog Mixer — Double Balanced		
12509	E	Two-Modulus ÷5/÷6, 600 MHz Typical		
12511	E	Two-Modulus ÷8/÷9, 600 MHz Typical		
12513	E	Two-Modulus ÷10/÷11, 600 MHz Typical		
12514	E	Counter-Control Logic		
12540	C	Phase-Frequency Detector		
12560	E	Crystal Oscillator (100K–2 MHz)		
12561	E	Crystal Oscillator (2–20 MHz)		

◇ ASICs (semi-custom) arrays are available in plastic and ceramic dual-in-line packages, pin grid arrays (PGA) and leadless and leaded ceramic chip carrier packages (LCC/LDCC). Specific pin numbers depend on array complexity.

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Memories

HCMOS III Static RAMs

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
6164-55(M)	X, U	8K x 8 Fast Static RAM, 55 ns	8552505	
6164-70(M)	X, U	8K x 8 Fast Static RAM, 70 ns	8552504	
6168-55(M)	R, Y, U	4K x 4 Fast Static RAM, 55 ns	8670507	
6168-70(M)	R, Y, U	4K x 4 Fast Static RAM, 70 ns	8670509	
6268-35(M)	R, Y, U	4K x 4 Fast Static RAM, 35 ns	8670503	
6268-45(M)	R, Y, U	4K x 4 Fast Static RAM, 45 ns	8670505	
6287-35(M)	X, U	64K x 1 Fast Static RAM, 35 ns		
6287-45(M)	X, U	64K x 1 Fast Static RAM, 45 ns		
6288-35(M)	X, U	16K x 4 Fast Static RAM, 35 ns		
6288-45(M)	X, U	16K x 4 Fast Static RAM, 45 ns		

RAMs-TTL (93XXX)

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
93L422(M)	W, K, U	256 x 4 Bit RAM, 3-State Output (55 ns)		23112
93L422A(M)	W, K, U	256 x 4 Bit RAM, 3-State Output (55 ns)		
93415(M)	E, 2	1024 x 1 Bit RAM, Open Collector		
93422(M)	W, K, U	256 x 4 Bit RAM, 3-State Output (60 ns)		
93422A(M)	W, K, U	256 x 4 Bit RAM, 3-State Output (45 ns)		
93425(M)	E, F, 2	1024 x 1 Bit RAM, 3-State Output		

Linear

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
0026	C, G, P	Dual MOS Clock Driver		
101A	P, G	General Purpose Adjustable Oper. Amplifier		
10318	E	High Speed 8-Bit D/A Converter		
10319	J	High Speed 8-Bit Analog-tp-Digital Flash Converter		
108(M)	C, G, P, 2	Precision Operational Amplifier		
108A(M)	C, G, P, 2	Precision Operational Amplifier		
11	C	Precision Operational Amplifier		
111	P, G	High Performance Voltage Comparator		
124(M)	C, 2	Quad Low Power Operational Amplifier		
139(M)	C, 2	Quad Single Supply Comparator	7700801	
139A(M)	C, 2	Quad Single Supply Comparator		
1488	C	Quad MDTL Line Driver (T_A = 0°C to +75°C)		
1489(M)	C, 2	Quad MDTL Line Receiver (T_A = 0°C to +75°C)		
1489A(M)	C, 2	Quad MDTL Line Receiver (T_A = 0°C to +75°C)		
1508	E	8-Bit Multiplying D-to-A Converter		
1514	C	Dual Differential Comparator		
1525	E	Pulse Width Modulator Control Circuit		
1526	V	Pulse Width Modulation Control Circuit	8551501	12603
1536	P, G	High-Voltage Operational Amplifier	7800304	
1537	C	Dual Operational Amplifier		
1539	C, G, P	High Slew-Rate Operational Amplifier		
1544	E	AC-Coupled 4-Channel Sense Amplifier		
1545	C, I	Wideband Amplifier	8671201	
1550	I	RF/IF Amplifier		
1554	I	1-Watt Power Amplifier		
1555	P, G	Timing Circuit		
1556	C, G	High Performance Operational Amplifier		
1558(M)	C, G, P, 2	Dual Operational Amplifier		
1558S	C, G, P	High Slew-Rate Dual Operational Amplifier		
1563	I	Adjustable Negative Voltage Regulator		
1568	C, I	Dual ±15 Volt Tracking Regulator		
1569	I	Adjustable Positive Voltage Regulator		
158	P, G	Dual Low Power Operational Amplifier	8771001	

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/

Linear (Continued)

MIL-STD-883C Products	Case Suffix B-AJC	Function	DESC/ SMD Products	JAN JM38510/
1590	G	Wideband Amplifier with AGC		
1594	E	Four-Quadrant Multiplier		
1595	C	Four-Quadrant Multiplier		
1596	C, I	Balanced Modulator-Demodulator		
1709	C, G, P	General Purpose Operational Amplifier		
1710	C, G	Differential Comparator		
1723	C, I	Adjustable Positive or Negative Voltage Regulator		
1733	C, I	Differential Video Amplifier	8418501	
1741(M)	C, G, P, 2	General Purpose Operational Amplifier		
1741S	P, G	High Slew-Rate Operational Amplifier		
1747	C, I	Dual 1741 Operational Amplifier		
1748	P, G	General Purpose Operational Amplifier		
1776	P, G	Programmable Operational Amplifier		
1842	P	High Performance Current Mode Controller		
193	G	Dual Comparator		
193A	G	Dual Comparator		
2003	E	Darlington Driver		14103
26LS31(M)	E, F, 2	Quad RS-422 Line Driver with 3-State Outputs	7802301	
3346	C	General Purpose Transistor Array (−40°C to +85°C)		
3503	C	Quad Differential-Input Operations Amplifier		
35063	P	DC to DC Converter Control Circuit		
35074	C	Quad High-Performance Single-Supply Op-Amp		
35084	C	Quad High-Speed JFET Input Operational Amp		
3517(M)	E, 2	Continuously-Variable-Slope Delta MOD/DEMOD	8764301	
3520	E	Switchmode Regulator Control Circuit		
3523	P	Overvoltage Sensing Circuit		
3556	C	Dual Timing Circuit		
431	P	Programmable Precision References	8410901	14801
55107	C	Dual Line Receiver		10401
55108	C	Dual Line Receiver		
6875A	E	6800 MPU Clock Generator/Driver		
8T95	E	Hex Three-State Buffer/Inverter (0 to +75°C)		
8T96	E	Hex Three-State Buffer/Inverter (0 to +75°C)		
8T97	E	Hex Three-State Buffer/Inverter (0 to +75°C)		
8T98	E	Hex Three-State Buffer/Inverter (0 to +75°C)		

Cross Reference: DESC/SMD Part to 883C Part

DESC/ SMD Number	883C Number
5962-8515301	54HC73
5962-8515401	54HC107
5962-8550102	14584B
5962-8552504	6164-70
5962-8552505	6164-55
5962-8602102	68881-16
5962-8603202	68020-16
5962-8606101	54HC157
5962-8670503	6268-35
5962-8670505	6268-45
5962-8671001	54F381
5962-8671201	1545
5962-8681201	54HC368
5962-8681601	54HC595
5962-8682101	54HC42
5962-8682201	54HC154
5962-8682301	54HC158
5962-8682401	54HC160
5962-8682501	54HC173
5962-8682601	54HC194
5962-8682701	54HC195
5962-8682801	54HC366
5962-8683401	54F243
5962-8686701	54HCT373
5962-8687401	54F241
5962-8688601	54HC4538
5962-8700101	10H536
5962-8750101	10H515
5962-8750201	10H516
5962-8750301	10H501
5962-8750401	10H504
5962-8750501	10H535
5962-8750601	10H574
5962-8750701	10H505
5962-8750801	10H525
5962-8750901	10H588
5962-8751001	10H589
5962-8751101	10H541
5962-8751201	10H576
5962-8754101	10H610
59628755701	10H502
5962-8755801	10H513
5962-8755901	10H518
5962-8756001	10H524
5962-8756101	10H531
5962-8756201	10H560
5962-8756301	10H586
5962-8756401	10H506
5962-8756501	10H503
5962-8756601	10H558

DESC/ SMD Number	883C Number
5962-8756701	10H561
5962-8756801	10H571
5962-8756901	10H609
5962-8759001	10H416
5962-8764701	54HC03
7600201	54LS157
7600301	54LS122
7600401	54LS132
7600501	54LS138
7600601	54LS193
7600701	54LS139
7600801	54LS161A
7600901	54LS191
7601001	54LS151
7601101	54LS153
7601201	54LS75
7601301	54LS76A
7601401	54LS83A
7601601	54LS251
7601701	54LS253
7601801	54LS279
7601901	54LS298
7602001	54LS26
7603101	54LS42
7603201	54LS90
7603301	54LS158
7603401	54LS163A
7603501	54LS190
7603601	54LS192
7603701	54LS257A
7603801	54LS258A
7603901	54LS123
7604201	54LS221
7604301	54LS283
7604501	54LS47
7700101	54LS93
7700601	54LS165
7700801	139
7700901	54LS160A
7702001	14502B
7702401	14081B
7703501	14514B
7704201	54LS670
7705101	14073B
7705701	54LS244
7705901	14082B
7706001	14072B
7800304	1536
7800901	10516

DESC/ SMD Number	883C Number
7801001	54LS273
7801101	54LS374
7801201	54LS240
7802301	26LS31
7802601	54LS390
7901301	14023B
7901601	14557B
8001701	54LS166
8001901	54LS09
8002001	54LS242
8002101	54LS245
8002501	54LS170
8202102	68000-8
8202102	68000-8T
8202103	68000-10
8202103	68000-10T
8400101	54ALS574
8401201	54ALS573
8403701	54HC00
8403801	54HC10
8403901	54HC20
8404001	54HC30
8404101	54HC02
8404201	54HC27
8404301	54HC266
8404501	54HC32
8404601	54HC86
8404701	54HC08
8404801	54HC11
8405601	54HC74
8406201	54HC138
8407001	54HC75
8407101	54HC374
8407201	54HC373
8407301	54HC174
8407401	54HC240
8407501	54HC161
8408801	54HC112
8408901	54HC175
8409001	54HC243
8409101	54HC14
8409201	54HC139
8409301	54HC153
8409401	54HC162
8409501	54HC165
8409601	54HC244
8409801	54HC04
8409901	54HC273

Cross Reference: DESC/SMD Part to 883-C Part (Continued)

DESC/ SMD Number	883C Number
8410001	54HC393
8410901	431
8412801	54HC151
8415401	54LS399
8416201	54HC164
8418501	1733
8500101	54HC365

DESC/ SMD Number	883C Number
8500201	54HC367
8500301	54HC4020
8512401	54HC257
8512501	54HC251
8512801	54HC251
8513001	54HCT244
8551101	54F245

DESC/ SMD Number	883C Number
8551501	1526
8600901	54HC390
8601001	54HCU04
8601101	54HC4017
8601201	54HC4024
8601301	54HC85
8607601	54HC163
8607701	54HC280

Cross Reference: JAN38510 Part to 883C Part

JAN 38510/ Number	883C Number
06001	10501
06002	10502
06003	10505
06004	10506
06005	10507
06006	10509
06101	10531
06102	10631
06103	10576
06104	10535
06201	10504
06202	10597
06301	10524
06302	10525
10401	55107
12603	1526
14103	2003
14801	431
23112	93L422
30001	54LS00
30002	54LS03
30003	54LS04
30004	54LS05
30005	54LS10
30006	54LS12
30007	54LS20
30008	54LS22
30009	54LS30
30101	54LS73A
30102	54LS74A
30103	54LS112A
30104	54LS113A
30105	54LS114A
30106	54LS174
30107	54LS175
30108	54LS107A

JAN 38510/ Number	883C Number
30109	54LS109A
30110	54LS76A
30201	54LS40
30202	54LS37
30203	54LS38
30204	54LS28
30301	54LS02
30302	54LS27
30303	54LS266
30401	54LS51
30402	54LS54
30501	54LS32
30502	54LS86
30601	54LS194A
30602	54LS195A
30603	54LS95B
30605	54LS164
30608	54LS165
30609	54LS166
30701	54LS138
30702	54LS139
30703	54LS42
30704	54LS47
30801	54LS181
30901	54LS151
30902	54LS153
30903	54LS157
30904	54LS158
30905	54LS251
30906	54LS257A
30907	54LS258A
30908	54LS253
30909	54LS298
31001	54LS11
31003	54LS21
31004	54LS08

JAN 38510/ Number	883C Number
31005	54LS09
31101	54LS85
31201	54LS83A
31202	54LS283
31301	54LS13
31302	54LS14
31303	54LS132
31401	54LS133
31402	54LS221
31403	54LS122
31501	54LS90
31502	54LS93
31503	54LS160A
31504	54LS161A
31505	54LS168
31507	54LS192
31508	54LS193
31509	54LS191
31510	54LS92
31511	54LS162A
31512	54LS163A
31513	54LS190
31601	54LS75
31602	54LS279
31603	54LS259
31604	54LS375
31901	54LS670
32003	54LS290
32004	54LS293
32102	54LS26
32201	54LS365A
32202	54LS366A
32203	54LS367A
32204	54LS368A
32301	54LS125A
32302	54LS126A

Cross Reference: JAN38510 Part to 883C Part (Continued)

JAN 38510/ Number	883C Number
32401	54LS240
32402	54LS241
32403	54LS244
32501	54LS273
32502	54LS373
32503	54LS374
32504	54LS377
32601	54LS155
32602	54LS156
32702	54LS393
32801	54LS242
32802	54LS243
32803	54LS245
32901	54LS280
33001	54F00
33002	54F04
33003	54F10
33004	54F20
33201	54F240
33202	54F241

JAN 38510/ Number	883C Number
33203	54F244
33301	54F02
33401	54F64
33501	54F32
33601	54F194
33701	54F138
33702	54F139
33802	54F182
33803	54F381
33804	54F382
33901	54F151
33902	54F153
33903	54F157A
33905	54F251
33906	54F257A
33907	54F258A
33908	54F253
33909	54F352
33910	54F353
34001	54F08

JAN 38510/ Number	883C Number
34002	54F11
34101	54F74
34102	54F109
34104	54F175
34105	54F374
34106	54F534
34107	54F174
34108	54F378
34109	54F379
34201	54F283
34302	54F163A
34501	54F86
34601	54F373
34602	54F533
34802	54F243
34803	54F245
34901	54F280
35002	54F399
65705	54HC244

Military Products
Discrete Devices
Qualified Products List

The following table lists devices which appear in QPL-19500 (Qualified Products List) and are available in the JAN, JANTX, JANTXV and JANS versions as specified. Check with your local Motorola sales office or franchised distributor for current qualification status and availability.

Type Number	Detail Spec.	Specification Levels			
		JAN	JTX	JTXV	JANS
1N746A through 1N759A	/127	X	X	X	
† 1N746A-1 through † 1N759A-1	/127	X	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	X	
† 1N827-1	/159	X	X	X	
1N829	/159	X	X	X	
† 1N829-1	/159	X	X	X	
1N962B through 1N992B	/117	X	X	X	
† 1N962B-1 † through 1N984B-1	/117	X	X	X	
† 1N2970B, RB through † 1N2977B, RB	/124	X	X	X	
† 1N2979B, RB	/124	X	X	X	
† 1N2980B, RB	/124	X	X	X	
† 1N2982B, RB	/124	X	X	X	
† 1N2984B, RB	/124	X	X	X	
† 1N2985B, RB	/124	X	X	X	
† 1N2986B, RB	/124	X	X	X	
† 1N2988B, RB through † 1N2993B, RB	/124	X	X	X	
† 1N2995B, RB	/124	X	X	X	
† 1N2997B, RB	/124	X	X	X	
† 1N2999B, RB through † 1N3004B, RB	/124	X	X	X	

† Preferred device, MIL-STD-701

Type Number	Detail Spec.	Specification Levels			
		JAN	JTX	JTXV	JANS
† 1N3005B, RB	/124	X	X	X	
† 1N3007B, RB	/124	X	X	X	
† 1N3008B, RB	/124	X	X	X	
† 1N3009B, RB	/124	X	X	X	
† 1N3011B, RB	/124	X	X	X	
† 1N3012B, RB	/124	X	X	X	
† 1N3014B, RB	/124	X	X	X	
† 1N3015B, RB	/124	X	X	X	
1N3016B through 1N3051B	/115	X	X	X	
1N3305B, RB through 1N3312B, RB	/358	X	X		
1N3314B, RB	/358	X	X		
1N3315B, RB	/358	X	X		
1N3317B, RB	/358	X	X		
1N3319B, RB	/358	X	X		
1N3320B, RB					
1N3321B, RB					
1N3323B, RB through 1N3328B, RB	/358	X	X		
1N3330B, RB	/358	X	X		
1N3332B, RB	/358	X	X		
1N3334B, RB through 1N3340B, RB	/358	X	X		
1N3342B, RB	/358	X	X		
1N3343B, RB	/358	X	X		
1N3344B, RB	/358	X	X		
1N3346B, RB	/358	X	X		
1N3347B, RB	/358	X	X		
1N3349B, RB	/358	X	X		
1N3350B, RB	/358	X	X		
1N3821A through 1N3828A	/115	X	X		
1N3890, R	/304	X	X		
† 1N3891, R	/304	X	X		
† 1N3893, R	/304	X	X		

QUALIFIED PRODUCTS LIST (CONTINUED)

Type Number	Detail Spec.	Specification Levels JAN	JTX	JTXV	JANS
† 1N3910, R** through 1N3913, R**	/308	X	X		
† 1N3993A, RA through † 1N4000A, RA	/272	X	X		
1N4099 through 1N4135	/435	X	X	X	
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	
1N4549B, RB through 1N4554B, RB	/358	X	X		
† 1N4565A, -1 through † 1N4574A, -1	/452	X	X	X	
1N4614, -1 through 1N4627, -1	/435	X	X	X	
† 1N5283 through 1N5314	/463	X	X	X	
1N5518B, -1 through 1N5546B, -1	/437	X	X	X	
1N6309 through 1N6324	/533	X	X		
M19500/558-01	/558	X	X	X	
M19500/558-02	/558	X	X	X	
M19500/559-01	/559	X	X	X	
M19500/559-02	/559	X	X	X	
2N703	/153	X			
2N706	/120	X			
2N708	/312	X	X		
2N718A	/181	X	X	X	
2N869A	/283	X	X		
2N914	/373	X	X		
† 2N916	/271	X			

† Preferred device, MIL-STD-701
* Only 1 type on 701
** Only 2 types on 701

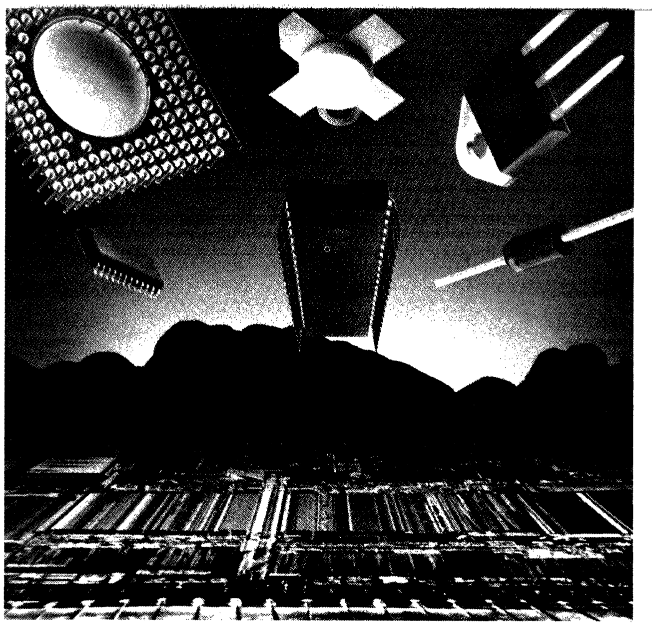
Type Number	Detail Spec.	Specification Levels JAN	JTX	JTXV	JANS
† 2N918	/301	X	X	X	X
2N930	/253	X	X		
2N1132, L	/177	X			
2N1613, L	/181	X	X	X	
† 2N2060	/270	X	X	X	X
2N2218	/255	X	X	X	
2N2218A, L	/255	X	X	X	
2N2219	/255	X	X	X	
† 2N2219A, AL	/255	X	X	X	X
2N2221, A	/255	X	X	X	
2N2222	/255	X	X	X	
† 2N2222A	/255	X	X	X	X
† 2N2369A	/317	X	X	X	X
2N2481	/268	X	X		
† 2N2484	/376	X	X	X	
† 2N2605	/354	X	X	X	
† 2N2608	/295	X			
† 2N2609	/296	X			
† 2N2857	/343	X	X	X	
2N2904, A	/290	X	X	X	
2N2905	/290	X	X	X	
2N2905A, L	/290	X	X	X	X
2N2906, A	/291	X	X	X	
2N2907	/291	X	X	X	
† 2N2907A	/291	X	X	X	X
2N2919	/355	X	X	X	X
† 2N2920	/355	X	X	X	X
† 2N3013	/287	X	X		
† 2N3019, S	/391	X	X	X	X
2N3057A	/391	X	X	X	X
2N3227	/317	X	X	X	
2N3250A	/323	X	X	X	
† 2N3251A	/323	X	X	X	
2N3253	/347	X	X		
2N3253S	/347	X	X		
2N3330	/378	X	X		
2N3331	/378	X	X		
† 2N3375	/341	X	X	X	
† 2N3439, L	/368	X	X	X	
† 2N3440, L	/368	X	X	X	
2N3444	/347	X	X		
† 2N3444S	/347	X	X		
† 2N3467, L	/348	X	X	X	
2N3468, L	/348	X	X	X	
† 2N3485A*	/392	X	X		
† 2N3486A*	/392	X	X		
2N3498, L	/366	X	X	X	X
2N3499, L	/366	X	X	X	X
† 2N3500, L*	/366	X	X	X	X
† 2N3501, L	/366	X	X	X	X
† 2N3506, L	/349	X	X	X	
† 2N3507, L	/349	X	X	X	
2N3553	/341	X	X	X	
2N3634, L through 2N3637, L	/357	X	X	X	

QUALIFIED PRODUCTS LIST (CONTINUED)

Type Number	Detail Spec.	Specification Levels			
		JAN	JTX	JTXV	JANS
2N3700	/391	X	X	X	X
† 2N3715*	/408	X	X	X	
† 2N3716	/408	X	X	X	
† 2N3735	/395	X	X	X	X
† 2N3737	/395	X	X	X	X
† 2N3739	/402	X	X	X	
† 2N3740*	/441	X	X	X	
† 2N3741	/441	X	X	X	
† 2N3743	/397	X	X	X	
† 2N3762, L	/396	X	X	X	
2N3763, L	/396	X	X	X	
† 2N3764	/396	X	X	X	
2N3765	/396	X	X	X	
† 2N3766*	/518	X	X	X	
† 2N3767	/518	X	X	X	
† 2N3791*	/379	X	X	X	
† 2N3792	/379	X	X	X	
† 2N3810	/336	X	X	X	X
† 2N3811	/336	X	X	X	X
2N3821	/375	X	X	X	
2N3822	/375	X	X	X	
† 2N3823	/375	X	X	X	
† 2N3866, A	/398	X	X	X	X
2N3867S	/350	X	X	X	
† 2N3868S	/350	X	X	X	
† 2N3960	/399	X	X	X	
† 2N4033	/512	X	X	X	
2N4091	/431	X	X	X	
2N4092	/431	X	X	X	
2N4093	/431	X	X	X	
† 2N4199***	/372	X			
through					
† 2N4204***					
† 2N4261	/511	X	X	X	
† 2N4399	/433	X	X	X	
2N4405	/448	X	X		
† 2N4416A	/428	X	X	X	
† 2N4440	/341	X	X	X	
† 2N4449	/317	X	X	X	
2N4453	/283	X	X		
† 2N4854	/421	X	X	X	
† 2N4856	/385	X	X		
† 2N4857**	/385	X	X	X	
2N4858					
2N4930	/397	X	X	X	
2N4931	/397	X	X	X	
† 2N4947	/388	X	X		
† 2N4948	/388	X	X		
2N4949	/388	X	X		
† 2N4957	/426	X	X	X	
† 2N5038	/439	X	X	X	
† 2N5039	/439	X	X	X	
† 2N5109	/453	X	X	X	
† 2N5302	/456	X	X	X	
† 2N5303	/456	X	X	X	

† Preferred device, MIL-STD-701 * Only 1 type on 701
** Only 2 types on 701 *** Only 4 types on 701

Type Number	Detail Spec.	Specification Levels			
		JAN	JTX	JTXV	JANS
2N5339	/560	X	X	X	
† 2N5415, S	/485	X	X	X	
2N5416, S					
2N5431	/425	X	X		
† 2N5581*	/423	X	X		
† 2N5582*	/423	X	X		
† 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	
† 2N5793,94	/495	X	X	X	
† 2N5796,95	/496	X	X	X	
† 2N6051	/501	X	X	X	
† 2N6052	/501	X	X	X	
† 2N6058	/502	X	X	X	
† 2N6059	/502	X	X	X	
† 2N6116*	/493	X	X	X	
† 2N6117*	/493	X	X	X	
2N6118	/493	X	X	X	
2N6193	/561	X	X	X	
† 2N6283	/504	X	X	X	
† 2N6284	/504	X	X	X	
† 2N6286	/505	X	X	X	
† 2N6287	/505	X	X	X	
2N6298	/540	X	X	X	
2N6299	/540	X	X	X	
2N6300	/539	X	X	X	
2N6301	/539	X	X	X	
2N6306	/498	X	X		
2N6308	/498	X	X		
2N6378	/515	X	X	X	
2N6379	/515	X	X	X	
† 2N6383	/523	X	X	X	
† 2N6384	/523	X	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	
† 2N6603	/522	X	X	X	
† 2N6604	/522	X	X	X	
† 2N6648*	/527	X	X	X	
† 2N6649*	/527	X	X	X	
† 2N6650	/527	X	X	X	
2N6671	/536	X	X	X	
2N6673	/536	X	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	



Product Literature and Technical Training

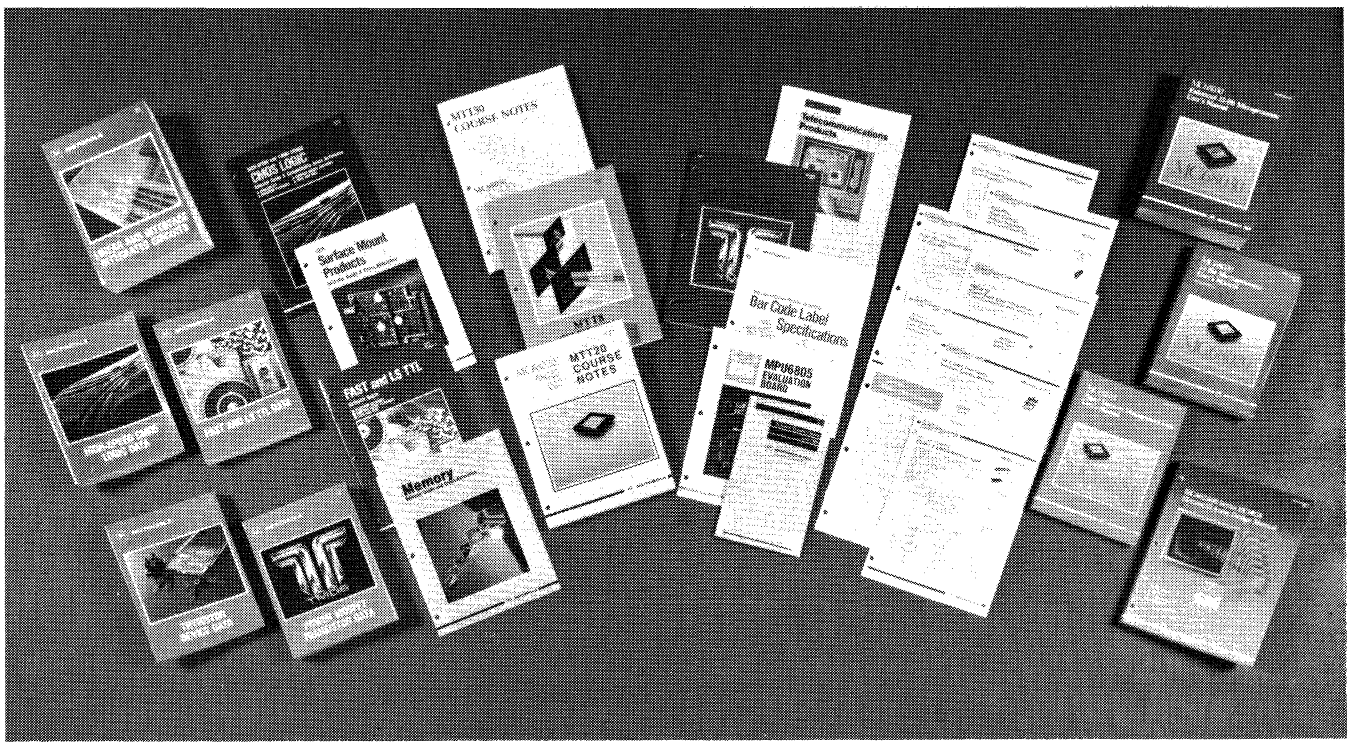
In Brief . . .

With the rapid 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

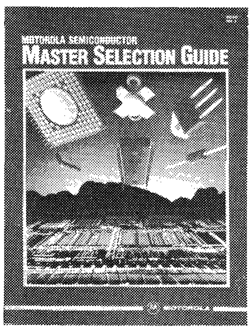
These products and services are described on the following pages.



The Motorola Semiconductor Technical Information System

Literature and services designed to keep you fully informed of Motorola semiconductor devices and their applications.

The Product Update System



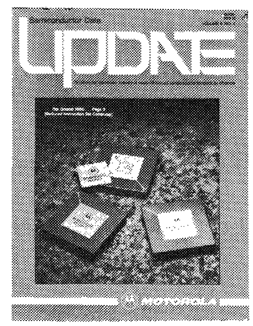
Motorola Semiconductor Master Selection Guide

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. Basically, it serves two purposes:

1. It lists in computer sort all standard products in the vast Motorola semiconductor inventory for rapid identification, and . . .
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 technology is a rapidly moving technology, and each month, after its initial printing, the Master Selection Guide becomes more and more outdated. To bridge the gap between successive MSG printings, therefore, we publish a periodical called **Semiconductor Data Update.**

Semiconductor Data Update



This highly informative periodical is available to all semiconductor users on a free subscription basis. It describes briefly the technical qualifications of all new products introduced between successive issues 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 easily digestible overview of the latest and most important events at Motorola that influence the efficient implementation and most cost-effective use of semiconductor devices.

If you have received a copy of the latest Master Selection Guide, you are eligible for a free subscription to the Semiconductor Update periodical. To subscribe, simply contact your Motorola sales representative, or your most convenient Motorola sales office or distributor, and request to be put on the mailing list.

Specs In Seconds — The Motorola Data Disk:

Selection of Motorola discrete semiconductors is now as quick as your desk-top computer.

Motorola has put semiconductor device selection into the computer age with the introduction of the Motorola Data Disk. This easy-to-use disk, an IBM PC-compatible floppy, provides the answers you need to select the discrete devices best suited for your application — as quickly as you can pop the questions to your computer.

The high-speed electronic selector guide includes information on power and small signal transistors, RF devices, rectifiers, zeners, thyristors, optoelectronic products, sensors and other specialty items. With it, a designer can enter values for device parameters that are important for a given application and, with a single keystroke, obtain a list of devices meeting these requirements. What's more, every search is filtered through a multi-level sort that not only lists the devices in order of electrical compliance, but also provides price information. It even recommends suitable Motorola equivalents (cross reference) for device numbers not carried in the Motorola inventory.

The data disk is menu-driven for ease of use and provides language support in English, French, German, Italian and Spanish.

Currently available for discrete products only, the program is now being expanded to encompass the entire Motorola product line.

Subscribers to the Motorola Technical Literature Subscription Service (see below) will automatically receive a copy of each disk as it is introduced and updated. To all others, each Motorola Data Disk is available for $2.00 from the Motorola Literature Distribution Center.

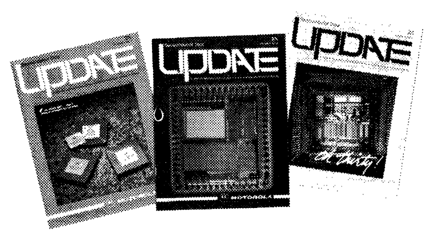
Motorola's Technical Literature Subscription Service

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 Hard Copy Subscription Service. This service provides a complete library of technical data and applications information for all new products soon after they are introduced.

Subscribers receive data sheets on new products, data book compendiums of complete product lines, applications information and new product brochures. And it includes the latest version of the Motorola Data Disk as well as all updated versions for as long as the subscription remains in force.

The cost of this service — $50.00* per year — is the estimated cost of the postage and special handling alone . . . not for the literature itself. Therefore, if you require a compre-



hensive and rapid technical update service, this Literature Subscription service may be the best literature bargain in the industry.

* This applies to US subscribers only. Because of the high postal rates to other countries, subscribers outside the US should contact their Motorola sales representative or distributor for their literature requirements.

Free Microfiche Subscription Service Hard copy in space-saving form

For designers with access to a microfiche viewer, the Motorola Microfiche Subscription Service represents a very convenient desk-top new-product data system. Immediately after publication of a Semiconductor Data Update Issue, the data sheets for the new products described in the issue (as well as selected new application notes) are made available on microfiche. This provides the user with a complete file of new-product data that is easily stored and conveniently retrieved. If you receive SDU and would like to receive Motorola data in Microfiche form, please send your request to Motorola Semiconductor Products, Inc., P.O. Box 20924, Phoenix, Arizona 85036-0912.

The Motorola Data Library

Complete technical data for the world's most comprehensive inventory of semiconductor components.

The Motorola Data Library currently consists of 18 databooks/handbooks (and growing), each one containing a complete set of data sheets for an entire product line. Individual books are available free from your Motorola sales representative or distributor, or you can order them from the Motorola Literature Distribution Center at a nominal cost. For prices, please send for BR101/D or call the Literature Distribution Center — (602) 994-6561.

Microcomputer Components

DL113/D	Memory Data
DL139/D	Microprocessor, Microcontroller and Peripheral Data
FR68K/D	M68000 Family Reference

Logic Families

DL121/D	FAST and LS TTL
DL122/D	MECL
DL129/D	High-Speed CMOS
DL131/D	CMOS Logic Data
DL138/D	FACT 74AC/ACT
HB205/D	MECL System Design Handbook

Linear Circuits

DL128/D	Linear & Interface
HB206/D	Voltage Regulator Handbook

Special Functions

DL136/D	Telecommunications
DL130/D	NMOS/CMOS Special Functions

Discrete Components

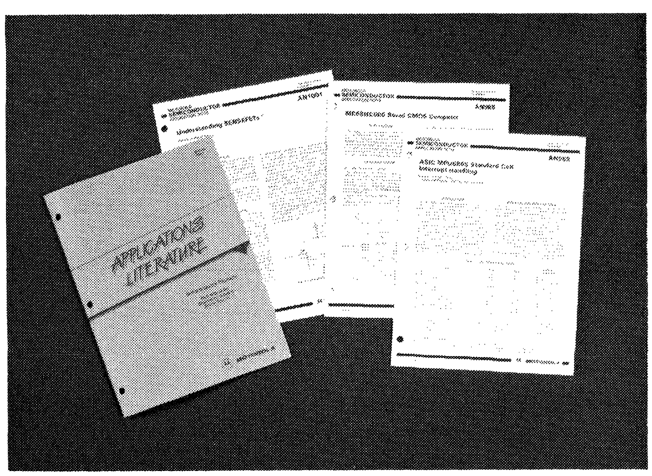
DL110/D	RF
DL111/D	Bipolar Power Transistors/Thyristors
DL118/D	Opto
DL125/D	Rectifiers, Zener Diodes
DL126/D	Small-Signal Transistors
DL135/D	TMOS Power MOSFETs
DL137/D	Thyristor Data Book

Motorola Applications Data

Semiconductors in theory and practice.

Over the years, Motorola engineers have published hundreds of Application Notes (ANs) and Application Articles (ARs). The most important of these, covering circuit designs with products of current interest, are inventoried and available for distribution to engineers and technicians. To find out what topics are available, send for the latest edition of the Motorola Application Note Catalog (BR135/D) available from sales offices or distributors.

Individual documents are available free from any Motorola sales office or distributor, or from the Literature Distribution Center.



Expanding The Library

Manuals and reference guides for specific products.

Motorola attempts to fill the need for applications information concerning today's highly complex electronic components. A series of User's Manuals and Design Manuals deals with the applications of products too complex to be covered by application notes and data sheets. The documents listed below can be obtained from the Literature Distribution Center. For prices, please send for BR101/D or call the Literature Distribution Center — (602) 994-6561.

User's Manuals and Design Manuals

Microcomputer-Related

DSP56000UM/AD	DSP56000 Digital Signal Processor User's Manual
M68HC11PM/AD	M68HC11 Microcomputer Programming Reference Manual
MC68HC11A8RG/AD	MC68HC11A8 Programming Reference Guide
MC68HC11E9RG/AD	MC68HC11E9 Programming Reference Guide
M6805UM/AD2	M6805/M146805 MCU/MPU User's Manual
M6809PM/AD	MC6809-MC6809E Microprocessor Programming Manual
M68000UM/AD	MC68000/08/10/HC000 Microprocessor User's Manual
M68000RG/AD	MC68000/08/10 Programming Reference Guide
MC68020UM/AD	MC68020 Microprocessor User's Manual
MC68030UM/AD	MC68030 Microprocessor User's Manual
MC68824UM/AD	Token Bus Controller User's Manual
MC68851UM/AD	MC68851 Paged Memory Management Unit User's Manual
MC68881UM/AD	MC68881/MC68882 Floating Point Co-processor User's Manual

ASICs

BR107/D	MCA600ECL & MCA1200ECL MECL 10000 Macrocell Arrays
BR110/D	High Performance TTL-Compatible Macrocell Arrays Design Manual (MCA500ALS & MCA1300ALS)
BR165/D	MCA800/MCA2500ECL, Macrocell Array Design Manual
BR312/D	MCA2800RAM, MCA2800ALS, MCA2900ETL Macrocell Arrays
HCA62A00DM/D	HCA62A00 Series HCMOS Macrocell Array Design Manual
BR335DM/D	3-Micron Standard Cell Design Manual
BR359DM/D	2-Micron Standard Cell Design Manual
BR349/D	Converting LSTTL to Motorola CMOS Macrocells & Standard Cells
BR367DM/D	BiMOS Design Manual
BR368/D	Standard Cell MPU 6805 Evaluation Board

Textbooks and Handbooks

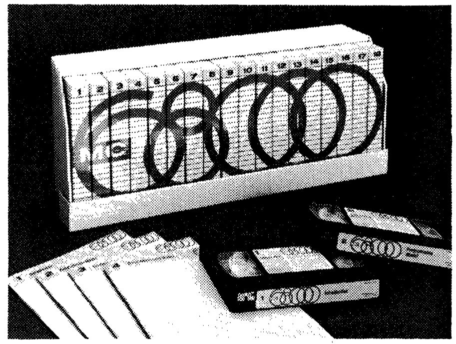
HB205/D	MECL Design Handbook
HB206/D	Voltage Regulator Handbook
HB211/D	Programming the 6800 Microprocessor/Southern
TB300/D	Basic Integrated Circuit Engineering/Hamilton & Howard
TB301/D	Basic Microprocessors and the 6800/Bishop
TB302/D	What Every Engineer Should Know About Microcomputers/Bennet & Evert
TB303/D	Using Microprocessors and Microcomputers: The 6800 Family/Greenfield and Wray
TB304/D	Pascal Programming Structures for Motorola Microprocessors/Cherry
TB305/D	Programming Microprocessor Interface for Control & Instrumentation/Andrews
TB308/D	What Every Engineer Should Know About Systems Design and Debugging/Wray and Crawford
TB309/D	Programming the 6809/Zaks and Labiak
TB312/D	Introduction to Integrated Circuit Layout/Spinks
TB313/D	Efficient C/Plum
TB314/D	The Motorola MC68000 MPU Family/Harmon and Lawson
TB315/D	The 68000 Microprocessor/Triebe and Singh
TB316/D	Single and Multiple Chip Microcomputer Interface/Lipovski
TB317/D	68000, 68010, 68020 Primer/Kelly-Bootle and Fowler
TB318/D	Microprocessor Systems Design, 68000 Hardware, Software and Interfacing/Clements
TB319/D	MC68000 Assembly Language and Systems Programming/Ford and Topp

Expanding The Mind Technical Training Instructor-led, Video, and Audio Courses

Motorola Training and Technical Operations offers a variety of training tools. We offer the best Instructor-led training in the industry, as well as Video courses for those who cannot attend an Instructor-led course but who need in-depth study, and 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) 994-6900.**

Video Training

An Introduction to the MC68000 16-bit Microprocessor
MTTV2 Video Training Series



Course Description
This course is designed to introduce the student to the MC68000 microprocessor. It will prepare the student to use and design with the MC68000. The general features of the MC68000 such as pin functions, registers, addressing modes, and instruction set are covered. In addition, the unique features such as primitive instructions for high-level software, exception handling, and position independent machine code generation are discussed. The MC68000 Educational Computer Board in a lab setting is also covered.

For more information on the MC68000 Video Training Series, or for a complete copy of the Technical Training Course Catalog describing all course offerings, **call 1-800-521-6274.**

Instructor-led Course Descriptions

Basic M6800 Microprocessor Family (MTT1)
An introduction to microcomputers based on the original MC6800 8-bit microprocessor and associated family devices.
4 days.

M68000 16-/32-bit Microprocessor Family (MTT8)
An advanced microcomputer course based on the M68000 16-/32-bit microprocessor family (MC68008 and MC68010).
4 days.

MC68020 32-bit Microprocessor (MTT20)
An advanced microcomputer course based on the MC68020 32-bit microprocessor family.
4 days.

Developing Systems with the MC68HC11 (MTT24)
An advanced course covering all phases of development with the 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 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.
4 days.

Call 1-800-521-6274
For a complete copy of our Technical Training Catalog

Technical Training Centers

Regional Training Centers

Austin
1701 Director's Blvd., Ste. 480
Austin, TX 78759
(512) 442-4944

Chicago
1295 E. Algonquin Rd.
Schaumburg, IL 60196
(312) 576-8600

Dallas
1200 E. Campbell Rd., Ste. 108
Richardson, TX 75081
(214) 699-3900

Phoenix
1140 S. Priest Dr.
Tempe, AZ 85281
(602) 994-6900

San Jose
1150 Kifer Rd.
Sunnyvale, CA 94086
(408) 749-0510

Toronto
4000 Victoria Park Ave.
North York, Ontario M2H 3P4
(416) 497-8181

Washington, D.C.
8945 Guilford Rd., Ste. 145
Columbia, MD 21045
(301) 381-1570

Worldwide Training Centers

Munich, West Germany
Phone: (89) 92103-571

Solna, Sweden
Phone: (8) 830200

Buckinghamshire, United Kingdom
Phone: (0296) 393312

Kwai Chung, N.T. Hong Kong
Phone: 0-223111

Vanves Cedex, France
Phone: (1) 47 36 03 41

Assago Milano, Italy
Phone: 928 22 01

Madrid, Spain
Phone: 457 82 04

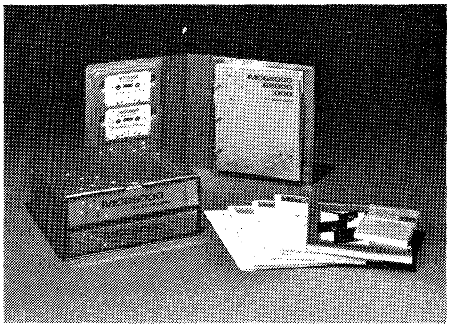
Ramat, Israel
Phone: 972-3-7538288

Cooperative Training Program

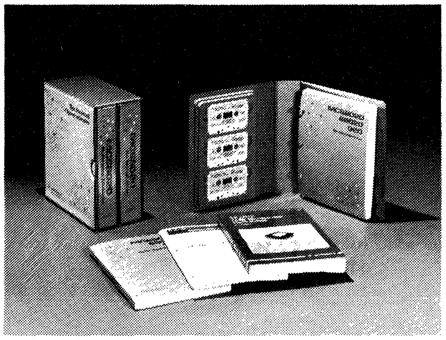
Motorola has teamed up with universities and professors across the country to present courses on its powerful M68000 Family of microprocessors. Courses are held at selected university campuses in the evenings and/or on Saturdays. These courses offer you the opportunity to obtain knowledge on the MC68000, MC68020 and MC68030 without the loss of scheduled work hours. If you would like more information on courses in your area, please call or write to Motorola Training and Technical Operations, P.O. Box 21007, Phoenix, AZ 85036, (602) 994-6900.

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 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

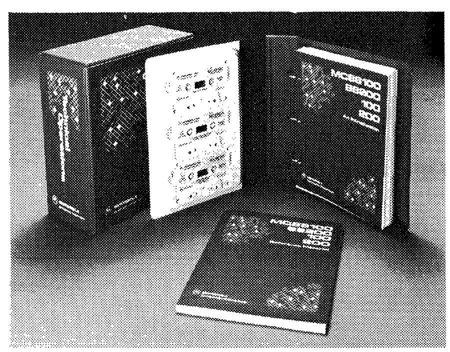
Course Description
The course is composed of three audio cassette tapes containing approximately three and one-half hours of material. Course notes for the tapes are supplied to aid the student. Each topic begins with clearly stated objectives, and continues with a comprehensive study of the subject including self-evaluation exercises (answers are provided). Upon successful completion, the student will have a working, technical knowledge of the MC68030.

An Introduction to the DSP56000/1
MTTA5 Audio Cassette Course

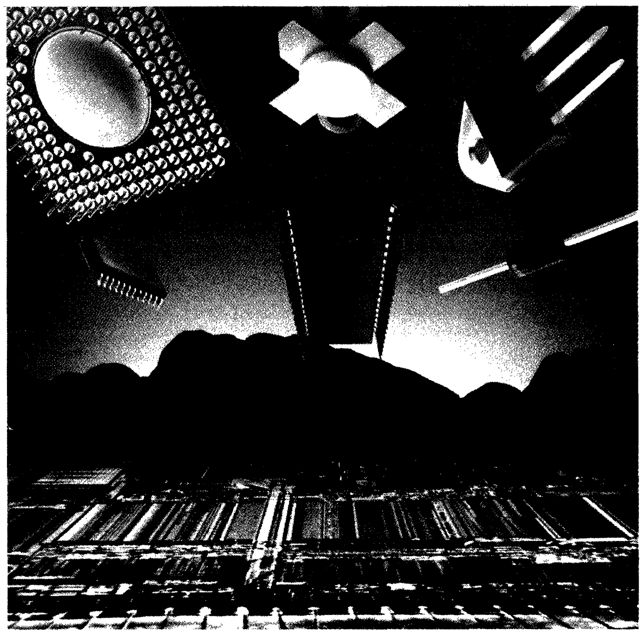
Course Description
This course is composed of three audio cassette tapes containing approximately four and one-half hours of material. For each topic, there will be stated objectives and self-evaluation exercises with answers. Upon completion the student will have a working, technical knowledge of the 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.**



Product Index
Subject Cross-Reference

In Brief . . .

Product 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 numerical sequence and then in an ascending alpha 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. The table also lists common semiconductor device and applications categories, and refers the user to the appropriate page(s) where matching products are described.

Product Index

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

PRODUCT INDEX (continued)

Abbreviations and Acronyms

(For page numbers, see Subject Cross Reference below.)

ASICs . . . . Application Specific ICs
BAM . . . . Bus Arbitration Module
BIC . . . . Broad Band Interface Controller
BIM . . . . Bus Interrupt Module
CQUAM . . . . . . CQUAM AM Stereo Decoders
DDMA . . . . Dual Direct Memory Access Controller
DLT Circuits . . . Digital Loop Transceiver Circuits
DMAC . . . . Direct Memory Access Controller
DSI Circuit . . . . Data Set Interface Circuit
DSP . . . . Digital Signal Processors
DTL Circuits . . . Diode-Transistor Logic
DUART . . . . Dual Universal Asynchronous Receiver
ECLinPS . . . . . . ECL in Picoseconds
EDDMA . . . . Expanded Dual DMA
EMS . . . . Energy Management Series
EPCI . . . . Enhanced Peripheral Communication Interface
EVB . . . . Evaluation Board
IGBTs . . . . Isolated Gate Bipolar Transistors
IPC . . . . Interface Parallel Controller
IRED . . . . Infrared Emitting Diodes
MFP . . . . Multifunction Peripheral Circuits
MMU . . . . Memory Management Unit
MPCC . . . . Multi-Protocol Communication Controller
PI/T . . . . Parallel Interface/Timer
PMMU . . . . Paged Memory Management Unit
SCI . . . . Serial Communications Interface
SLIC . . . . Subscriber Loop Interface Circuit
SOIC . . . . Small Outline Integrated Circuit Packages
SOT . . . . Small Outline Transistor Packages
SPA . . . . System Performance Analyzer
SPI . . . . Serial Peripheral Interface
TBC . . . . Token Bus Controller
TCD . . . . Temperature Compensated Diodes
TSAC . . . . Time Slot Assigner Circuit
UART . . . . (see DUART)
UDLT . . . . Universal Digital Loop Transceiver
UJT . . . . Unijunction Transistor

Subject Cross-Reference

APPLICATION SPECIFIC
INTEGRATED CIRCUITS (ASICs)

MICROCOMPUTER
COMPONENTS

STANDARD LOGIC FAMILIES

LINEAR and INTERFACE
INTEGRATED CIRCUITS

DISCRETE PRODUCTS

MILITARY PRODUCTS

PRODUCT LITERATURE and
TECHNICAL TRAINING

INDEX and SUBJECT
CROSS REFERENCE

MOTOROLA SEMICONDUCTOR SALES OFFICES

AMERICA'S DISTRICT OFFICES

ALABAMA, Huntsville	(205)830-1051
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CALIFORNIA, Agoura Hills	(818)706-1929
CALIFORNIA, Orange	(714)634-2844
CALIFORNIA, Sacramento	(916)922-7152
CALIFORNIA, San Diego	(619)560-5226
CALIFORNIA, San Jose	(408)749-0510
COLORADO, Colorado Springs	(719)599-7404
COLORADO, Denver	(303)337-3434
CONNECTICUT, Wallingford	(203)284-0810
FLORIDA, Maitland	(407)628-2636
FLORIDA, Pompano Beach/ Ft. Lauderdale	(305)486-9775
FLORIDA, St. Petersburg	(813)576-6035
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