SONY

Semiconductor IC

Data Book 1989

SPECL Standard Logic

SONY®

SPECL Standard Logic Family Semiconductor Integrated Circuit Data Book 1989

PREFACE

This date book contains device specifications for SONY SPECL* (SONY Picosecond ECL) Standard Logic Family capable of picosecond and GHz digital signal processing. The Family offers a single gate delay time of 410ps and a Flip-Flop toggle frequency of 3.0GHz while maintaining electrical compatibility to interface with existing 100K standard logic IC's.

SPECL Standard Logic Family was developed for the use of super high speed and high performance standard logic functions in such applications as measuring instruments, automatic testers, optical and wireless communications and computers.

SPECL Standard Logic Family is fabricated using a 0.6 micron emitter process with double poly-silicon electrode structure developed by SONY. The device has a transistor f_T of 10GHz and the chip has a propagation delay time of 100ps at the internal gate.

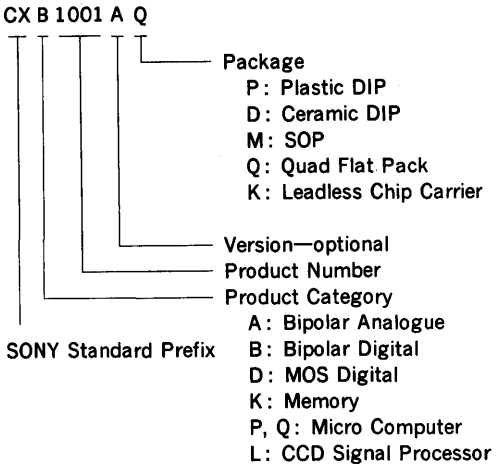
The family is designed using SONY E3G70 or E3G200 Gate Arrays. Specific functions can easily be implemented through close consultation with the user and ECL system design engineers.

SPECL Standard Logic Family is offered in a 30mil Quad Flat Package. This package feature reduced parasitics and good thermal conductivity for effective heat sinking. The high density surface mount it provides offers the user potential advantages.

*SPECL is a trade mark of SONY Corp. and pronounced "Special".

Numerical Index and Selection Guide

Nomenclature of IC product name



Numerical Index

Part Number	Function	*Speed	Number of Pins	Page
CXB1100Q	Quad 3-input OR/NOR Gate	410ps	24	5-4
CXB1101Q	Quad 3-input AND/NAND Gate	490ps	24	5-6
CXB1102Q	Quad EX-OR/NOR Gate	530ps	24	5-8
CXB1103Q	Quint Line Receiver with Differential I/O	430ps	24	5-10
CXB1104Q	Dual D Flip-Flop with Set, Reset and Differential I/O	3.2GHz	24	5-12
CXB1105Q	Triple Fan-out Buffers with Common Enable and Differential Output	660ps	24	5-14
CXB1106Q	4-bit Ripple Down Counter with Enable and Reset	3.0GHz	24	5-16
CXB1107Q	Decision Circuit with Differential I/O	2.3GHz	24	5-18
CXB1108Q	Laser Driver	2.0Gbps	16	5-20
CXB1109Q	Quad D Flip-Flop with Master Reset and Differential I/O	3.1GHz	24	5-24
CXB1110Q	16-Line to 1-Line Data Selector/Multiplexer	1170ps	24	5-26
CXB1111Q	4-bit Look-Ahead Carry Generator	700ps	24	5-28
CXB1112Q	Phase Frequency Detector with Differential I/O	800MHz	24	5-30
CXB1113Q	4-bit Multiplexer	1.8GHz	24	5-32
CXB1114Q	4-bit Demultiplexer	2.1GHz	24	5-38
CXB1130Q	9, 8, Dual 4-bit Multiplexer	1.6GHz	32	5-42
CXB1131Q	9, 8, Dual 4-bit Demultiplexer	1.5GHz	32	5-48
CXB1132Q	9, 8, Dual 4-bit Universal Shift Register	1.3GHz	32	5-56
CXB1133Q	22, 15, 7 Stage Data Scrambler with Differential I/O	1.4GHz	24	5-60
CXB1134Q	22, 15, 7 Stage Descrambler with Differential I/O	1.4GHz	24	5-64
CXB1135Q	8 to 16-bit Serial Data Comparator	1.4GHz	32	5-68
CXB1136Q	8-bit Universal Counter with Preset and Master Reset	1.1GHz	32	5-72
CXB1137Q	8-bit Shift Matrix	1450ps	24	5-76
CXB1138Q	4-bit Arithmetic Logic Unit (ALU)	1440ps	24	5-80
	New Products			
CXB1115Q	1 to 10 Clock Distributor	760ps	32	5-86
CXB1116Q	4 bit Ripple Up/Down Counter with Enable and Reset	3.0GHz	24	5-88
CXB1139Q	Programmable Delay Line/Duty Cycle Controller	760ps-4650ps	24	5-90

Note: * ; Typical Value

Functional Index

Gates

Function	Part Number	Page
Quad 3-input OR/NOR Gates	CXB1100Q	5-4
Quad 3-input AND/NAND Gates	CXB1101Q	5-6
Quad EX-OR/NOR Gates	CXB1102Q	5-8

Buffers/Inverters

Function	Part Number	Page
Quint Line Receivers with Diff. I/O	CXB1103Q	5-10
Triple Fan-Out Buffers with common Enable and Diff. output	CXB1105Q	5-14

Flip-Flops

Function	Part Number	Page
Dual D-FF with Set, Reset and Diff. I/O	CXB1104Q	5-12
Decision Circuit with Diff. I/O	CXB1107Q	5-18
Quad D-FF with Master Reset and Diff. I/O	CXB1109Q	5-24

Multiplexers

Function	Part Number	Page
16 Line to 1 Line Data Selector/Multiplexer	CXB1110Q	5-26
4-bit Multiplexer	CXB1113Q	5-32
9, 8, Dual 4-bit Multiplexer	CXB1130Q	5-42

Demultiplexers

Function	Part Number	Page
4-bit Demultiplexer	CXB1114Q	5-38
9, 8, Dual 4-bit Demultiplexer	CXB1131Q	5-48

Counters

Function	Part Number	Page
4-bit Ripple Down Counter with Enable and Reset	CXB1106Q	5-16
8-bit Universal Counter with Preset and Master Reset	CXB1136Q	5-72

Arithmetic Operators

Function	Part Number	Page
4-bit Look-Ahead Carry Generator	CXB1111Q	5-28
4-bit Arithmetic Logic Unit (ALU)	CXB1138Q	5-80
8-bit Shift Matrix	CXB1137Q	5-76

Shift Registors

Function	Part Number	Page
9, 8, Dual 4-bit Universal Shift Register	CXB1132Q	5-56

Parallel to Serial Converters

Function	Part Number	Page
4-bit Multiplexer	CXB1113Q	5-32
9, 8, Dual 4-bit Multiplexer	CXB1130Q	5-42

Serial to Parallel Converters

Function	Part Number	Page
4-bit Demultiplexer	CXB1114Q	5-38
9, 8, Dual 4-bit Demultiplexer	CXB1131Q	5-48

Data Scrambler/Descrambler

Function	Part Number	Page
22, 15, 7 stage Scrambler with Diff. I/O	CXB1133Q	5-60
22, 15, 7 stage Descrambler with Diff. I/O	CXB1134Q	5-64

Special Functions

Function	Part Number	Page
Decision Circuit with Diff. I/O	CXB1107Q	5-18
Laser Driver	CXB1108Q	5-20
Phase Frequency Detector with Diff. I/O	CXB1112Q	5-30
8 to 16-bit Serial Data Comparator	CXB1135Q	5-68

General Information

Chapter 2. General Information

General Information

1. SPECL Standard Logic Family

SPECL Standard Logic Family was designed to meet engineers' requirements in which the existing 10K/10KH and 100K ECL (Emitter Coupled Logic) families are not sufficient in their propagation delay time and edge rate to realize state of the art systems.

SPECL Standard Logic Family operates with −4.5V power supply and has a capability of driving 50 Ω load into −2V termination voltage. The logic circuit employs an emitter coupled logic with reduced voltage swing in internal gates to increase speed, while maintaining direct interface compatibility to existing ECL logics. The internal gate utilizes two stage series gating and is biased by a stabilized reference voltage source.

The family has the following characteristics:

- Low propagation delay time ....100ps internal gate
- Fast edge rate ....200ps tr and tf
- Very small pin-to-pin time skew 40ps
- Excellent AC characteristics ....3.0GHz Flip-Flop toggle frequency
- Compatibility with existing ECL logics and memories
- Temperature compensation over wide temperature range
- Wide operation voltage range
- Simultaneous complementary outputs
- Good noise immunity
- Internal series gating and reduced internal voltage swing
- High gain transfer characteristics
- Low input capacitance 3pF
- External wired-OR capability
- Internal 27KΩ input termination

A basic ECL inverter circuit used in the family is shown in Figure 1. All input ports of the family IC have termination resistors as shown in the figure.

When an input terminal is left open, this resistor network pulls down this terminal voltage to −2V, keeping it to logic Low voltage level.

Input voltage of standard ECL logic level is translated into internal logic level by the input buffer. The internal logic level is designed to be 400mV to obtain higher speed in internal circuit.

The internal voltage swing is again translated into standard ECL logic level and buffered to drive an external circuit in the output buffer stage. Data outputs are provided by emitter follower transistors.

An internal temperature stabilized voltage reference is implemented in the circuit to provide a threshold voltage for interfacing with the external circuit and internal biasing.

Input and output terminals are guarded against an ESD (Electro Static Discharge) by protection diodes and resistors.

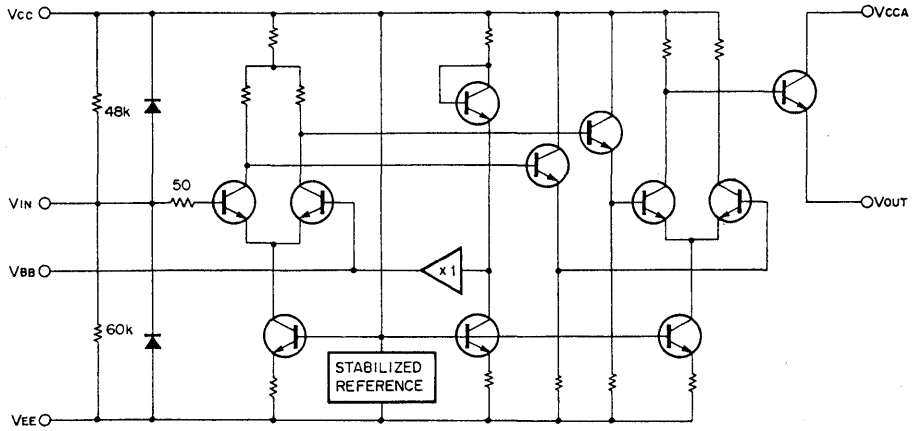
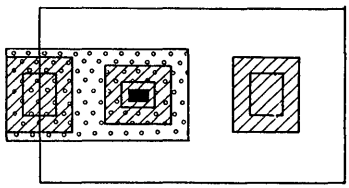


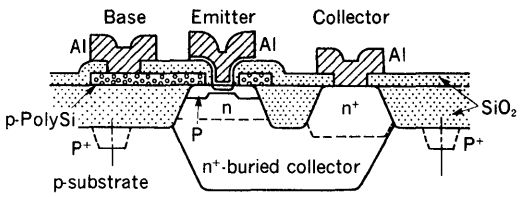
Figure 1. Basic ECL Inverter Circuit

2. Fablication Process of SPECL

SPECL Standard Logic Family is fabricated on a double poly-silicon electrode process developed by SONY. This process realizes an emitter width of 0.6microns, a base dimension of 2.4microns × 3.0 microns and a transistor cell size of 9.6 × 16microns for the minimum geometry. Very small size and dimensions offer very high transistor ft of 10GHz and very low parasitic capacitances. Furthermore, the process offers a poly-silicon resistor with very low parasitics and a low temperature coefficient.



(b)



(a)

Figure 2.

Figures 2-a and 2-b show the cross section and minimum geometry of the transistor.

This structure has three excellent features in comparison with a convensional structure.

(1) The emitter is self-aligned to the base poly-silicon electrode, and has a width of 0.6microns. A spacer dielectric 0.3microns thick separates base and emitter electrode reducing extrinsic base region.

(2) The base electrode is formed by the poly-silicon encircling the emitter region to make contact with the external circuit. This structure makes a base resistance small and also reduces extrinsic base region and base parasitics.

(3) The emitter electrode is formed by a thin poly-silicon to reduce junction depth and enhance an emitter efficiency.

Figure 3 shows a transistor ft as a function of collector current.

The maximum ft of 10GHz is attained by this structure. Table 1 shows electric characteristics of the transistor.

Table 1. Transistor Parameters

h_{FE}	100
BV_{CEO}	6.5V
BV_{CBO}	20V
BV_{EBO}	4.0V
C_{CB}	10fF
C_{BE}	8fF
C_{CS}	30fF
f_T	10GHz
tpd (Ring Osc.)	75ps

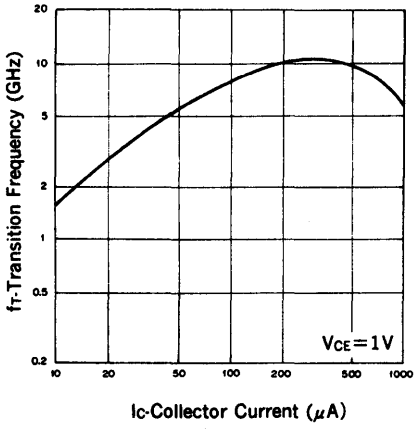


Figure 3. f_T vs Ic

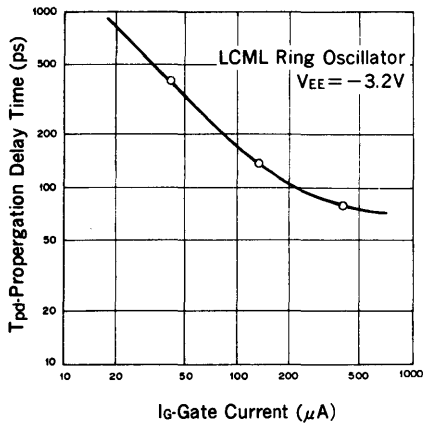


Figure 4. Propagation Delay Time measured by an LCML Ring oscillator

3. Definition of Letter Symbols and Terms

I_{EE} Total power supply current drawn from the negative power supply V_{EE}.

I_I Current into the input pin of the device.

I_{IH} HIGH level input current into the input pin with a specific HIGH level (V_{IHMAX}) voltage applied.

I_O Output current from the device.

V_{CC} Circuit ground for the device. This is the most positive potential of the system and is used as the reference level for other voltages.

V_{CCA} Circuit ground for output emitter follower transistor.

V_{EE} Negative power supply voltage for the device (usually −4.5V for the family). This is the most negative potential in the system.

V_{BB} Reference bias voltage which is used as input and output threshold level.

V_{IN} Input voltage to the device.

V_{IH} Input logic HIGH voltage level.

V_{IL} Input logic LOW voltage level.

V_{OH} Output logic HIGH voltage level: The voltage level at an output terminal for a specified output current or load, with the specified conditions applied to establish a HIGH level at the output.

V_{OL} Output logic LOW voltage level: The voltage level at the output terminal for a specified output current or load, with the specified condition applied to establish a LOW level at the output terminal.

V_{TT} Line load-resistor terminating voltage (usually −2V for the Family) for outputs from the device.

T_{pd} Propagation delay time, input to output.

T_{PLH} Propagation delay time, input to output rising edge from the 50% point of input waveform at the pin to the 50% point of output waveform at the pin.

T_{PHL} Propagation delay time, input to output falling edge from the 50% point of input waveform at the pin to the 50% point of output waveform at the pin.

T_{TLH} Waveform rise time from 20% to 80%.

T_{THL} Waveform fall time from 80% to 20%.

T_S Setup time: The minimum time (50% to 50%) before transition of the clock pulse that information must be present at the Data input terminal to insure proper operation of the device.

T_h Hold time: The minimum time (50% to 50%) after the transition of the clock pulse that information must remain unchanged at the Data input terminal to insure proper operation.

$T_{SG\text{-}G}$ Gate to gate time skew

T_R Release time: The minimum time (50% to 50%) before transition of the clock pulse where Set or Reset must be released at the Set or Reset input terminal to insure proper operation.

T_{PW} Pulse width: The minimum pulse width (50% to 50%) of Set or Reset pulse at the Set or Rest input terminal to insure proper operation.

f_{MAX} Maximum Toggle frequency of a flip-flop or counter device, maximum Shift frequency of a shift register, or maximum frequency at that the output waveform level decreases 3dB down from DC level with specified condition applied to input terminal.

T_{stg} Maximum temperature at which device may be stored without damage or performance degradation.

T_j Junction temperature of the device.

T_a Ambient (environment) temperature.

θ_{ja} Thermal resistance of an IC package, junction to ambient.

θ_{jc} Thermal resistance of an IC package, junction to case.

C_{IN} Input capacitance at input terminal.

C_{OUT} Output capacitance at output terminal.

R_L Load resistance for output.

R_P An input pull-down resistor.

R_T Termination load resistor to V_{TT}.

4. Technical Data

VOLTAGE TRANSFER CURVES

SPECL Standard Logic Family permits direct interface with slower prevailing ECL logic families and ECL memories.

The typical voltage swing is 780mV and all voltage levels are specified with a 50Ω load to −2V at all outputs to provide transmission line drive capability.

The voltage transfer characteristics for the differential outputs are represented by two curves: one to describe OR output and one to describe NOR output.

Typical transfer curves are shown in Figure 5-a for case temperature ranges of 0°C to +125°C.

An IC has a temperature stabilized voltage reference source inside it, and has very small temperature coefficient for switching threshold (V_{BB}). V_{OH} and V_{OL} depend slightly on temperature. This is because the compensation network for an output stage is eliminated to provide maximum transition speed at the output terminal. In spite of this compromise, the noise margin is maintained over a wide temperature range.

Figure 5-b shows the change in transfer curves vs. change in supply voltage.

The voltage gain at the transition point of OR/NOR gate is typically 15 in contrast to the small gain of 4 in prevailing ECL families. The high voltage gain and good temperature stability of threshold voltage ensures a large noise margin.

OUTPUT CHARACTERISTICS

As the output terminal has an inherently low output impedance, a relatively constant output level is maintained for the change of output current.

Figure 8 shows output characteristic vs. output termination.

CHANGE IN I_{EE} vs. CHANGE IN V_{EE} and TEMPERATURE

As shown in Figure 10, V_{EE} power supply current also remains relatively constant over the specified voltage range (−4.2V to −4.8V); therefore the propagation delay time is relatively constant versus power supply voltage.

Figure 11 shows change in I_{EE} vs. change in temperature.

CHANGES IN TRANSITION CHARACTERISTICS vs. LOAD CAPACITANCE

All of the AC characteristics are measured using a strip-line test fixture and a sampling oscilloscope. The load capacitance of the fixture is less than 2pF. Figure 12 shows the typical characteristics of a dependence of the propagation delay time and rise/fall time on the load capacitance.

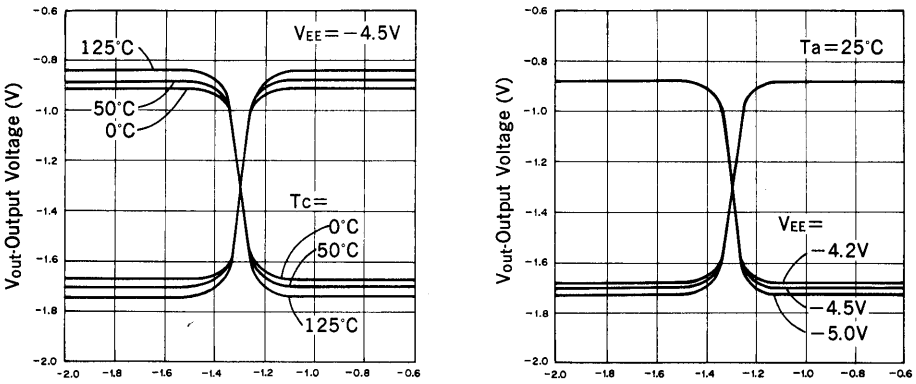


Figure 5. Transfer characteristics

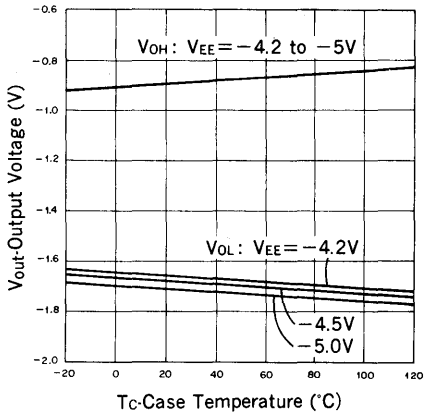


Figure 6. Change in Output Voltage vs Change in Case Temperature

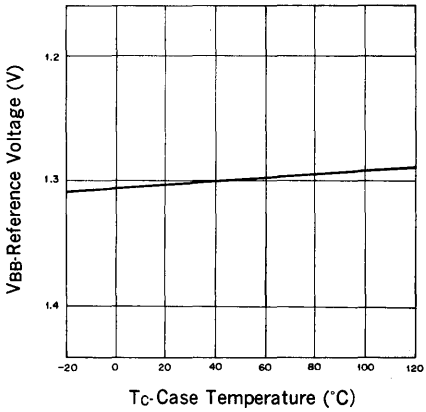


Figure 7. Change in Reference Voltage vs Change in Case Temperature

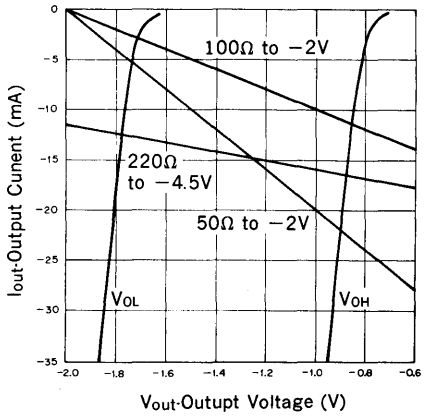


Figure 8. Output characteristics vs Output Termination

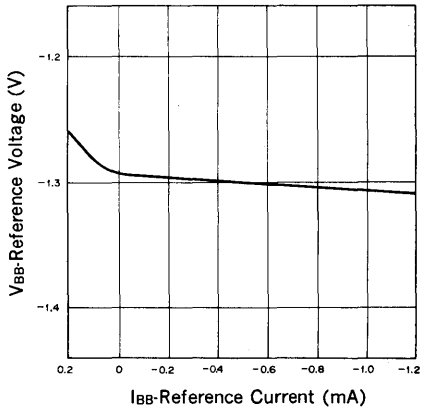


Figure 9. Change in Reference Voltage vs Reference current

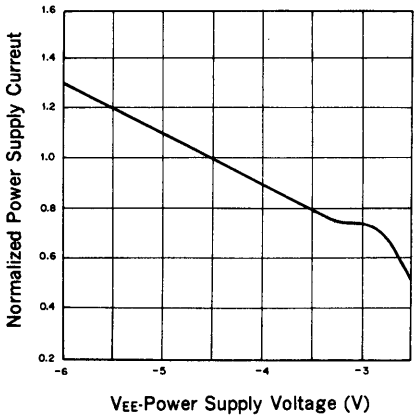


Figure 10. Change in I_{EE} vs. Change in V_{EE}

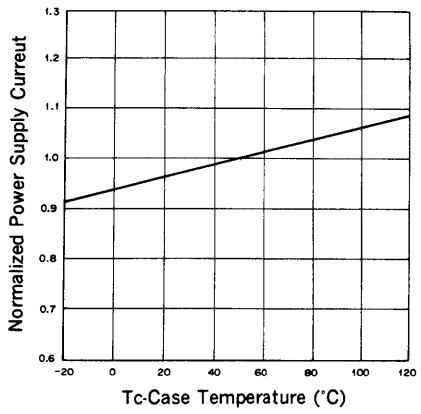
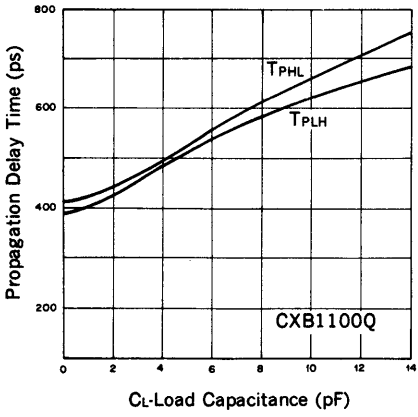


Figure 11. Change in I_{EE} vs Change in Case Temperature



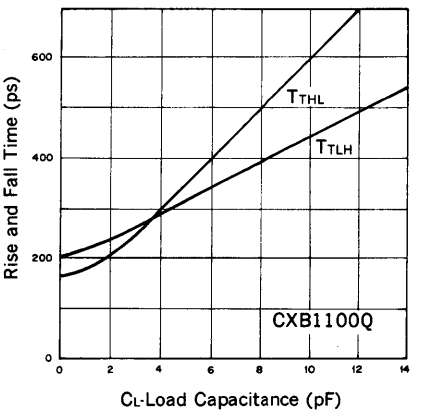


Figure 12. Transition Characteristics vs. Load Capacitance

5. Handling Precautions

Explained below are procedures that must be taken in fabrication to prevent the electrostatic destruction of semiconductor devices.

The following basic rules must be obeyed.

① Equalize potentials of terminals when transporting or storing.

② Equalize the potentials of the electric device, work bench, and operator's body that may come in contact with the semiconductor device.

③ Prepare an environment that does not generate static electricity.
One method is keeping relative humidity in the work room to about 50%.

Operator

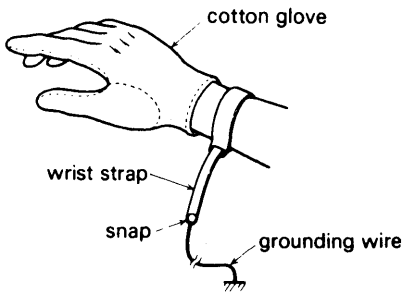
(1) Clothes

Do not use nylon, rubber and other materials which easily generate static electricity. For clothes, use cotton, or antistatic-treated materials. Wear gloves during operation.

(2) Grounding of operator's body

The operator should connect the specified wrist strap to his arm. If the wrist strap is not available, then the operator should touch the grounding point with his hand, before handling any semiconductor device.

example of grounding band



When using a copper wire for grounding, connect a 1MΩ resistance in series near the hand for safety.

Equipment and tools

(1) Grounding of equipment and tools

Ground the equipments and tools that are to be used. Check insulation beforehand to prevent leakage.

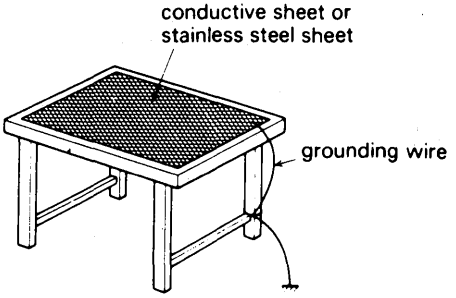
[Check point]

- measuring instrument
- conveyer
- electric deburr brush
- carrier
- solder dipping tank
- lead cutter
- shelves and racks

(2) Grounding of work table

Ground the work table as illustrated. Do not put anything which can easily generate static electricity, such as foam styrol, on the work table.

grounding of work table



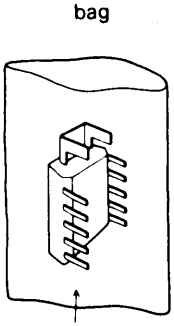
(3) Semiconductor device case

Use a metal case, or an antistatic plastic case (lined with conductive sheet or aluminum foil).

Transporting, storing and packaging methods

(1) Bag

Use a conductive bag to store ICs. If the use of a vinyl bag is unavoidable, be sure to wrap the IC with aluminum foil.



(2) Handling of mounted substrates

Wear cotton gloves when handling. As far as possible, avoid touching soldered faces. When handling mounted substrates individually, be sure to use a conductive or paper bag. Do not use a polyethylene bag.

Resistance to soldering heat

(1) Specification of JIS

JIS specifies the method for testing the resistance to soldering heat. This method is used for guaranteeing the IC resistance against thermal stresses by soldering. An abstract of this standard is as follows:

- Dip the device terminal only once for 10 ± 1 seconds in a solder bath of $260°C \pm 5°C$, or for $3^{+0.5}_{-0}$ seconds in a solder bath of $350°C \pm 10°C$, for a distance of up to 1 to 1.5 mm from the main body.

  For the solder flow system temperature should be 260 °C ±5 °C. To solder by soldering iron temperature should be 350 °C ±10 °C.
- Leave the device for more than two hours after dipping, then measure the device characteristics.
- Normally, the warranty is limited to 10 seconds at 260 °C ±5 °C. The distance between the device main body and solder bath is 1.6 mm.

6. Quality Assurance and Reliability

Sony's Policy of Quality Assurance

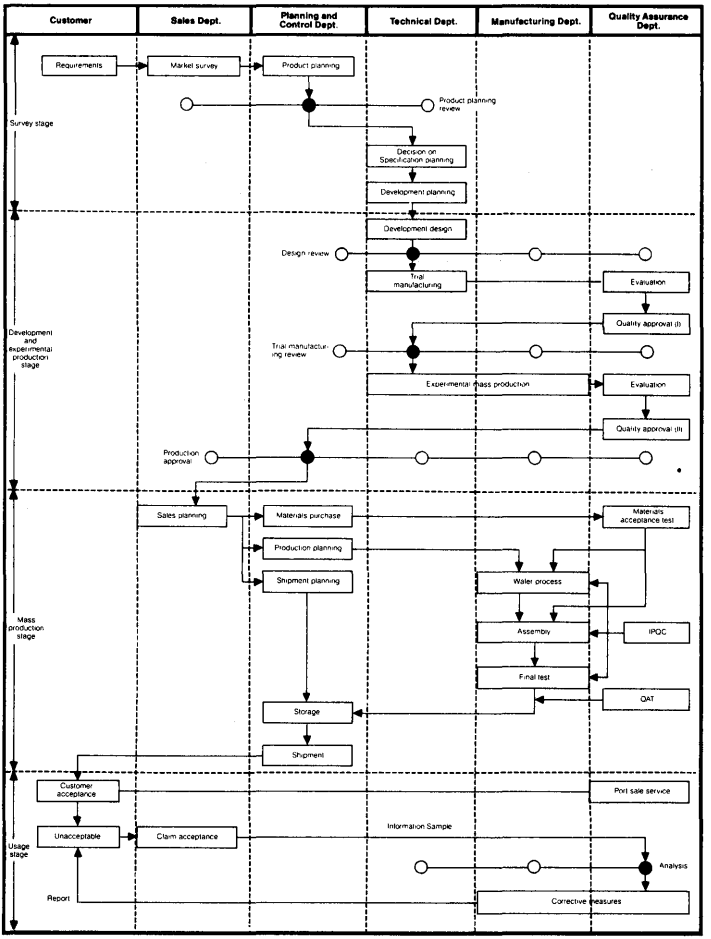
The Sony semiconductor embodies two fundamental ideas: "highest quality" and "lowest cost". These are the two key points for realizing such ideas.

One is the "quality" of men fabricating the semiconductor devices. The reliability of these people is reflected in the Sony products. Accordingly, Sony is making a continuous effort to raise the "quality" of people capable of manufacturing and fabricating Sony semiconductor devices.

The other point is a source management system combined with the concept of thorough quality design. With this system, higher quality products can be steadily manufactured through automation of device design, process design, and the fabrication process.

Sony is making constant efforts to supply the most economical and most useful products of very high quality to users.

Quality assurance system of semiconductor products



Quality assurance criteria and reliability test criteria

1) Quality assurance in shipping

Establishing quality in the design and in fabrication is essential to keep the quality and reliability levels of the semiconductor devices at a high level. This is done by the "Zero-defect" (ZD) movement. Further sampling checks, in units of shipping lot, is done on products that have been "totally-inspected" at the final fabrication stage, thus ensuring no defective items. This sampling inspection is done in accordance with MIL-STD-105D.

2) Reliability

The reliability test is done, periodically, to confirm reliability level.

Periodical reliability test

Item		Test Hour	LTPD
Electrical characteristic test		In order to establish the quality level, some types are selected and tested again.	
LIFE TEST	High temperature operation	Up to 1000 hr	10%
	High temperature storage	Up to 1000 hr	10%
	Low temperature storage	Up to 1000 hr	10%
	High temperature and high humidity storage	Up to 1000 hr	10%
	High humidity bias test	Up to 1000 hr	10%
	High temperature and high humidity with bias	Up to 500 hr	10%
	Pressure cooker	Up to 200 hr	10%
ENVIRONMENT TEST	Soldering heat resistance heat cycle	10 s	15%
	Heat cycle	10 cycle	15%
MECHANICAL TEST	Solderability	Japan Industrial Standard (JIS)	15%
	Lead strength		15%
OTHER TESTS	If necessary, tests are selected according to JIS C7021, C7022, EIAJ SD121, IC121.		

• These tests are selected by sampling standard.

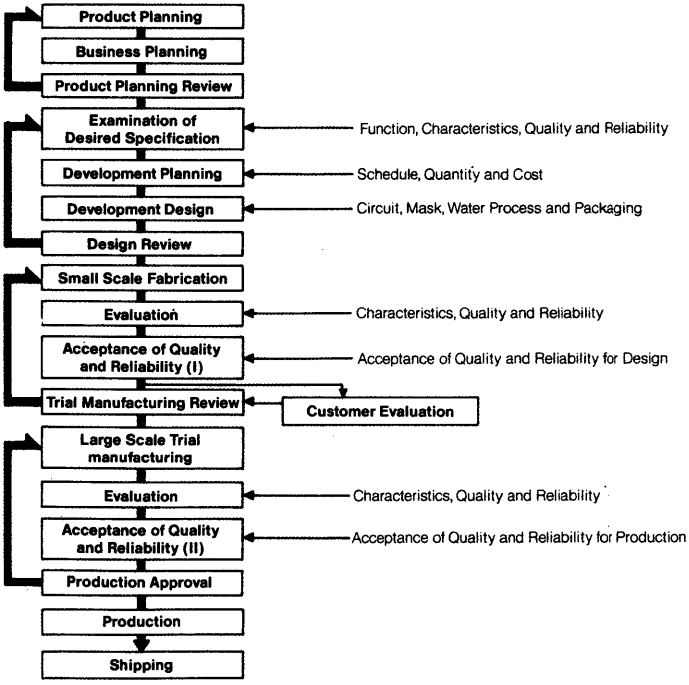
These tests and Inspection data are useful not only to improve design and wafer processes, but also serve to forecast reliability at the consumer level.

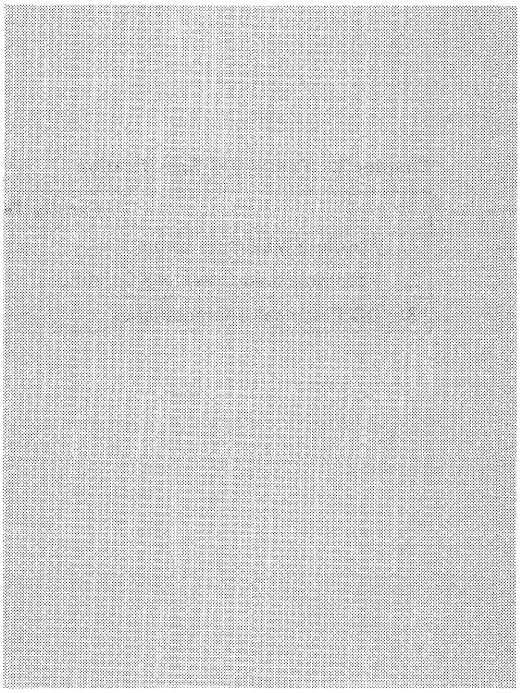
Reliability test standard for acceptance of products

Type of Test	Condition	Supply voltage	Testing time	LTPD
High temperature operation	Ta = 125°C, 150°C	Typ	1000 hr	5%
High temperature with bias	Ta = 125°C, 150°C	Typ	1000 hr	5%
High temperature storage	Ta = 150°C		1000 hr	5%
Low temperature storage	Ta = − 65°C		1000 hr	5%
High temperature and humidity storage	Ta = 85°C, 85%RH		1000 hr	5%
High temperature and High humidity with bias	Ta = 85°C, 85%RH	Typ (1 hr on/3 hr off)	1000 hr	5%
Pressure cooker	Ta = 121°C, 100%RH, 30 pounds per square inch		200 hr	5%
Temperature cycle	Ta = − 65°C to + 150°C		100 C	10%
Heat shock	Ta = 0°C to + 100°C		5 C	10%
Soldering heat resistance	Tsolder = 260°C		10 S	10%
Solderability	Tsolder = 230°C (Rosin type flux)		5 S	10%
Mechanical shock	X, Y, Z 1500G 0.5 ms half sine wave		3 times for each direction	10%
Vibration	X, Y, Z 20G 10 to 2000 to 10 Hz (4 min) sine wave vibration		16 minutes for each direction	10%
Constant acceleration	X, Y, Z 20,000 G centrifugal acceleration		1 minute for each direction	10%
Fall by gravity	Falling from the height of 75cm to maple plate by gravity		3 times	10%
Lead strength (Bend) (Pull)	Japan Industrial Standard (JIS)			10%
Electrostatics strength	Device must be designed again, when electrostatic strength is below standard supplying surge voltage To each pin under the conditions of C = 200PF and Rs = 0 Ω.			

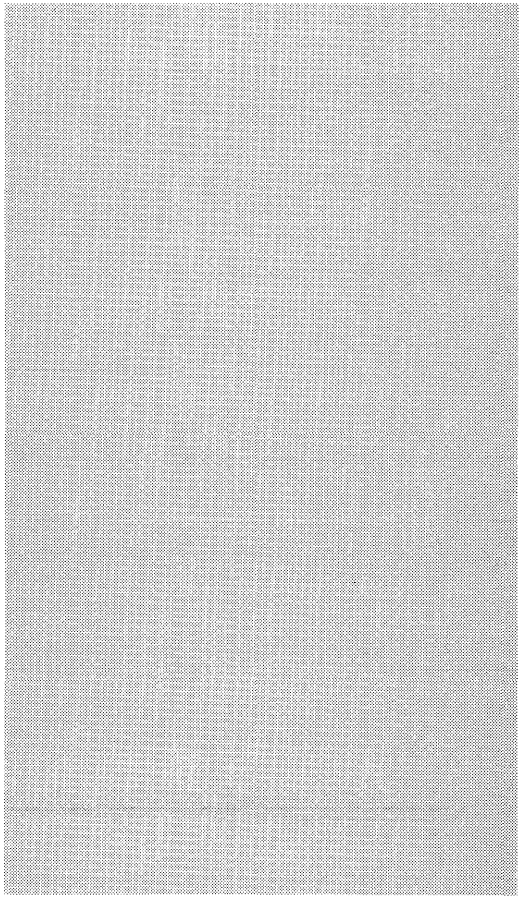
Flow Chart from Development to Manufacturing

Sony attains high quality and high reliability of semiconductor products by designing devices with quality and reliability from the initial steps of development and evaluating them sufficiently in each step of the development.





Family DC Specification



Chapter 3. Family DC Specification

Family DC Specification

DC characteristics specified in this section apply to each member of the Family unless otherwise specified on the individual device data sheet.

Each member of the Family is electrically compatible with existing ECL 100K.

Absolute Maximum Ratings $V_{CC}=V_{CCA}=0V$

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{EE}	+0.3 to −6	V
Input voltage	V_I	0 to −4	V
Output current — Continuous — Surge	I_O	 0 to 50 0 to 100	mA
Operating case temperature	T_C	−55 to 125	°C
Storage temperature	T_{stg}	−65 to 150	°C

Stresses greater than these conditions may cause permanent damage to the devices or affect their reliability.

Input terminal should not be connected to V_{EE} for logic LOW level. LOW voltage level is maintained with input pins left open.

Recommended Operating Conditions $V_{CC}=V_{CCA}=0V$

Item	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{EE}	−4.2	−4.5	−4.8	V
Output termination to $V_{TT}=-2V$	R_T	45	50		Ω
Operating case temperature	T_C	0		85	°C

The devices should be operated under these conditions, beyond which the parametric values are not specified.

DC Electrical Characteristics

$V_{EE}=-4.5V$ ($V_{CC}=V_{CCA}=GND$, $T_C=0°C$ to $85°C$, $R_L=50\Omega$ to $V_{TT}=-2V$)

Symbol	Characteristic	Conditions	Min.	Typ.	Max.	Unit
V_{OH}	Output HIGH voltage	$V_{IN}=V_{IH}$ (max)	−1025	−880	−810	mV
V_{OL}	Output LOW voltage	or V_{IL} (min)	−1810	−1700	−1620	mV
V_{IH}	Input HIGH voltage		−1165		−810	mV
V_{IL}	Input LOW voltage		−1810		−1475	mV
I_{IH}	Input HIGH current	$V_{IN}=V_{IH}$ (max)			120	μA
V_{BB}	Reference bias voltage		−1380	−1320	−1260	mV

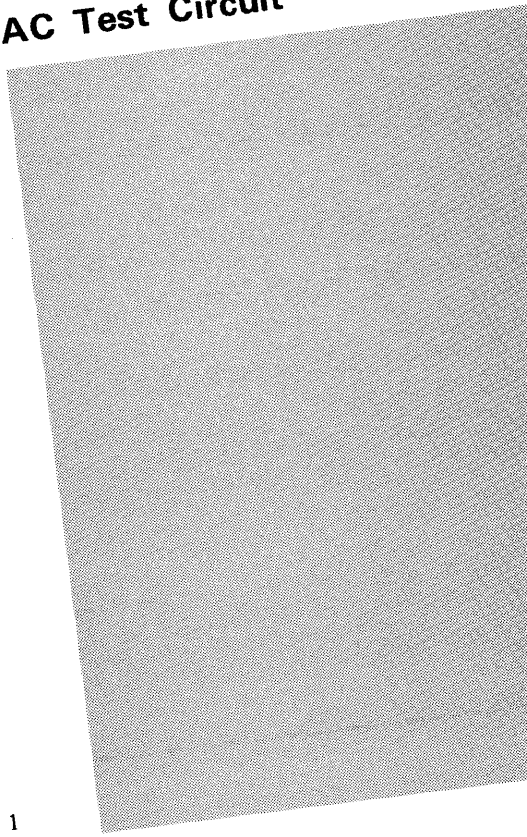
$V_{EE}=-4.2V$ ($V_{CC}=V_{CCA}=GND$, $T_C=0°C$ to $85°C$, $R_L=50\Omega$ to $V_{TT}=-2V$)

Symbol	Characteristic	Conditions	Min.	Typ.	Max.	Unit
V_{OH}	Output HIGH voltage	$V_{IN}=V_{IH}$ (max)	−1020	−880	−810	mV
V_{OL}	Output LOW voltage	or V_{IL} (min)	−1790	−1680	−1605	mV
V_{IH}	Input HIGH voltage		−1165		−810	mV
V_{IL}	Input LOW voltage		−1790		−1475	mV
I_{IH}	Input HIGH current	$V_{IN}=V_{IH}$ (max)			120	μA
V_{BB}	Reference bias voltage		−1380	−1320	−1260	mV

$V_{EE}=-4.8V$ ($V_{CC}=V_{CCA}=GND$, $T_C=0°C$ to $85°C$, $R_L=50\Omega$ to $V_{TT}=-2V$)

Symbol	Characteristic	Conditions	Min.	Typ.	Max.	Unit
V_{OH}	Output HIGH voltage	$V_{IN}=V_{IH}$ (max)	−1035	−880	−810	mV
V_{OL}	Output LOW voltage	or V_{IL} (min)	−1840	−1730	−1620	mV
V_{IH}	Input HIGH voltage		−1165		−810	mV
V_{IL}	Input LOW voltage		−1840		−1475	mV
I_{IL}	Input HIGH current	$V_{IN}=V_{IH}$ (max)			120	μA
V_{BB}	Reference bias voltage		−1400	−1340	−1280	mV

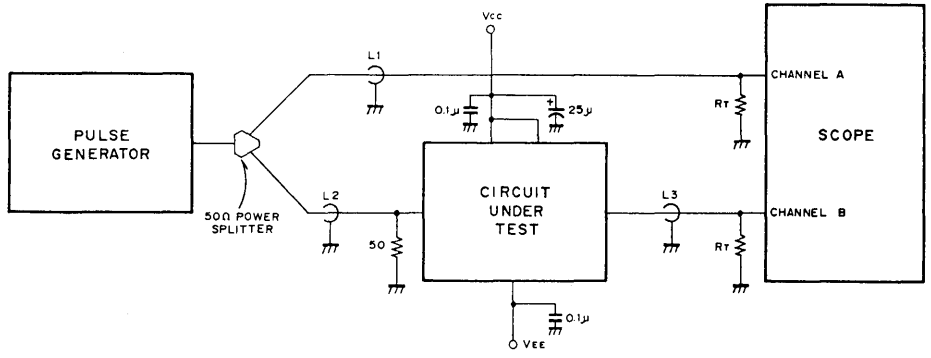
AC Test Circuit



Chapter 4. AC Test Circuit

AC Test Circuit

Propagation Delay and Transition Time



V_{CC}, V_{CCA} = +2V, V_{EE} = −2.5V
L1 = L2 + L3 50Ω coaxial cables
R_T = 50Ω terminator
Complementary input is connected to V_{BB} = +0.68V.
All unused outputs are loaded with 50Ω to GND.
C_L = Fixture and stray capacitance ≤ 2pF

Figure 1. AC Test Circuit

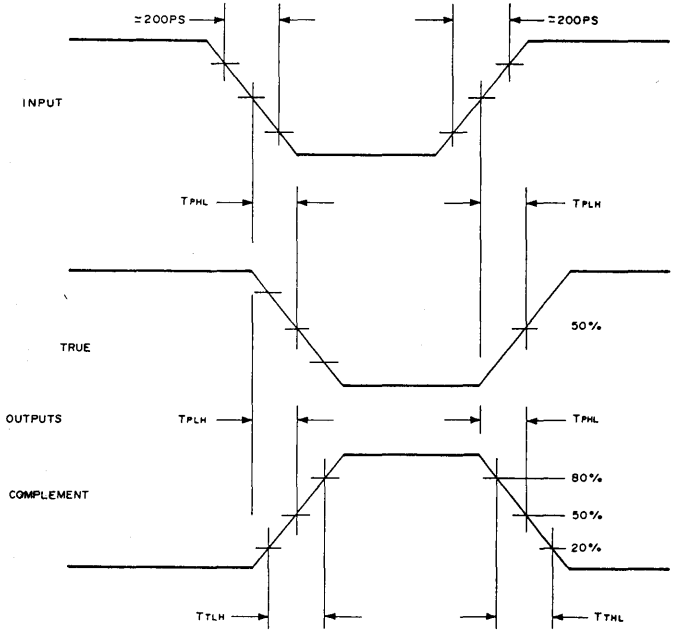


Figure 2. Propagation Delay and Transition time

Propagation Delay (Clock, Set, Reset), Transition Time, Data Setup/Hold Time and Release Time

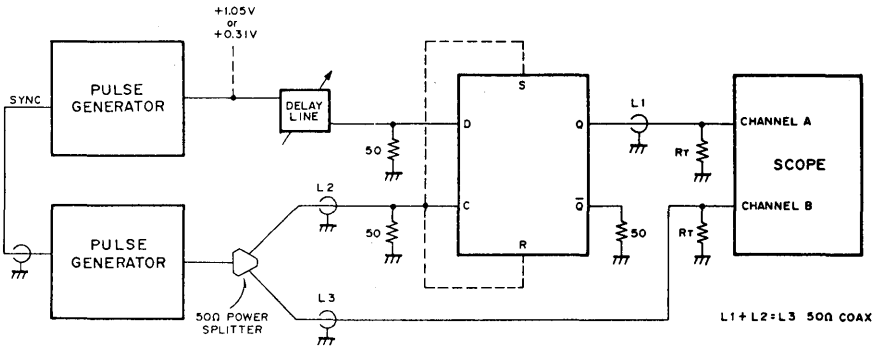


Figure 3. AC Test Circuit (Flip-Flop)

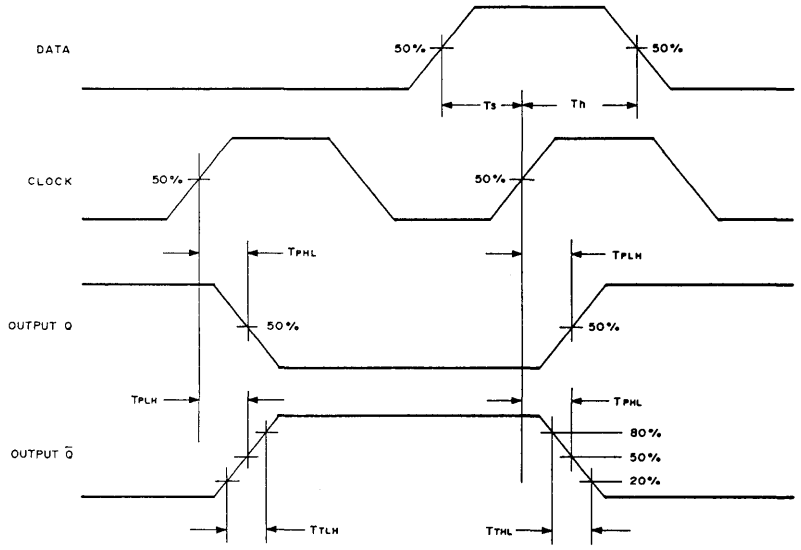


Figure 4. Propagation Delay (Clock), Transition Time and Data Setup/Hold Time

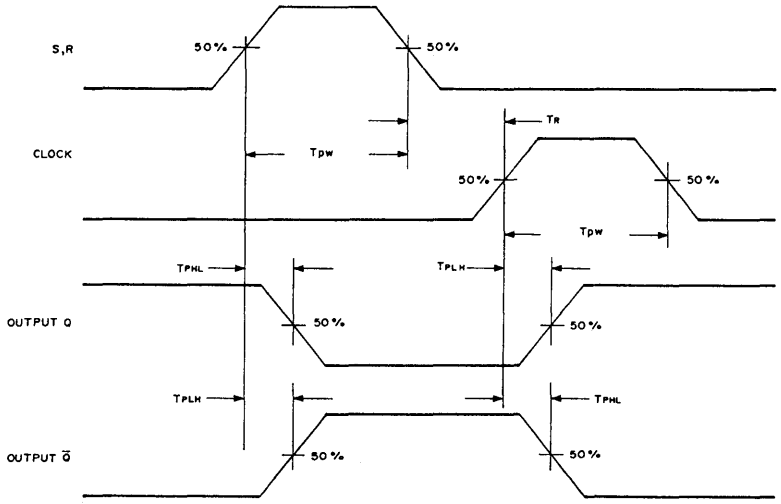
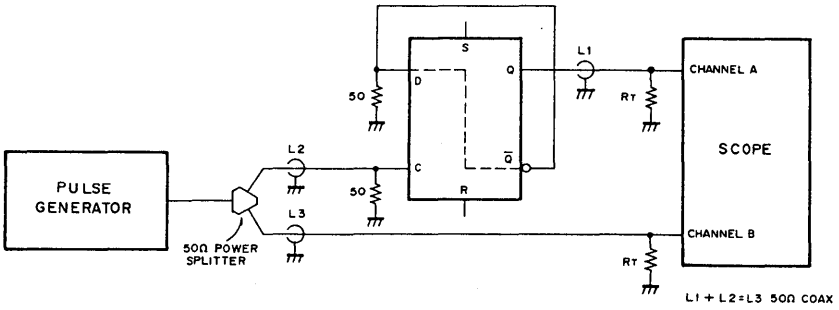


Figure 5. Propagation Delay (Set, Reset) and Release Time

Toggle Frequency



Some parts have an internal feed back loop from $\overline{Q}$ to D.

Figure 6. Toggle Frequency Test Circuit

SONY

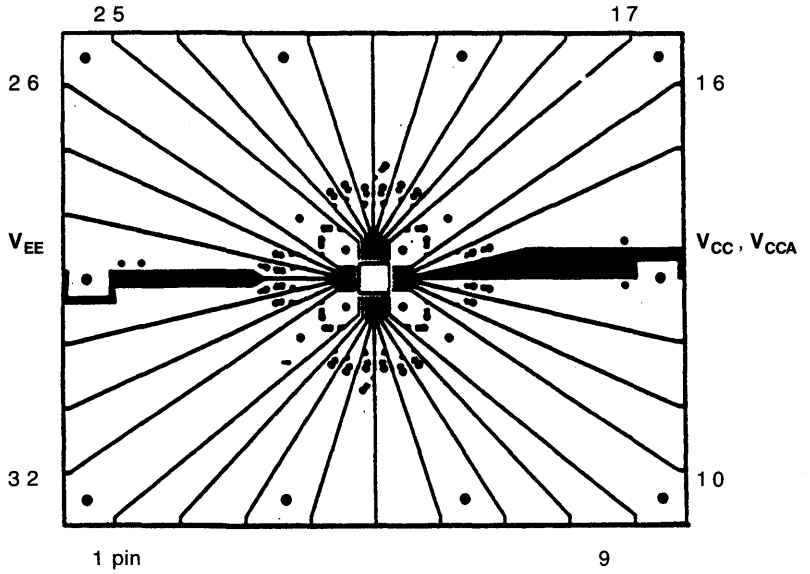
SPECL Evaluation Board

The evaluation boards for SPECL devices.

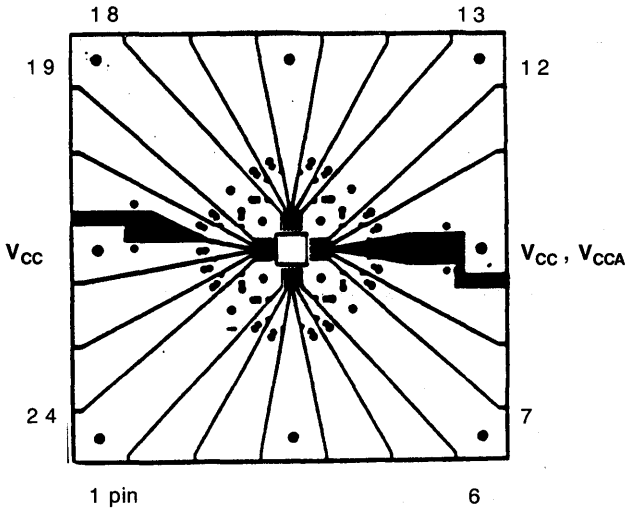
Abstract

On the evaluation board, using Epsilam-10 (ϵ = 10.2, t = 0.64mm), the characteristics impedance of microstrip line is 50 Ω. The SMA connector is already assembled at the input or output terminals and the device can be replaceable with the screw socket.

32 pin FQFP package



24 pin FQFP package

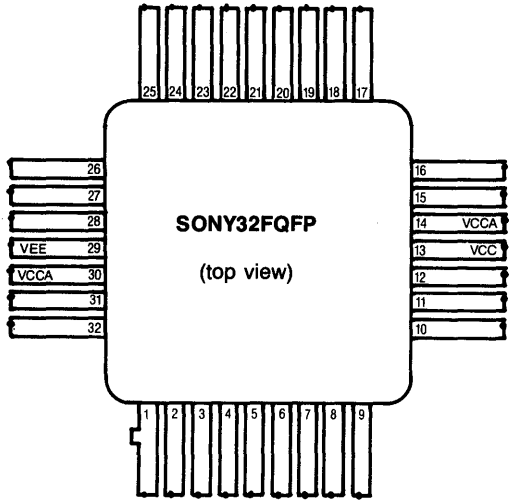


Delay time due to the microstrip line

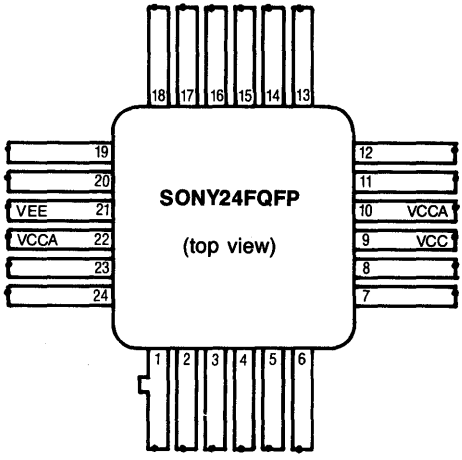
Package	Pin number	Delay time
24 pin FQFP	1, 6, 7, 12, 13, 18, 19, 24	420 psec
	2, 5, 8, 11, 14, 17, 20, 23	365 psec
	3, 4, 15, 16, 22	330 psec
32 pin FQFP	10, 16, 26, 32	575 psec
	1, 9, 17, 25	565 psec
	11, 15, 27, 31	535 psec
	2, 8, 12, 18, 24, 28, 30	490 psec
	3, 7, 19, 23	430 psec
	4, 6, 20, 22	390 psec
	5, 21	375 psec

Delay Time : 8.2 psec/mm

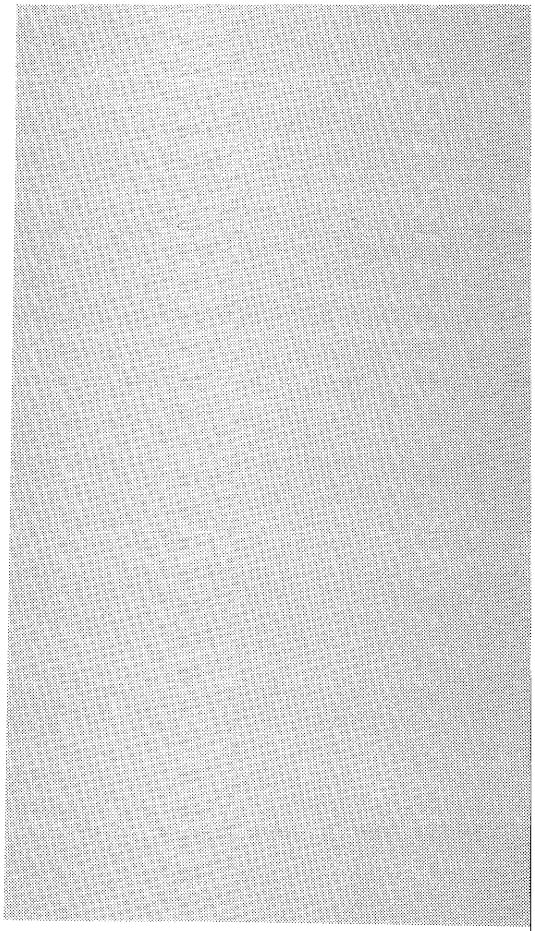
Pin assignment of SPECL devices



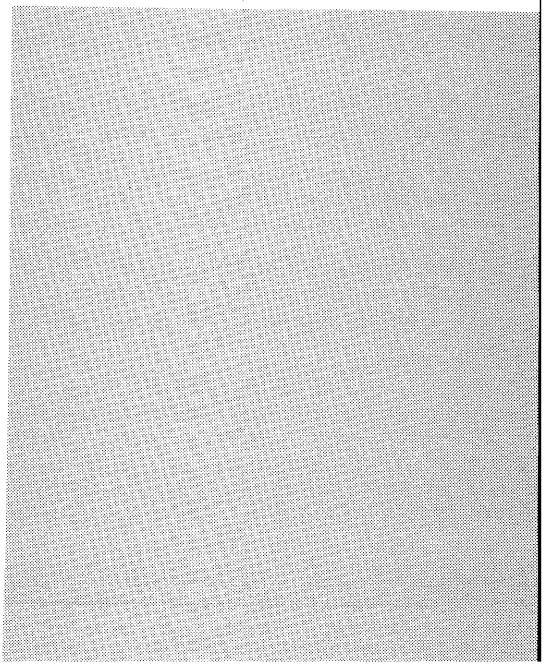
32 pin FQFP package



24 pin FQFP package



Data Sheets



Chapter 5 Data Sheets

Quad 3-input OR/NOR Gate

Description

The CXB1100Q is an ultra high speed monolithic ECL IC, which contains four 3-input OR/NOR gates.

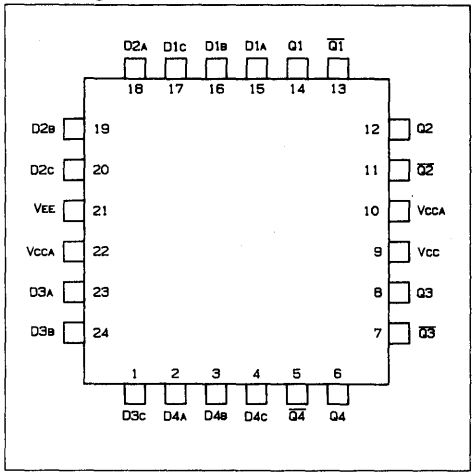
Features

- Typical AC characteristics T_{pd}=410ps
  T_{TLH}=210ps
  T_{THL}=160ps
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential output

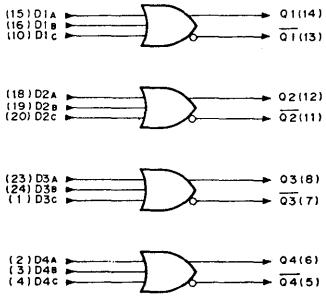
Pin Names

D_{nA}-D_{nC}	Data inputs
Qn, $\overline{Qn}$	Data outputs
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−127	−93	−65	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Dn	Qn		300	410	520	ps
	T_{PHL}				300	410	520	
Rise time	T_{TLH}			20% to 80%		210	270	
Fall time	T_{THL}					160	210	

Note: AC test circuit; See page 4-3.

Quad 3-input AND/NAND Gate

Description

The CXB1101Q is an ultra high speed monolithic ECL IC, which contains four 3-input AND/NAND gates.

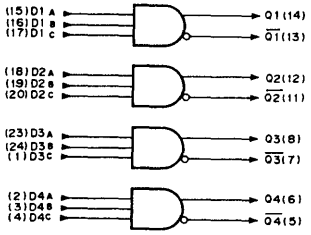
Features

- Typical AC characteristics T_{pd}=490ps, T_{TLH}=230ps, T_{THL}=170ps
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential output

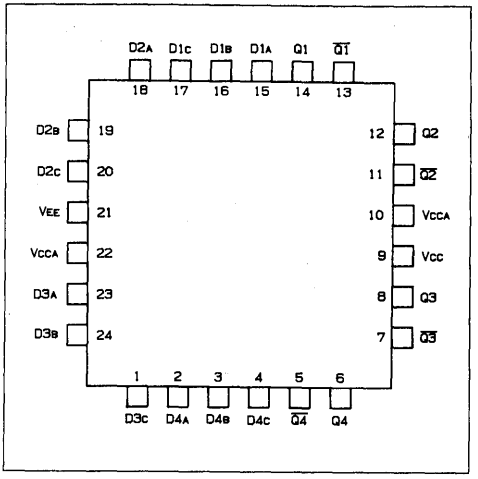
Pin Names

D_{nA}-D_{nC}	Data inputs
Qn, $\overline{Qn}$	Data outputs
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−179	−131	−91	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Dn	Qn		350	460	580	ps
	T_{PHL}				370	490	620	
Rise time	T_{TLH}			20% to 80%		230	290	
Fall time	T_{THL}					170	220	

Note: AC test circuit; See page 4-3.

Quad Exclusive OR/NOR Gate

Description

The CXB1102Q is an ultra high speed monolithic ECL IC, which contains four Exclusive OR/NOR gates.

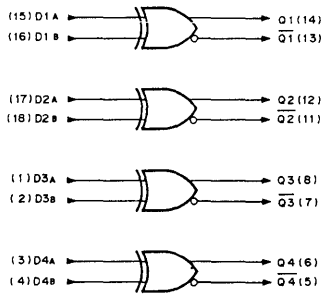
Features

- Typical AC characteristics T_{pd}=530ps
  T_{TLH}=220ps
  T_{THL}=170ps
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential output

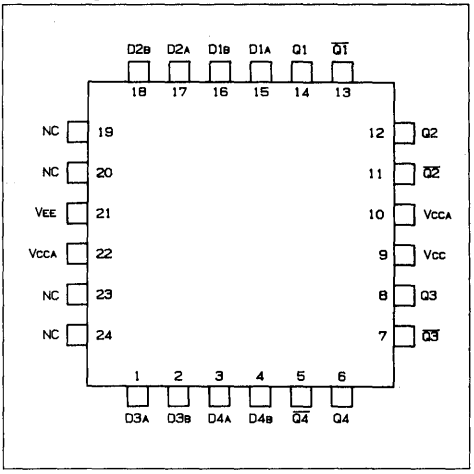
Pin Names

D_{nA}-D_{nB}	Data inputs
Qn, $\overline{Qn}$	Data outputs
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

INPUT		OUTPUT	
D_{nA}	D_{nB}	Qn	$\overline{Qn}$
L	L	L	H
L	H	H	L
H	L	H	L
H	H	L	H

Note: H; HIGH voltage level
L; LOW voltage level

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−170	−125	−87	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	D_{nA}, D_{nB}	Qn		400	530	670	ps
	T_{PHL}				380	510	650	
Rise time	T_{TLH}			20% to 80%		220	280	
Fall time	T_{THL}					170	220	

Note: AC test circuit; See page 4-3.

Quint Line Receiver with Differential I/O

Description

The CXB1103Q is an ultra high speed monolithic ECL IC, which contains five differential line receivers with a built-in reference voltage supply (V_{BB}). With V_{BB} tied to one of the input pins of each differential input pair, each gate can be used as a single input line receiver.

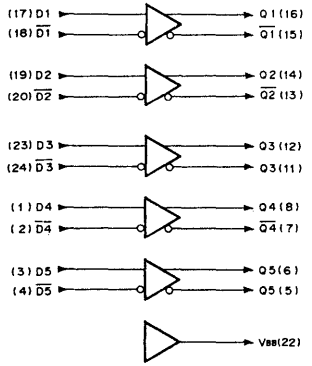
Features

- Typical AC characteristics T_{pd}=430ps
  T_{TLH}=220ps
  T_{THL}=170ps
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential I/O

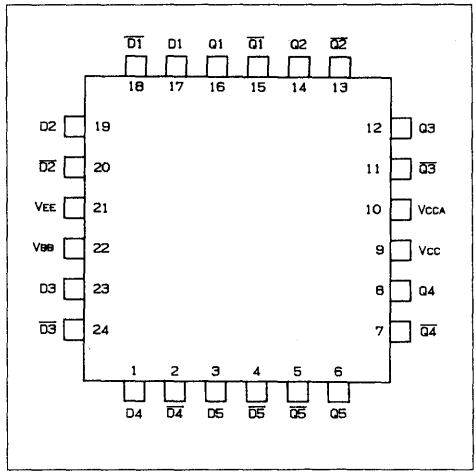
Pin Names

Dn, $\overline{Dn}$	Data inputs
Qn, $\overline{Qn}$	Data outputs
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−154	−113	−79	mA
Min. differential input voltage*1	Vp-p		50			mVpp

Note: Other DC characteristics; See page 3-3, 3-4.

*1: Minimum voltage required to obtain full logic swing on output

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Dn	Qn		310	410	520	ps
	T_{PHL}				320	430	540	
Gate-to-Gate skew	$T_{SG\text{-}G}$					50	90	
Rise time	T_{TLH}			20% to 80%		220	280	
Fall time	T_{THL}					170	220	

Note: AC test circuit; See page 4-3.

Dual D Flip-Flop with Set, Reset and Differential I/O

Description

The CXB1104Q is an ultra high speed monolithic ECL IC, which contains two D type Flip-Flops with separate direct Set (Sn) and Reset (Rn). Data inputs have differential input pins Dn and $\overline{Dn}$. Separate clock inputs also have differential input pins Cn and $\overline{Cn}$. Built-in reference voltage is provided at V_{BB} pin to facilitate single input operation.

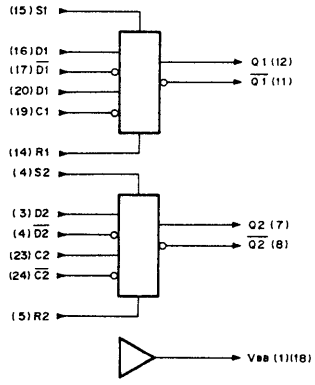
Features

- Typical: clock rate up to 3.2GHz
- Differential Data and Clock inputs
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

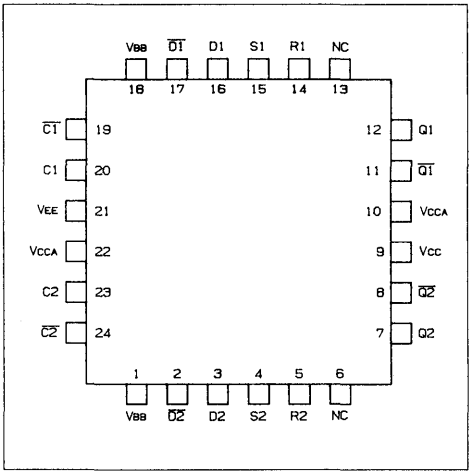
Pin Names

Dn, $\overline{Dn}$	Data inputs
Qn, $\overline{Qn}$	Data outputs
Sn	Direct Set inputs
Rn	Direct Reset inputs
Cn, $\overline{Cn}$	Clock inputs (positive edge trigger)
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

Input				Output	
S	R	C	D	Q	$\overline{Q}$
H	L	×	×	H	L
L	H	×	×	L	H
H	H	×	×	×	×
L	L	⌐	L	L	H
L	L	⌐	H	H	L

Note: H; HIGH voltage Level
L; LOW voltage Level
X; Don't care
⌐; Positive transition edge

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−146	−107	−74	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Cn	Qn		450	610	810	ps
	T_{PHL}				460	630	830	
	T_{PLH}	Sn			600	760	990	
	T_{PHL}				600	760	990	
	T_{PLH}	Rn			570	720	940	
	T_{PHL}				580	730	950	
Set up time	T_S	Dn, Cn			40			
Hold time	T_h	Cn, Dn			240			
Release time	T_R	Sn, Cn			310			
		Rn, Cn			320			
Min. Pulse width	T_{PW}	Sn			270			
		Rn			270			
Max. Toggle frequency	f_{max}	Cn			2.4	3.2		GHz
Rise time	T_{TLH}	Cn	Qn	20% to 80%		200	280	ps
Fall time	T_{THL}					160	240	

Note: AC test circuit; See page 4-4, 4-5.

Triple Fan-Out Buffer with Common Enable and Differential Output.

Description

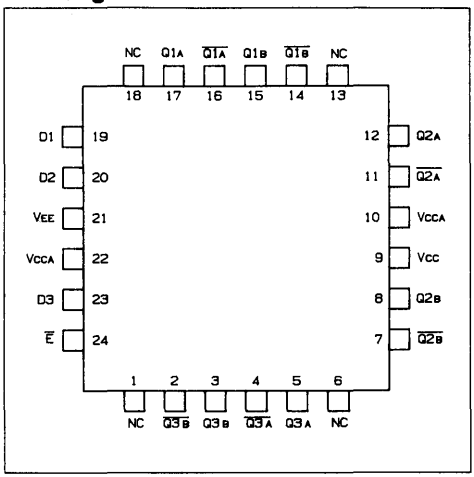
The CXB1105Q is an ultra high speed monolithic ECL IC, which contains three Line Drivers. Each driver has two paires of differential output pins (Q_{nA}, Q_{nB}, $\overline{Q_{nA}}$, $\overline{Q_{nB}}$).

Enable ($\overline{E}$) input enables data (D1-D3) input. With D1-D3 maintained LOW, $\overline{E}$ acts as a fan-out buffer with six differential outputs.

Features

- Typical propagation delay time: T_{pd}=610ps (Dn to Q_{nA}, Q_{nB} Typ.)
- Small time skew: 50ps ($\overline{E}$ to Q_{nA}, Q_{nB})
- Enable input
- Six differential fan-out capability
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential output.

Pin Assignment



Pin Names

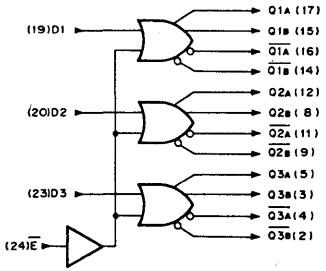
Dn	Data inputs
Q_{nA}, $\overline{Q_{nA}}$, Q_{nB}, $\overline{Q_{nB}}$	Data outputs
$\overline{E}$	Data enable (active LOW)
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Truth Table

Input		Output	
$\overline{E}$	Dn	Qn	$\overline{Qn}$
L	L	L	H
L	H	H	L
H	×	H	L

Note: H; HIGH voltage level
L; LOW voltage level
X; Don't care

Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−164	−120	−84	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Dn	Q_{nA}, Q_{nB}		470	620	790	ps
	T_{PHL}				440	590	750	
	T_{PLH}	$\overline{E}$			500	660	840	
	T_{PHL}				500	630	800	
Gate-to-Gate time skew	$T_{SG\text{-}G}$	$\overline{E}$					50	
Rise time	T_{TLH}	Dn, $\overline{E}$		20% to 80%		250	320	
Fall time	T_{THL}					220	280	

Note: AC test circuit; See page 4-3.

4-bit Ripple Down Counter with Enable and Reset

Description

The CXB1106Q is an ECL ultra high speed monolithic Binary Ripple Down Counter with divide-by-2/4/8/16 outputs.

Clock input has differential input pins C and $\overline{C}$. Built-in reference voltage V_{BB} is provided to facilitate the use of single clock input. Enable input ($\overline{E}$) enables clock input. Common direct reset input (R) resets the counter and separate Set inputs (Sn) set each stage of the counter.

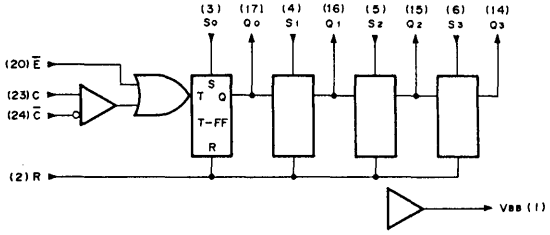
Features

- Typical: clock rate up to 3.0GHz
- Differential Clock input (positive edge trigger)
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

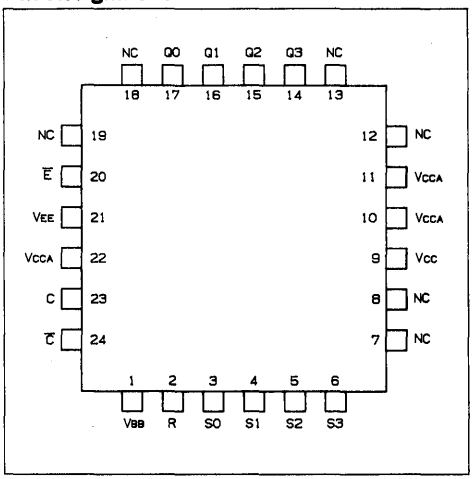
Pin Names

C, $\overline{C}$	Clock inputs
Qn, $\overline{Qn}$	Data outputs
Sn	Direct set inputs
R	Common direct Reset input
$\overline{E}$	Clock enable (active LOW)
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Sequencial Truth Table

Inputs							Outputs			
R	$\overline{E}$	S0	S1	S2	S3	C	Q0	Q1	Q2	Q3
H	×	L	L	L	L	×	L	L	L	L
H	H	L	L	L	L	×	L	L	L	L
L	H	L	L	L	L	×	L	L	L	L
L	L	L	L	L	L	↓	H	H	H	H
L	L	L	L	L	L	↓	L	H	H	H
L	L	L	L	L	L	↓	H	L	H	H
L	L	L	L	L	L	↓	L	L	H	H
L	L	L	L	L	L	↓	H	H	L	H
L	L	L	L	L	L	↓	L	H	L	H
L	L	L	L	L	L	↓	H	L	L	H
L	L	L	L	L	L	↓	L	L	L	H
L	L	L	L	L	L	↓	H	H	H	L
L	L	L	L	L	L	↓	L	H	H	L
L	L	L	L	L	L	↓	H	L	H	L
L	L	L	L	L	L	↓	L	L	H	L
L	L	L	L	L	L	↓	H	H	L	L
L	L	L	L	L	L	↓	L	H	L	L
L	L	L	L	L	L	↓	H	L	L	L
L	L	L	L	L	L	↓	L	L	L	L
L	×	L	L	H	H	×	L	L	H	H
L	×	L	H	L	H	×	L	H	H	H
L	↓	L	L	L	L	L	H	L	H	H
L	↓	L	L	L	L	L	L	L	H	H
H	×	H	H	H	H	×	×	×	×	×

Note: H; HIGH voltage level
L; LOW voltage level
X; Don't care

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−202	−148	−103	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C, $\overline{E}$	Q0		540	870	1100	ps
	T_{PHL}				550	880	1110	
	T_{PLH}		Q1		710	1040	1270	
	T_{PHL}				720	1050	1280	
	T_{PLH}		Q2		830	1160	1390	
	T_{PHL}				840	1170	1400	
	T_{PLH}		Q3		1140	1470	1700	
	T_{PHL}				1150	1480	1710	
	T_{PLH}	Sn	Qn		560	810	1130	
	T_{PHL}	R			640	890	1180	
Release time	T_R	S0, C	Q0		160			
		S1, C	Q1		−20			
		S2, C	Q2		−230			
		S3, C	Q3		−450			
		R, C	Q0		430			
		$\overline{E}$, C			170			
Min. Pulse width	T_{PW}	Sn	Qn		330			
		R			390			
Max. Toggle frequency	f_{MAX}	C	Qn		2.4	3.0		GHz
Rise time	T_{TLH}	C	Qn	20% to 80%		270	320	ps
Fall time	T_{THL}					220	270	

Note: Other AC test circuit; See page 4-4, 4-5.

Decision Circuit with Differential I/O

Description

The CXB1107Q is an ECL ultra high speed monolithic Decision Circuit, which contains a D Flip-Flop with High Gain Slicer at the input stage.

Differential data input is amplified by the High Gain Slicer and stored in the D Flip-Flop at the positive transition of the Clock. The stored data is held at Q and $\overline{Q}$ pins untill the next positive transition of the Clock occurs. The Clock input has differential input pins C and $\overline{C}$. Built-in reference voltage is provided at V_{BB} pins to facilitate the use of single input operation.

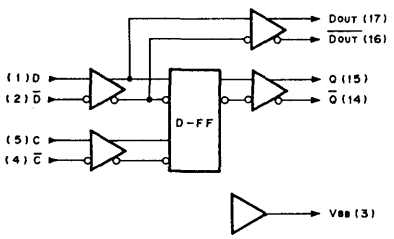
Features

- Typical AC characteristics: Clock rate up to 3.2GHz
  Data rate up to 2.3GHz at an input level of 50mV
- Differential Data and Clock inputs
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

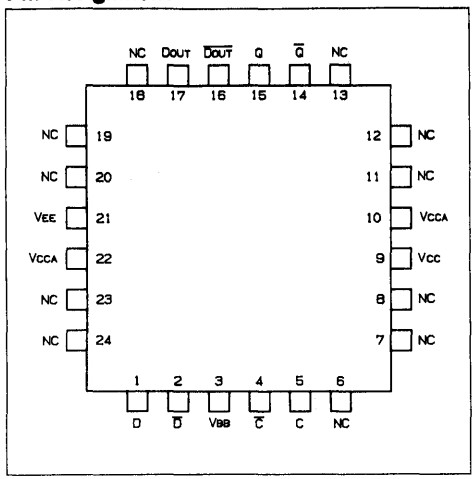
Pin Names

D, $\overline{D}$	Data input
C, $\overline{C}$	Clock inputs (positive edge trigger)
Q, $\overline{Q}$	Data output
D_{OUT}, $\overline{D_{OUT}}$	Buffered input data outputs
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

Input		Output	
D	C	Q	D_{OUT}
L	L	Hold	L
H	L	Hold	H
L	∫	L	L
H	∫	H	H
L	H	Hold	L
H	H	Hold	H

Note: H; HIGH voltage level
L; LOW voltage level
∫; Positive transition edge
Hold; Means no-change in the output

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−116	−85	−59	mA
Input voltage range	V_{IN}		−2.0	−1.3	−0.5	V
Min. Decision voltage	V_D	$f_{CLOCK}=1.8GHz$	50			mVpp

Note: Other DC paracteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C	Q		460	610	770	ps
	T_{PHL}				440	590	750	
	T_{PLH}	D	D_{OUT}		420	570	730	
	T_{PHL}				400	550	710	
Set up time	T_S	D, C	Q		220			
Hold time	T_h	C, D			120			
Max. Toggle frequency	f_{MAX}	D		Vin=50mVpp	1.8	2.3		GHz
				Vin=800mVpp	2.6	3.2		
Rise time	T_{TLH}	C	Q			220	280	ps
Fall time	T_{THL}					170	220	

Note: AC test circuit; See page 4-3, 4-4 and 4-5.

Laser Driver

Description

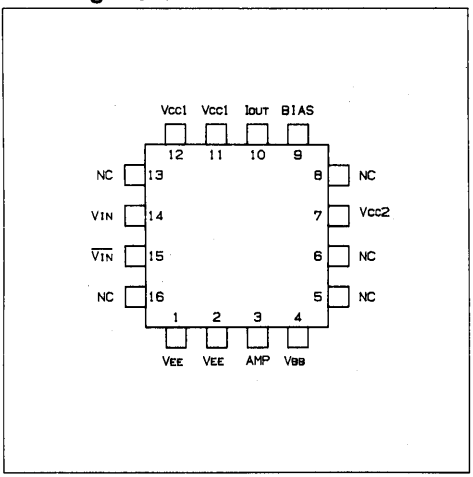
The CXB1108Q is an ultra high speed monolithic Laser Driver/Current Switch Circuit with ECL input level.

Open collector output is provided at the output pin and has a capability of driving peak-to-peak current of 50mA up to a data rate of 2Gbps (NRZ). AMP input controls the peak-to-peak current amplitude, and BIAS input sets a current bias level. Open collector output I_{OUT} sinks current of $2 \times I_{AMP} + \text{Bias Current}$. Data input has differential input pins (V_{IN} and $\overline{V_{IN}}$). Built-in reference voltage is provided at V_{BB} pin to facilitate the use of single input operation.

Features

- Typical data rate up to 2.0Gbps (NRZ)
- Differential Data input
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible Input level

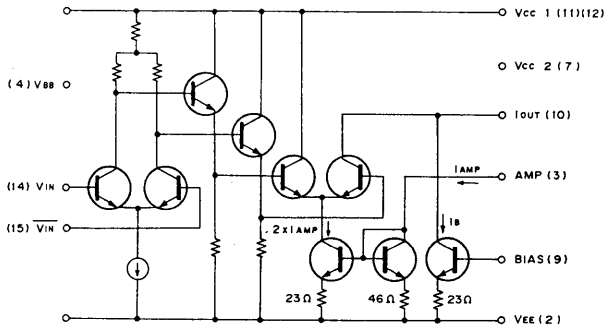
Pin Assignment



Pin Names

V_{IN}, $\overline{V_{IN}}$	Data input
I_{OUT}	Current output
AMP	Current amplitude control input
BIAS	Bias Current control input
V_{BB}	Reference voltage output
V_{CC1}	Circuit ground
V_{EE}	Negative power supply
V_{CC2}	Reference voltage generation circuit ground

Circuit Diagram



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC1}=V_{CC2}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_L=10\Omega$ to V_{CC1}

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}	V_{IN}=H, $\overline{V_{IN}}$=L, I_{OUT}=100mA, I_{AMP}=25mA	−224	−164	−114	mA
Output Current	I_{OUT}		0		120	mA
		$I_{AMP}=0$ $V_{AMP}=V_{EE}$	0		60	
		$I_B=0$ $V_{BIAS}=V_{EE}$	0		60	
Input voltage range	V		−2.0		−0.5	V

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC1}=V_{CC2}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_L=50\Omega$ to V_{CC1}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Max. Data rate	f_{DMAX}	V_{IN}	I_{OUT}	NRZ	1.7	2.0		Gbps
Rise time	T_{TLH}			20% to 80%		200	240	ps
Fall time	T_{THL}					200	240	

Note: AC test circuit; See page 4-3.

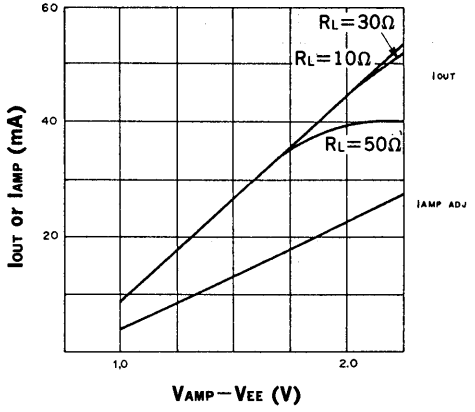


Figure 1. $V_{AMP}-V_{EE}$ vs I_{OUT} (BIAS=Open)

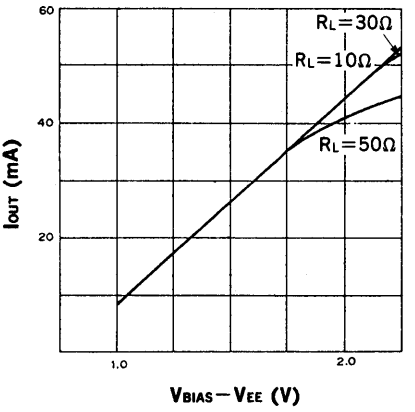


Figure 2. $V_{BIAS}-V_{EE}$ vs I_{OUT} (AMP=Open)

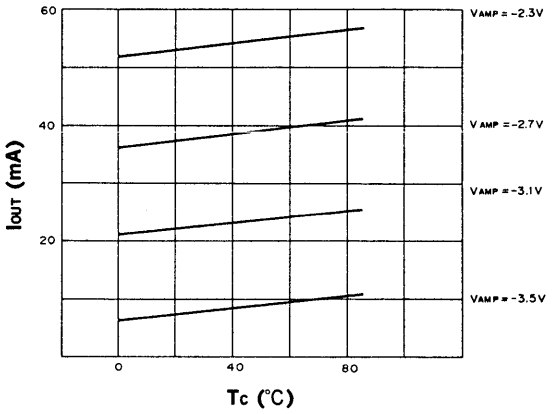
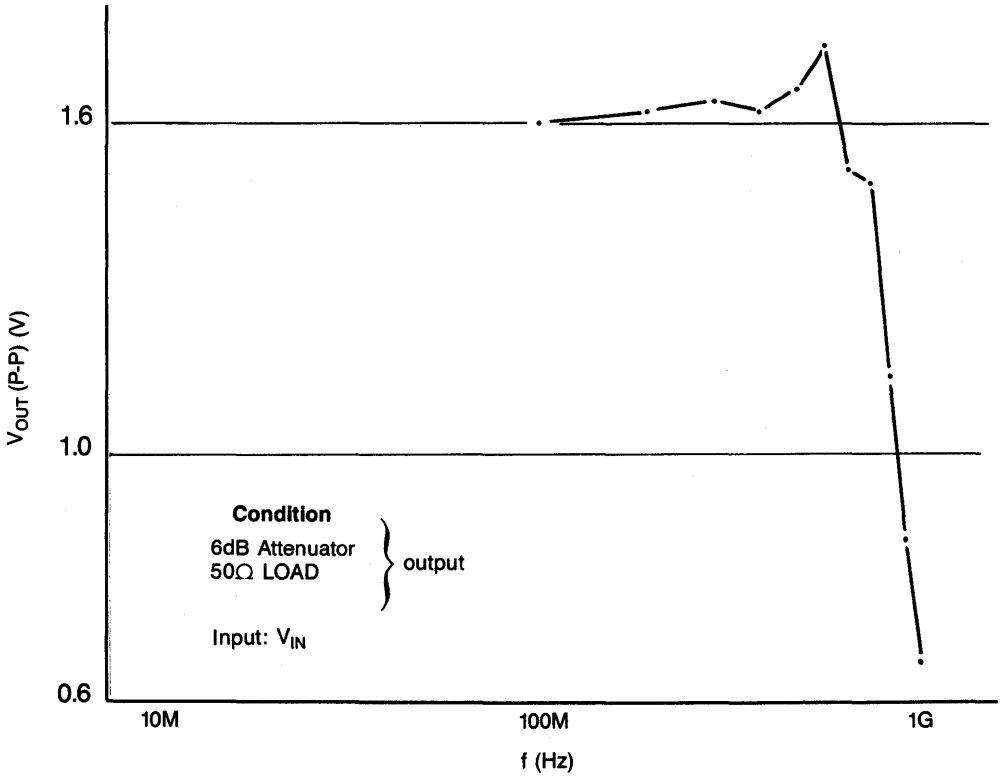


Figure 3. T_C vs I_{OUT}



V_{OUT} (P-P) (Voltage at I_{OUT}) vs Frequency

Figure 4.

Quad D Flip-Flop with Master Reset and Differential I/O

Description

The CXB1109Q is an ultra high speed monolithic ECL IC, which contains four D Flip-Flop's.

Positive edge of Master Clock C_A and C_B triggers the Flip-Flop's, and Master Reset (MR) resets them. Data inputs have differential input pins Dn and $\overline{Dn}$. Built-in reference voltage is provided at V_{BB} pin to facilitate the use of single input operation.

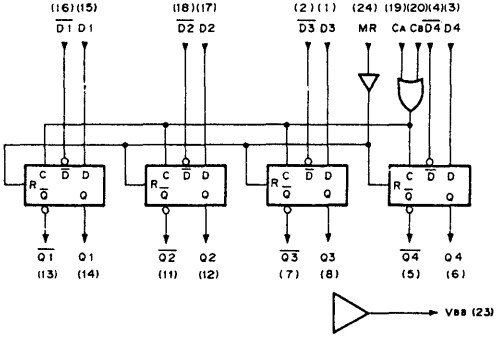
Features

- Typical data rate up to 3.1GHz
- Differential data inputs and outputs
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

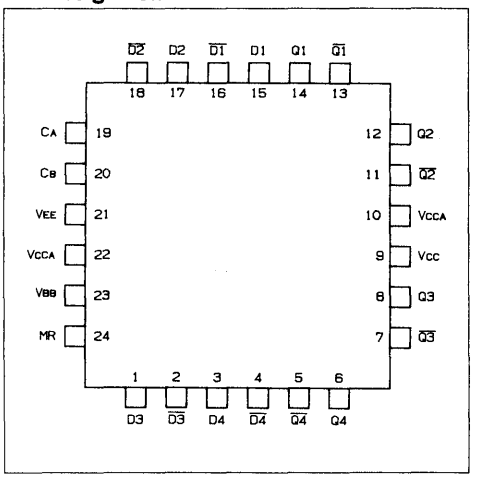
Pin Names

Dn, $\overline{Dn}$	Data inputs
C_A, C_B	Common Clock inputs (positive edge trigger)
MR	Direct Master Reset input
Qn, $\overline{Qn}$	Data outputs
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

Input			Output			
MR	C_A	C_B	Q_1	Q_2	Q_3	Q_4
H	×	×	L	L	L	L
L	⌐	L	D_1	D_2	D_3	D_4
L	L	⌐	D_1	D_2	D_3	D_4
L	⌐	⌐	D_1	D_2	D_3	D_4

Note: H; HIGH voltage level
L; LOW voltage level
X; Don't care
⌐; Positive transition edge

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−204	−150	−105	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C_A, C_B	Qn		560	710	890	ps
	T_{PHL}				560	710	890	
	T_{PLH}	MR			510	790	990	
	T_{PHL}				520	800	1000	
Set up time	T_S	Dn → C_A, C_B			150			
Hold time	T_h	C_A, C_B → Dn			250			
Min. Pulse width	T_{PW}	MR			430			
Release time	T_R	MR → C_A, C_B			500			
Max. Toggle frequency	f_{MAX}	C_A, C_B			2.5	3.1		GHz
Rise time	T_{TLH}			20% to 80%		210	260	ps
Fall time	T_{THL}					180	230	

Note: AC test circuit; See page 4-3, 4-4, 4-5.

16-Line to 1-Line Data Selector/Multiplexer

Description

The CXB1110Q is an ultra high speed monolithic ECL 16-Line to 1-Line Data Selector/Multiplexer.

The IC select 1 out of 16 inputs for the output. The data present at inputs (In) is selected and sent to the output (Z) in accordance with four bit Select inputs (Sn).

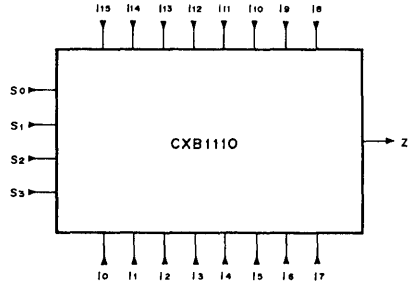
Features

- Typical AC characteristics: T_{pd}=620ps (In)
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

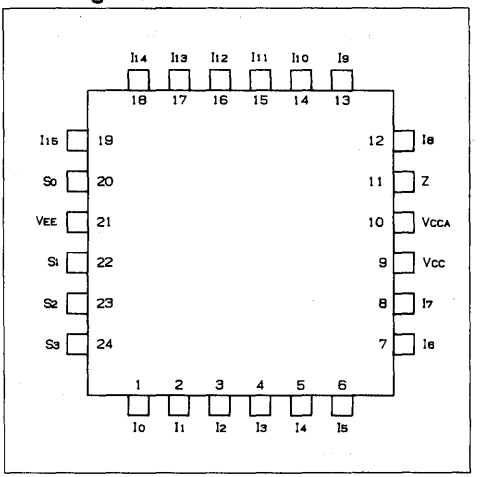
Pin Names

In	Data inputs
Z	Data output
Sn	Select inputs
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for output
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

Select Inputs				Output
S_0	S_1	S_2	S_3	Z
L	L	L	L	I_0
H	L	L	L	I_1
L	H	L	L	I_2
H	H	L	L	I_3
L	L	H	L	I_4
H	L	H	L	I_5
L	H	H	L	I_6
H	H	H	L	I_7
L	L	L	H	I_8
H	L	L	H	I_9
L	H	L	H	I_{10}
H	H	L	H	I_{11}
L	L	H	H	I_{12}
H	L	H	H	I_{13}
L	H	H	H	I_{14}
H	H	H	H	I_{15}

Note: H; HIGH voltage level
L; LOW voltage level

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−204	−150	−105	mA

Note: Other DC characteristics; See page 3-3, 3-4.

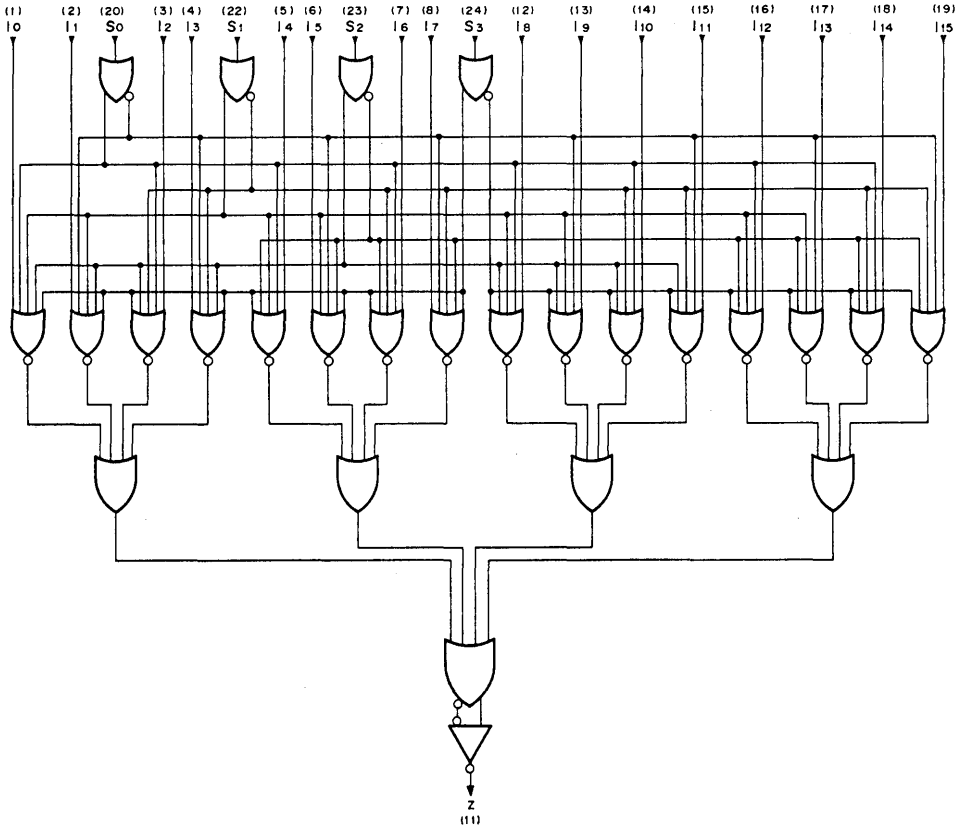
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	In	Zn		460	610	770	ps
	T_{PHL}				470	620	780	
	T_{PLH}	Sn			680	830	990	
	T_{PHL}				1010	1170	1330	
Rise time	T_{TLH}	In,Sn		20% to 80%		270	340	
Fall time	T_{THL}	In,Sn				180	230	

Note: AC test circuit; See page 4-3.

Logic Diagram



4-bit Look-Ahead Carry Generator

Description

The CXB1111Q is an ultra high speed monolithic ECL 4bit Look-Ahead Carry Generator.

When used with the CXB1138Q (4-bit ALU), this IC functions as an ultra fast second order or higher look ahead.

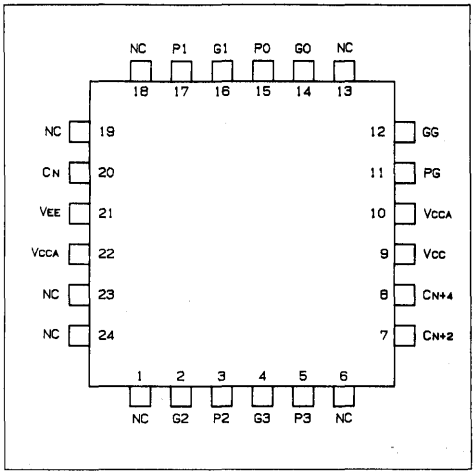
Features

- Typical AC characteristics: T_{pd}=700ps
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

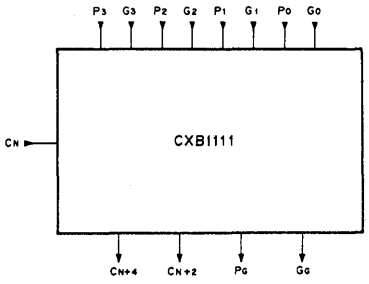
Pin Names

C_N	Carry input
Pn	Carry Propagate inputs
Gn	Carry Generate inputs
C_{N+2},C_{N+4}	Carry outputs
P_G	Group carry Propagate output
G_G	Group carry Generate output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

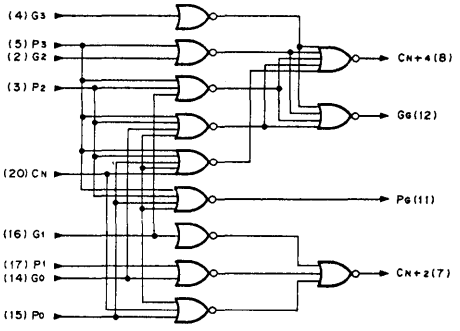
Pin Assignment



Logic Symbol



Logic Diagram



$P_G = P_0 + P_1 + P_2 + P_3$

$G_G = (G_0 + P_1 + P_2 + P_3)(G_1 + P_2 + P_3)(G_2 + P_3)G_3$

$C_{N+2} = (C_N + P_0 + P_1)(G_0 + P_1)G_1$

$C_{N+4} = (C_N + P_0 + P_1 + P_2 + P_3)(G_0 + P_1 + P_2 + P_3)(G_1 + P_2 + P_3)(G_2 + P_3)G_3$

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−170	−125	−87	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	P_3	C_{N+4}		520	690	880	ps
	T_{PHL}				480	640	810	
	T_{PLH}	P_1	C_{N+2}		530	700	890	
	T_{PHL}				530	680	850	
	T_{PLH}		G_G		530	700	890	
	T_{PHL}				530	680	850	
	T_{PLH}		P_G		480	650	840	
	T_{PHL}				480	640	810	
Rise time	T_{TLH}	All Inputs	All Outputs	20% to 80%		310	390	
Fall time	T_{THL}					210	270	

Note: AC test circuit; See page 4-3.

Phase Frequency Detector with Differential I/O

Description

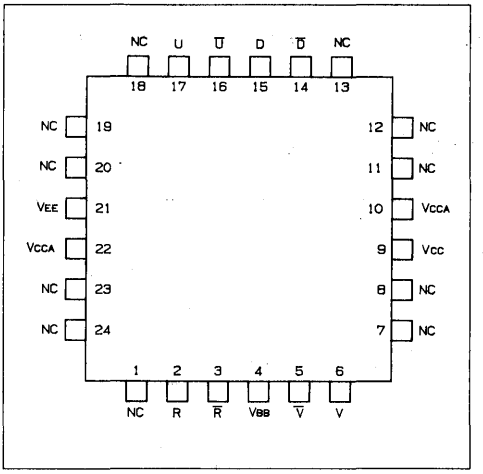
The CXB1112Q is an ultra high speed monolithic ECL Phase Frequency Detector capable of 800MHz operation.

The IC detects the difference of both phase and frequency between the data present at two differential input pins, R and V. In combination with a voltage controlled oscillator, this IC is used in an application for Phase-Locked-Loop.

Features

- Typical: Data rate up to 800MHz
- Differential inputs and outputs
- Built-in reference voltage for single ended input operation
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

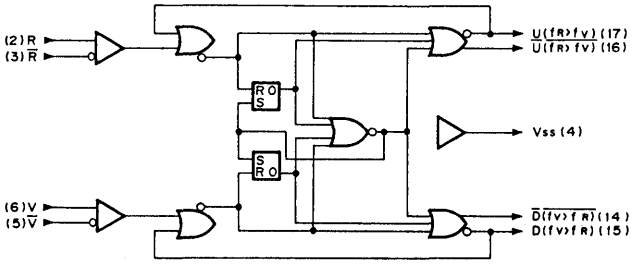
Pin Assignment



Pin Names

V, $\overline{V}$, R, $\overline{R}$	Data inputs
U, $\overline{U}$	Outputs ($f_R > f_V$)
D, $\overline{D}$	Outputs ($f_V > f_R$)
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Diagram



Truth Table (for Test)

Input		Output			
$\overline{R}$	V	U	D	$\overline{U}$	$\overline{D}$
L	L	X	X	X	X
L	H	X	X	X	X
H	H	X	X	X	X
L	H	X	X	X	X
H	H	H	L	L	H
L	H	H	L	L	H
H	H	H	L	L	H
H	L	H	L	L	H
H	H	L	L	H	H
H	L	L	L	H	H
H	H	L	H	H	L
H	L	L	H	H	L
H	H	L	H	H	L
L	H	L	H	H	L
H	H	L	L	H	H

Note: H; HIGH voltage
L; LOW voltage
X; Don't care

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−134	−98	−68	mA

Note: Other DC characteristics; See page 3-3, 3-4.

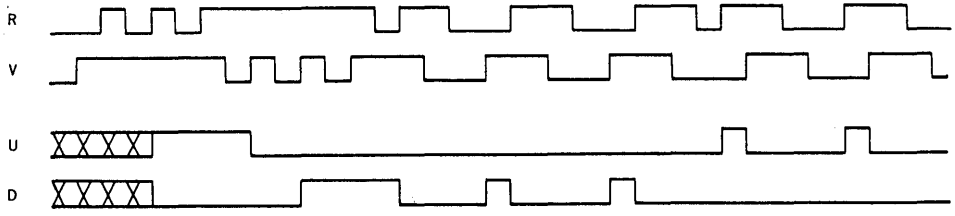
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	R	U		450	640	840	ps
	T_{PHL}				450	640	850	
	T_{PLH}		D		590	780	980	
	T_{PHL}				590	780	990	
	T_{PLH}	V	U		590	780	980	
	T_{PHL}				590	780	990	
	T_{PLH}		D		450	640	840	
	T_{PHL}				450	640	850	
Max. Toggle frequency	f_{MAX}	R, V	U, D		600	800		MHz
Rise time	T_{TLH}			20% to 80%		340	430	ps
Fall time	T_{THL}					200	250	

Note: AC test circuit; See page 4-5.

Timing Diagram



4-bit Multiplexer

Description

The CXB1113Q is an ultra high speed monolithic ECL Multiplexer which functions as a 4bit Parallel to Serial Converter.

The IC fetches 4bit parallel data present at the inputs (Dn) and converts them to serial data. Multiplexing is carried out in sequence from D0 to D3.

With Load Select (LS) input set to Low, internal load pulse loads parallel data. Start load pulse (ST), which starts multiplexing, has to be maintained High for at least 3 clock periods.

With LS set to High, External Load pulse ($\overline{EL}$) loads parallel data.

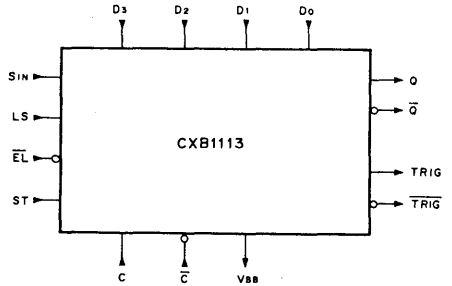
Features

- Tyical clock rate up to 1.8GHz
- Differential clock input and output
- Built-in reference voltage for single ended input operation
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

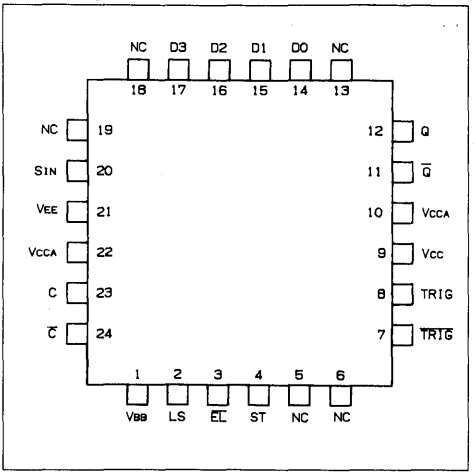
Pin Names

Dn	Parallel Data inputs
LS	Load Select input
ST	Load Start input
$\overline{EL}$	External Load input
S_{IN}	Serial data input
C, $\overline{C}$	Clock inputs (positive edge trigger)
Q, $\overline{Q}$	Multiplexed serial data outputs
TRIG, $\overline{TRIG}$	Trigger pulse outputs
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

LS	ST	$\overline{EL}$	C		
L	L	×	∫	Internal Load	Parallel data load, shift right
L	H	×	∫		Initialize (3clock period min.)
H	×	L	∫	External Load	Parallel data load
H	×	H	∫		Shift right, serial data output

Note: H; HIGH voltage level
L; LOW voltage level
X; Don't care
∫; Positive transition edge

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CCA}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $Tc=0°C$ to $85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−272	−200	−140	mA

Note: Other DC characteristics; See page 3-3, 3-4.

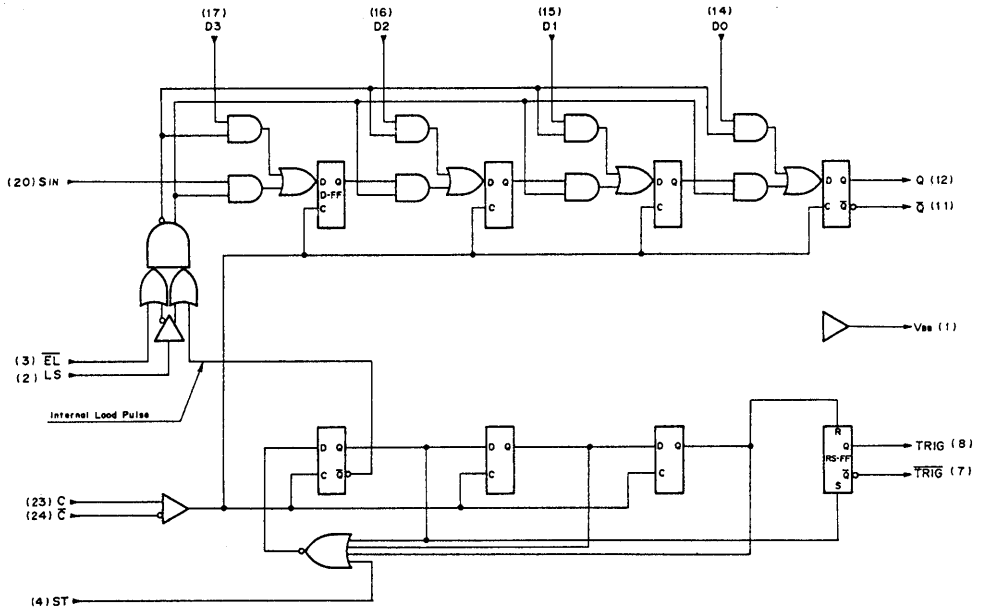
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $Tc=0°C$ to $85°C$, $R_T=50\Omega$ to V_{TT}

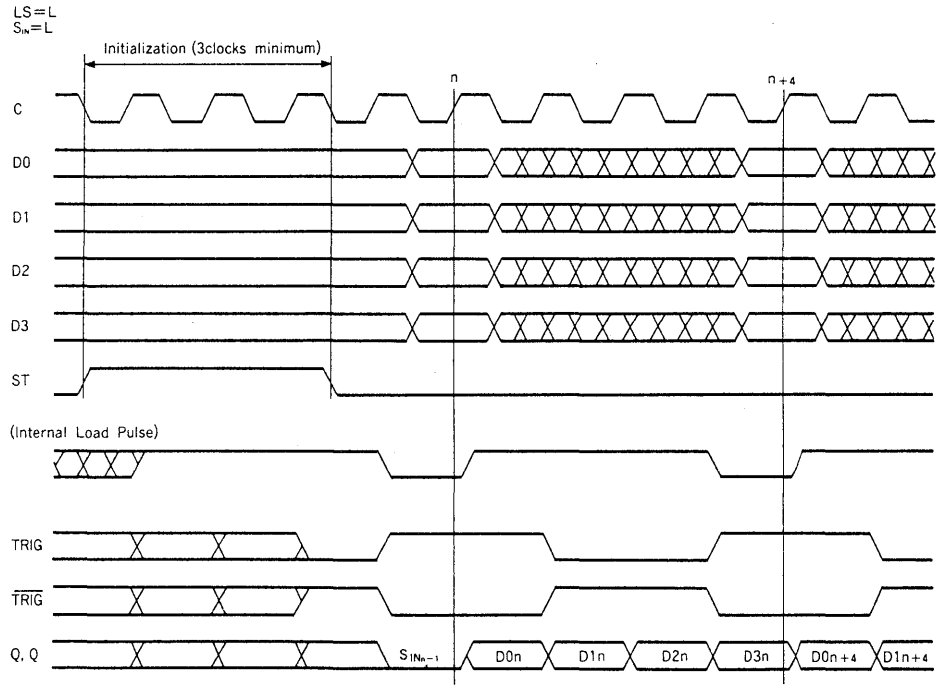
Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C	Q		900	1050	1220	ps
	T_{PHL}				900	1050	1220	
	T_{PLH}		TRIG		560	710	880	
	T_{PHL}				570	720	890	
Set up time	T_S	Dn, S_{IN}→C	Q		−110			
		$\overline{EL}$, C			−170			
Hold time	T_h	C→Dn, S_{IN}			810			
		$\overline{EL}$, C			450			
Max. toggle frequency	f_{MAX}	C			1.4	1.8		GHz
Release time	T_R	ST, C			−50			ps
Rise time	T_{TLH}	C	Q, TRIG	20% to 80%		230	290	
Fall time	T_{THL}					170	220	

Note: AC test circuit; See page 4-4, 4-5.

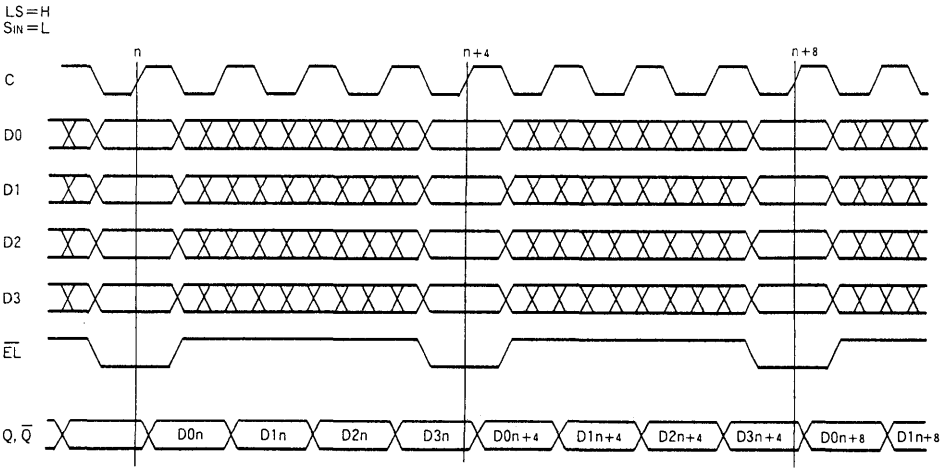
Logic Diagram



Timing Diagram : Internal Load



Timing Diagram : External Load



Typical Application

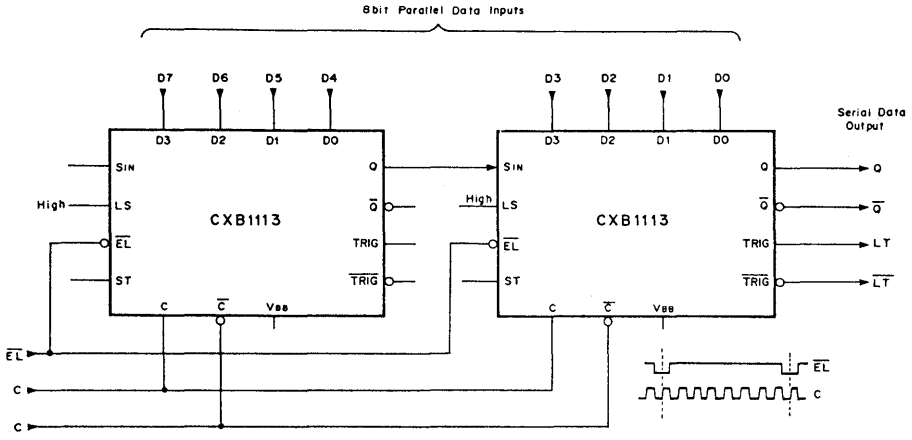


Figure 1. 8 to 1 Multiplexer/Parallel to Serial Converter

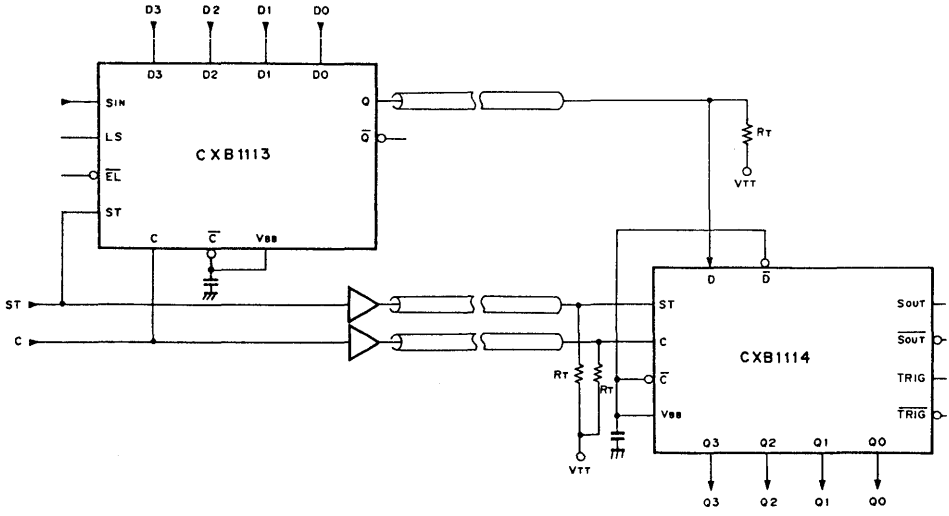


Figure 2. Serial Data Transmission

4-bit Demultiplexer

Description

The CXB1114Q is an ultra High speed monolithic ECL Demultiplexer which functions as a 4-bit Serial to Parallel Converter.

The IC converts serial data into 4-bit demultiplexed parallel data. Load Start (ST) input, which starts the demultiplexing, has to be maintained High for at least three clock periods. Trigger (TRIG) pulse is provided for an external circuit to fetch the output data.

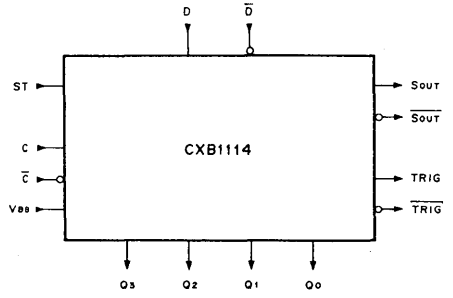
Features

- Typical clock rate up to 2.1GHz
- Differential Clock and Data inputs
- Built-in reference voltage for single ended input operation
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

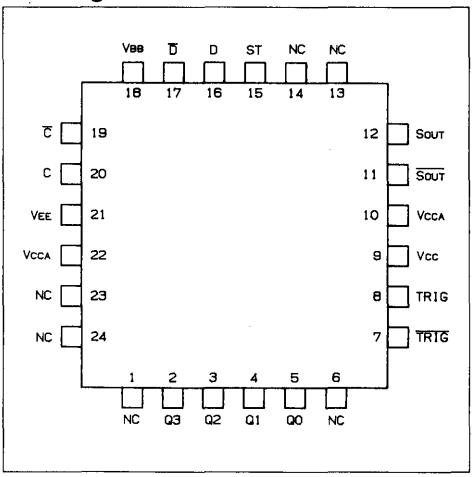
Pin Names

D, $\overline{D}$	Serial Data inputs
ST	Load Start input
C, $\overline{C}$	Clock inputs (positive edge trigger)
Qn	Demultiplexed parallel data outputs
TRIG, $\overline{TRIG}$	Trigger pulse outputs
SOUT, $\overline{SOUT}$	Serial data outputs
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Truth Table

ST	C	Function
L	⌐	Serial data input, porallel data out
H	⌐	Initialize (3 clock period min.)

Note: H; HIGH voltage level
L; LOW voltage level
⌐; Positive transition edge

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−297	−218	−152	mA

Note: Other DC characteristics; See page 3-3, 3-4

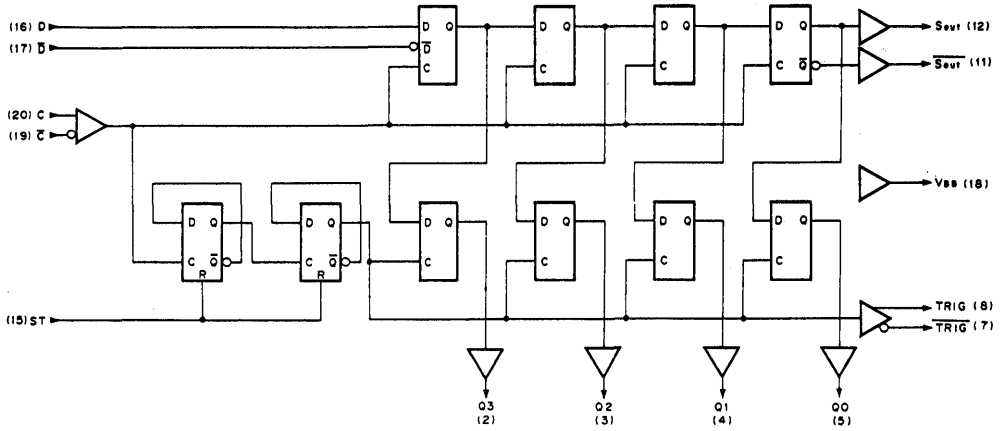
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

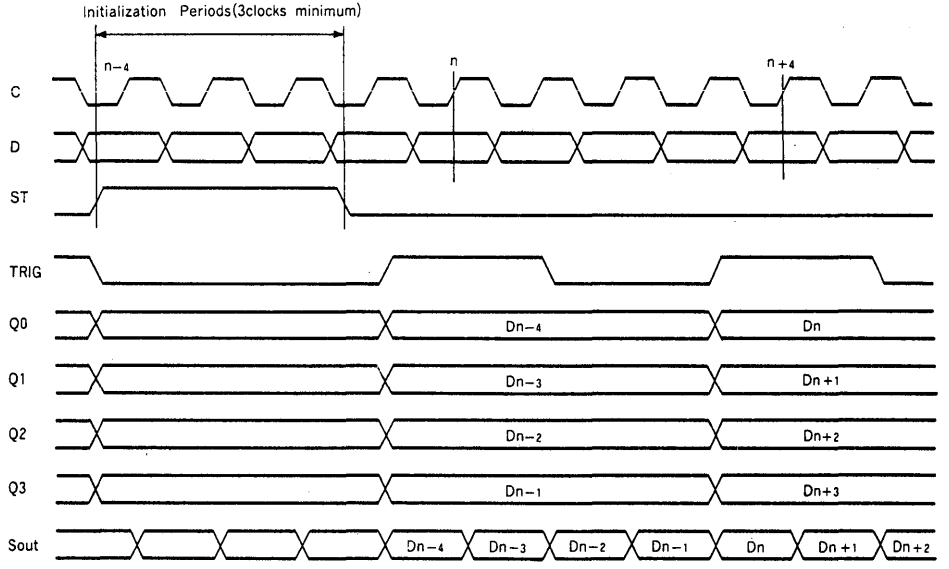
Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C	Qn		1280	1430	1600	ps
	T_{PHL}				1270	1420	1590	
	T_{PLH}		S_{OUT}		790	940	1110	
	T_{PHL}				820	970	1180	
	T_{PLH}		TRIG		1090	1260	1430	
	T_{PHL}				1150	1320	1490	
Set up time	T_S	D, C	Qn		−20			
Hold time	T_h	C, D			520			
Release time	T_R	R, C			320			
Min. Pulse width	T_{PW}	R	TRIG		330			
Max. Toggle frequency	f_{MAX}	C	Q		1.6	2.1		GHz
Rise time	T_{TLH}		Qn. S_{OUT} TRIG	20% to 80%		400	500	ps
Fall time	T_{THL}					350	430	

Note: AC test circuit; See page 4-4, 4-5

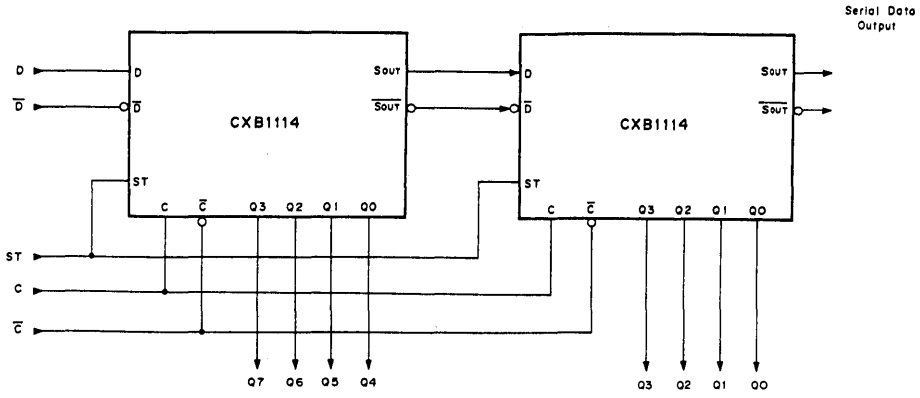
Logic Diagram



Timing Diagram



Typical Application 1 to 8 Demultiplexer/Serial to Parallel Converter



9, 8, Dual 4-bit Multiplexer

Description

The CXB1130Q is an ultra high speed monolithic ECL Multiplexer which functions as a 9-bit, 8-bit or dual 4-bit Parallel to Serial Converter.

The IC fetches a parallel data (D0-D8) present at the inputs and converts it into a serial data. Multiplexing is carried out in sequence from D0 to D8. S1 and S2 select a bit length.

With Load Select (LS) input set to LOW, internal load pulse loads parallel data. Start Load pulse (ST), which starts multiplexing, has to be maintaind HIGH for at least (bit length−1) clock periods.

With LS set to HIGH, External Load pulse (EL) loads parallel data. The bit length is determined by a period of EL.

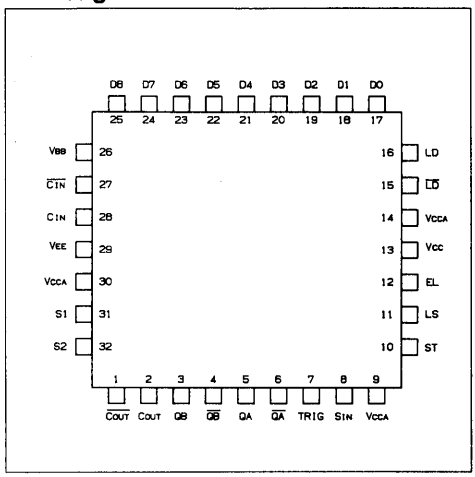
Features

- Typical clock rate up to 1.6 GHz
- Variable bit length: 9-bit, 8-bit and dual-4-bit
- Internal pull down resistors on input pins to maintain logic Low level with the pins left open
- ECL 100K compatible I/O levels

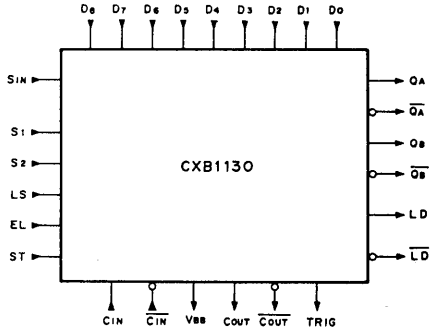
Pin Names

Dn	Parallel Data inputs
Sn	Bit length Select inputs
LS	Load Select input
ST	Load Start input
EL	External Load pulse input
S_{IN}	Serial data input
C_{IN},$\overline{C_{IN}}$	Clock inputs (positive edge trigger)
Q_A,$\overline{Q_A}$	Multiplexed serial data outputs (9, 8 and 4-bit)
Q_B,$\overline{Q_B}$	Multiplexed serial data outputs (4bit)
TRIG	Trigger pulse output
C_{OUT},$\overline{C_{OUT}}$	Buffered Clock outputs
LD,$\overline{LD}$	Load pulse outputs
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−190	−140	−98	mA

Note: Other DC characteristics; See page 3-3, 3-4

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item		Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time		T_{PLH}	C_{IN}	Q_A, Q_B		1000	1330	1690	ps
		T_{PHL}				1010	1350	1710	
		T_{PLH}		C_{OUT}		760	1010	1280	
		T_{PHL}				760	1010	1280	
		T_{PLH}		TRIG	ST=L	970	1290	1640	
		T_{PHL}				1100	1470	1870	
		T_{PLH}		LD	LS=L	970	1290	1640	
		T_{PHL}				1000	1330	1690	
		T_{PLH}	EL		LS=H	650	860	1090	
		T_{PHL}				660	880	1110	
Set up time		T_S	$D_n, S_{IN} \rightarrow C_{IN}$	Q_A, Q_B	LS=L	−290			
			E_I, C_{IN}		LS=H	100			
Hold time		T_h	$C_{IN} \rightarrow D_n, S_{IN}$		LS=L	640			
			C_{IN}, E_I		LS=H	220			
Release time		T_R	ST, C_{IN}			100			
Max. Toggle frequency	9Bit	f_{MAX}	C_{IN}			1.5	1.9		GHz
	8Bit					1.3	1.6		
	4Bit					1.3	1.6		
	External					1.7	2.1		
Rise time		T_{TLH}		Q_A, Q_B, LD TRIG, C_{OUT}	20% to 80%		400	500	ps
Fall time		T_{THL}					360	460	

Note: AC test circuit; See page 4-4, 4-5

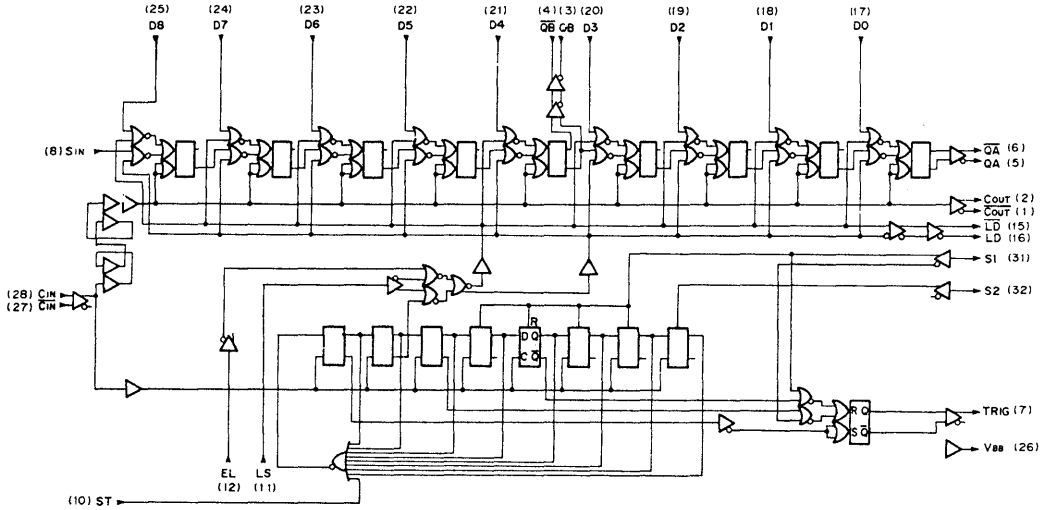
Function Table

LS	S1	S2	ST	EL	C	Function		
L	L	L	L	×	∫	Internal Load	9bit	Load and Shift Right, D0-D8 → QA
L	L	L	H	×	∫			Initialize
L	L	H	L	×	∫		8bit	Load and Shift Right, D0-D7 → QA
L	L	H	H	×	∫			Initialize
L	H	×	L	×	∫		4bit ×2	Load and Shift Right, D0-D3 → QA, D4-D7 → QB
L	H	×	H	×	∫			Initialize
H	×	×	×	L	∫	External Load	Shift Right	≥ 9bit D0-D8 → QA; ≤ 4bit { D0-D3 → QA, D4-D7 → QB
H	×	×	×	H	∫		Load Data	

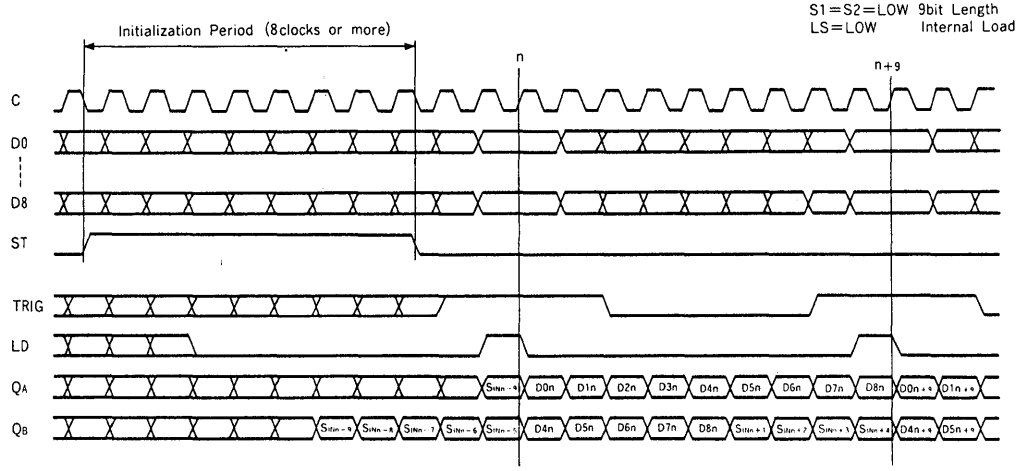
H: HIGH level voltage, L: LOW level voltage, ∫: Positve trasition edge, X: Don't care

In the External Load mode, any bit length can be selected by the period of the External Load (EL) pulse. See Timing Diagram.

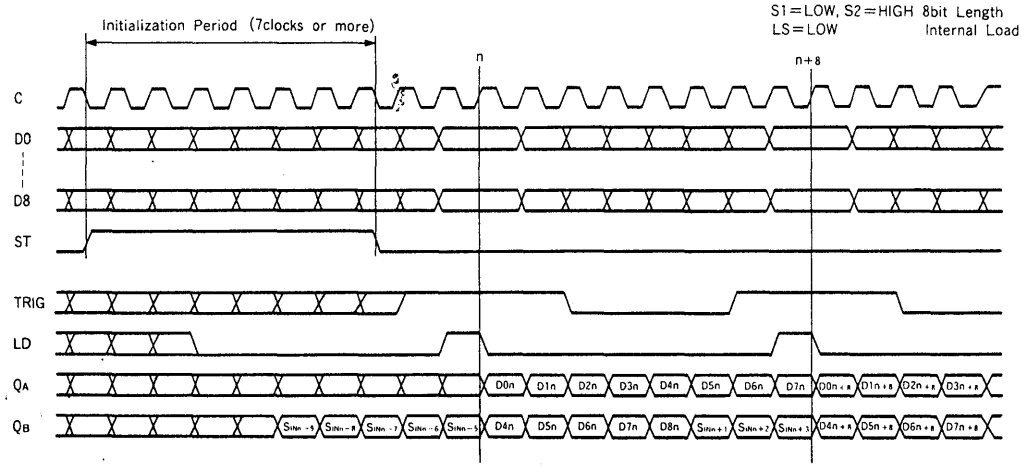
Logic Diagram



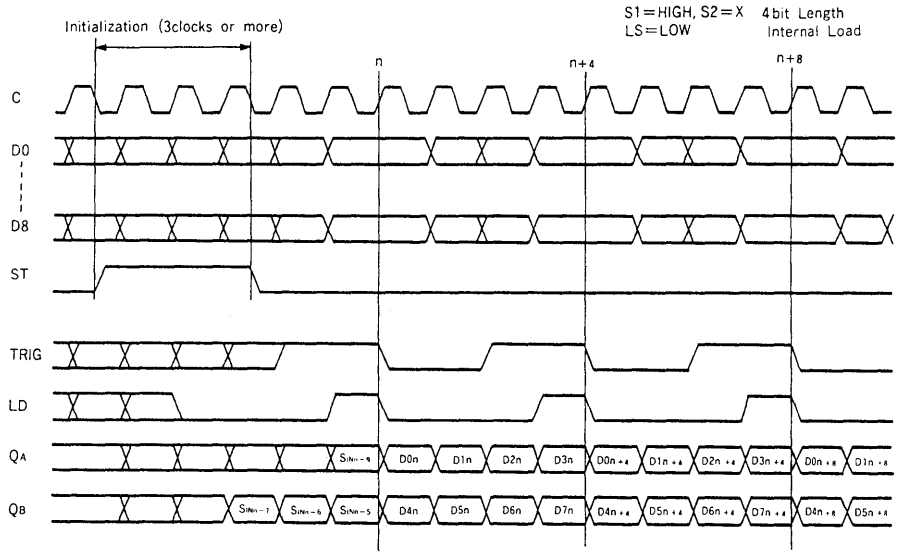
Timing Diagram—9bit



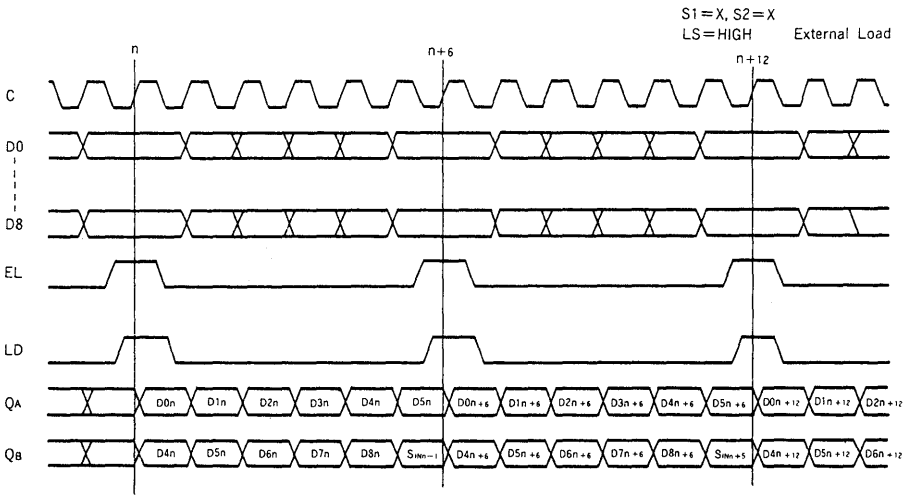
Timing Diagram—8bit



Timing Diagram—4bit×2



Timing Diagram—6bit External Load



9, 8, Dual 4-bit Demultiplexer

Description

The CXB1131Q is an ultra high speed monolithic ECL Demultiplexer which functions as a 9-bit, 8-bit or dual 4-bit Serial to Parallel Converter. S1 and S2 select a bit length.

With Load Select (LS) input set to LOW, start Load pulse (ST) starts loading of the data. ST has to be maintaind High for at least (bit length −1) clock periods.

With LS set to HIGH, External Load (EL) pulse loads parallel data. The bit length is determined by a period of EL.

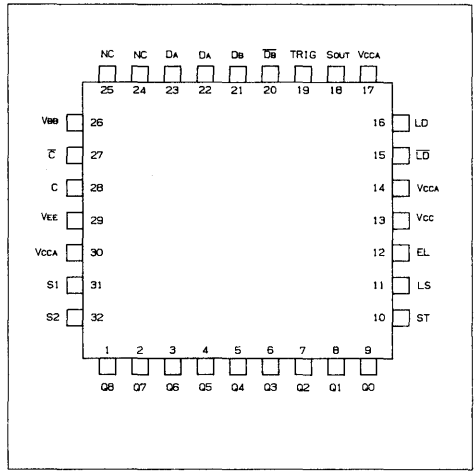
Features

- Typical clock rate up to 1.5 GHz
- Variable bit length: 9-bit,8-bit and Dual 4-bit
- Internal pull down resistors on input pins to maintain logic Low level with the pins left open
- ECL 100K compatible I/O levels
- Differential clock, data input and latch pulse output

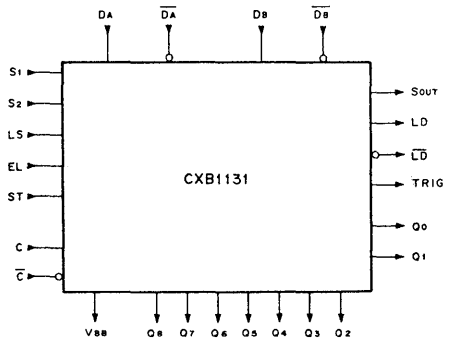
Pin Names

D_A,$\overline{D_A}$	Serial Data inputs (9, 8 and 4-bit operation)
D_B,$\overline{D_B}$	Serial Data inputs (4-bit operation)
Sn	Bit length Select inputs
LS	Load Select input
ST	Load Start input
EL	External Load pulse input
C,$\overline{C}$	Clock inputs (positive edge trigger)
Qn	Demultiplexed parallel data outputs (9, 8 and 4-bit)
S_{OUT}	Serial data output
TRIG	Trigger pulse output
LD,$\overline{LD}$	Load pulse outputs
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Neggative voltage supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−258	−190	−133	mA

Note: Other DC characteristics; See page 3-3, 3-4

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item		Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time		T_{PLH}	C	Qn		1380	1840	2340	ps
		T_{PHL}				1350	1800	2290	
		T_{PLH}		S_{OUT}		890	1180	1500	
		T_{PHL}				870	1160	1470	
		T_{PLH}		TRIG	ST=L	1140	1520	1930	
		T_{PHL}				1130	1500	1900	
		T_{PLH}		LD	LS=L	1240	1650	2050	
		T_{PHL}				1030	1370	1740	
		T_{PLH}	EL		LS=H	750	970	1200	
		T_{PHL}				750	970	1200	
Set up time		T_S	D_A,C	Qn	LS=L	−110			
			D_B,C			260			
			C,EL		LS=H	50			
Hold time		Th	C,D_A		LS=L	390			
			C,D_B			130			
			EL,C		LS=H	400			
Release time		T_R	ST,C			150			
Max. Toggle frequency	9Bit	f_{MAX}	C			1.4	1.7		GHz
	8Bit					1.2	1.5		
	4Bit					1.3	1.6		
	External					1.4	1.7		
Rise time		T_{TLH}		Qn,LD S_{OUT},TRIG	20% to 80%		420	530	ps
Fall time		T_{THL}					360	460	

Note: AC test circuit; See page 4-4, 4-5

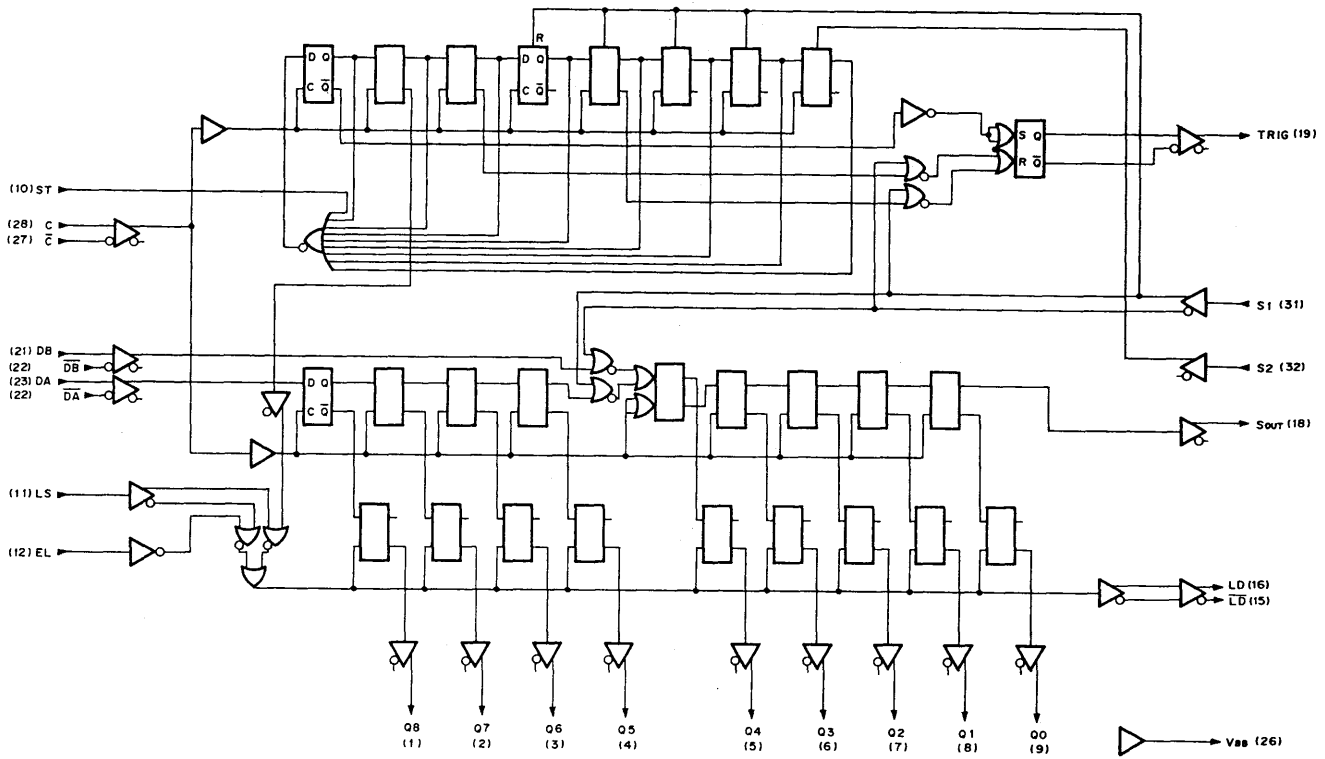
Function Table

LS	S1	S2	ST	EL	C	Function			
L	L	L	L	×	∫	Internal Load	9bit	Load and output, DA → Q0-Q8	
L	L	L	H	×	∫			Initialize (8 clock period minimum)	
L	L	H	L	×	∫		8bit	Load and output, DA → Q1-Q8	
L	L	H	H	×	∫			Initialize (7 clock period minmum)	
L	H	×	L	×	∫		4bit ×2	Load and Shift	DA → Q5-Q8 DB → Q1-Q4
L	H	×	H	×	∫			Initialize (3 clock period minmum)	
H	L	×	×	×	∫	External Load	5 ≤ bit length ≤ 9		Serial Data Load
H	L	×	×	∫	×				Parallel Data Output
H	H	×	×	×	∫		bit length ≤ 4		Serial Data Load
H	H	×	×	∫	×				Parallel Data Output

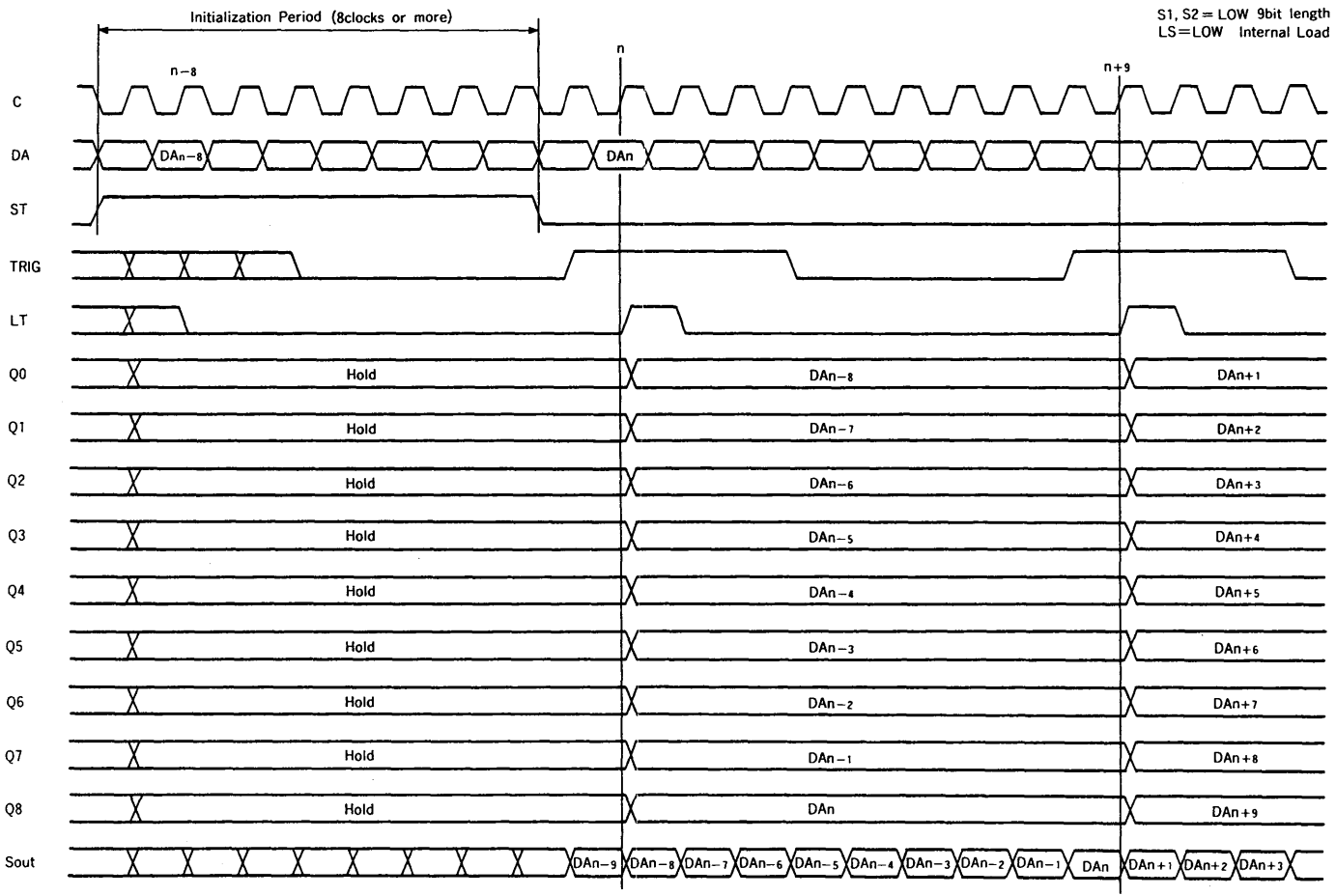
H: HIGH voltage level, L: LOW voltage level, ∫: Positve transition edge, X: Don't care

In the External Load mode, serial input data is entered synchronusly with clock (C) and parallel output data is output to output pins synchronously with External Load (EL). The bit length can be datermined by the period of EL pulse. See Timing Diagram.

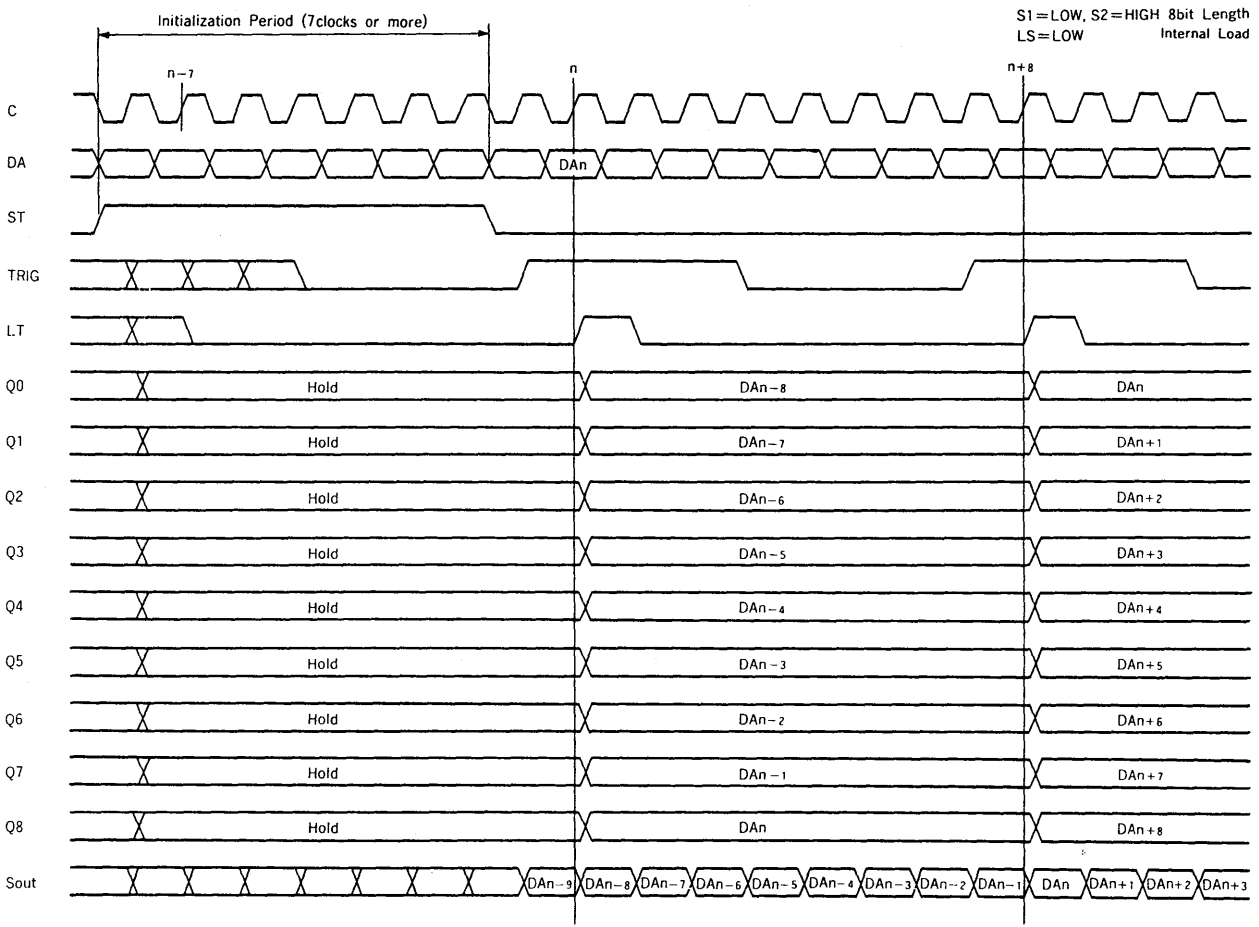
Block Diagram



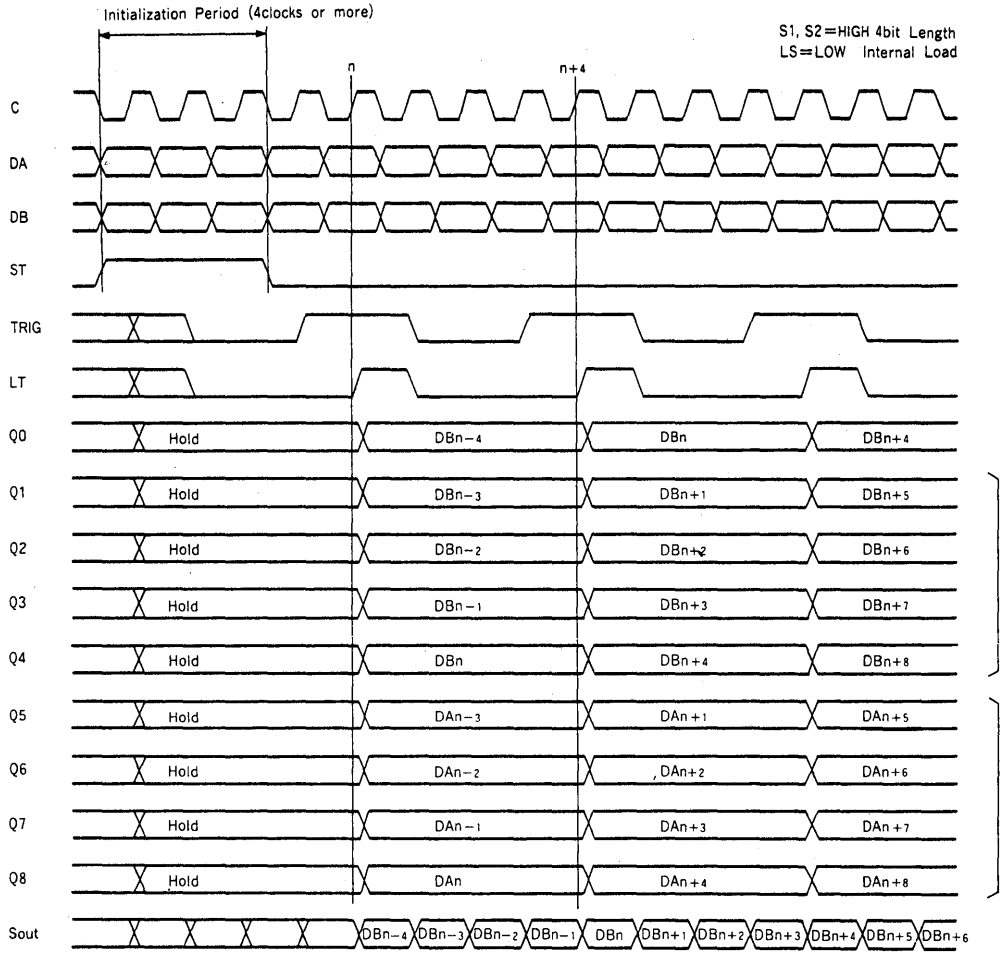
Timing Diagram — 9-bit



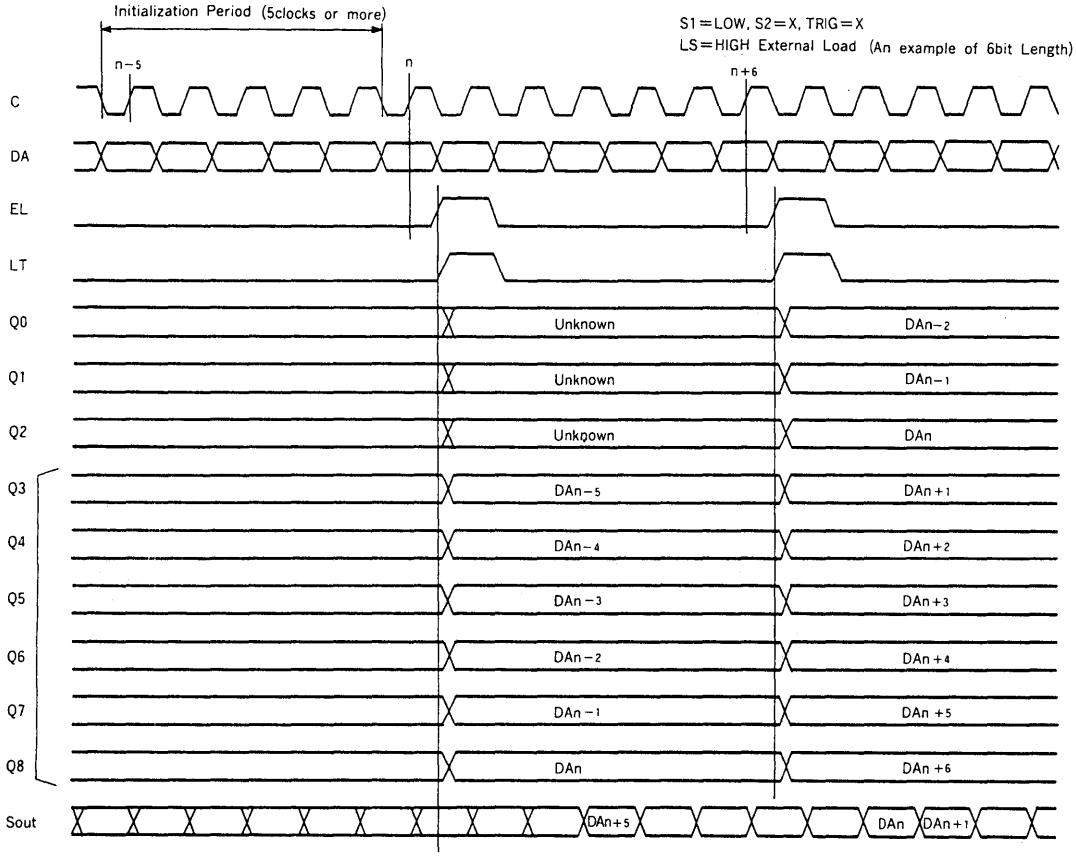
Timing Diagram — 8-bit



Timing Diagram — 4-bit×2



Timing Diagram — 6-bit External Load



9, 8, Dual 4-bit Universal Shift Register

Description

The CXB1132Q is an ultra high speed monolithic Universal Shift Register with variable bit length.

Select inputs S1 and S2 select a function mode from parallel load, hold, shift right, and shift left. S3 and S4 select a bit length. The operation is shown in Function Table.

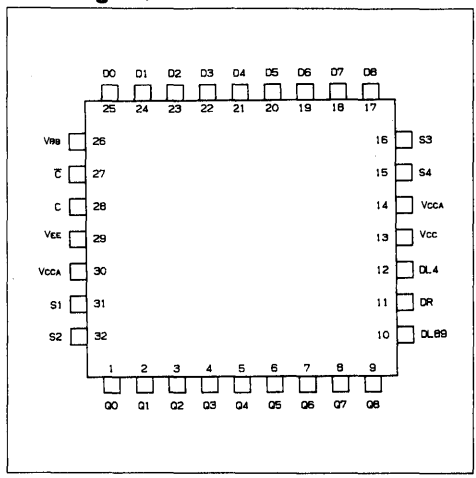
Features

- Typical clock rate up to 1.3GHz
- Variable bit length: 9-bit, 8-bit and 4-bit
- Internal pull down resistors on input pins to maintain logic LOW level the pins left open
- ECL 100K compatible I/O levels
- Differential clock input

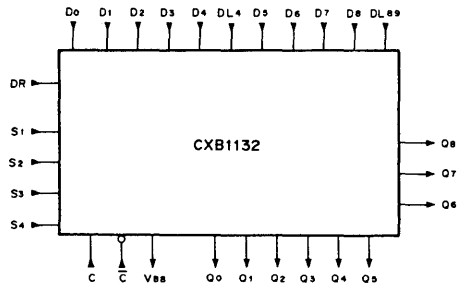
Pin Names

Dn	Data inputs
DR, DL4, DL89	Data inputs
Sn	Select inputs
C, $\overline{C}$	Clock inputs (positive edge trigger)
Qn	Data outputs
V_{BB}	Reference voltage output
Vcc	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative voltage supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−236	−173	−121	mA

Note: Other DC characteristics; See page 3-3, 3-4

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C	Qn		800	1070	1360	ps
	T_{PHL}				770	1030	1310	
Set up time	T_S	Dn, C	Qn		210			
		D_R, C	Q_0		190			
		D_{L4}, C	Q_4		220			
		D_{L89}, C	Q_7, Q_8		320			
		S_1, $S_2\rightarrow C$	Qn		650			
Hold time	T_h	C, Dn	Qn		220			
		C, D_R	Q_0		160			
		C, D_{L4}	Q_4		230			
		C, D_{L89}	Q_7, Q_8		10			
		$C\rightarrow S_1$, S_2	Qn		−30			
Max. Toggle frequency	f_{MAX}	C	Qn		1.0	1.3		GHz
Rise time	T_{TLH}			20% to 80%		430	550	ps
Fall time	T_{THL}					380	480	

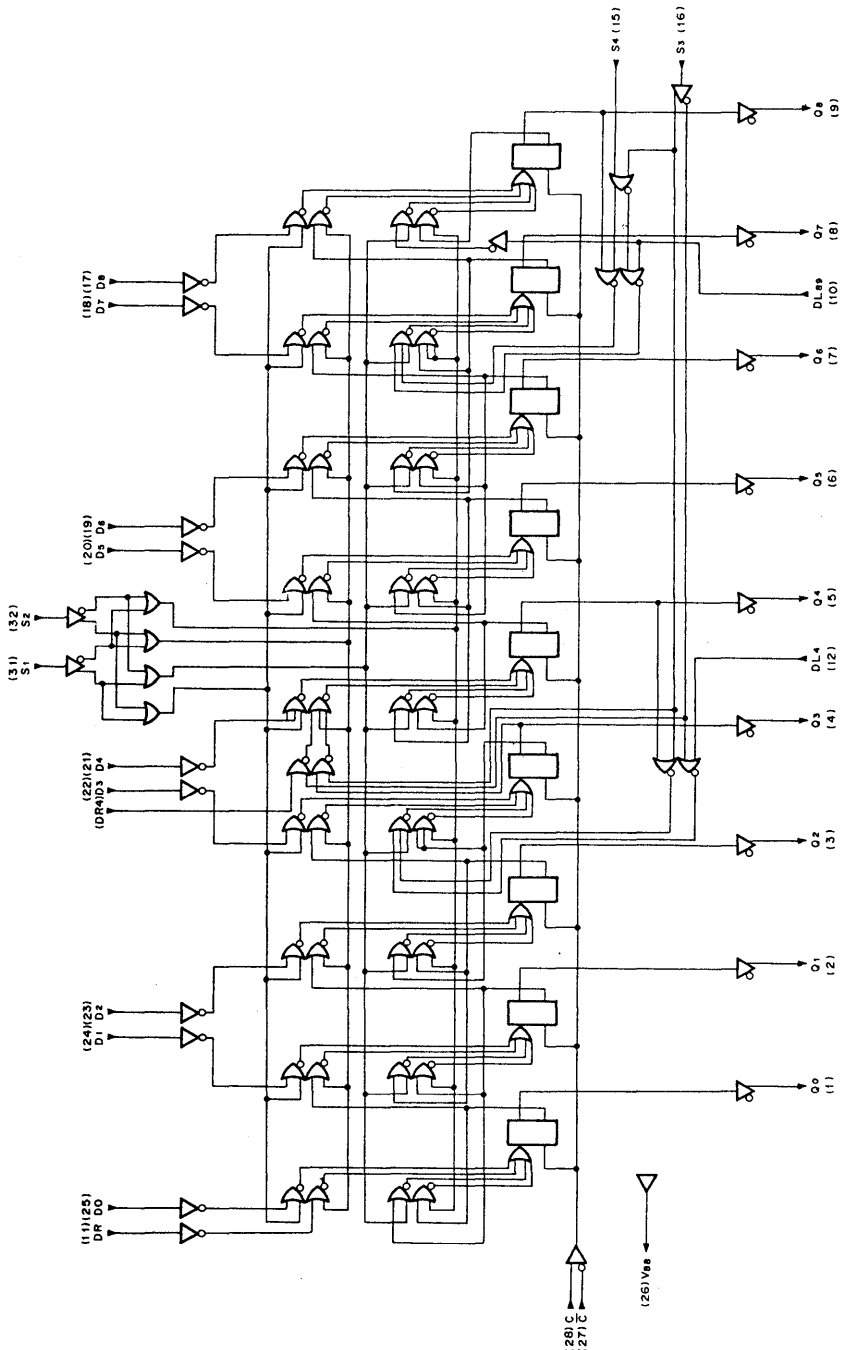
Note: AC test circuit; See page 4-4, 4-5

Function Table

Pin / Function	Inputs								Outputs								
	DR	DL89	DL4	S1	S2	S3	S4	C	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Load	×	×	×	L	L	×	×		D0	D1	D2	D3	D4	D5	D6	D7	D8
Shift left 9 bit length	×	DL89	×	L	H	L	L		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	DL89
Shift left 8 bit length	×	DL89	×	L	H	L	H		Q1	Q2	Q3	Q4	Q5	Q6	Q7	DL89	DL89
Shift left 4 bit length	×	DL89	DL4	L	H	H	×		Q1	Q2	Q3	DL4	Q5	Q6	Q7	DL89	DL89
Shift right 9 bit length	DR	×	×	H	L	L	L		DR	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Shift right 8 bit length	DR	×	×	H	L	L	H		DR	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Shift right 4 bit length	DR	×	×	H	L	H	×		DR	Q0	Q1	Q2	L	Q4	Q5	Q6	Q7
Hold	×	×	×	H	H	×	×	×	——— No change ———								

×: Don't care
↑: Positive transition edge
H: HIGH voltage level
L: LOW voltage level

Block Diagram



DR4 is fixed to "L" level.

22, 15, 7 Stage Data Scrambler with Differential I/O

Description

The CXB1133Q is an ultra high speed monolithic ECL Data Scrambler with variable bit length.

Select switch M selects a mode: "scrambler" or "Maximal code sequence generator". In scrambler mode, input data is converted into a quasi-random data sequence. The quasi-random data can be re-converted into the original input data by a Descrambler such as the CXB1134Q. In M-code sequence generator mode, the IC generates a quasi-random number sequence.

Select inputs S1 and S2 select a bit length.

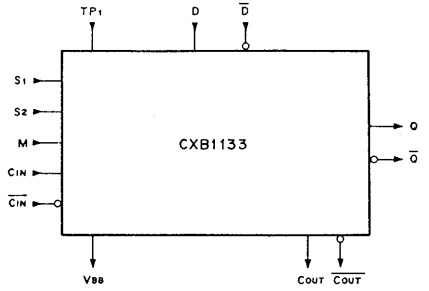
Features

- Typical clock rate up to 1.4GHz
- Variable bit length: 22-bit, 15-bit, 7-bit
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential input and output

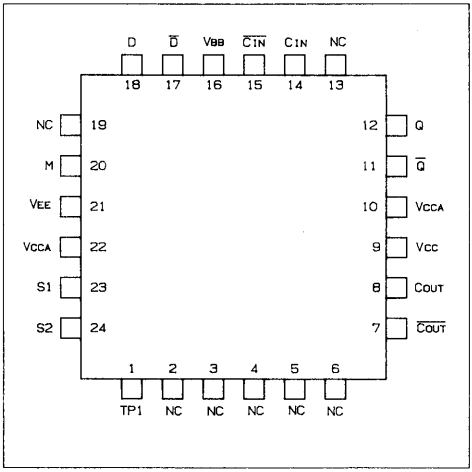
Pin Names

D, $\overline{D}$	Data inputs in scrambler mode
M	Mode Select input
Sn	Select inputs
C_{IN}, $\overline{C_{IN}}$	Clock inputs (positive edge trigger)
Q, $\overline{Q}$	Data outputs
C_{OUT}, $\overline{C_{OUT}}$	Buffered clock outputs
TP1	Test point (It must be left open)
V_{BB}	Reference voltage
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Nagative voltage supply

Logic Symbol



Pin Assignment



Stage Select

S1	S2	Operation
L	L	22 Stage
L	H	15 Stage
H	L	7 Stage
H	H	

Function Select

M	Operation
H	Maximal code sequence generator
L	Data scrambler

H: HIGH voltage level, L: LOW voltage level

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−147	−108	−76	mA

Note: Other DC characteristics; See page 3-3, 3-4

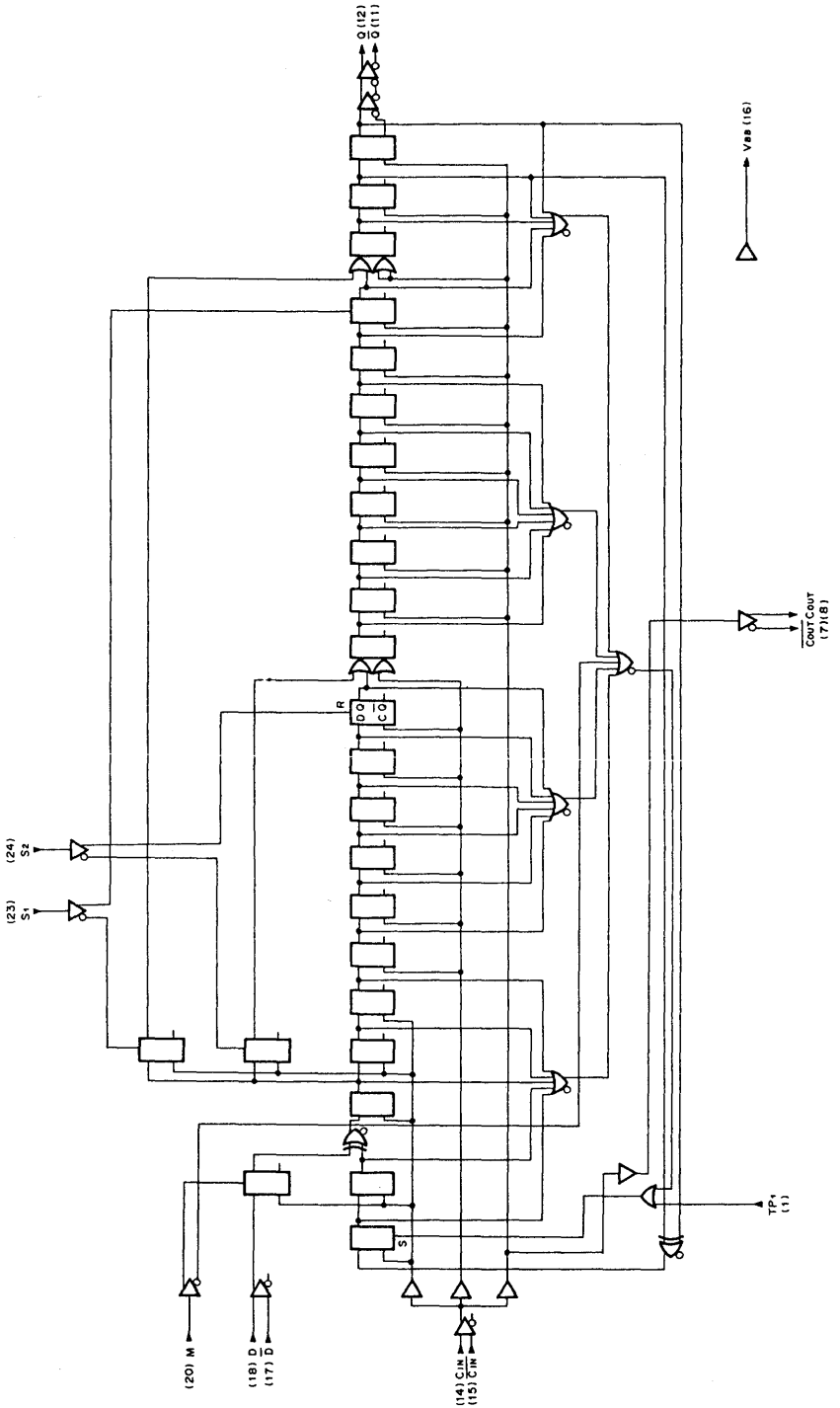
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C_{IN}	Q		1040	1390	1765	ps
	T_{PHL}				1030	1370	1740	
	T_{PLH}		C_{OUT}		650	870	1100	
	T_{PHL}				650	870	1100	
Set up time	T_S	D, C_{IN}	Q	S1=S2=L M=L	80			ps
Hold time	T_h	C_{IN}, D			290			
Max. Toggle frequency	f_{MAX}	C_{IN}			1.1	1.4		GHz
Rise time	T_{TLH}		Q, C_{OUT}	20% to 80%		300	380	ps
Fall time	T_{THL}					280	355	

Note: AC test circuit; See page 4-4, 4-5

Block Diagram



Scrambler/Descrambler principle

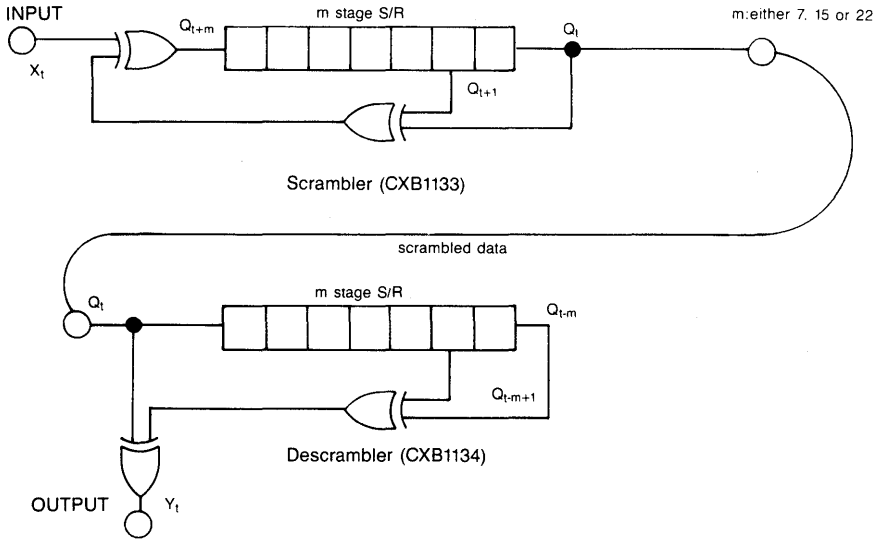


Figure 1. Scrambler/Descrambler (Timming at t)

Scrambler:

$$(Q_t + Q_{t+1}) + X_t = Q_{t+m} \quad \text{--------(1)}$$

Descrambler:

$$(Q_{t-m} + Q_{t-m+1}) + Q_t = Y_t \quad \text{--------(2)}$$

When $t = t + m$ at (2) ;

$$(Q_t + Q_{t+1}) + Q_{t+m} = Y_{t+m} \quad \text{--------(3)}$$

Put (1) into (3);

$$(Q_t + Q_{t+1}) + (Q_t + Q_{t+1}) + X_t = Y_{t+m}$$

$$0 + X_t = Y_{t+m}$$

Thus,

$$X_t = Y_{t+m}$$

Then, data will be restored after m clock.

22, 15, 7 Stage Descrambler with Differential I/O

Description

The CXB1134Q is an ultra high speed monolithic ECL Date Descrambler with variable bit length.

Select switches S1 and S2 select a bit length. This IC is used in combination with the CXB1133Q Scrambler/Maximal code generator to re-convert a qusi-random data sequence into the original data sequence.

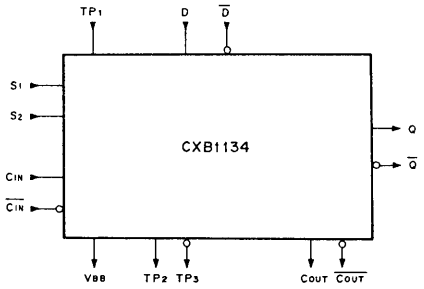
Features

- Typical clock rate up to 1.4GHz
- Variable bit length: 22-bit, 15-bit, 7-bit
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential input and output

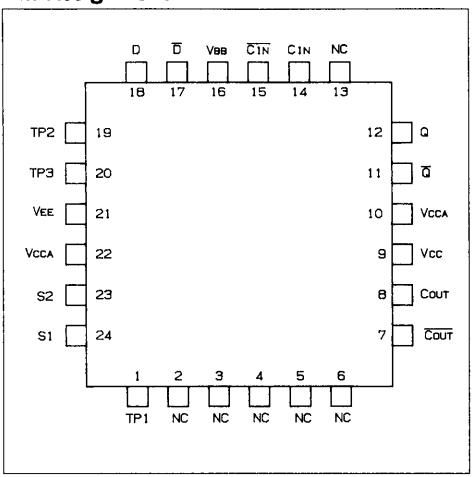
Pin Names

D, $\overline{D}$	Data inputs
Sn	Select inputs
C_{IN}, $\overline{C_{IN}}$	Clock inputs (positive edge trigger)
Q, $\overline{Q}$	Data outputs
C_{OUT}, $\overline{C_{OUT}}$	Buffered clock outputs
TPn	Test points (They must be left open)
V_{BB}	Reference voltage
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative voltage supply

Logic Symbol



Pin Assignment



Stage Select

S1	S2	Operation
L	L	22 Stage
L	H	15 Stage
H	L	7 Stage
H	H	

H: HIGH volntage level
L: LOW voltage level

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−150	−110	−77	mA

Note: Other DC characteristics; See page 3-3, 3-4

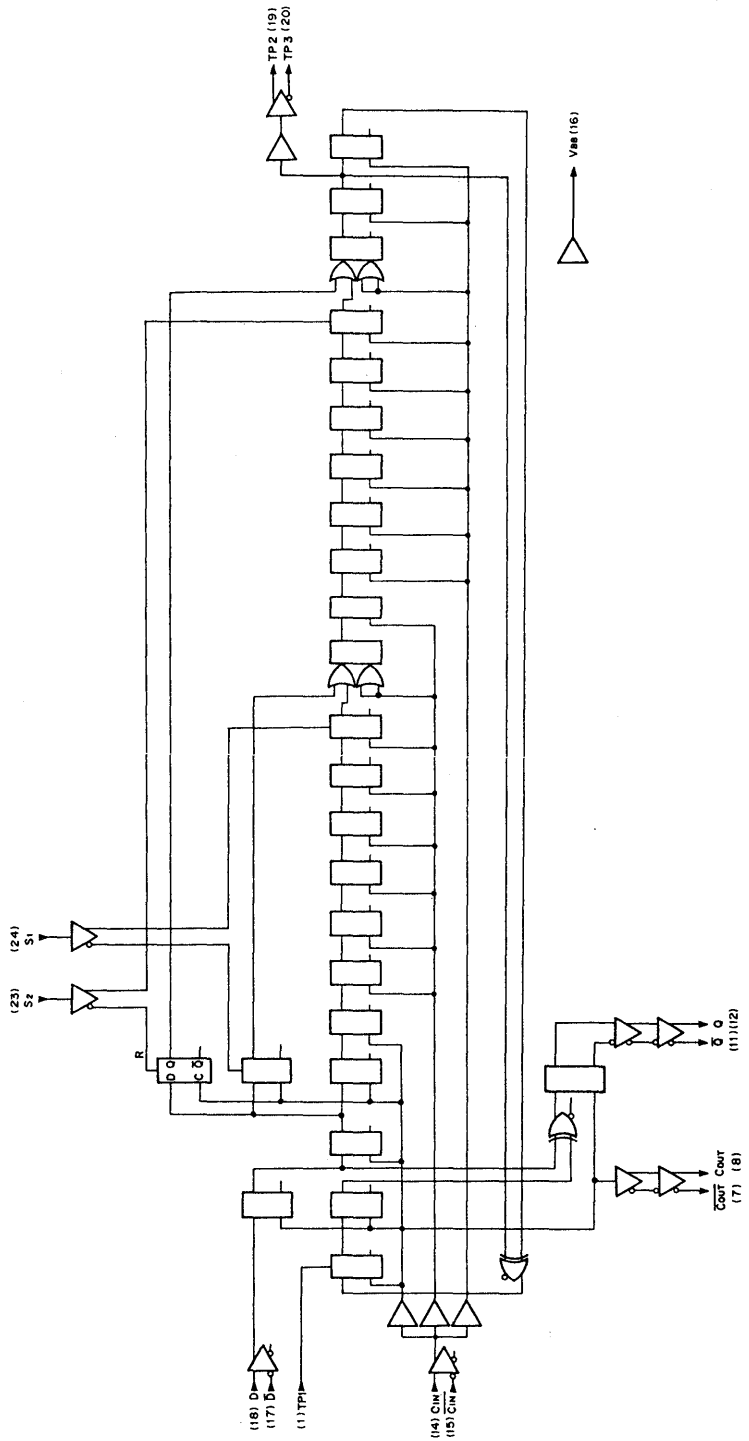
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C_{IN}	Q		950	1270	1610	ps
	T_{PHL}				920	1220	1550	
	T_{PLH}		C_{OUT}		680	900	1140	
	T_{PHL}				680	910	1150	
Set up time	T_S	D, C_{IN}	Q		20			
Hold time	T_h	C_{IN}, D			340			
Max. Toggle frequency	f_{MAX}	C_{IN}			1.1	1.4		GHz
Rise time	T_{TLH}		Q, C_{OUT}	20% to 80%		320	410	ps
Fall time	T_{THL}					280	360	

Note: AC test circuit; See page 4-4, 4-5

Block Diagram



8 to 16-bit Serial Data Comparator

Description

The CXB1135Q is an ultra high speed monolithic ECL Serial Data Comparator with variable bit length of 8 to 16. This IC compares serial input data (D_{IN}) with the preset parallel data (Dn) and indicates the coincidence of two data at outputs Zs and Z_A.

Select switches (S1-S4) select a bit length.

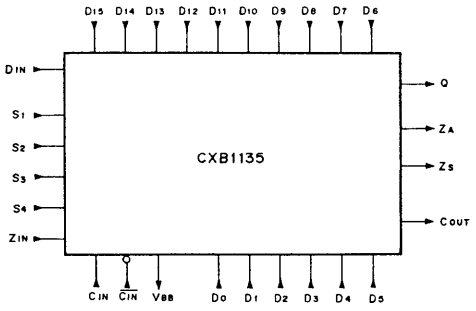
Features

- Typical clock rate up to 1.4GHz
- Variable bit length: 8-bit to 16-bit
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

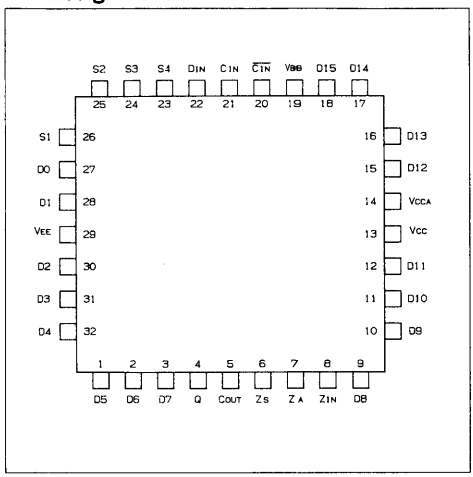
Pin Names

Dn	Parallel Data inputs
D_{IN}	Serial Data input
Z_{IN}	Serial data input for bit length extension
Sn	Bit length Select inputs
C_{IN}, $\overline{C_{IN}}$	Clock inputs (positive edge trigger)
Q	Serial output
Zs	Synchronous coincidence output
Z_A	Asynchronous coincidence output
C_{OUT}	Buffered clock output
V_{BB}	Reference voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative voltage supply

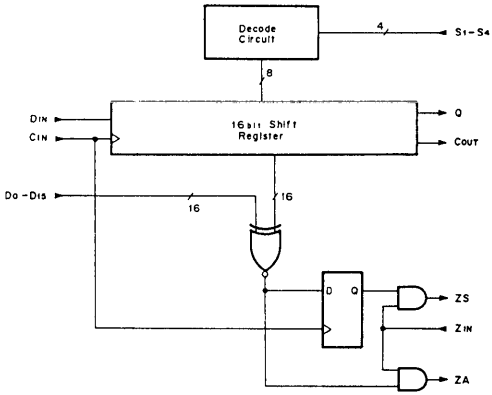
Logic Symbol



Pin Assignment



Block Diagram



Bit Length Select

S1	S2	S3	S4	Operation	Parallel inputs
L	L	L	L	8bit	D0 to D7
L	L	L	H	9bit	D0 to D8
L	L	H	L	10bit	D0 to D9
L	L	H	H	11bit	D0 to D10
L	H	L	L	12bit	D0 to D11
L	H	L	H	13bit	D0 to D12
L	H	H	L	14bit	D0 to D13
L	H	H	H	15bit	D0 to D14
H	L	L	L	16bit	D0 to D15

H: HIGH voltage level, L: LOW voltage level

DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−174	−128	−90	mA

Note: Other DC characteristics; See page 3-3, 3-4

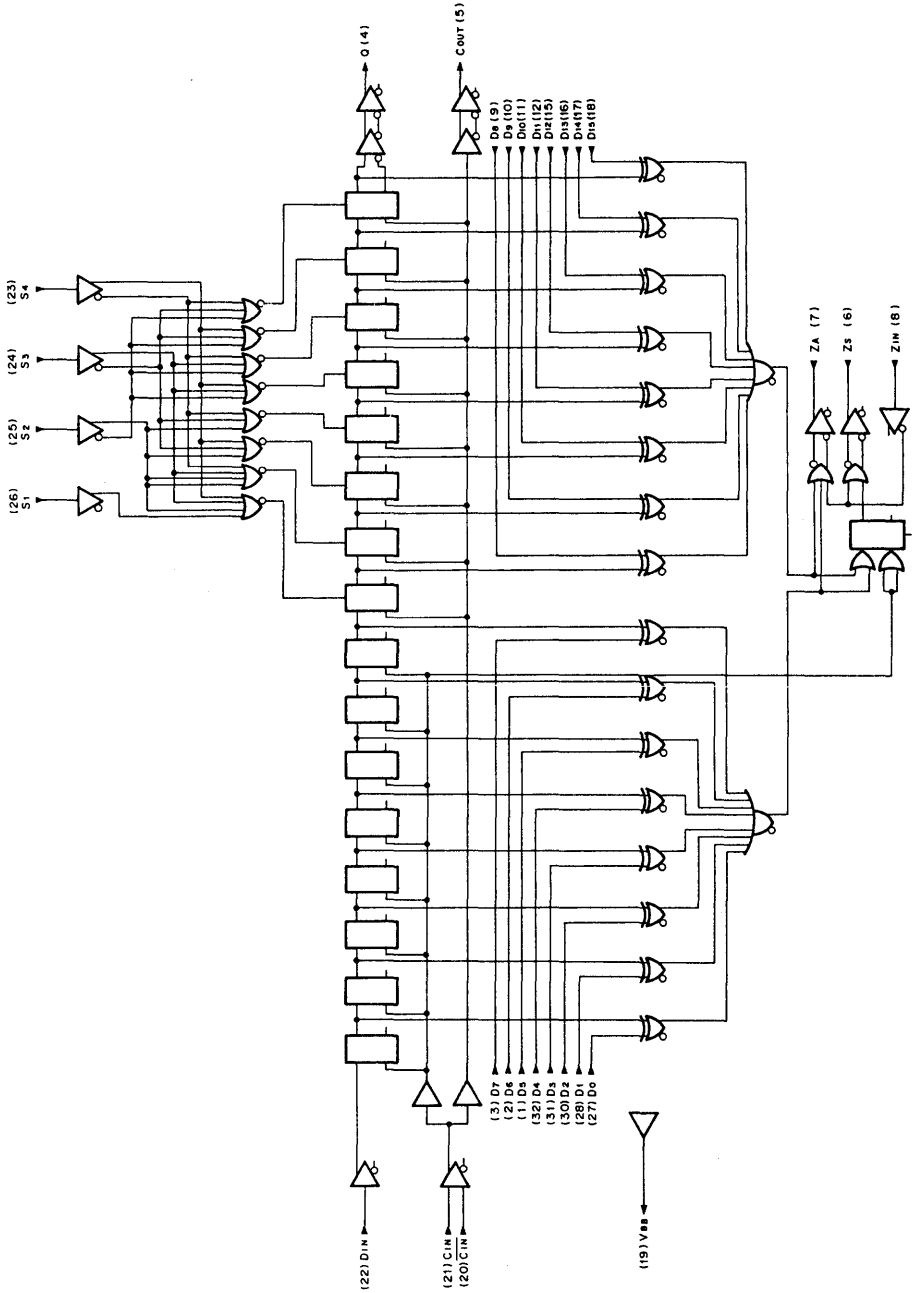
AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item		Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time		T_{PLH}	C_{IN}	ZA	$Z_{IN}=H$	1420	1890	2400	ps
		T_{PHL}				1120	1490	1890	
		T_{PLH}		ZS		1140	1520	1930	
		T_{PHL}				1080	1440	1830	
		T_{PLH}		Q		1060	1410	1790	
		T_{PHL}				1030	1370	1740	
		T_{PLH}		C_{OUT}		850	1130	1430	
		T_{PHL}				860	1150	1460	
		T_{PLH}	Z_{IN}	ZA		760	1010	1280	
		T_{PHL}				510	680	860	
		T_{PLH}		ZS		730	970	1230	
		T_{PHL}				500	670	850	
Set up time		T_S	D_{IN}, C_{IN}	ZA, ZS	$Z_{IN}=H$	−230			
			Dn, C_{IN}			240			
Hold time		T_h	C_{IN}, D_{IN}			550			
			C_{IN}, Dn			420			
Max. Toggle frequency	8-Bit	f_{MAX}	C_{IN}			1.1	1.4		GHz
	9to16-Bit					1.1	1.4		
Rise time		T_{TLH}		ZA, ZS, Q, C_{OUT}	20% to 80%		500	630	ps
Fall time		T_{THL}					480	580	

Note: AC test circuit; See page 4-3, 4-4, 4-5

Block Diagram

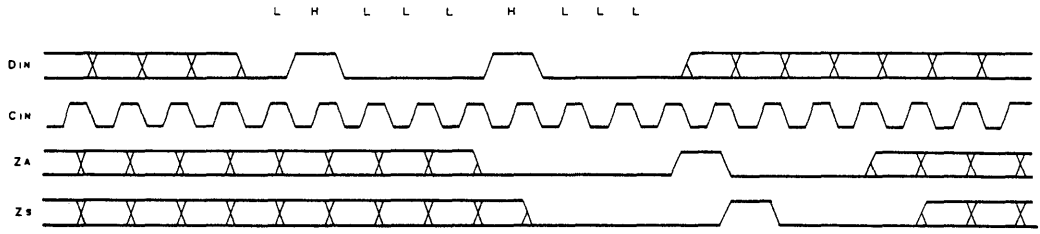


Timing Diagram—9-bit

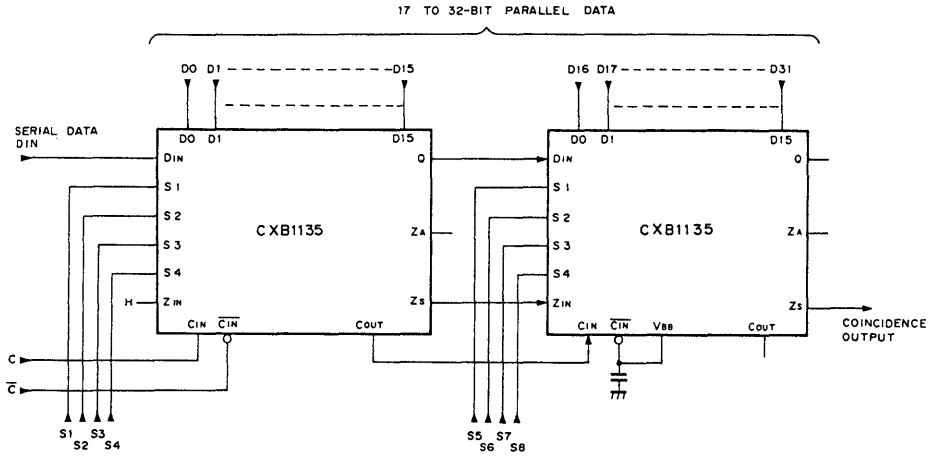
S1 to S3=LOW
S4=HIGH
9-bit length

D8	D7	D6	D5	D4	D3	D2	D1	D0
L	H	L	L	L	H	L	L	L

Example of 9-bit parallel input data. Parallel deta input pins which are not used (D9 to D15) must be open.



Typical Application—17 to 32-bit Serial Data Comparator



8-bit Universal Counter with Preset and Master Reset

Description

The CXB1136Q is an ultra high speed monolithic ECL 8-bit Universal Counter.

Two Select (S1, S2) inputs select modes: up count, down count, preset and hold. Carry-in ($\overline{C_{IN}}$) and Carry out (C_{OUT}) is provided for the expasion of bit length.

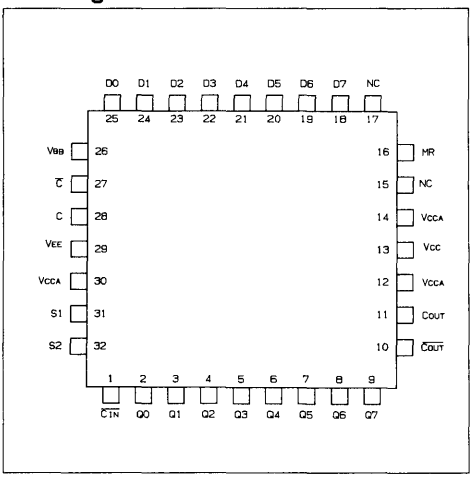
Features

- Typical clock rate up to 1.1GHz
- Up/Down/Preset/Hold modes
- Differential clock input
- Reference voltage output for single ended input operation
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels
- Differential clock input

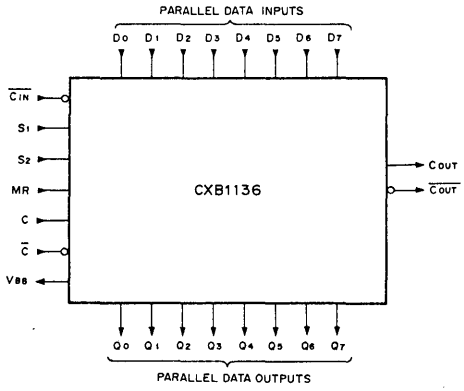
Pin Names

Dn	Parallel Data inputs
Sn	Select inputs
$\overline{MR}$	Master direct Reset input
$\overline{C_{IN}}$	Carry input
C, $\overline{C}$	Clock inputs (positive edge trigger)
Qn	Parallel data outputs
C_{OUT}, $\overline{C_{OUT}}$	Carry outputs
V_{BB}	Reference voltage output
V_{CC}	Cirucit ground
V_{CCA}	Cirucit ground for output
V_{EE}	Negative voltage supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−194	−143	−100	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	C	Qn		770	1020	1300	ps
	T_{PHL}				770	1020	1300	
	T_{PLH}		C_{OUT}		850	1130	1440	
	T_{PHL}				910	1210	1540	
	T_{PLH}	$\overline{C_{IN}}$			1210	1610	2040	
	T_{PHL}				1260	1660	2090	
	T_{PLH}	MR			1130	1500	1900	
	T_{PHL}				1130	1500	1900	
	T_{PHL}		Qn		950	1240	1610	
Set up time	T_S	Dn, C	Qn		530			
		S1, C			900			
		S2, C			870			
		$\overline{C_{IN}}$, C	C_{OUT}		1150			
Hold time	T_h	C, Dn	Qn		200			
		C, S1			−350			
		C, S2			−350			
		C, $\overline{C_{IN}}$	C_{OUT}		−30			
Release time	T_R	MR, C	Qn		370			
Min. Pulse width	T_{PW}	MR			330			
Max. Toggle frequency Count up	f_{MAX}	C			1.0	1.3		GHz
Max. Toggle frequency Count down					0.8	1.1		
Rise time	T_{TLH}			20% to 80%		500	630	ps
Fall time	T_{THL}					400	500	

Note: AC test circuit; See page 4-3, 4-4, 4-5.
All output pins are left open except measured output pins.

Sequential Truth Table

Pin	Inputs													Outputs								
Mode	MR	S1	S2	DO	D1	D2	D3	D4	D5	D6	D7	$\overline{CIN}$	CLK	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	$\overline{COUT}$
Preset	L	L	L	L	L	H	H	H	H	H	H	X	∫	L	L	H	H	H	H	H	H	L
Count up	L	L	H	X	X	X	X	X	X	X	X	L	∫	H	L	H	H	H	H	H	H	H
	L	L	H	X	X	X	X	X	X	X	X	L	∫	L	H	H	H	H	H	H	H	H
	L	L	H	X	X	X	X	X	X	X	X	L	∫	H	H	H	H	H	H	H	H	L
	L	L	H	X	X	X	X	X	X	X	X	H	∫	H	H	H	H	H	H	H	H	H
	L	L	H	X	X	X	X	X	X	X	X	H	∫	H	H	H	H	H	H	H	H	H
Hold	L	H	H	X	X	X	X	X	X	X	X	X	∫	H	H	H	H	H	H	H	H	H
Preset	L	L	L	H	H	L	L	L	L	L	L	X	∫	H	H	L	L	L	L	L	L	L
Count Down	L	H	L	X	X	X	X	X	X	X	X	L	∫	L	H	L	L	L	L	L	L	H
	L	H	L	X	X	X	X	X	X	X	X	L	∫	H	L	L	L	L	L	L	L	H
	L	H	L	X	X	X	X	X	X	X	X	L	∫	L	L	L	L	L	L	L	L	L
	L	H	L	X	X	X	X	X	X	X	X	L	∫	H	H	H	H	H	H	H	H	H
MR	H	X	X	X	X	X	X	X	X	X	X	X	X	L	L	L	L	L	L	L	L	L

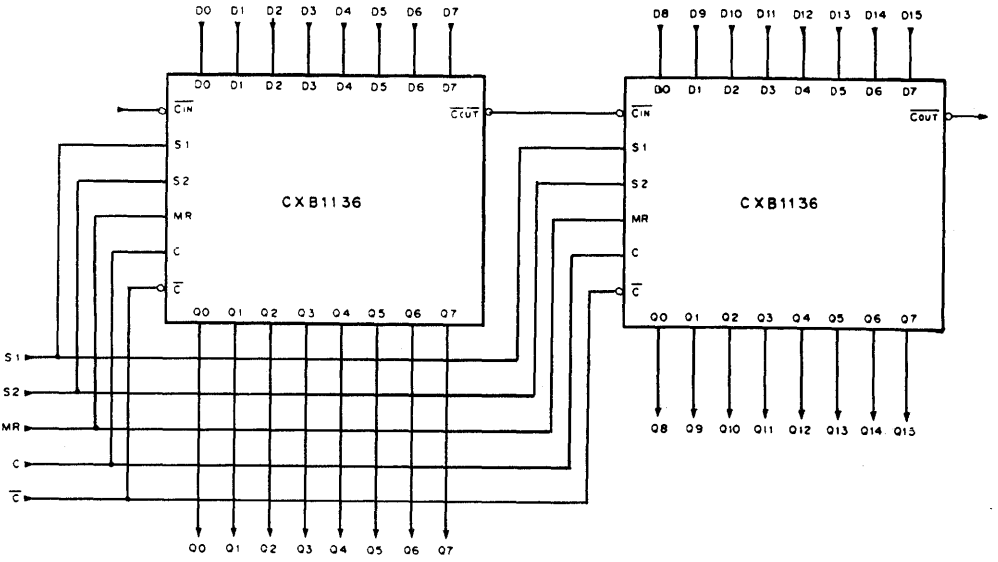
H : HIGH voltage level

L : LOW voltage level

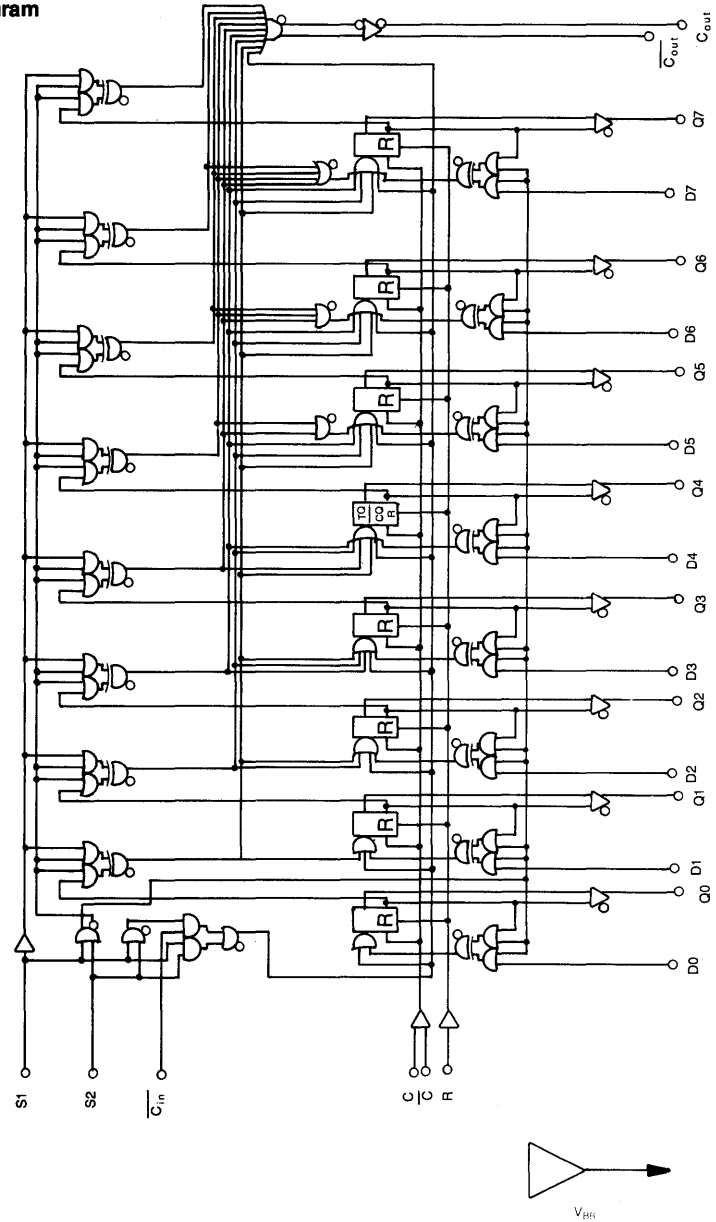
X : Don't care

∫ : Positive transition edge

Typical Application — 16bit Up/Down Counter



Logic Diagram



8-bit Shift Matrix

Description

The CXB1137Q is an ultra high speed monolithic ECL 8-bit Shift Matrix. Three Select (Sn) inputs define the number of places which an 8-bit word (Dn) present at the inputs is shifted to the left and presented at the outputs (Zn). A mode control (M) input determines the mode: "low back fill" or "barrel shifting".

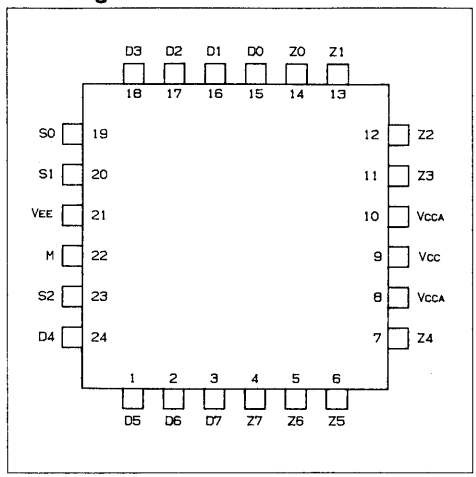
Features

- Typical propagation delay time 1.45ns (D to Zn)
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

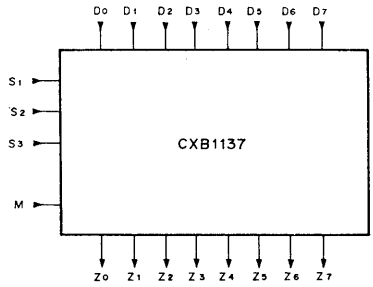
Pin Names

Dn	Word inputs
Sn	Shift control inputs
M	Mode select input
Zn	Data outputs
V_{CC}	Cirucit ground
V_{CCA}	Cirucit ground for output
V_{EE}	Negative voltage supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−178	−131	−92	mA

Note: Other DC characteristics; See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Dn	Zn		1020	1450	1840	ps
	T_{PHL}				760	1100	1400	
	T_{PLH}	S0			1010	1340	1700	
	T_{PHL}				980	1310	1660	
	T_{PLH}	S1, S2			990	1320	1680	
	T_{PHL}				920	1230	1560	
	T_{PLH}	M			830	1110	1410	
	T_{PHL}				810	1080	1370	
Rise time	T_{TLH}	Dn, Sn, M		20% to 80%		400	510	
Fall time	T_{THL}					340	430	

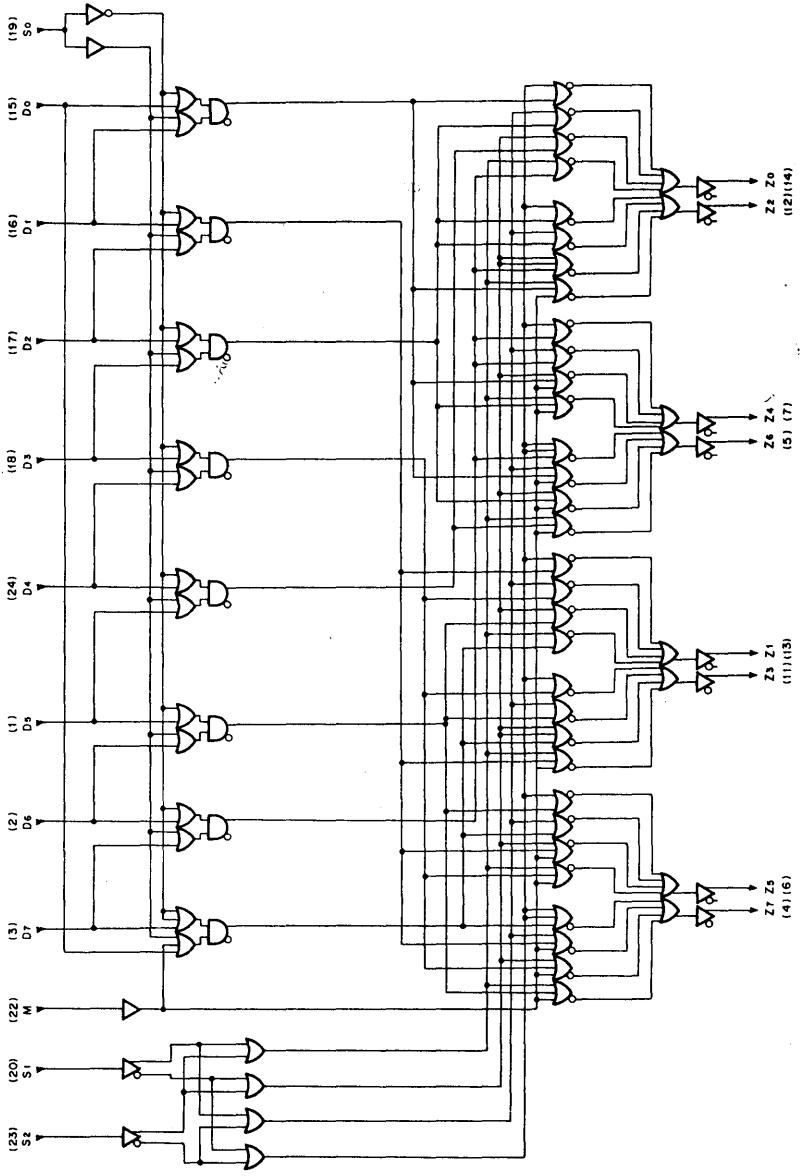
Note: AC test circuit; See page 4-3.

Truth Table

Inputs				Outputs							
M	S_0	S_1	S_2	Z_0	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7
×	L	L	L	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
L	H	L	L	D_1	D_2	D_3	D_4	D_5	D_6	D_7	L
L	L	H	L	D_2	D_3	D_4	D_5	D_6	D_7	L	L
L	H	H	L	D_3	D_4	D_5	D_6	D_7	L	L	L
L	L	L	H	D_4	D_5	D_6	D_7	L	L	L	L
L	H	L	H	D_5	D_6	D_7	L	L	L	L	L
L	L	H	H	D_6	D_7	L	L	L	L	L	L
L	H	H	H	D_7	L	L	L	L	L	L	L
H	H	L	L	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_0
H	L	H	L	D_2	D_3	D_4	D_5	D_6	D_7	D_0	D_1
H	H	H	L	D_3	D_4	D_5	D_6	D_7	D_0	D_1	D_2
H	L	L	H	D_4	D_5	D_6	D_7	D_0	D_1	D_2	D_3
H	H	L	H	D_5	D_6	D_7	D_0	D_1	D_2	D_3	D_4
H	L	H	H	D_6	D_7	D_0	D_1	D_2	D_3	D_4	D_5
H	H	H	H	D_7	D_0	D_1	D_2	D_3	D_4	D_5	D_6

H : HIGH voltage level
L : LOW voltage level
× : Don't care

Block Diagram



4-bit Arithmetic Logic Unit (ALU)

Description

The CXB1138Q is an ultra high speed monolithic ECL IC, which contains an 8-bit Arithmetic Logic Unit capable of 16 arithmetic operations on two 4-bit words.

Arithmetic logic operations are selected by function Select (S0-S3) inputs as indicated in Function Table. This IC uses internal look-ahead carry to minimize delay to the Function (Fn) output and to the ripple Carry (C_{N+4}) output.

Group Carry Generate (G_G) and Group Carry Propagate (P_G) are provided to obtain fast operation on very long words in combination with the CXB1111Q Look-Ahead Carry Generator.

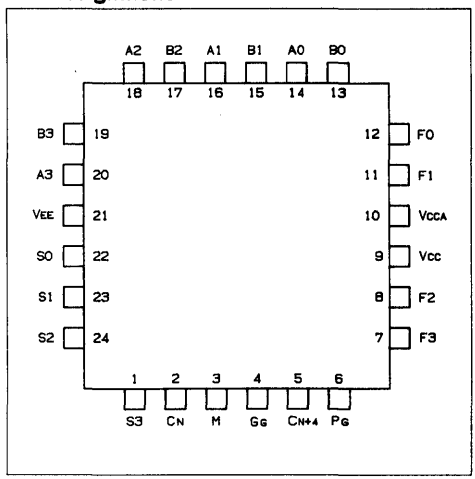
Features

- Typical propagation delay time 1.44ns (Bn to Fn)
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

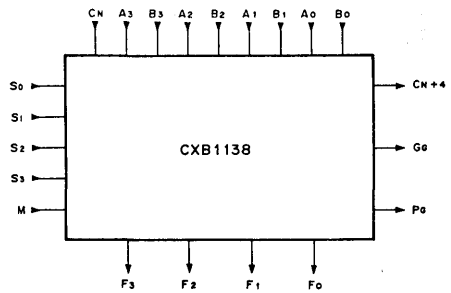
Pin Names

An-Bn	Word A and B operand inputs
C_N	Carry input
M	Mode select input
Sn	Function Select inputs
Fn	Function outputs
C_{N+4}	Carry output
G_G	Group carry Generate output
P_G	Group carry Propagate output
V_{CC}	Cirucit ground
V_{CCA}	Cirucit ground for output
V_{EE}	Negative voltage supply

Pin Assignment



Logic Symbol



DC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply current	I_{EE}		−175	−129	−90	mA

Note: Other DC characteristics: See page 3-3, 3-4.

AC Characteristics

$V_{EE}=-4.5\pm0.3V$, $V_{CC}=V_{CCA}=GND$, $V_{TT}=-2.0V$, $T_C=0°C$ to $+85°C$, $R_T=50\Omega$ to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation delay time	T_{PLH}	Bn	Fn		700	1440	1830	ps
	T_{PHL}				820	1370	1740	
	T_{PLH}		P_G		750	1000	1270	
	T_{PHL}				910	1210	1540	
	T_{PLH}	Bo	G_G		790	1050	1330	
	T_{PHL}				980	1310	1660	
	T_{PLH}		C_{N+4}		890	1180	1500	
	T_{PHL}				990	1320	1680	
Rise time	T_{TLH}	All Inputs	All Outputs	20% to 80%		500	630	
Fall time	T_{THL}					400	510	

Note: AC test circuit; See page 4-3.

All output pins are left open except measured output pins.

Function Table

1. Positive Logic

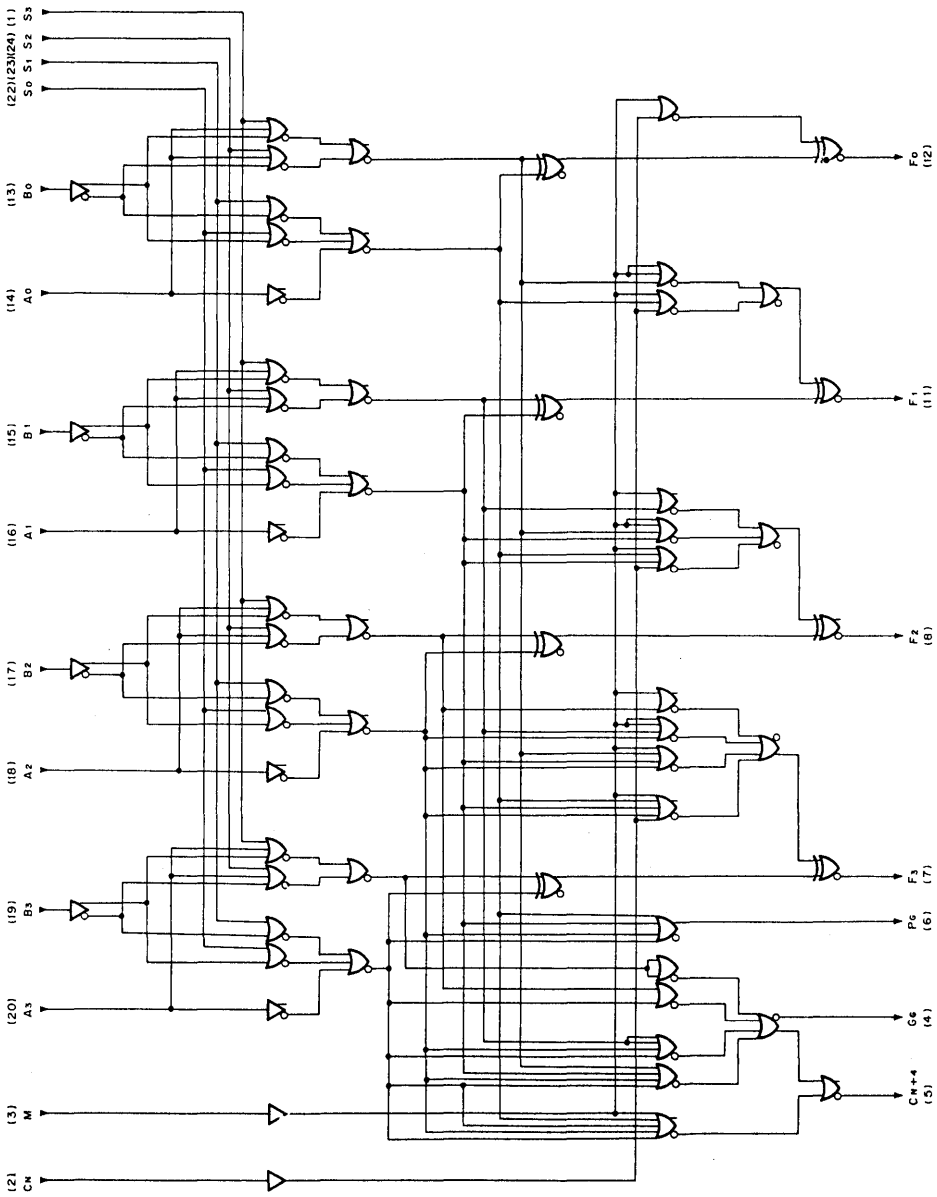
Function select				Logic function (M= "H")	Arithmetic operation (M= "L", C_N= "L")
S3	S2	S1	S0	F	F
L	L	L	L	$F=\overline{A}$	F=A+0
L	L	L	H	$F=\overline{A}+\overline{B}$	$F=A+(A\cdot\overline{B})$
L	L	H	L	$F=\overline{A}+B$	$F=A+(A\cdot B)$
L	L	H	H	F= "H"	F=A×2
L	H	L	L	$F=\overline{A\cdot B}$	$F=(A+B)+0$
L	H	L	H	$F=\overline{B}$	$F=(A+B)+(A\cdot\overline{B})$
L	H	H	L	$F=\overline{A\oplus B}$	F=A+B
L	H	H	H	$F=A+\overline{B}$	$F=A+(A+B)$
H	L	L	L	$F=\overline{A}\cdot B$	$F=(A+\overline{B})+0$
H	L	L	H	$F=A\oplus B$	F=A−B−1
H	L	H	L	F=B	$F=(A+\overline{B})+(A\cdot B)$
H	L	H	H	F=A+B	$F=(A+\overline{B})+A$
H	H	L	L	F= "L"	F=−1 (two's complement)
H	H	L	H	$F=A\cdot\overline{B}$	$F=(A\cdot\overline{B})-1$
H	H	H	L	F=A·B	F=(A·B) −1
H	H	H	H	F=A	F=A−1

2. Negative Logic

Function select				Logic function (M= "H")	Arithmetic operation (M= "L", C_N= "H")
S3	S2	S1	S0	F	F
L	L	L	L	$F=\overline{A}$	F=A−1
L	L	L	H	$F=\overline{A+B}$	$F=A+(A+\overline{B})$
L	L	H	L	$F=\overline{A}\cdot B$	$F=A+(A+B)$
L	L	H	H	F= "L"	F=A×2
L	H	L	L	$F=\overline{A\cdot B}$	F=(A·B) −1
L	H	L	H	$F=\overline{B}$	$F=(A\cdot B)+(A+\overline{B})$
L	H	H	L	$F=A\oplus B$	F=A+B
L	H	H	H	$F=A\cdot\overline{B}$	$F=A+(A\cdot B)$
H	L	L	L	$F=\overline{A}+B$	$F=(A\cdot\overline{B})-0$
H	L	L	H	$F=\overline{A\oplus B}$	F=A−B−1
H	L	H	L	F=B	$F=(A\cdot\overline{B})+(A+B)$
H	L	H	H	F=A·B	$F=(A\cdot\overline{B})+A$
H	H	L	L	F= "H"	F=−1 (two's complement)
H	H	L	H	$F=A+\overline{B}$	$F=(A+\overline{B})+0$
H	H	H	L	F=A+B	F=(A+B) +0
H	H	H	H	F=A	F=A+0

H : HIGH voltage level
L : LOW voltage level

Block Diagram



Typical Application

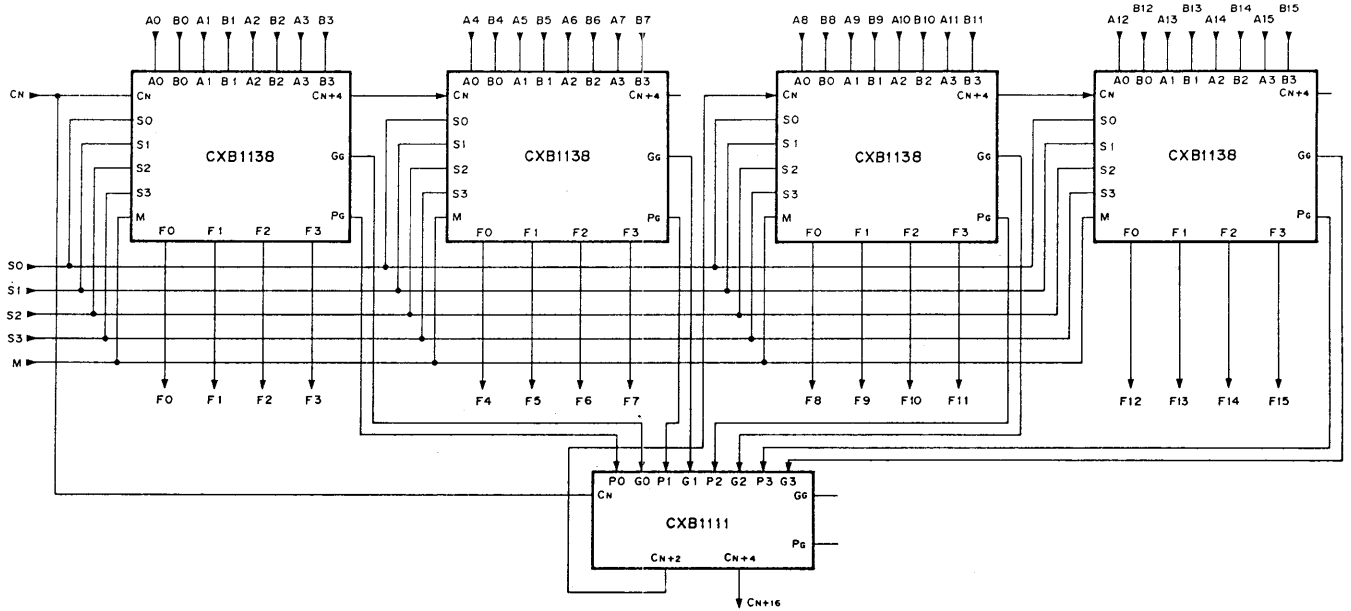


Figure 1. 16-bit ALU with Carry Look Ahead

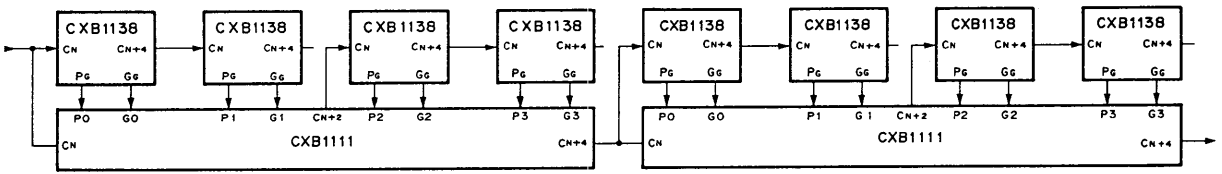


Figure 2. 32-bit ALU with Carry Look Ahead

New Products

Preliminary Data Sheets

Preliminary

1 to 10 Clock Distributor with Enable

Description

The CXB1115 is an Ultra high speed monalithic IC, with low skew (50ps typ.). Clock input has differential input pins C and $\overline{C}$. The input signal is fanned out to 10 differential outputs. Enable inputs ($\overline{EN1}$-$\overline{EN3}$) enable clock inputs. Built-in reference voltage is provided at V_{BB} pin to facilitate the use of single input operation.

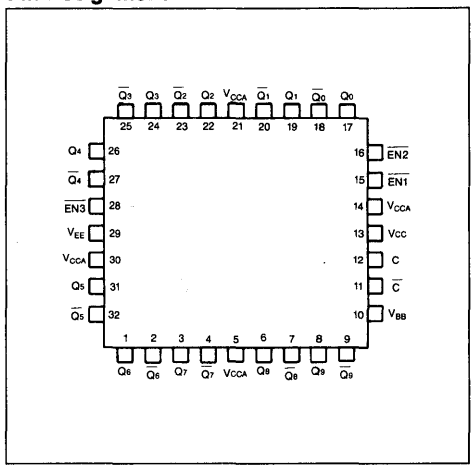
Features

- Small gate-to-gate skew = 50 pS (typ.)
- Differential clock input and output
- Built-in reference voltage for single ended input operation
- Internal pull down registors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

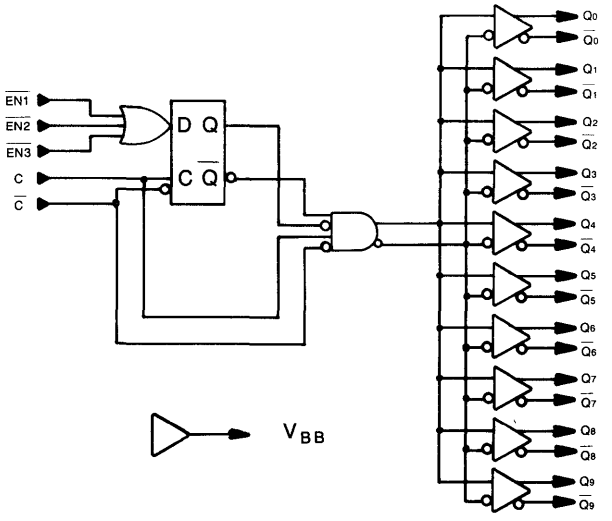
Pin Names

C, $\overline{C}$	Clock inputs
Qn, $\overline{Qn}$	Clock Outputs
$\overline{ENn}$	Clock enables (active LOW)
V_{BB}	Reference Voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Pin Assignment



Block Diagram



DC Characteristics

V_{EE} = -4.5 ± 0.3V , V_{CC} = V_{CCA} = GND, V_{TT} = -2.0V , T_C = 0°C to 85°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power Supply Current	I_{EE}		-244	-178	-124	mA

AC Characteristics

V_{EE} = -4.5V ± 0.3V , V_{CC} = V_{CCA} = GND, V_{TT} = -2.0V , T_C = 0°C to 85°C , R_T = 50Ω to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time	T_{PLH}	C	Q_n		570	760	970	ps
	T_{PHL}				570	760	970	
Gate-to-Gate Skew	T_sG-G						50	
Set up Time	T_s					0		
Hold Time	T_h					260		
Rise Time	T_{TLH}			20% to 80%		180	230	
Fall Time	T_{THL}					180	230	

Preliminary

4bit Ripple Up/Down Counter with Enable and Reset

Description

The CXB1116Q is an ECL ultra high speed monolithic Binary Ripple Up/Down Counter with divide by 2/4/8/16 outputs.

Clock input has differential input pins C and $\overline{C}$. Built-in reference voltage V_{BB} is provided to facilitate the use of single clock input. Enable input ($\overline{E}$) enables clock input. Common direct reset input (R) resets the counter and separate Set inputs (Sn) set each stage of the counter.

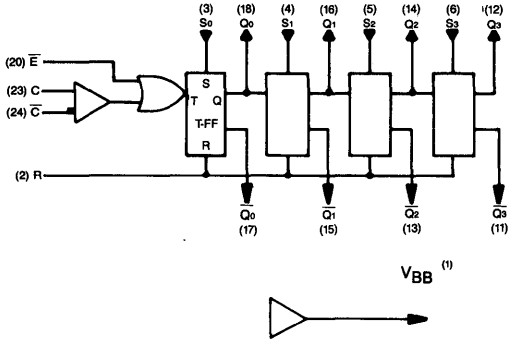
Features

- Typical: clock rate up to 3.0GHz
- Differential clock input (positive edge trigger)
- Internal pull down resistors on input pins to maintain logic LOW level with the pins left open
- ECL 100K compatible I/O levels

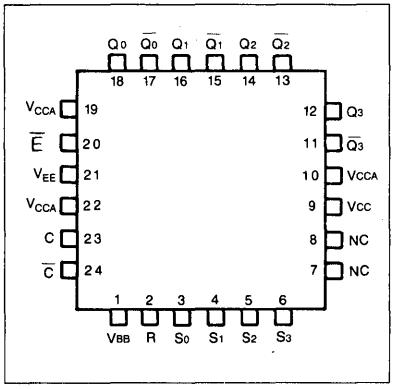
Pin Names

C, $\overline{C}$	Clock inputs
Qn, $\overline{Qn}$	Data outputs
Sn	Direct set inputs
R	Common direct Reset input
$\overline{E}$	Clock enable (active LOW)
V_{BB}	Reference Voltage output
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

Logic Symbol



Pin Assignment



Sequential Truth Table

Inputs							Outputs			
R	$\overline{E}$	S0	S1	S2	S3	C	Q0	Q1	Q2	Q3
H	X	L	L	L	L	X	L	L	L	L
H	H	L	L	L	L	X	L	L	L	L
L	H	L	L	L	L	X	L	L	L	L
L	L	L	L	L	L	∫	H	H	H	H
L	L	L	L	L	L	∫	L	H	H	H
L	L	L	L	L	L	∫	H	L	H	H
L	L	L	L	L	L	∫	L	L	H	H
L	L	L	L	L	L	∫	H	H	L	H
L	L	L	L	L	L	∫	L	H	L	H
L	L	L	L	L	L	∫	H	L	L	H
L	L	L	L	L	L	∫	L	L	L	H
L	L	L	L	L	L	∫	H	H	H	L
L	L	L	L	L	L	∫	L	H	H	L
L	L	L	L	L	L	∫	H	L	H	L
L	L	L	L	L	L	∫	L	L	H	L
L	L	L	L	L	L	∫	H	H	L	L
L	L	L	L	L	L	∫	L	H	L	L
L	L	L	L	L	L	∫	H	L	L	L
L	L	L	L	L	L	∫	L	L	L	L
L	X	L	L	H	H	X	L	L	H	H
L	X	L	H	L	H	X	L	H	H	H
L	∫	L	L	L	L	L	H	L	H	H
L	∫	L	L	L	L	L	L	L	H	H
H	X	H	H	H	H	X	X	X	X	X

Note: H; HIGH voltage Level
L; LOW voltage level
X; Don't care
∫; LOW to HIGH transient

DC Characteristics

V_{EE} = -4.5 ± 0.3V , V_{CC} = V_{CCA} = GND, V_{TT} = -2.0V , T_C = 0°C to 85°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power Supply Current	I_{EE}			-155		mA

AC Characteristics

V_{EE} = -4.5V ± 0.3V , V_{CC} = V_{CCA} = GND,V_{TT} = -2.0V , T_C = 0°C to 85°C , R_T = 50Ω to V_{TT}

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propogation Delay Time	T_{PLH}	C, $\overline{E}$	Q_0			730		ps
	T_{PHL}					730		
	T_{PLH}		Q_1			900		
	T_{PHL}					910		
	T_{PLH}		Q_2			1090		
	T_{PHL}					1110		
	T_{PLH}		Q_3			1240		
	T_{PHL}					1260		
	T_{PLH}	S_n	Q_n			760		
	T_{PHL}	R				900		
Release Time	T_R	S_0 , C	Q_0			40		
		S_1 , C	Q_1			-150		
		S_2 , C	Q_2			-350		
		S_3 , C	Q_3			-510		
		R , C	Q_0			310		
		$\overline{E}$, C				-130		
Min. Pulse Width	T_{PW}	S_n	Q_n			210		
		R				210		
Max. Toggle Frequency	f_{MAX}	C				3.0		GHz
Rise Time	T_{TLH}			20% to 80%		200		ps
Fall Time	T_{THL}					160		

Preliminary

Programmable Delay Line/Duty Cycle Controller

Description

The CXB1139Q is an ultra high speed monolithic ECL Delay Line/Duty Cycle Controller IC.

Five binary inputs, S_0 to S_4, program an amount of delay time from input D_I to output Z_d in 23 steps. Binary input code 00001 through 00110 gives delay of 120ps for each increment of the code, and 00111 through 10111 gives delay of 190ps for each step.

A pulse with plus (long) duty cycle is provided at output Z_p, and a pulse with minus (short) duty cycle at output Z_m. The duty cycle is also controlled by the input data.

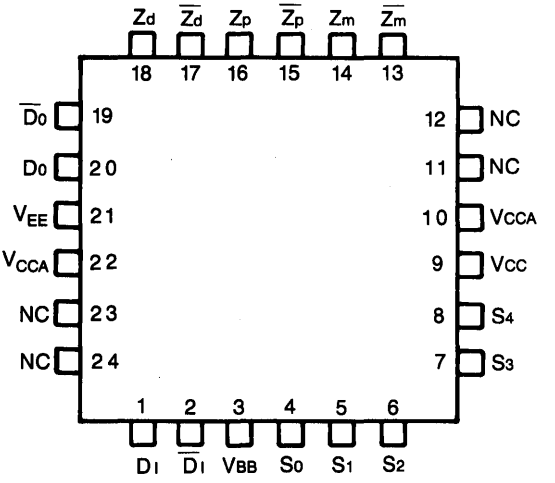
Features

- Programmable delay time: 775ps to 4700ps
- Programmable duty cycle
- Plus and minus duty cycle outputs
- Fast rise and fall time: 230ps

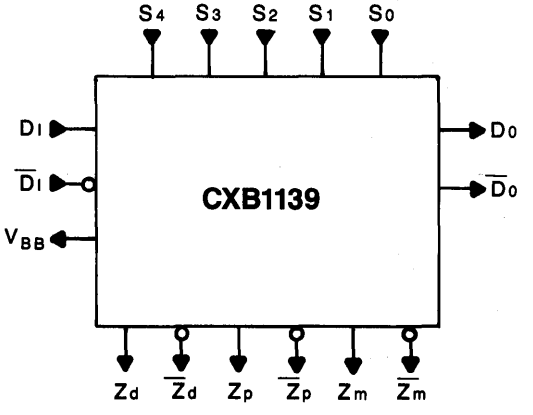
Pin Names

D_I , $\overline{D_I}$	Data inputs
D_O , $\overline{D_O}$	Buffered data outputs
Z_d , $\overline{Z_d}$	Delayed data outputs
Z_p , $\overline{Z_p}$	Plus duty cycle outputs
Z_m , $\overline{Z_m}$	Minus duty cycle outputs
V_{CC}	Circuit ground
V_{CCA}	Circuit ground for outputs
V_{EE}	Negative power supply

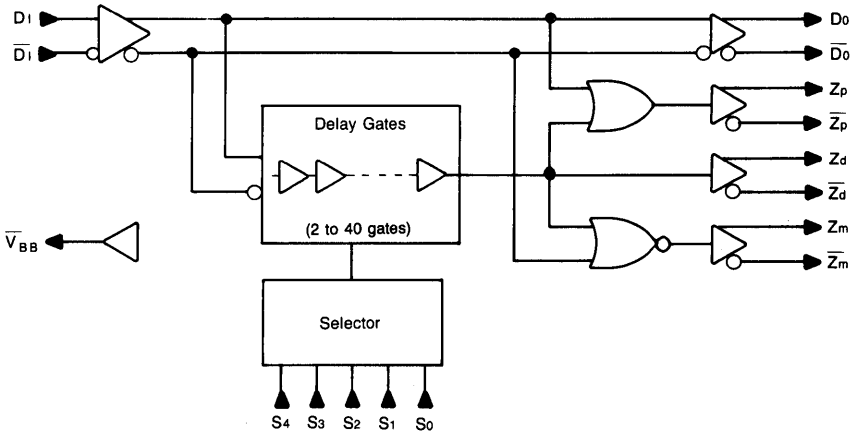
Pin Assignment



Logic Symbol



Block Diagram



Truth Table

N	Input					Number of Gate	Output, Zd Typical Delay
	S4	S3	S2	S1	S0		
0	L	L	L	L	L		Zd = LOW
1	L	L	L	L	H	2	775 ps
2	L	L	L	H	L	3	915 ps
3	L	L	L	H	H	4	1015 ps
4	L	L	H	L	L	5	1175 ps
5	L	L	H	L	H	6	1305 ps
6	L	L	H	H	L	7	1405 ps
7	L	L	H	H	H	8	1595 ps
8	L	H	L	L	L	10	1795 ps
9	L	H	L	L	H	12	2010 ps
10	L	H	L	H	L	14	2165 ps
11	L	H	L	H	H	16	2385 ps

N	Input					Number of Gate	Output, Zd Typical Delay
	S4	S3	S2	S1	S0		
12	L	H	H	L	L	18	2580 ps
13	L	H	H	L	H	20	2800 ps
14	L	H	H	H	L	22	2950 ps
15	L	H	H	H	H	24	3165 ps
16	H	L	L	L	L	26	3295 ps
17	H	L	L	L	H	28	3510 ps
18	H	L	L	H	L	30	3665 ps
19	H	L	L	H	H	32	3880 ps
20	H	L	H	L	L	34	4080 ps
21	H	L	H	L	H	36	4295 ps
22	H	L	H	H	L	38	4455 ps
23	H	L	H	H	H	40	4690 ps

Typical delay time is calculated approximately by formula;

$T_d = (650 + 125N \pm 50)$ ps $\pm$ 7% $\quad (N \leq 6)$

$T_d = (1400 + 190\,(N-6) \pm 90$ ps $\pm$ 7% $\quad (7 \leq N \leq 23)$.

DC Characteristics

V_{EE} = -4.5 ± 0.3V , V_{CC} = V_{CCA} = GND, V_{TT} = -2V , T_C = 0°C to + 85°C

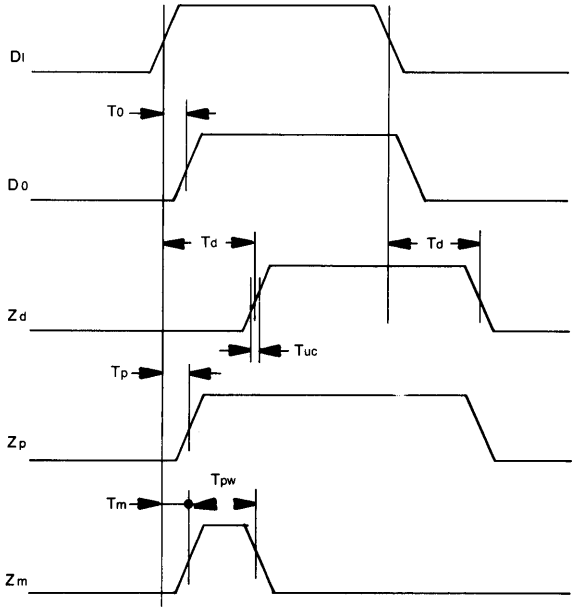
Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power Supply Current	I_{EE}		-198	-144	-100	mA

AC Characteristics

V_{EE} = -4.5 ± 0.3V, V_{CC} = V_{CCA} = GND, V_{TT} = -2V, T_C = 0°C to +85°C , R_T = 50Ω to $\overline{V}_{TT}$

Item	Symbol	Input	Output	Test Condition	Min.	Typ.	Max.	Unit
Propogation Delay Time	T_{dLH}	DI	Zd	So = HIGH S1,S4 = LOW	620	775	970	ps
	T_{dHL}				610	760	950	
	T_{dLH}			S4=S2=S1=So = HIGH S3 = LOW	4220	4650	5050	
	T_{dLH}				4220	4650	5050	
	T_{oLH}		Do		350	440	550	
	T_{oHL}				345	430	540	
	T_{pLH}		Zp	So = HIGH S1,S4 = LOW	510	640	800	
	T_{pHL}				500	630	785	
	T_{mLH}		Zm	S4=S2=S1=So = HIGH S3 = LOW	520	650	810	
	T_{mHL}				510	640	800	
Rise Time	T_{TLH}		Zd , Do Zp , Zm	20% to 80%		230	285	
Fall Time	T_{THL}					195	245	
Minimum pulse width	T_{pw}		Zm	So = HIGH S1,S4 = LOW	247	265	285	
Jitter (d)	T_{uc}		Zd	S4=S2=S1=So = HIGH S3 = LOW		5	12	

Timing Diagram



$Ta \fallingdotseq (650 + 125N \pm 50\ ps) \pm 7\% \quad (N \leq 6)$

$Ta \fallingdotseq \{1400 + 190\ (N-6) \pm 90\ ps\} \pm 7\% \quad (7 \leq N \leq 23)$

$Do(T) = DI(T - To)$

$Zd(T) = DI(T - Td)$

$Zp(T) = Do(T) + \overline{Zd(T)}$

$Zm(T) = Do(T) \cdot \overline{Zd(T)}$

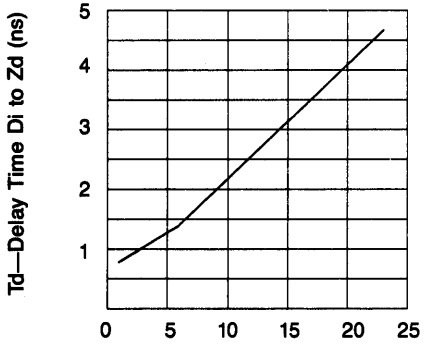


Figure 1. Input Data vs Delay Time

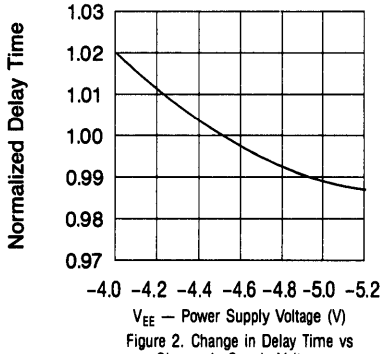
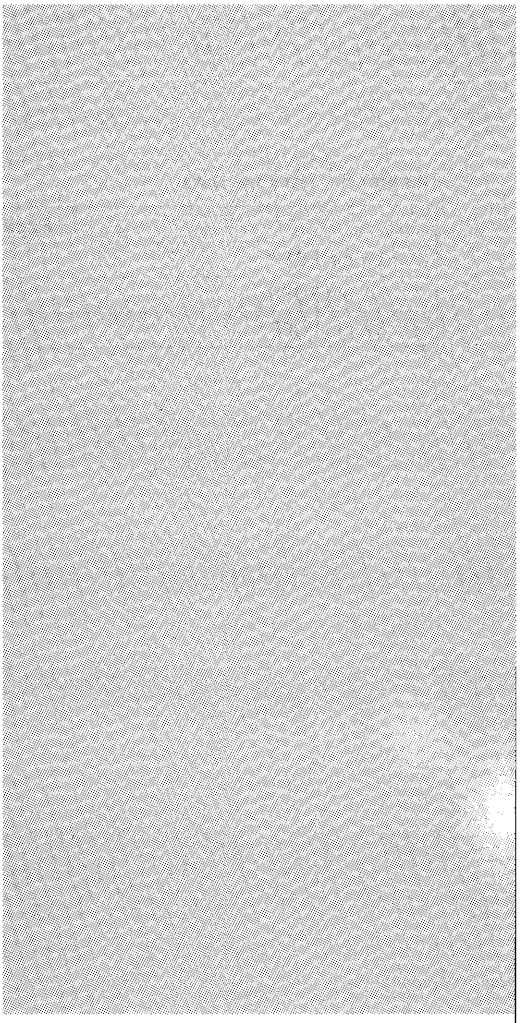
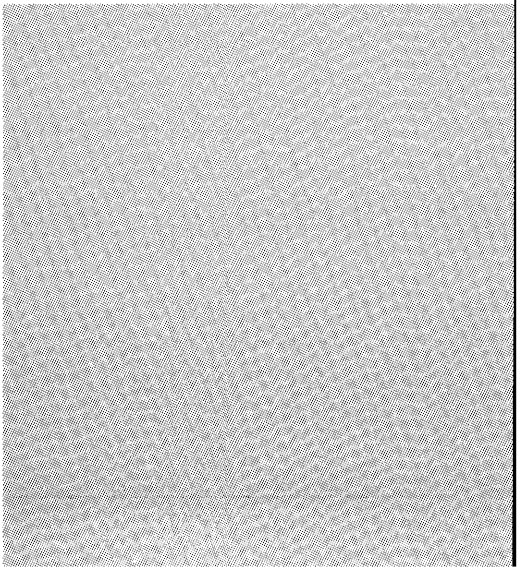


Figure 2. Change in Delay Time vs Change in Supply Voltage



Package Data

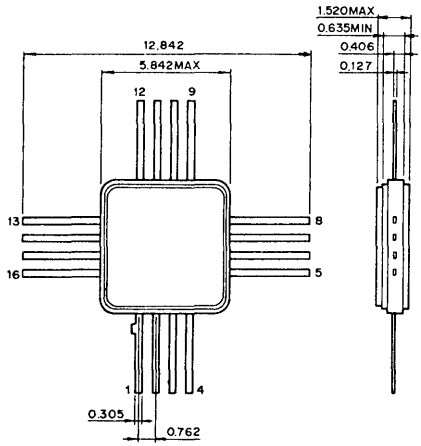


Chapter 6. Package Data

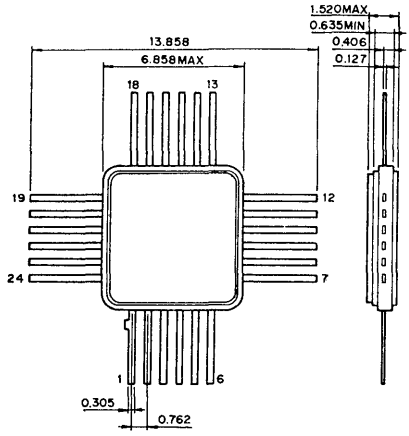
Package Data

Package Outline Uuit : mm

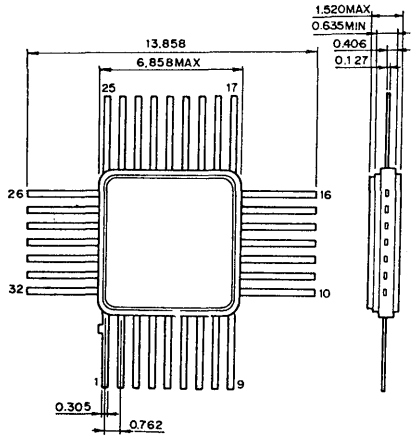
16pin FQFP



24pin FQFP



32pin FQFP



Application Note

Chapter 7. Application Note

Application Note

1. Advantages of the Family Logic

SPECL Standard Logic Family specifications can be found in both AC and DC parameters under full operating conditions. (supply voltage and operating case temperature range). Input and output interface levels are temperature compensated to facilitate interface with other Family devices or existing ECL100K logic IC's.

The family devices have the same features as common ECL logic IC's. That is:

Complementary output
Wired OR capability
High common mode noise rejection
Low output impedance
High current drive capability
High input impedance
Low cross talk.

Furthermore, the family have the advantages over the existing ECL families in the following features.

Low Propagation Delay: Family devices have an internal delay time of 50ps and a pin-to-pin transition delay time of 410ps for a simple gate.

Fast edge rate: The rise and the fall time at the output pin are 200ps from 20% to 80% of the waveform. Very high speed transition capability makes the device applicable to data processing at GHz rate. Most ECL logic ICs to date have a limitation in data rate because of the decrease in amplitude at the output waveform.

Complementary Input Capability: Most of the Family devices have differential input pins for high speed signal inputs in clocks or data.

Small time Skew: With very small internal delay time and a careful routing design inside the chip, the time skew at the outputs is very small. For a Fanout buffer CXB1105, the time skew is 50ps at the output.

2. Design Consideration

As family devices have a very fast transition time, a careful design of the circuit board is required for their utilization.

Power Supply/Ground Plane

SPECL Family devices are characterized by the V_{CC} at ground potential and the V_{EE} at $-4.5V$.

The devices have very good noise immunity. Any noise induced on the V_{EE} line is applied to the circuit as a common-mode signal which in turm is rejected by the differential operation of the ECL circuit. The differential input stage also provides a good noise immunity even at GHz data rate. Noise induced on the V_{CC} line, however, is not cancelled out that way. Hence, a good system ground at the V_{CC} bus line is required for best noise immunity. A circuit board should have two or three level metallizations at least, with wide ground plane to prevent voltage drop between supply and device and to produce a low source inductance.

SPECL devices have two V_{CC} pins. V_{CCA} supplies current to the output transistors and V_{CC} is connected to the internal circuit ground. The separate V_{CC} pins reduce cross coupling between individual devices when the outputs are driving heavy loads. A large source impedance in ground bus line produces significant noise when the transition current flows from the ground V_{CCA} into the loads. All V_{CC} pins should be connected to the ground plane as close to the package as possible to reduce inductances.

Although little noise is generated on V_{EE} line because the major switching current does not flow into the line, power supply bypass capacitors are recommended to suppress the switching noise caused by stray capacitance and assymmetric circuit loading.

Power supply with a regulation of 7% or better is recommended.

The $-4.5V$ power supply will result in best circuit speed - power consumption performance. A more negative supply voltage will increase speed and noise margin at a cost of increased power dissipation. A less negative supply voltage will have just the opposite effect. A parallel combination of a $1.0\mu F$ and a 100nF capacitor at the entrance to the board, and a 10nF low-inductance capacitors such as ceramic chip capacitors between ground and the $-4.5V$ line for each device are recommended.

Circuit Interconnections

The multilayer printed circuit boards offer a number of advantages in the development of very high speed logic cards. Not only multilayer boards achieve a much higher package density, but they also provides the minimized propagation delay time between individual devices owing to a shorter lead length. Moreover, the multilayer circuit boards offer unbroken ground plane to minimize ground plane impedance and permit a precice control of transmission line impedances. In handling a waveform with very fast rise and fall time, it is very important to design the transmission line impedance and to terminate the line with a load which has the same impedance as the line impedance. When the two impedances are unmatched, the waveform will show an overshoot and an undershoot at the rising and falling edge which result in a ringing in the waveform.

In ECL circuits, pull-down resistors are required at the end point of the interconnections because the output stages of the ECL are of the simple open-emitter type. These resistors are not only simple pull-down resistors but also termination resistors with proper matched impedance which terminate the line to prevent reflections on the line, and hence prevent overshoot, undershoot and ringings.

When the wire length of point-to-point wiring is kept short, the matched line temination is not so much important in existing ECL logics. However in very high speed logics such as SPECL, the rise and fall time is very small and the line length permissible without proper termination is very short.

Figure 1 shows an equivalent circuit of the wiring between the output and input of the devices. If a proper termination is not provided at the receiving end point of the line, the wave propagating in the line reflects at the receiving point comming back to sending point, and reflects back again at the sending point. This reflection eventually gives over shoots and undershoots at both points. If the propagation delay time along the line is shorter than the rise and the fall time, the reflection has little effect on the waveform. Be sure that the reflection effect depends on the rise and fall time but not on the frequency or the cycle time of the signal.

Figure 2 shows several ways of connecting pull-down resistors.

Resistor values for the connection in Figure 2(a) may range from 170Ω to 600Ω depending on line impedance. This way is suitable for wiring on a back plane because the line impedance is around 200Ω (refer to the next paragraph).

The best power-speed performance is obtained by pulling down by 50Ω to 150Ω to −2V termination voltage V_{TT}, as shown in Figure 2(b). This way is suitable for strip line transmission or coaxial transmission line in which the line impedance can be determined precisely.

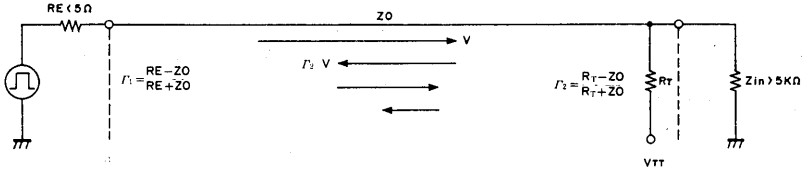


Figure 1. Equivalent Circuit of Interconnetion

Figure 2(c) shows a parallel termination scheme where the termination voltage is not available. This way is electrically equivalent to that of Figure 2(b), but it costs an increased power dissipation.

Use of series damping resistor, Figure 2(d), will extend permissible length of unmatched-impedance interconnections with some loss of edge speed. With proper choise of the series damping resistor, line length can be extended to any length, while limiting overshoot and undershoot to a predetermined amount.

Power dissipation in termination resistors and output emitter follower transistor is shown in table 1 for Figure 2(b) and in Table 2 for Figure 2(c), for various termination resistor values.

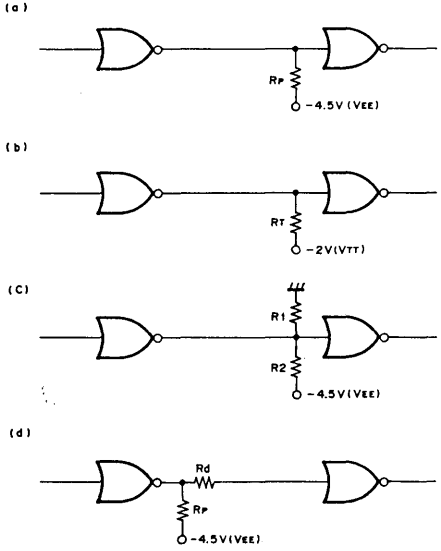


Figure 2. Pull-down Techniques

Table 1. Termination to V_{TT}

$R_T(\Omega)$	Power Dissipation (mW)		
to −2V	R_T	Output Tr	Total
25	20	36	56
50	10	18	28
75	6.5	12.1	18.6
100	4.9	9.1	14.0
150	3.3	6.1	9.4

One major advantage of ECL over other logic is its capability for driving matched-impedance transmission lines. Use of transmission lines retains signal integrity over long distances. The SPECL emitter follower output transistor can drive a 50Ω transmission line terminated to −2.0V DC. This is equivalent to a load current of −22mA in the HIGH state and −6mA in the LOW state.

Matched Impedance Termination

The line impedance of the wire over a ground plane, as shown in Figure 3, is given by the equation

$$Z_o = 60/\sqrt{\varepsilon_r} \cdot \ln(4h/d)$$

where ε_r is the effective dielectric constant surrounding the wire. The wire over a ground plane is most useful for breadboard layout or/and for back plane wiring. By choosing d=0.3 to 0.5mm, h=3 to 6mm and ε_r=1(air), Z_o ranges from 190 to 260Ω. The line impedance will decrease a little with the existence of an insulator of the wire and the board. The termination technique shown in Figure 2(a) may be used in this back plane wiring, with some degradation of the waveform.

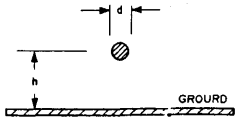


Figure 3. Wire Over Ground

Table 2. Parallel Termination to V_{EE}

R_O	Resistor (Ω)		Power Dissipation (mW)		
(Ω)	R1	R2	R_L	Output Tr	Total
25	45	56	220	36	256
50	90	113	110	18	128
75	135	170	73	12	85
100	180	225	55	9	64
150	270	340	36	6	42

A coaxial cable is one of the ideal transmission lines. The characteristic impedance of the cable is

$$Zo = 60/\sqrt{\varepsilon_r} \cdot \ln(D/d)$$

Some common types of coaxial cables have the characteristic impedances of 50, 75 or 125Ω. Figure 4 shows the way of the termination. The propagation delay along the cable depends on the dimension and the dielectric constant of the insulating material used for the cable. Common coaxial cables have a delay time of 5 to 7 ns/m.

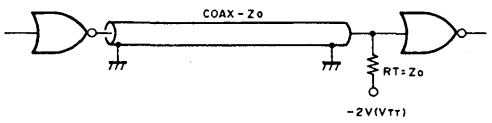


Figure 4. Coax Transmission Line

A micro-strip line is also an ideal transmission line because the characteristic line impedance can be determined precisely. Figure 5 shows the cross section of the strip line. Fiber-glass epoxy boards (ε_r= 4.5−5.0) is the most popular material.

Teflon*[1] board is an excellent material with good frequency characteristics, but it is not so suitable for strip line application because of its low dielectric constant and resulting wide strip line width. Epsilam−10*[2] has a dielectric constant of 10.2 and may be used for the strip line board.

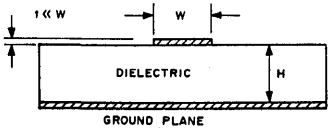


Figure 5. Micro-strip Line

The characteristic impedance of micro-strip lines for various geometries and insulators is plotted in Figure 7.

Fiqure 8 shows curves for the characteristic impedance of fiber-glass epoxy board which has the dielectric constant 4.7.

Figures 9 and 10 show curves for the micro-strip capacitance per meter as a function of line width and insulator thickness. The inductance per meter may be calculated using the formula,

$$Lo = Zo^2 Co$$

where Zo=characteristic impedance,
Co=capacitance per meter.

The propagation delay of the line depends only on the dielectric constant and may be calculated by the followring formula;

$$tpd = 3.34\sqrt{0.48\ \varepsilon_r + 0.67}\ (ns/m)$$

A strip line consisting of a conductive ribbon centered in a dielectric medium between two conductive planes is shown in Figure 6. The characteristic impedance of the line is given by the following formula;

$$Zo = 94.15/\sqrt{\varepsilon_r}\ [W/(h-t) + 0.45 + 1.18t/h]\ .$$

Figures 11 and 12 show the curves of the characteristic impedance and capacitance per meter of strip line for fiber-glass epoxy board.

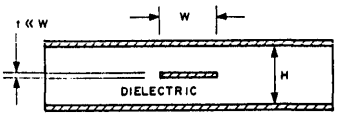


Figure 6. Strip Line

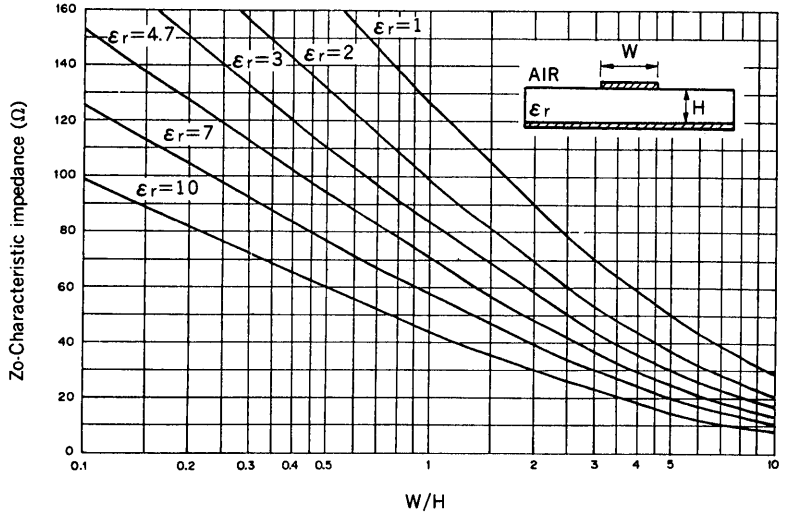


Figure 7. Characteristic Impedance vs. Strip Line Width/Dielectric Thickness

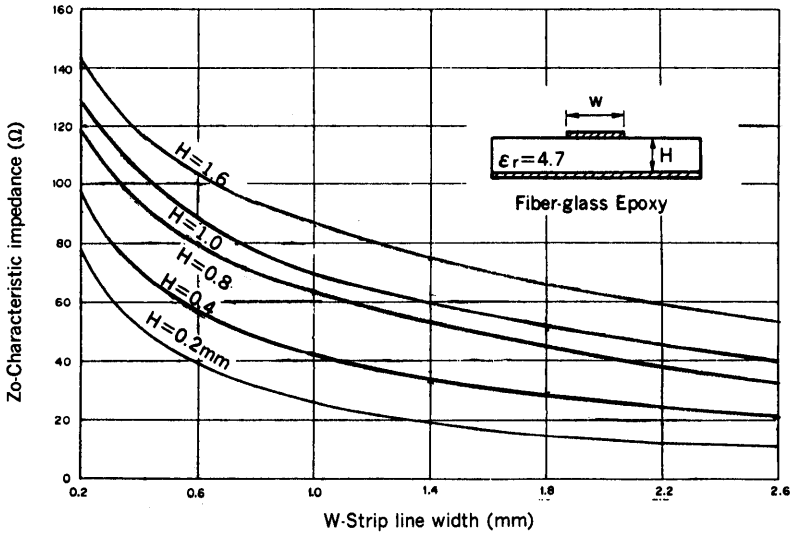


Figure 8. Characteristic Impedance vs. Strip Line Width

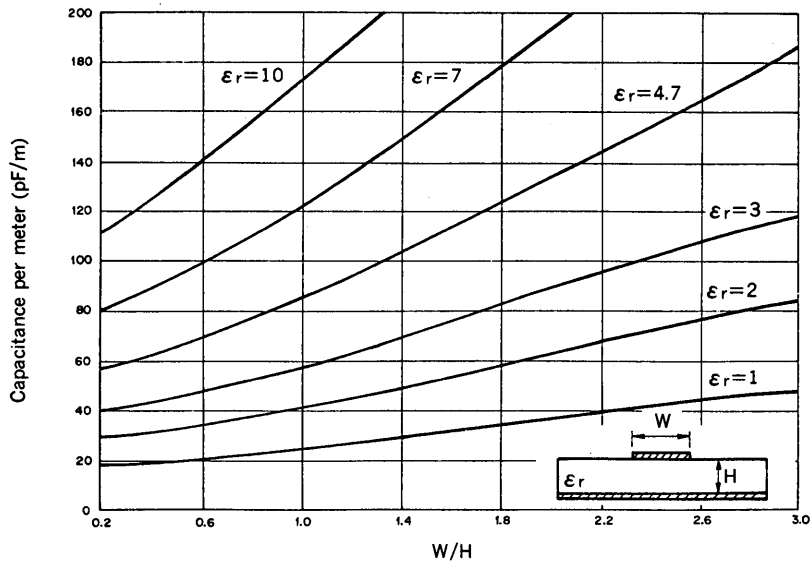


Figure 9. Capacitance vs. Strip Line Width/Dielectric Thickness

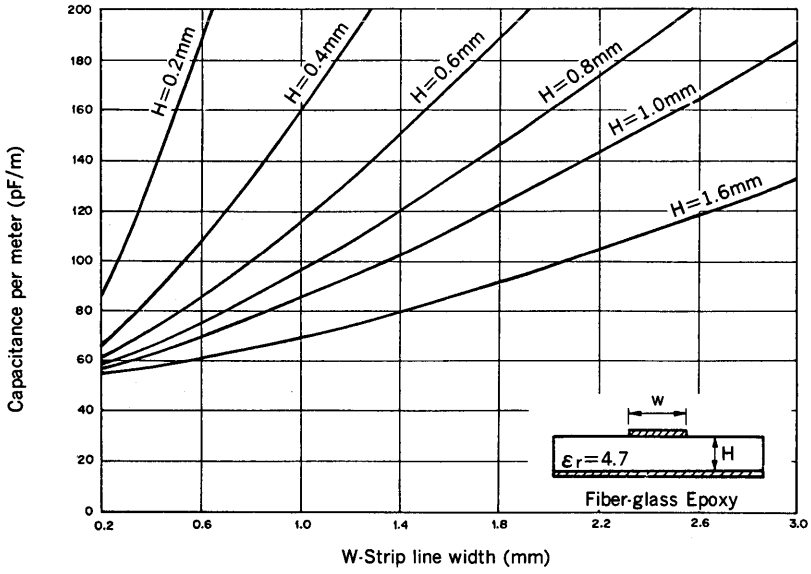


Figure 10. Capacitance vs. Strip Line Width

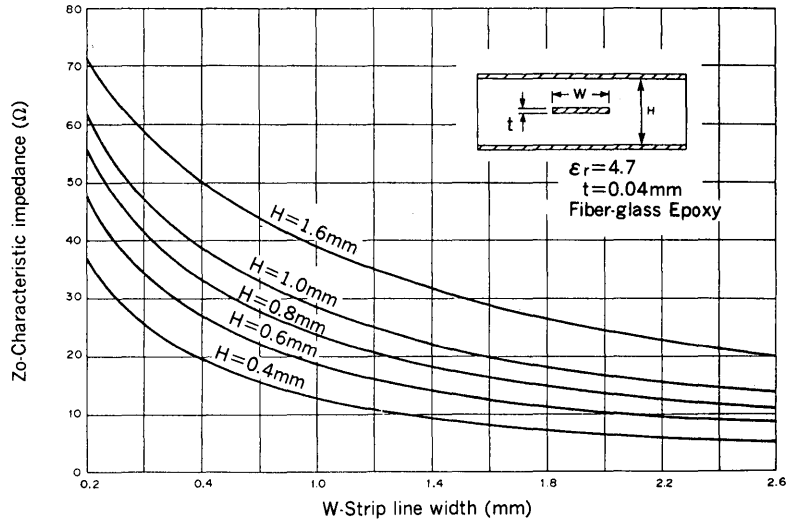


Figure 11. Characteristic Impedance vs. Strip Line Width

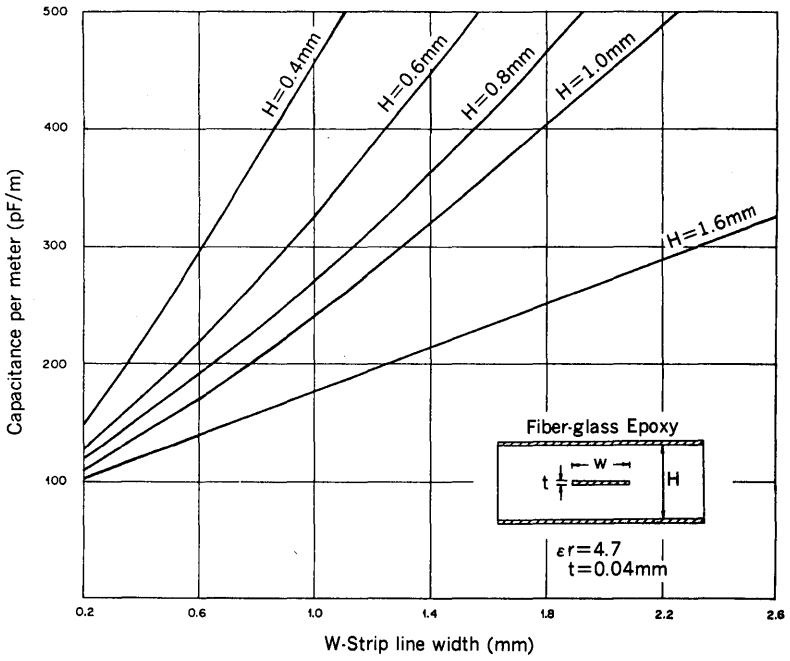


Figure 12. Capacitance vs. Strip Line Width

Interface to Other Logic

To interface to a slower circuit, a circuit with hysteresis (which is known as Schmitt Trigger) may be used to prevent multiple triggering at the rising and falling edge. Figure 13 shows an example of Schmitt Trigger circuit with a hysteresis of 100mV.

Figure 14 shows a way of interfacing to low level signals. As the circuit is AC coupled and self biased, it can be used as the interface circuit to signals that have non-ECL threshold voltage.

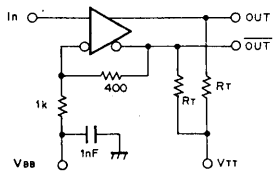


Figure 13. Schmitt Trigger Circuit

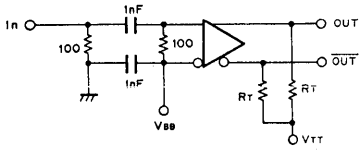


Figure 14. Low Level Input Amplifier

3. Thermal Consideration

Although SPECL devices are assembled in packages which have good thermal characteristics, appropriate thermal design is required to assure the circuit performance and long-term circuit reliability. Normally, both are affected by die temperature and are improved by keeping the IC junction temperature (Tj) low.

The junction temperature is estimated using formulas:

$$T_j = T_a + (\theta_{jc} + \theta_{ca}) \cdot P_d$$

or

$$T_j = T_a + \theta_{ja} \cdot P_d$$

where

T_j = junction temperature
T_a = ambient temperature
P_d = power dissipation including effects of external load
θ_{jc} = thermal resistance, junction to case
θ_{ca} = thermal resistance, case to ambient
θ_{ja} = thermal resistance, junction to ambient

θ_{jc} is the thermal resistance inherent to the package, and is essentially independent of mount assembly method and air flow. θ_{ca} and θ_{ja} can be varied by the user.

For applications where the case is held at an anbient temperature by mounting on a large or temperature-controlled heat sink, the junction temperature is calculated by the formula:

$$T_j = T_a + \theta_{jc} \cdot P_d$$

Table 3. Thermal Resistance of SPECL Devices

Package	θjc (°C/W)	θja (°C/W)	
		Free air*1	On board*2
16PIN	20.0	329	106
24PIN	17.5	276	102
32PIN	16.0	261	99

* 1 No board assembly
* 2 Still air without heat sink

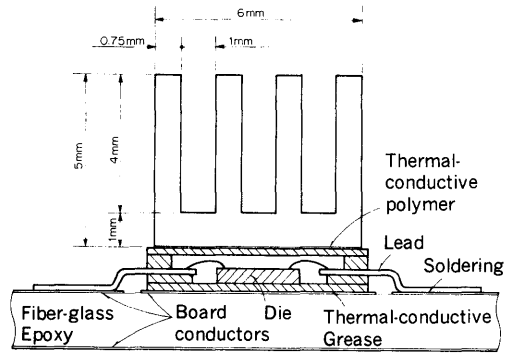
In Table 3, thermal resistances of SPECL devices are shown, where θ_{jc} is measured both in free air (with no heat-sinking, no board assemly and no air flow) and on a fiber-glass epoxy board (with no heat-sinking and no air flow). On the board, the IC leads are soldered to board conductors and thermal-conductive grease is applied between the IC and the board. θ_{jc} is improved drastically by board assembly.

It is recommended to apply thermal-conductive grease between the IC and the board or to bond the IC to the board by epoxy to reduce the thermal resistance, because the air between the IC and the board is not a good thermal conductor. If thermal-conductive materials are not in use, the air gap between the IC and the board should be made as small as possible. The existence of a conductor beneath the IC, too, improves thermal resistance.

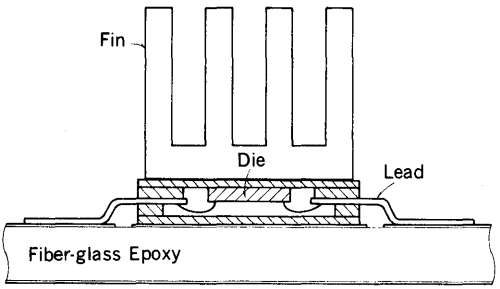
An appropriate heat-sink-fin and air flow are effective for reduction of thermal resistance.

Figure 15 shows an example of the fin and assembly method. As the Flat Packages can be mounted upside down, the Face-Down mounting can be employed with effective heat-sink-fin.

The effect of the fin and air flow is illustrated in figure 16 where the test set-up of thermal resistance measurement is the same as that shown in Figure 15. In the face-down mounting, the thermal resistance is larger than that of normal mounting because the heat can not be removed through the board. With the fin used in face-down mounting, the thermal resistance is almost the same as normal mounting. This result suggests that the thermal resistance can be reduced more effectively with larger heat-sink-fin used in face-down mount.



(a) Normal Mount



(b) Face-down Mount

Figure 15. Mount Assembly Method

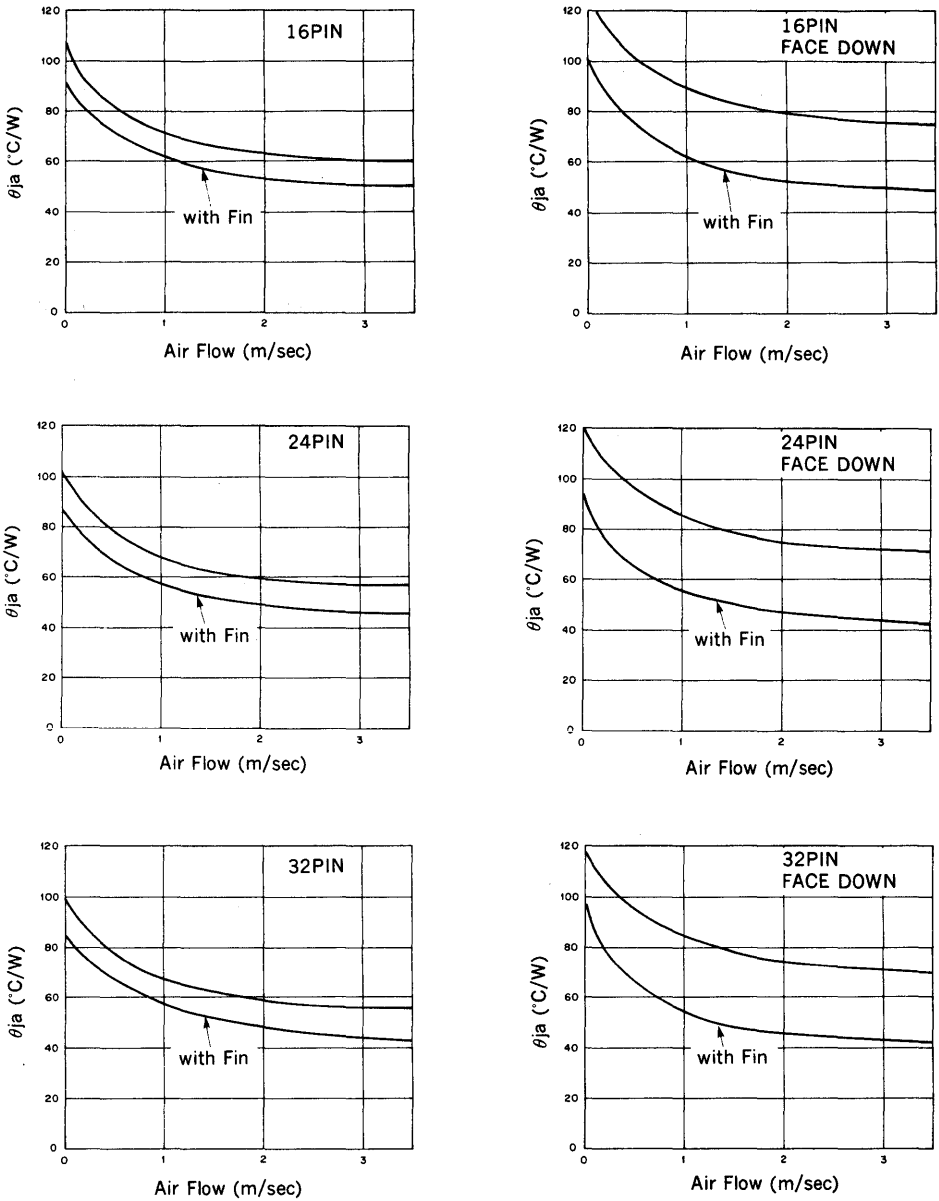


Figure 16. Thermal Resistance vs. Air Flow
(Heat-Sink-Fin is Shown in Figure 15)

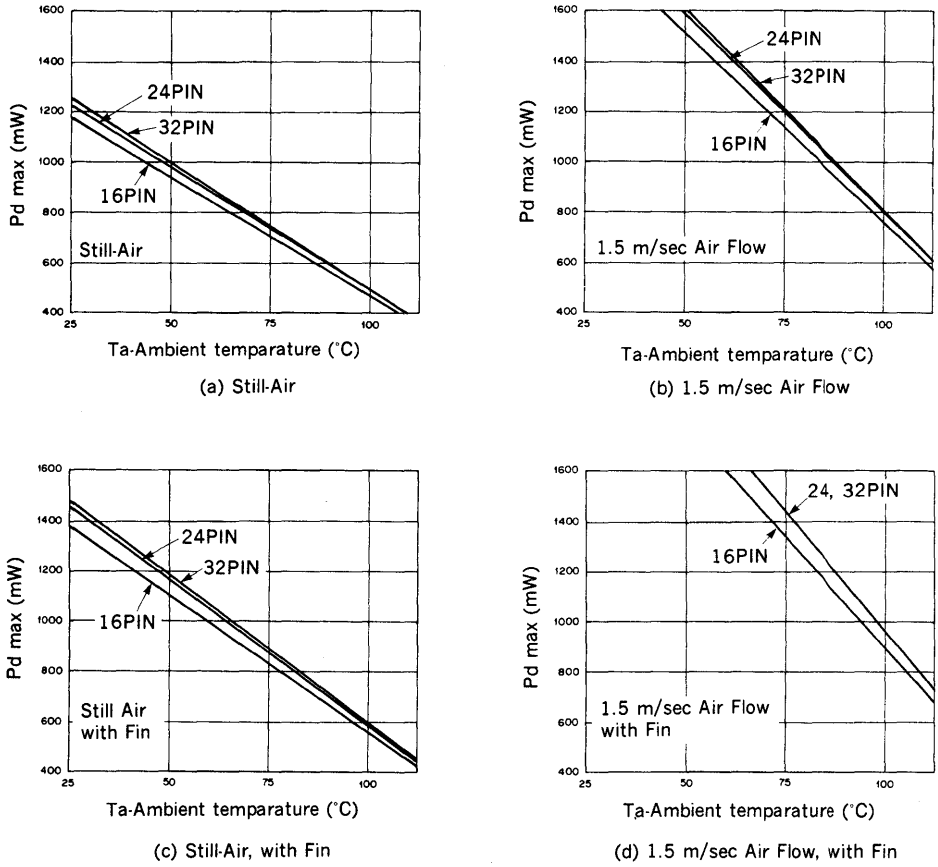


Figure 17. Maximum Allowed Power Dissipation vs. Ambient Temperature
(Heat-Sink-Fin is shown in Figure 15)

4. Simultaneous Switching Noise

Careful attention should be paid to the simultaneous switching noise because of very fast transition time. The following are technics to eliminate simultaneous switching noise.

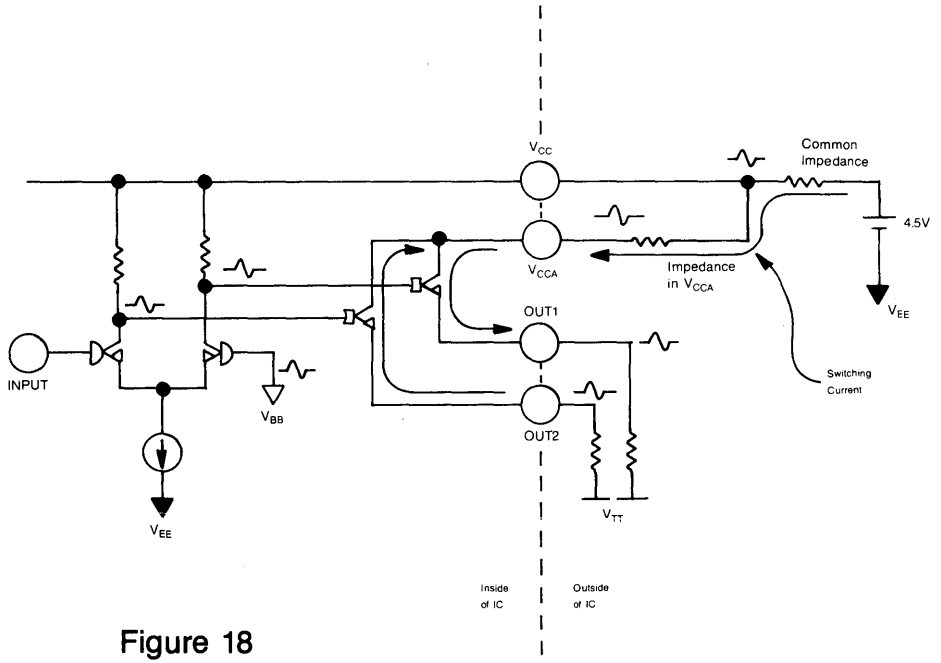


Figure 18

The current flow into V_{CCA} changes when the output is switching and the amount of change is proportional to the number of simultaneous switching output. The change of V_{CCA} current causes the switching noise at V_{CCA} due to the parasitic inductance and resistance. In this case, the difference output pair does not cause any switching noise because total current flow at V_{CCA} is constant.

Although the current flow at V_{CC} is more stable than V_{CCA} current, if there is common impedance between V_{CCA} and V_{CC}, V_{CC} will be affected by the switching noise in V_{CCA} and this may cause the switching noise in output and V_{BB}. Because the output and V_{BB} use V_{CC} as reference voltage. The switching noise in output and V_{BB} will trigger the mis-operation of IC. In order to decrease the switching noise, there are some techniques described as follows to solve this problem.

① To decrease the impedance (Inductance, Resistance) as small as possible in V_{CCA} and common line between V_{CCA} and V_{CC}.

- The edge portion (fall, rise) at the output contains high frequency component.
- The impedance of line becomes high at high frequency range because of the inductance which is included in line and skin effect in line.

② To insert by-pass capacitor at V_{CCA}.

- This capacitor can reduce the transient current at V_{CCA}.

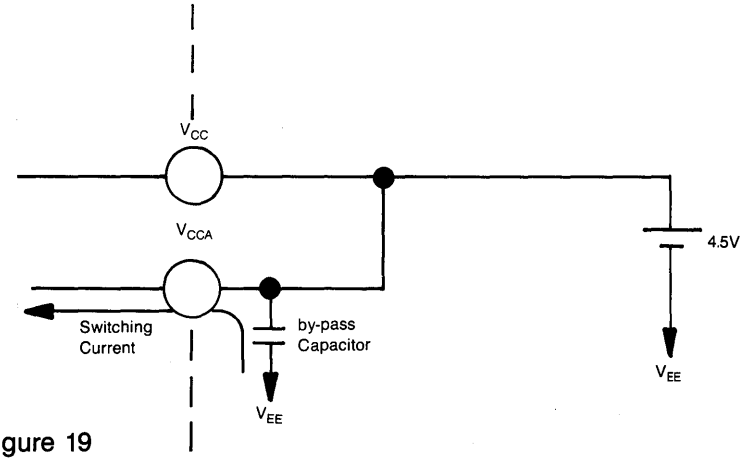


Figure 19

③ To terminate both differential outputs with the same valued load.

- Termination of both output keeps the amount of current in V_{CCA} constant.

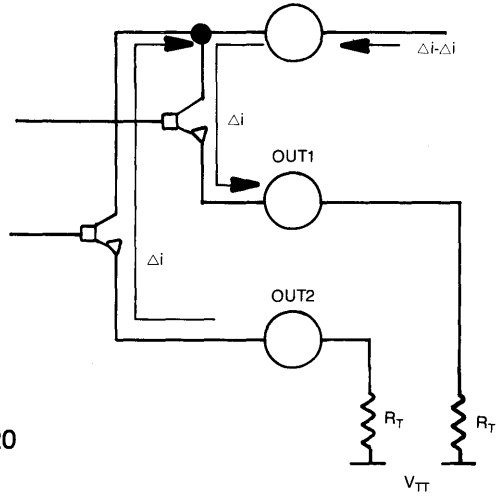


Figure 20

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