FUJITSU

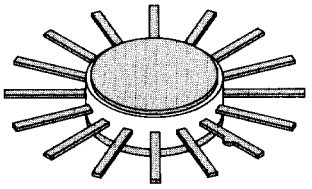
ULTRA HIGH SPEED ECL ICs

MB881/MB882
MB883/MB884
MB885/MB886

January 1989
Edition 3.0

ULTRA HIGH SPEED ECL FAMILY

The Fujitsu MB880 series is a family of ultra high speed ECL integrated circuits. It is useful for Giga-bits fiber communication systems, and electrical measuring instruments. The inputs/outputs interface and power voltage are compatible with ECL 10K series. The MB880 series devices are packaged in the compact circular ceramic flat packages that are convenient for mounting a high speed and high density printed circuit board.

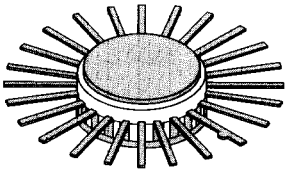


CERAMIC PACKAGE
FPT-16C-A01

- Guaranteed Flip Flop clock frequency up to 2.0 GHz.
- Ultra High Speed:
  Propagation delay time — 150 ps/gate typ.
- ECL Interface Level:
  10K ECL compatible inputs and outputs

Input/Output Characteristic

Parameter	Temperature Coefficient	V_{EE} Coefficient
V_{OH}	1.6 mV/°C typ.	20 mV/V typ.
V_{OL}	0.4 mV/°C typ.	250 mV/V typ.
Input threshold voltage	1.1 mV/°C typ.	140 mV/V typ.



CERAMIC PACKAGE
FPT-24C-A03

- Single Power Supply:
  -5.2 V for V_{EE}, -2.0 V for output load terminations
- Emitter Follower Output:
  Wired OR capability, 50 Ω line drivability
- Compact Circular Flat Package:
  Low thermal resistance (10°C/W typ. (junction to case) for FPT-16C-A01, 6°C/W typ. (junction to case) for FPT-24C-A03C), high density mounting capability.
- 2 Pins for 1 Input:
  Having 2 pins for each input makes it easy to design the signal patterns on the printed circuit board.

ABSOLUTE MAXIMUM RATINGS (V_{CC} = 0 V)

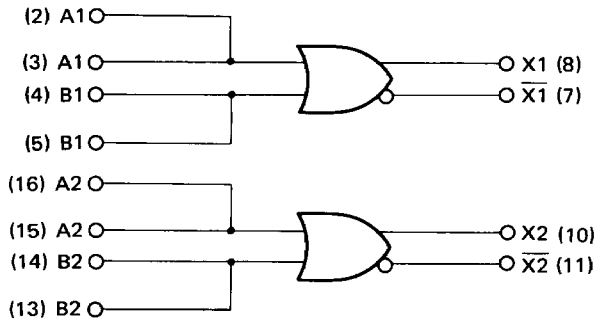
Parameter	Symbol	Rating	Unit
Supply Voltage	V_{EE}	-7.0 to 0	V
Input Voltage	V_I	-5.5 to 0	V
Output Current	I_{OUT}	50	mA
Case Temperature	T_C	-30 to 125	°C
Storage Temperature	T_{STG}	-55 to 150	°C

NOTE: Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

Fig. 1 MB 881 Logic Diagram and Pin Assignment

DUAL 2-Input OR/NOR GATE



$X = A + B$

$\overline{X} = \overline{A} + \overline{B}$

PIN ASSIGNMENTS

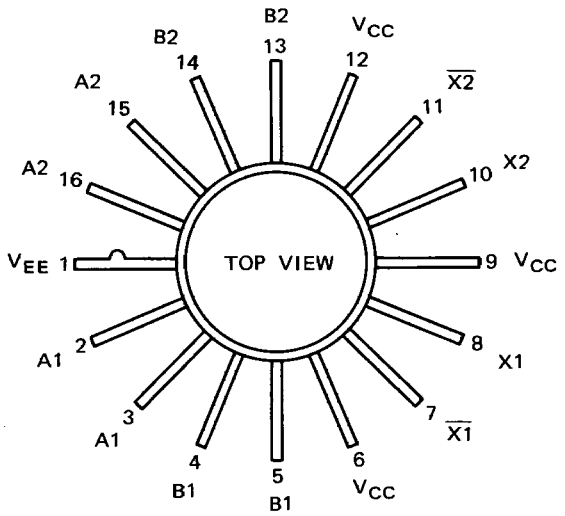
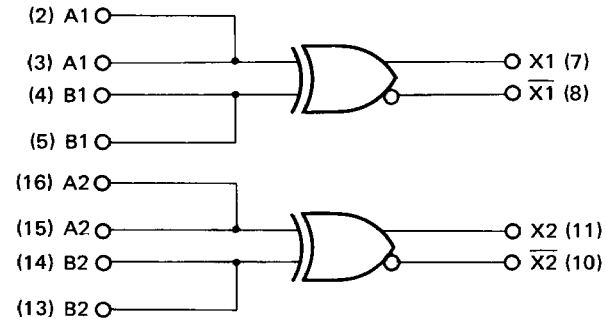


Fig. 2 MB 882 Logic Diagram and Pin Assignment

DUAL EXCLUSIVE OR/NOR GATE



$X = A \cdot \overline{B} + \overline{A} \cdot B$

$\overline{X} = A \cdot B + \overline{A} \cdot \overline{B}$

PIN ASSIGNMENTS

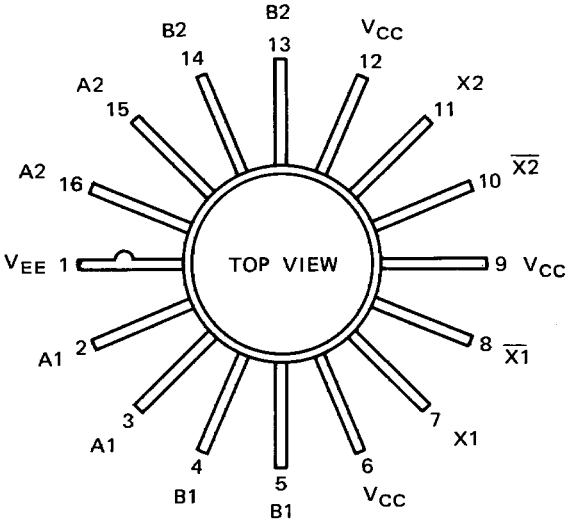
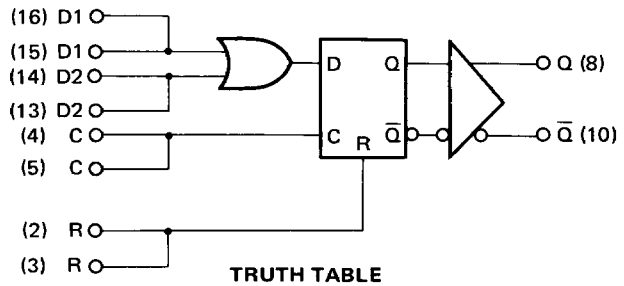


Fig. 3 MB 883 Logic Diagram and Pin Assignment

2-Input D-TYPE FLIP-FLOP WITH RESET



TRUTH TABLE

D	C	R	Q	Q̄
L	↑	L	L	H
H	↑	L	H	L
*	*	H	L	H

D = D1 + D2
* = H or L
↑ = L → H (Transition)

PIN ASSIGNMENTS

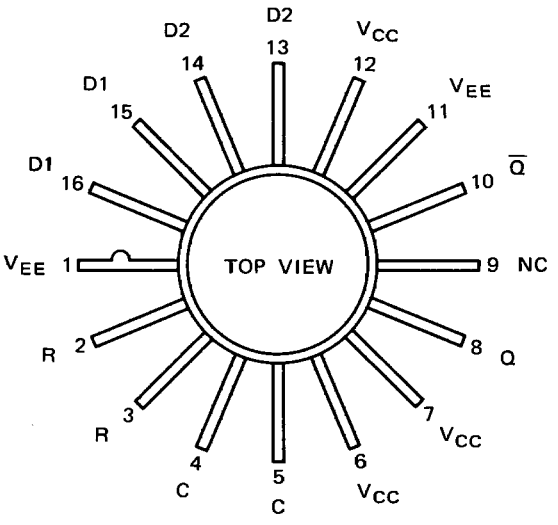
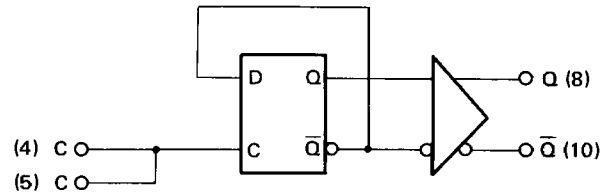


Fig. 4 MB 884 Logic Diagram and Pin Assignment

TOGGLE FLIP-FLOP



$Qn = \overline{Qn - 1}$

$\overline{Qn} = Qn - 1$

PIN ASSIGNMENTS

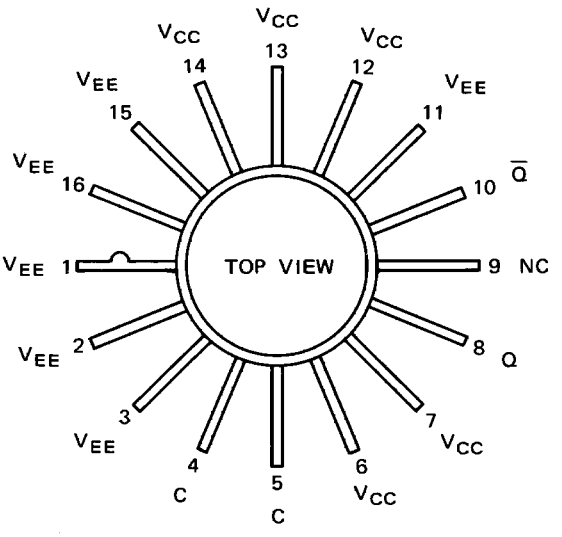
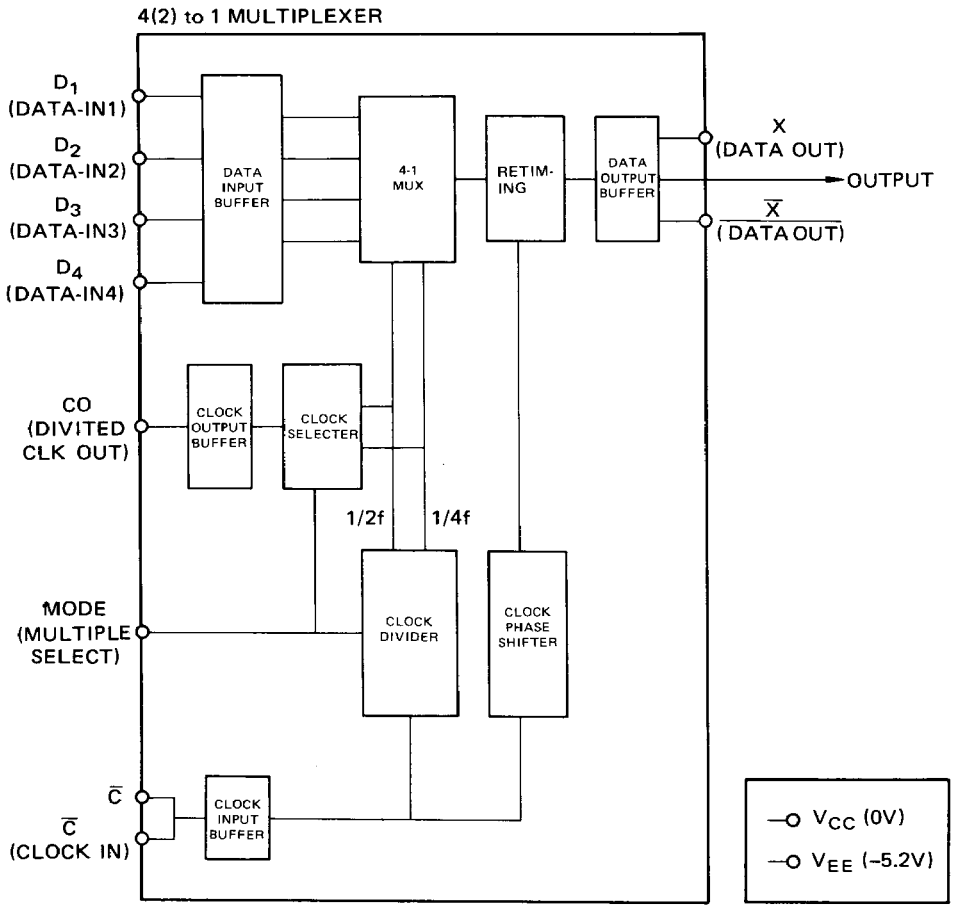
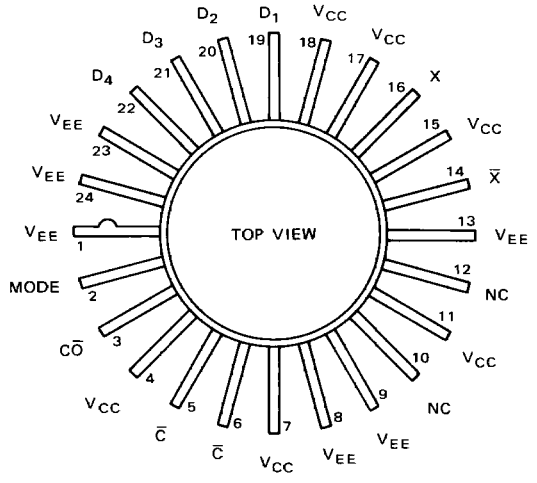


Fig. 5 – MB885 LOGIC DIAGRAM AND PIN ASSIGNMENT

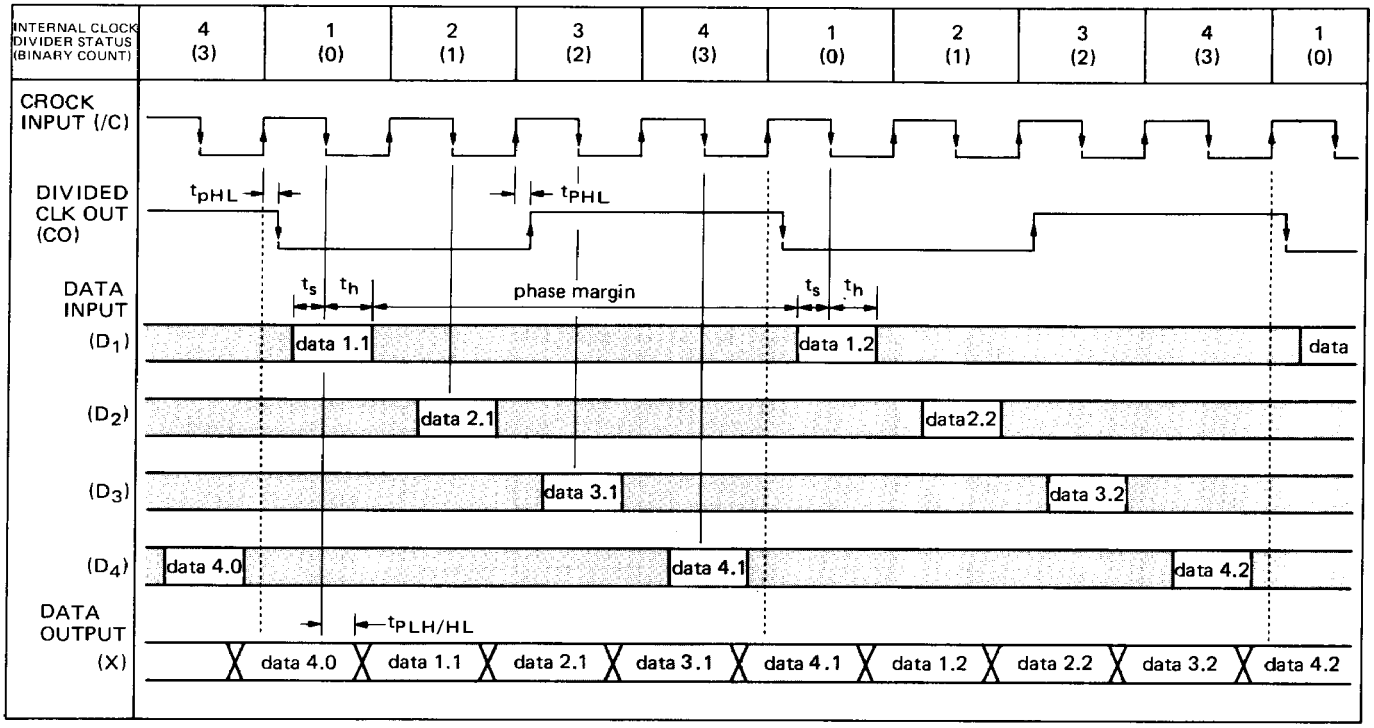


PIN ASSIGNMENTS



FUNCTIONAL TIMING CHART

MB885 4 to 1 MULTIPLEX MODE (MODE = "L")



MB885 2 to 1 MULTIPLEX MODE (MODE = "H")

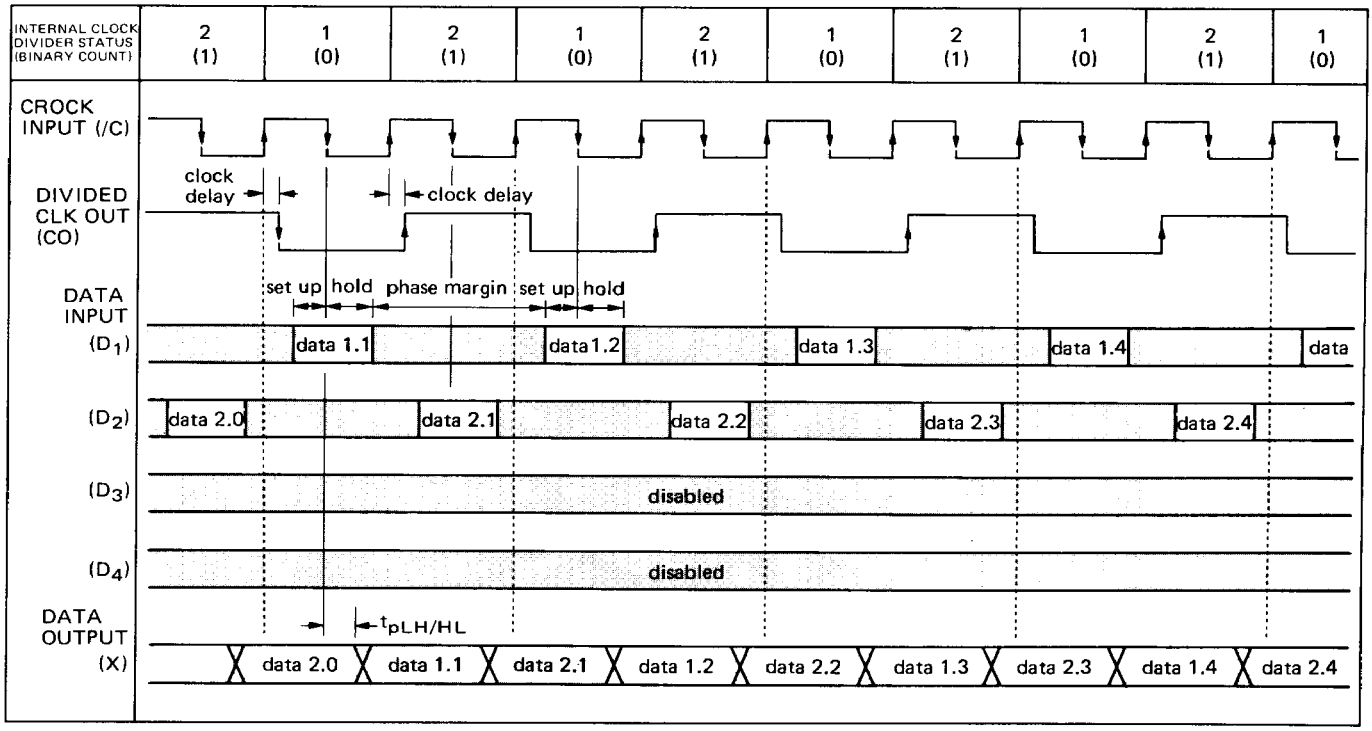
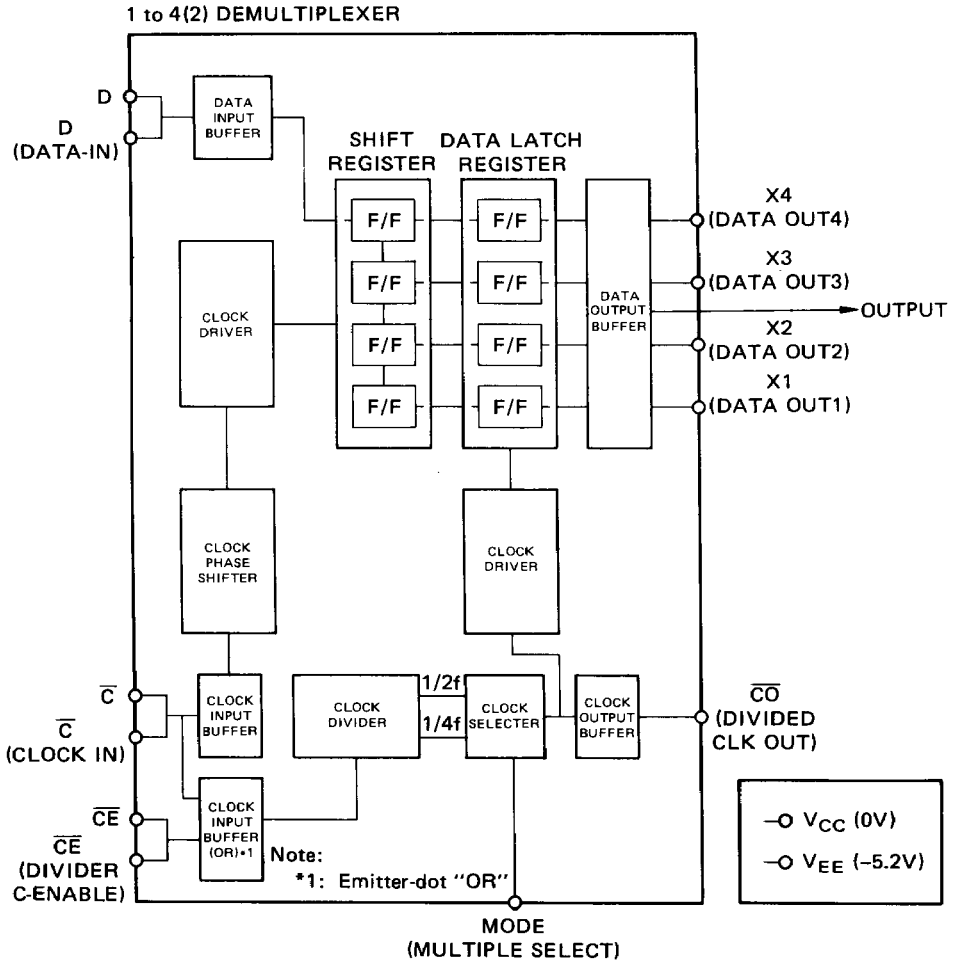
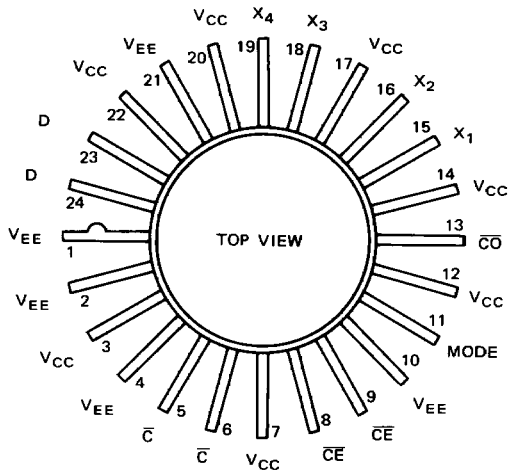


Fig. 6 – MB886 LOGIC DIAGRAM AND PIN ASSIGNMENT

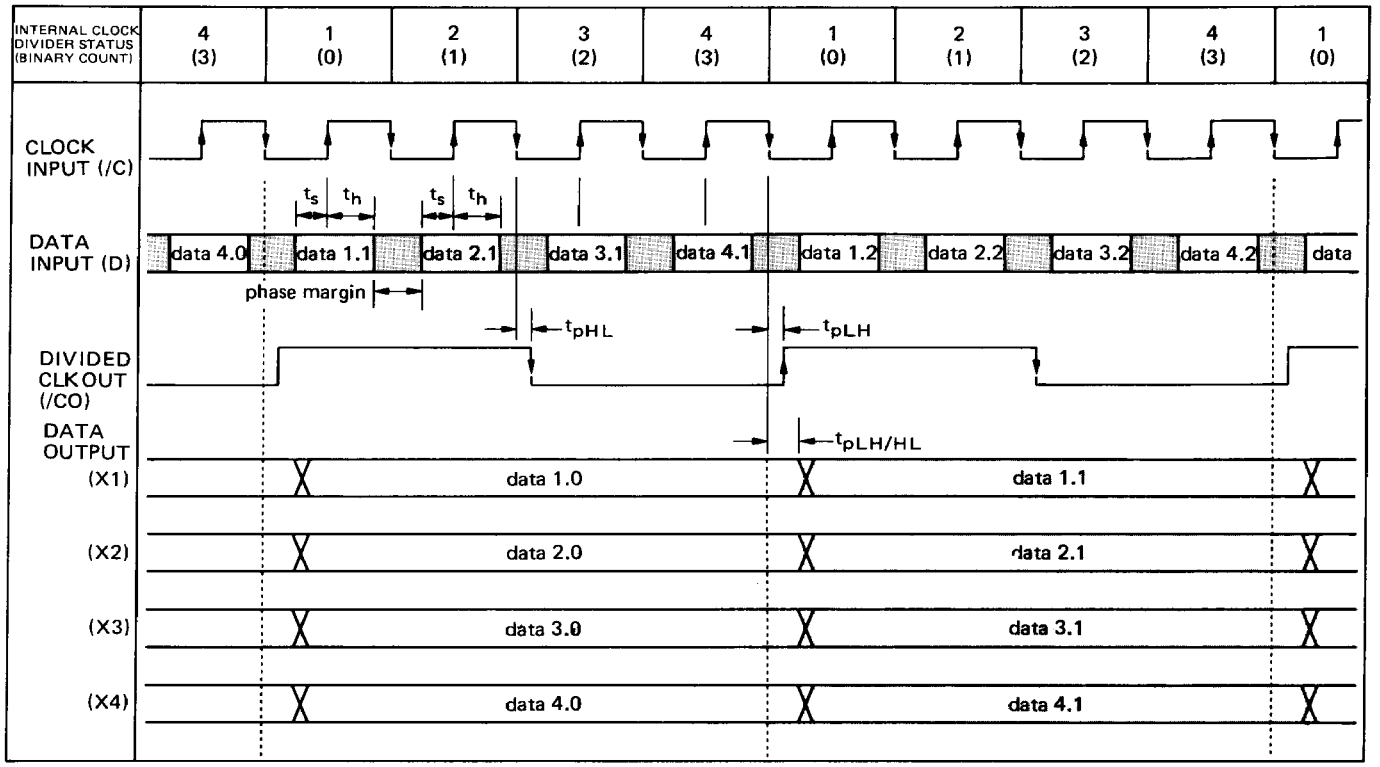


PIN ASSIGNMENTS

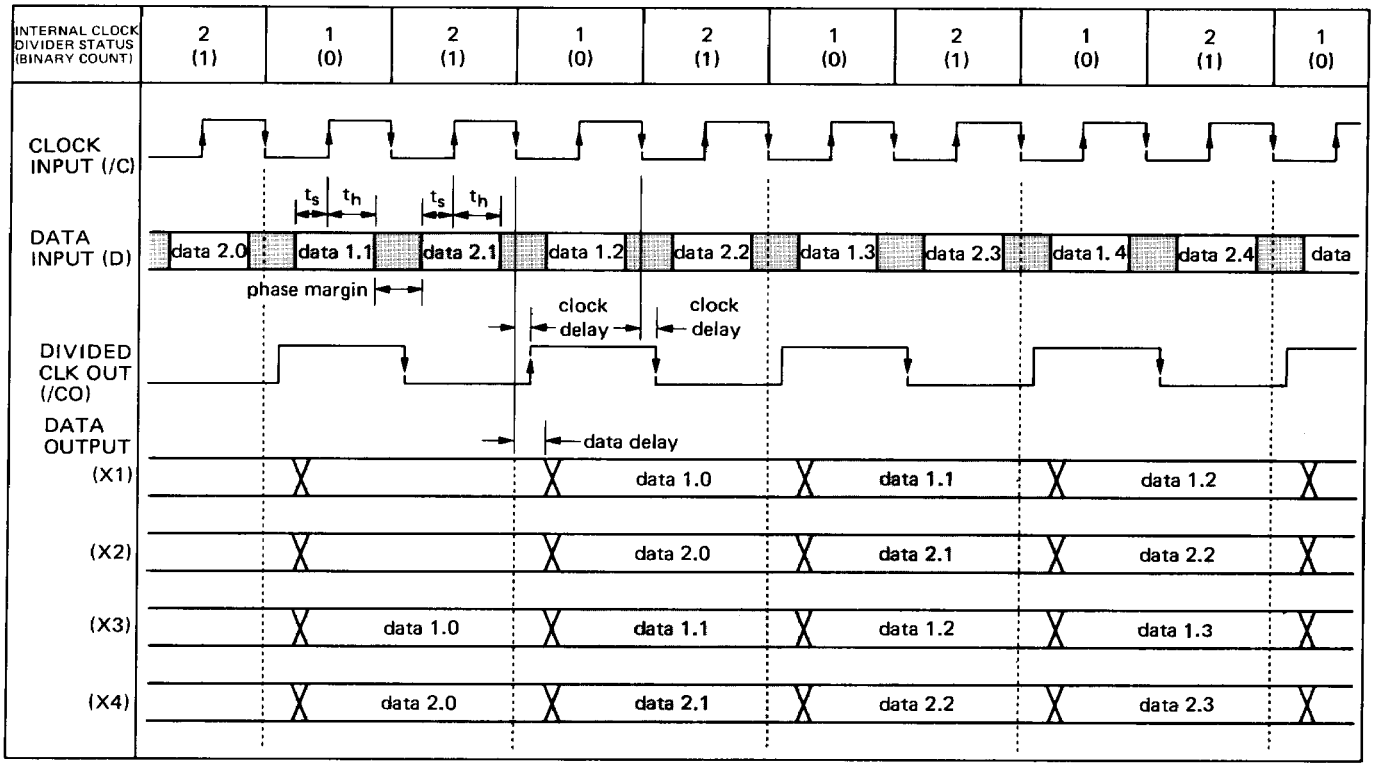


FUNCTIONAL TIMING CHART (Continued)

MB886 1 to 4 DEMULTIPREX MODE (MODE = "L")



MB886 1 to 2 DEMULTIPLEX MODE (MODE = "H")



RECOMMENDED OPERATING CONDITIONS

(V_{CC} = 0 V)

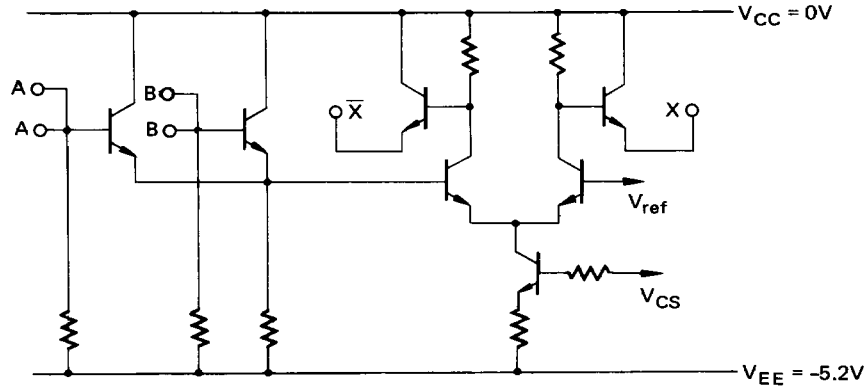
Parameter	Symbol	Value	Unit
Supply Voltage	V_{EE}	-5.2 ±5%	V
Termination Voltage	V_T	-2.0 ±5%	V
Output Termination Resistance	R_T	50	Ω
Input Termination Resistance	R_{TIN}	50	Ω
Case Temperature	T_C	0 to 70	°C

EQUIVALENT CIRCUIT

The basic circuit of the MB 880 series is a CS-EF (Current Switch – Emitter Follower) type ECL circuit. In order to develop both the input and switching characteristic, the emitter-follower is used at input stage basically.
The series gate technology, which uses doubled current switch circuit, is used at the Exclusive OR/NOR gate and Flip-Flop to improve lower power and high speed operation.

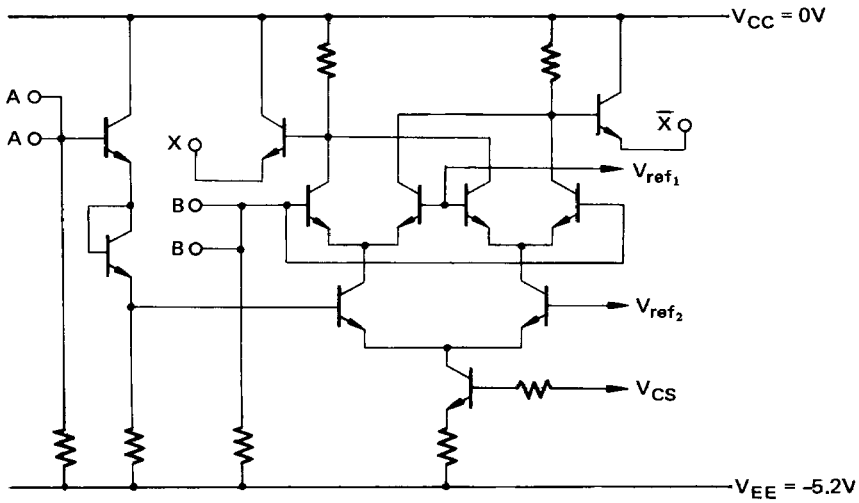
○BASIC GATE CIRCUIT

OR/NOR GATE (EXAMPLE)



○SERIES GATE CIRCUIT

EX.-OR/NOR GATE (EXAMPLE)



ELECTRICAL CHARACTERISTICS (MB 881)

DC CHARACTERISTICCS

V_{CC} (6, 9, 12 pin) = GND
V_{EE} (1 pin) = -5.2 V

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
Supply Current	V_{EE}	A1, A2 = V_{IH}	I_{EE}	25°C	-110	-79	-55	mA
High-level Input Current	A1 (A2)	A1 (A2) = V_{IH}, Other inputs = open.	I_{IH}	25°C		210	650	μA
	B1 (B2)	B1 (B2) = V_{IH}, Other inputs = open.		25°C		210	650	μA
Low-level Input Current	A1 (A2)	A1 (A2) = V_{IL}, Other inputs = open.	I_{IL}	25°C	1.0	160		μA
	B1 (B2)	B1 (B2) = V_{IL}, Other inputs = open.		25°C	1.0	160		μA
High-level Output Voltage	X1 (X2)	A1 (A2) = V_{IH}, Other inputs = open.	V_{OH}	0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	$\overline{X1}$ ($\overline{X2}$)	All inputs = open.		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
Low-level Output Voltage	X1 (X2)	All inputs = open.	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	$\overline{X1}$ ($\overline{X2}$)	A1 (A2) = V_{IH}, Other inputs = open.		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	

DC CHARACTERISTICS (Continued)

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
High-level Output Threshold Voltage	X1 (X2)	A1 (A2) = V_{IHA}	V_{OHA}	25°C	-0.980			V
	$\overline{X1}$ ($\overline{X2}$)	A1 (A2) = V_{ILA}		25°C	-0.980			
Low-level Output Threshold Voltage	X1 (X2)	A1 (A2) = V_{ILA}	V_{OLA}	25°C			-1.630	V
	$\overline{X1}$ ($\overline{X2}$)	A1 (A2) = V_{IHA}		25°C			-1.630	

Note: Output pins are connected to VT (-2.0 V) through 50 Ω.

INPUT APPLIED VOLTAGE:

Case Temp. (T_C)	V_{IH}	V_{IL}	V_{IHA}	V_{ILA}
0°C	-0.840 V	-1.870 V		
25°C	-0.810 V	-1.850 V	-1.105 V	-1.475 V
70°C	-0.720 V	-1.840 V		

AC CHARACTERISTICS (MB881)

V_{CC} (6, 9, 12 pin) = +2.0 V
V_{EE} (1 pin) = -3.2 V

Parameter	Under Test Pin	Symbol	Case Temp.	Value			Unit	Measured Pin		
				Min	Typ	Max		Input	Input Monitor	Output
Propagation Delay Time	X1	t_{PLH}	25°C		150	235	ps	A1(2)	A1(3)	X1
	X1	t_{PHL}	25°C		150	235	ps	A1(2)	A1(3)	X1
	$\overline{X1}$	t_{PLH}	25°C		120	235	ps	A1(2)	A1(3)	$\overline{X1}$
	$\overline{X1}$	t_{PHL}	25°C		150	235	ps	A1(2)	A1(3)	$\overline{X1}$
Rising time (20% to 80%)	X1	t_r	25°C		130	210	ps	A1(2)	A1(3)	X1
	$\overline{X1}$		25°C		130	210	ps	A1(2)	A1(3)	$\overline{X1}$
Falling time (80% to 20%)	X1	t_f	25°C		90	155	ps	A1(2)	A1(3)	X1
	$\overline{X1}$		25°C		80	155	ps	A1(2)	A1(3)	$\overline{X1}$

Note: Input monitor pin and output pins are connected to Ground through 50 Ω.
'Propagation delay time is measured as the time difference between the input monitor waveform and the output waveform. Number in parentheses indicates pin number.

ELECTRICAL CHARACTERISTICS (MB 882)

DC CHARACTERISTICS

V_{CC} (6, 9, 12 pin) = GND
V_{EE} (1 pin) = -5.2 V

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
Supply Current	V_{EE}	A1, A2 = V_{IH}	I_{EE}	25°C	-110	-79	-55	mA
High-level Input Current	A1 (A2)	A1 (A2) = V_{IH}, Other inputs = open.	I_{IH}	25°C		210	650	μA
	B1 (B2)	B1 (B2) = V_{IH}, Other inputs = open.		25°C		320	950	μA
Low-level Input Current	A1 (A2)	A1 (A2) = V_{IL}, Other inputs = open.	I_{IL}	25°C	1.0	160		μA
	B1 (B2)	B1 (B2) = V_{IL}, Other inputs = open.		25°C	1.0	110		μA
High-level Output Voltage	X1 (X2)	A1 (A2) = V_{IH}, Other inputs = open.	V_{OH}	0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
		B1 (B2) = V_{IH}, Other inputs = open.		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	$\overline{X1}$ ($\overline{X2}$)	All inputs = open.		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
		A1, B1 (A2, B2) = V_{IH}, Other inputs = open.		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
Low-level Output Voltage	X1 (X2)	All inputs = open.	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
		A1, B1 (A2, B2) = V_{IH}, Other inputs = open.		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	

DC CHARACTERISTICS (Continued)

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
Low-level Output Voltage	$\overline{X1}$ ($\overline{X2}$)	A1 (A2) = V_{IH}, Other inputs = open.	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
		B1 (B2) = V_{IH}, Other inputs = open.		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
High-level Output Threshold Voltage	X1 (X2)	A1 (A2) = V_{IHA}	V_{OHA}	25°C	-0.980			V
	$\overline{X1}$ ($\overline{X2}$)	A1 (A2) = V_{ILA}		25°C	-0.980			
Low-level Output Threshold Voltage	X1 (X2)	A1 (A2) = V_{ILA}	V_{OLA}	25°C			-1.630	V
	$\overline{X1}$ ($\overline{X2}$)	A1 (A2) = V_{IHA}		25°C			-1.630	

Note: Output pins are connected to VT (-2.0 V) through 50 Ω.

INPUT APPLIED VOLTAGE:

Case Temp. (T_C)	V_{IH}	V_{IL}	V_{IHA}	V_{ILA}
0°C	-0.840 V	-1.870 V		
25°C	-0.810 V	-1.850 V	-1.105 V	-1.475 V
70°C	-0.720 V	-1.840 V		

AC CHARACTERISTICS (MB 882)

V_{CC} (6, 9, 12 pin) = +2.0 V
V_{EE} (1 pin) = -3.2 V

Parameter	Under Test Pin	Symbol	Case Temp.	Value			Unit	Measured Pin		
				Min	Typ	Max		Input	Input Monitor	Output
Propagation Delay Time	X1	t_{PLH}	25°C		210	325	ps	A1(2)	A1(3)	X1
	X1	t_{PHL}	25°C		210	325	ps	A1(2)	A1(3)	X1
	$\overline{X1}$	t_{PLH}	25°C		160	325	ps	A1(2)	A1(3)	$\overline{X1}$
	$\overline{X1}$	t_{PHL}	25°C		220	325	ps	A1(2)	A1(3)	$\overline{X1}$
	X1	t_{PLH}	25°C		190	300	ps	B1(4)	B1(5)	X1
	X1	t_{PHL}	25°C		140	300	ps	B1(4)	B1(5)	X1
	$\overline{X1}$	t_{PLH}	25°C		140	300	ps	B1(4)	B1(5)	$\overline{X1}$
	$\overline{X1}$	t_{PHL}	25°C		200	300	ps	B1(4)	B1(5)	$\overline{X1}$
Rising time (20% to 80%)	X1	t_r	25°C		170	280	ps	A1(2)	A1(3)	X1
	$\overline{X1}$		25°C		180	280	ps	A1(2)	A1(3)	$\overline{X1}$
	X1	t_r	25°C		180	280	ps	B1(4)	B1(5)	X1
	$\overline{X1}$		25°C		170	280	ps	B1(4)	B1(5)	$\overline{X1}$
Falling time (80% to 20%)	X1	t_f	25°C		100	195	ps	A1(2)	A1(3)	X1
	$\overline{X1}$		25°C		80	195	ps	A1(2)	A1(3)	$\overline{X1}$
	X1	t_f	25°C		110	195	ps	B1(4)	B1(5)	X1
	$\overline{X1}$		25°C		120	195	ps	B1(4)	B1(5)	$\overline{X1}$

Note: Input monitor pin and output pins are connected to Ground through 50 Ω.
Propagation delay time is measured as the time difference between the input monitor waveform and the output waveform.
Number in parentheses indicates pin number.

ELECTRICAL CHARACTERISTICS (MB 883)

DC CHARACTERISTICS

V_{CC} (6, 7, 12 pin) = GND
V_{EE} (1, 11 pin) = – 5.2 V

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
Supply Current*1	V_{EE}	C = V_{IH}	I_{EE}	25°C	-120	-88	-60	mA
High-level Input Current	D1 (D2)	D1 (D2) = V_{IH}, Other inputs = open.	I_{IH}	25°C		230	700	μA
	C	C = V_{IH}, Other inputs = open.		25°C		210	650	μA
	R	R = V_{IH}, Other inputs = open.		25°C		300	900	μA
Low-level Input Current	D1 (D2)	D1 (D2) = V_{IL}, Other inputs = open.	I_{IL}	25°C	1.0	110		μA
	C	C = V_{IL}, Other inputs = open.		25°C	1.0	160		μA
	R	R = V_{IL}, Other inputs = open.		25°C	1.0	160		μA
High-level*2 Output Voltage	Q	D1 (D2) = V_{IH}, Other inputs = open.	V_{OH}	0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	$\overline{Q}$	All inputs = open.		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
Low-level*2 Output Voltage	Q	All inputs = open.	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	$\overline{Q}$	D1 (D2) = V_{IH}, Other inputs = open.		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
High-level*2 Output Threshold Voltage	Q	D1 (D2) = V_{IHA}, Other inputs = open.	V_{OHA}	25°C	-0.980			V

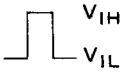
DC CHARACTERISTICS

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
Low-level*2 Output Threshold Voltage	Q	D1 (D2) = V_{ILA} Other inputs = open	V_{OLA}	25°C			-1.630	V

Note: Output pins are connected to VT (-2.0 V) throughout 50 Ω.

*1 When I_{EE} is measured, all V_{EE} pins are connected simultaneously.

*2 Output voltage is measured after clock pulse is applied to clock input. (4 pin)



INPUT APPLIED VOLTAGE:

Case Temp. (T_C)	V_{IH}	V_{IL}	V_{IHA}	V_{ILA}
0°C	-0.840 V	-1.870 V		
25°C	-0.810 V	-1.850 V	-1.105 V	-1.475 V
70°C	-0.720 V	-1.840 V		

AC CHARACTERISTICS (MB883)

V_{CC} (6, 7, 12 pin) = +2.0 V
V_{EE} (1, 11 pin) = – 3.2 V

Parameter	Under Test Pin	Symbol	Case Temp.	Value			Unit	Measured Pin		
				Min	Typ	Max		Input	Input Monitor	Output
Propagation Delay Time	Q	t_{PLH}	25°C		350	545	ps	C(4)	C(5)	Q
	Q	t_{PHL}	25°C		380	545	ps	C(4)	C(5)	Q
	$\overline{Q}$	t_{PLH}	25°C		500	700	ps	R(2)	R(3)	$\overline{Q}$
	$\overline{Q}$	t_{PHL}	25°C		490	700	ps	R(2)	R(3)	$\overline{Q}$
Rising time (20% to 80%)	Q	t_r	25°C		130	210	ps	C(4)	C(5)	Q
	$\overline{Q}$		25°C		130	210	ps	C(4)	C(5)	$\overline{Q}$
Falling time (80% to 20%)	Q	t_f	25°C		90	155	ps	C(4)	C(5)	Q
	$\overline{Q}$		25°C		90	155	ps	C(4)	C(5)	$\overline{Q}$
Setup Time*1	D1	t_s	25°C		90	150	ps	D1(16) C(4)	D1(15) C(5)	Q
Hold Time*1	D1	t_h	25°C		90	150	ps	D1(16) C(4)	D1(15) C(5)	Q
Clock Frequency	Q	f_{tog}	25°C	2.0			GHz	D1(16) C(4)	D1(15) C(5)	Q

Note: Input monitor pin and output pins are connected to Ground through 50 Ω.
Propagation delay time is measured as the time difference between the input monitor waveform and the output waveform. Number in parentheses indicates pin number.

*1 This value is not measured at shipping test.

ELECTRICAL CHARACTERISTICS (MB 884)

DC CHARACTERISTICS

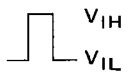
V_{CC} (6, 7, 12, 13, 14 pin) = GND
V_{EE} (1, 2, 3, 11, 15, 16 pin) = – 5.2 V

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min	Typ	Max	
Supply Current*1	V_{EE} (1, 2, (3, 11, 15, 16)	C = V_{IH}	I_{EE}	25°C	-120	-88	-60	mA
High-level Input Current	C	C = V_{IH}, Other inputs = open.	I_{IH}	25°C		210	650	μA
Low-level Input Current	C	C = V_{IL}, Other inputs = open.	I_{IL}	25°C	1.0	160		μA
High-level*2 Output Voltage	Q	All inputs = open.	V_{OH}	0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	$\overline{Q}$	All inputs = open.		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
Low-level*2 Output Voltage	Q	All inputs = open.	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	$\overline{Q}$	All inputs = open.		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	

Note : Output pins are connected to VT (-2.0 V) through 50 Ω.

*1 When I_{EE} is measured, all V_{EE} pins are connected simultaneously.

*2 Output voltage is measured after clock pulse is applied to clock input (4 pin).



INPUT APPLIED VOLTAGE:

Case Temp. (T_C)	V_{IH}	V_{IL}
0°C	-0.840 V	-1.870 V
25°C	-0.810 V	-1.850 V
70°C	-0.720 V	-1.840 V

AC CHARACTERISTICS (MB884)

V_{CC} (6, 7, 12, 13, 14 pin) = +2.0 V
V_{EE} (1, 2, 3, 11, 15, 16 pin) = -3.2 V

Parameter	Under Test Pin	Symbol	Case Temp.	Value			Unit	Measured Pin		
				Min	Typ	Max		Input	Input Monitor	Output
Propagation Delay Time	Q	t_{PLH}	25°C		380	570	ps	C(4)	C(5)	Q
	Q	t_{PHL}	25°C		400	570	ps	C(4)	C(5)	Q
Rising time (20% to 80%)	Q	t_r	25°C		130	210	ps	C(4)	C(5)	Q
	$\overline{Q}$		25°C		130	210	ps	C(4)	C(5)	$\overline{Q}$
Falling time (80% to 20%)	Q	t_f	25°C		90	150	ps	C(4)	C(5)	Q
	$\overline{Q}$		25°C		90	150	ps	C(4)	C(5)	$\overline{Q}$
Clock Frequency	Q	f_{tog}	25°C	2.0			GHz	C(4)	C(5)	Q

Note: Input monitor pin and output pins are connected to Ground through 50 Ω.
Propagation delay time is measured as the time difference between the input monitor waveform and the output waveform.
Number in parentheses indicates pin number.

ELECTRICAL CHARACTERISTICS (MB885)

DC CHARACTERISTICS

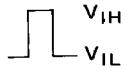
V_{CC} (4, 7, 11, 15, 17, 18 pin) = GND
V_{EE} (1, 8, 9, 13, 23, 24 pin) = -5.2V

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min.	Typ.	Max.	
Supply Current*1	V_{EE} (1, 8, 9, 13, 23, 24)	All Inputs = Open	I_{EE}	25°C	-330	-235		mA
High-level Input Current	D_1, D_2	D_1, D_2 = V_{IH} Other Inputs = Open	I_{IH}	25°C		100	300	μA
	D_3, D_4	D3, D_4 = V_{IH} Other Inputs = Open				100	300	
	$\overline{C}$	$\overline{C}$ = V_{IH} Other Inputs = Open				110	300	
	MODE	MODE = V_{IH} Other Inputs = Open				95	250	
Low-level Input Current	D_1, D_2	D_1, D_2 = V_{IL} Other Inputs = Open	I_{IL}	25°C	1	65		μA
	D_3, D_4	D_3, D_4 = V_{IL} Other Inputs = Open			1	65		
	$\overline{C}$	$\overline{C}$ = V_{IL} Other Inputs = Open			1	65		
	MODE	MODE = V_{IL} Other Inputs = Open			1	70		
High-level Output*2 Voltage	X	D_1, D_2, D_3, D_4 = V_{IH} Other Inputs = Open	V_{OH}	0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	$\overline{X}$	All Inputs = Open		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	CO	All Inputs = Open		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
Low-level Output*2 Voltage	X	All Inputs = Open	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	$\overline{X}$	D_1, D_2, D_3, D_4 = V_{IH} Other Inputs = Open		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	CO	All Inputs = Open		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
High-level Output*2 Threshold Voltage	X	D_1, D_2, D_3, D_4 = V_{IHA} Other Inputs = Open	V_{OHA}	25°C	-0.980			V
Low-level Output*2 Threshold Voltage	X	D_1, D_2, D_3, D_4 = V_{ILA} Other Inputs = Open	V_{OLA}	25°C			-1.630	V

Note: Output pin are connected to VT (-2.0V) through 50Ω.

*1 When I_{EE} is measured, all V_{EE} pins are connected simultaneously.

*2 Output voltage is measured after clock pulse is applied properly to clock input (5 pin).



INPUT APPLIED VOLTAGE:

Case Temp. (T_C)	V_{IH}	V_{IL}	V_{IHA}	V_{ILA}
0°C	-0.840V	-1.870V	–	–
25°C	-0.810V	-1.850V	-1.105V	-1.475V
70°C	-0.720V	-1.840V	–	–

AC CHARACTERISTICS (MB885)

V_{CC} (4, 7, 11, 15, 17, 18 pin) = +2.0V
V_{EE} (1, 8, 9, 13, 23, 24 pin) = -3.2V

Parameter	Under Test Pin	Symbol	Case Temp.	Value			Unit	Measured Pin			
				Min.	Typ.	Max.		Input	Input Monitor	Output	+1.1V
Propagation Delay Time*1 $\overline{C} \rightarrow X$	X	t_{PLH}	25°C		1600	2200	PS	$\overline{C}$(5)	$\overline{C}$(6)	X	D_1
	X	t_{PHL}	25°C		1600	2200	PS	$\overline{C}$(5)	$\overline{C}$(6)	X	D_1
$\overline{C} \rightarrow \overline{X}$	$\overline{X}$	t_{PLH}	25°C		1600	2200	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{X}$	D_1
	$\overline{X}$	t_{PHL}	25°C		1600	2200	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{X}$	D_1
$\overline{C} \rightarrow CO$	CO	t_{PLH}	25°C		1100	1510	PS	$\overline{C}$(5)	$\overline{C}$(6)	CO	–
	CO	t_{PHL}	25°C		1100	1510	PS	$\overline{C}$(5)	$\overline{C}$(6)	CO	–
Rise Time*1 (20% to 80%) X	X	t_r	25°C		135	215	PS	$\overline{C}$(5)	$\overline{C}$(6)	X	D_1
$\overline{X}$	$\overline{X}$		25°C		135	215	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{X}$	D_1
CO	CO		25°C		220	335	PS	$\overline{C}$(5)	$\overline{C}$(6)	CO	–
Fall Time*1 (80% to 20%) X	X	t_f	25°C		95	160	PS	$\overline{C}$(5)	$\overline{C}$(6)	X	D_1
$\overline{X}$	$\overline{X}$		25°C		95	160	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{X}$	D_1
CO	CO		25°C		170	265	PS	$\overline{C}$(5)	$\overline{C}$(6)	CO	–
Setup Time*1,*2,*4 $D_1 \rightarrow \overline{C}$	D_1	t_s	25°C		-840	-510	PS	D_1,(19) $\overline{C}$(5)	D_1,(19) $\overline{C}$(6)	X	–
Hold Time*1,*2,*4 $D_1 \rightarrow \overline{C}$	D_1	t_h	25°C		850	1180	PS	D_1,(19) $\overline{C}$(5)	D_1,(19) $\overline{C}$(6)	X	–
Clock Frequency*1,*3	$\overline{C}$	f_{tog}	25°C	2.0			GHz	$\overline{C}$(5)	$\overline{C}$(6)	CO	–

Note: Input monitor pin is connected to GND through 50Ω.
The propagation delay time is measured the time difference between input monitor waveform and output waveform.
Number in parentheses indicates pin number.

*1 The time when 4 to 1 multiplex mode.
*2 One eighth clock frequency pulse is supplied to input D_1.
*3 Make sure that $C\overline{O}$ output is one fourth input $\overline{C}$ frequency.
*4 This value is not measured at shipping test.

ELECTRICAL CHARACTERISTICS (MB886)

V_{CC} (3, 7, 12, 14, 17, 20, 22 pin) = GND
V_{EE} (1, 2, 4, 10, 21 pin) = -5.2V

DC CHARACTERISTICS

Parameter	Under Test Pin	Voltage Applied Pin	Symbol	Case Temp.	Value			Unit
					Min.	Typ.	Max.	
Supply Current*1	V_{EE} (1,2,4,10,21)	All Inputs = Open	I_{EE}	25°C	-380	-260	–	mA
High-level Input Current	D	D = V_{IH} Other Inputs=Open	I_{IH}	25°C		110	300	μA
	$\overline{C}$	$\overline{C}$ = V_{IH} Other Inputs=Open				110	300	μA
	$\overline{CE}$	$\overline{CE}$ = V_{IH}				100	300	μA
	MODE	MODE = V_{IH} Other Inputs=Open				90	250	μA
Low-level Input Current	$\overline{D}$	D = V_{IL} Other Inputs=Open	I_{IL}	25°C	1	65		μA
	$\overline{C}$	$\overline{C}$ = V_{IL} Other Inputs=Open			1	85		μA
	$\overline{CE}$	$\overline{CE}$ = V_{IL} Other Inputs=Open			1	75		μA
	MODE	MODE = V_{IL} Other Inputs=Open			1	65		μA
High-level Output*2 Voltage	X_1, X_2	D = V_{IH} Other Inputs=Open	V_{OH}	0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	X_3, X_4	D = V_{IH} Other Inputs=Open		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.910			
	$\overline{CO}$	All Inputs = Open		0°C	-1.010			V
				25°C	-0.960	-0.860		
				70°C	-0.110			
Low-level Output*2 Voltage	X_1, X_2	All Inputs = Open	V_{OL}	0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	X_3, X_4	All Inputs = Open		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
	$\overline{CO}$	All Inputs = Open		0°C			-1.660	V
				25°C		-1.750	-1.650	
				70°C			-1.620	
High-level Output*2 Threshold Voltage	X_1	D = V_{IHA} Other Inputs=Open	V_{OHA}	25°C	-0.980			V
Low-level Output*2 Threshold Voltage	X_1	D = V_{ILA} Other Inputs=Open	V_{OLA}	25°C			-1.630	V

Note: Output pins are connected to VT (-2.0V) through 50Ω.

*1 When I_{EE} is measured, all V_{EE} pins are connected simultaneously.

*2 Output voltage is measured after clock pulse is applied properly to clock input (5 pin).

INPUT APPLIED VOLTAGE

Case Temp. (T_C)	V_{IH}	V_{IL}	V_{IHA}	V_{ILA}
0°C	-0.840V	-1.870V	–	–
25°C	-0.810V	-1.850V	-1.105V	-1.475V
70°C	-0.720V	-1.840V	–	–

AC CHARACTERISTICS (MB886)

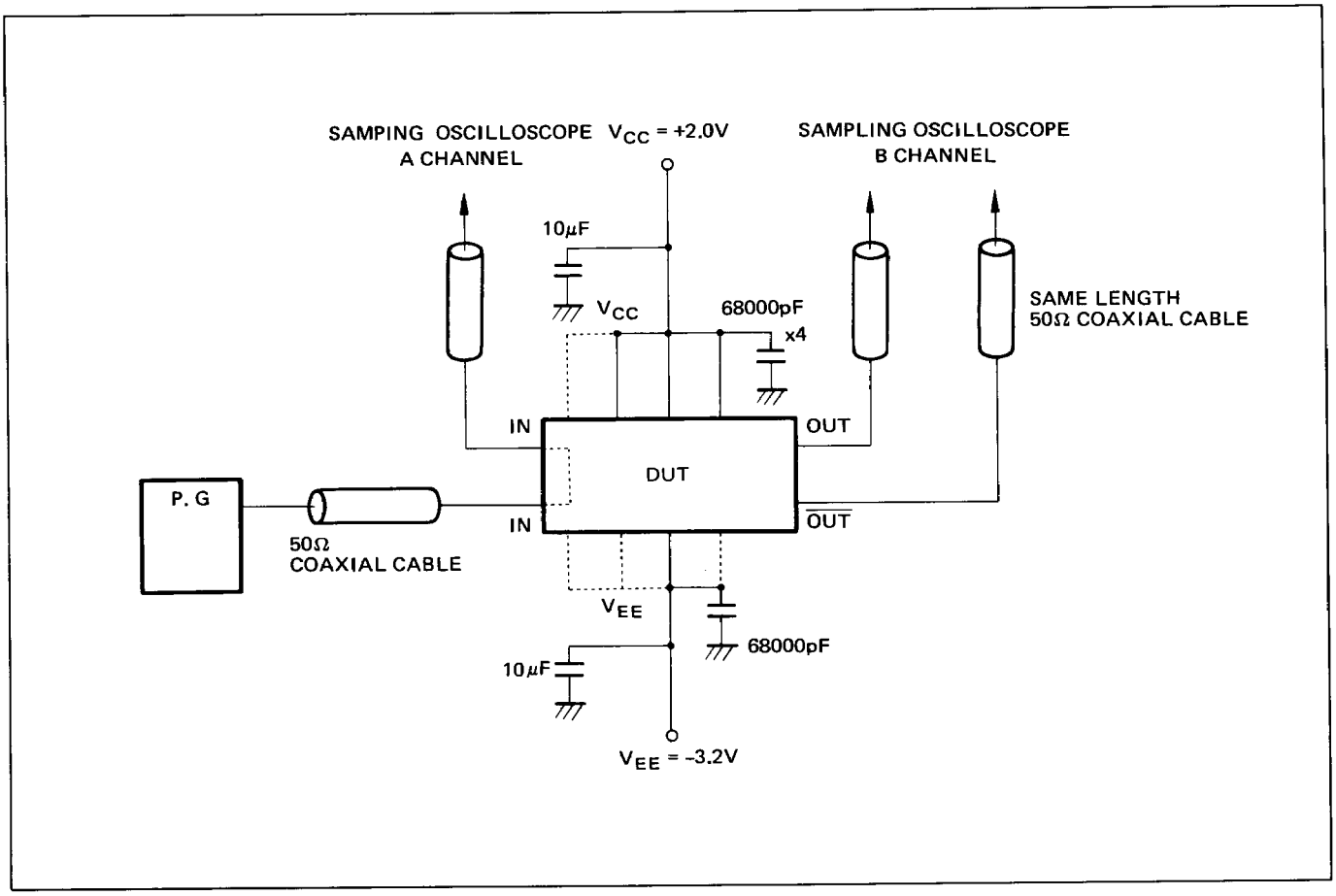
V_{CC} (3, 7, 12, 14, 17, 20, 22 pin) = +2.0V
V_{EE} (1, 2, 4, 10, 21 pin) = -3.2V

Parameter	Under Test Pin	Symbol	Case Temp.	Value			Unit	Measured Pin			
				Min.	Typ.	Max.		Input	Input Monitor	Output	+1.1V
Propagation*1 Delay Time $\overline{C} \rightarrow X_1$	X_1	t_{PLH}	25°C		1550	2120	PS	$\overline{C}$(5)	$\overline{C}$(6)	X_1	–
	X_1	t_{PHL}	25°C		1550	2120	PS	$\overline{C}$(5)	$\overline{C}$(6)	X_1	–
$\overline{C} \rightarrow \overline{CO}$	$\overline{CO}$	t_{PLH}	25°C		1100	1510	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{CO}$	–
	$\overline{CO}$	t_{PHL}	25°C		1100	1510	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{CO}$	–
Rising Time*1 (20% to 80%) X_1*2	X_1	t_r	25°C		305	455	PS	$\overline{C}$(5)	$\overline{C}$(6)	X_1	–
$\overline{CO}$	$\overline{CO}$		25°C		210	320	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{CO}$	–
Falling Time*1 (80% to 20%) X_1*2	X_1	t_f	25°C		225	345	PS	$\overline{C}$(5)	$\overline{C}$(6)	X_1	–
$\overline{CO}$	$\overline{CO}$		25°C		150	235	PS	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{CO}$	–
Setup Time*2, *4 $D \rightarrow \overline{C}$	D	t_{su}	25°C		-520	-300	PS	D(23) $\overline{C}$(5)	D(24) $\overline{C}$(6)	X_1	–
Hold Time*2, *4 $D \rightarrow \overline{C}$	D	t_{hd}	25°C		540	760	PS	D(23) $\overline{C}$(5)	D(24) $\overline{C}$(6)	X_1	–
Clock Frequency*1, *3	$\overline{CO}$	f_{tog}	25°C	2.0			GHz	$\overline{C}$(5)	$\overline{C}$(6)	$\overline{CO}$	–

Note: Input monitor pin and output pins are connected to ground through 50Ω.
Propagation delay time is measured as the time difference between the input monitor waveform and the output.
Number in parentheses indicates pin number.

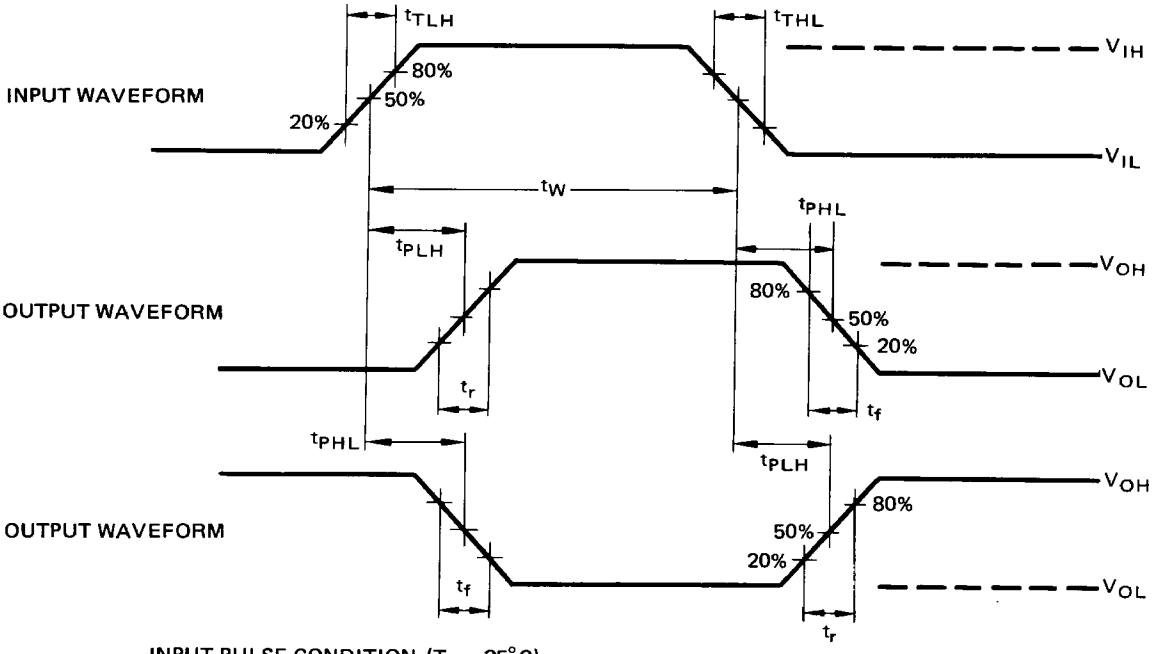
*1 The time when 1 to 4 demultiplex mode.
*2 One eighth clock frequency pulse is supplied to input D.
*3 Make sure that $\overline{CO}$ output is one fourth input $\overline{C}$ frequency.
*4 This test is not measured at shipping test.

SWITCHING MEASUREMENT CIRCUIT



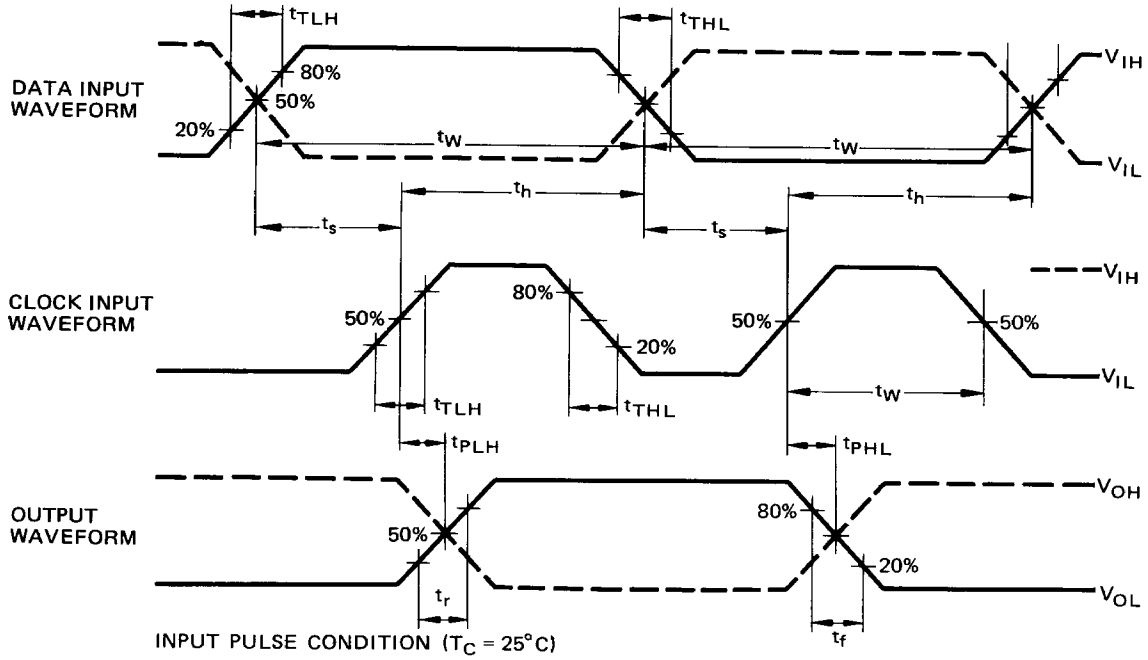
SWITCHING WAVEFORM

○INPUT/OUTPUT WAVEFORM OF MB881 TO MB884



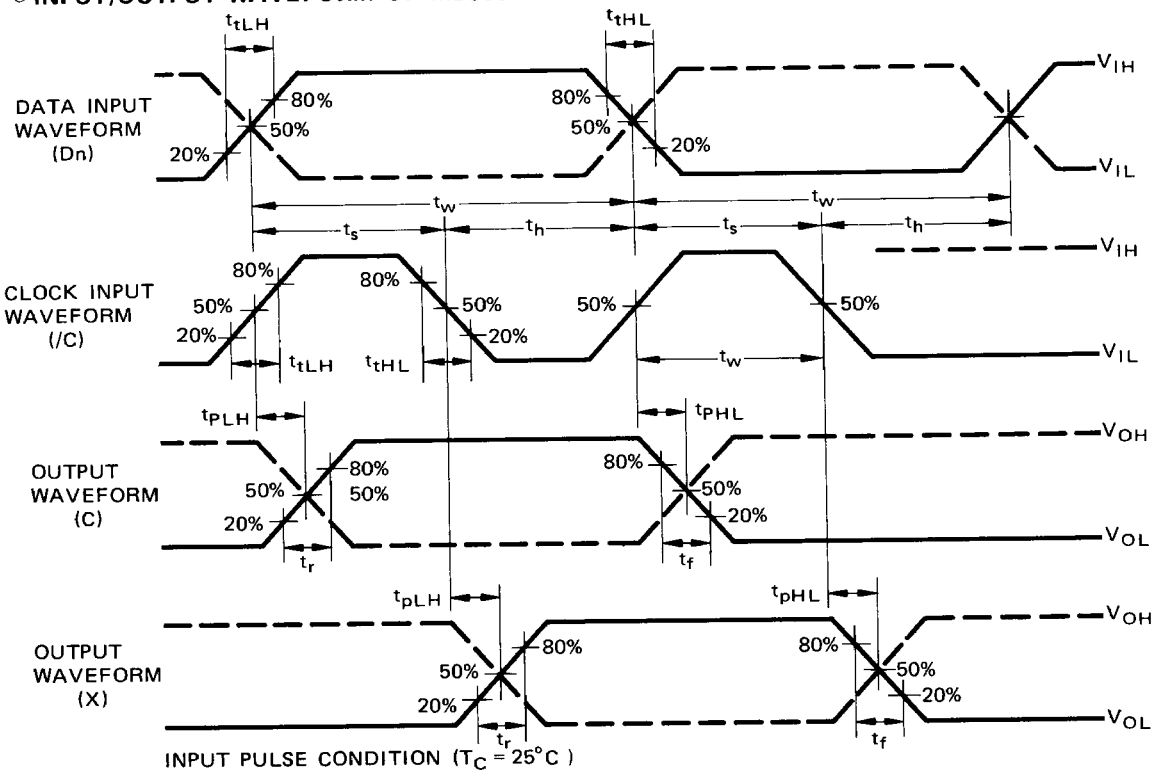
INPUT PULSE CONDITION (T_C = 25°C)
V_{IH} = +1.1V, V_{IL} = +0.3V, $t_{TLH}/t_{THL} \leqq$ 200 ps, PRR = 500 MHz, t_W = 1ns

○FLIP-FLOP SETUP/HOLD TIME OF MB883



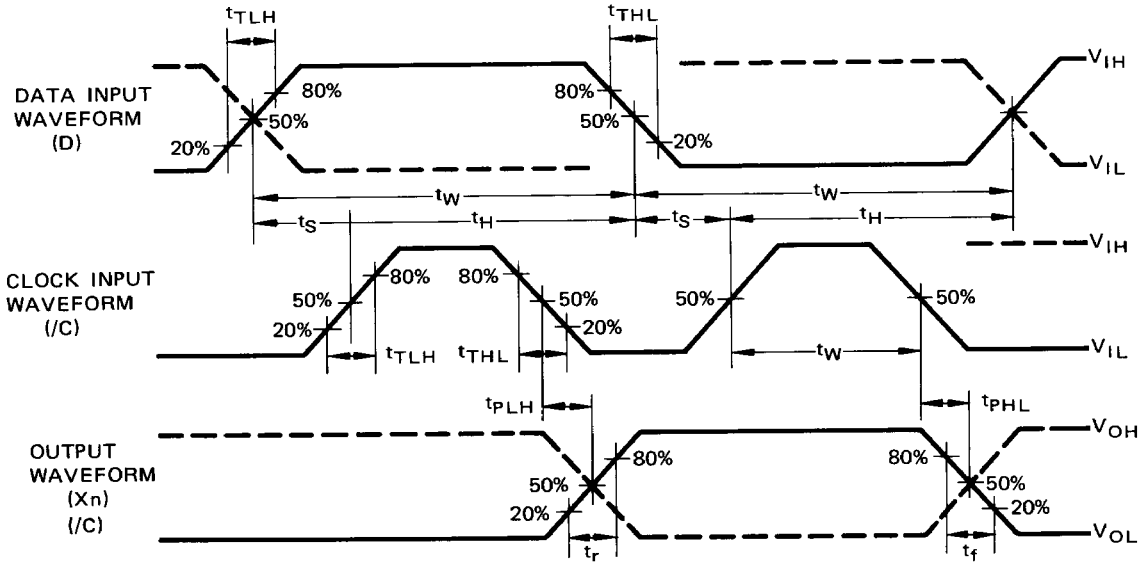
INPUT PULSE CONDITION (T_C = 25°C)
V_{IH} = +1.1V, V_{IL} = +0.3V, $t_{TLH}/t_{THL} \leqq$ 200 ps,
Clock Input: PRR = 500MHz, t_W = 1ns,
Data Input: PRR = 250MHz, t_W = 2ns

○ INPUT/OUTPUT WAVEFORM OF MB885



INPUT PULSE CONDITION (T_C = 25°C)
V_{IH} = +1.1V, V_{IL} = +0.3V, $t_{TLH}/t_{THL} \leqq$ 200 ps,
Clock Input: PRR = 500MHz, t_W = 1ns,
Data Input: PRR = 62.5MHz, t_W = 8ns

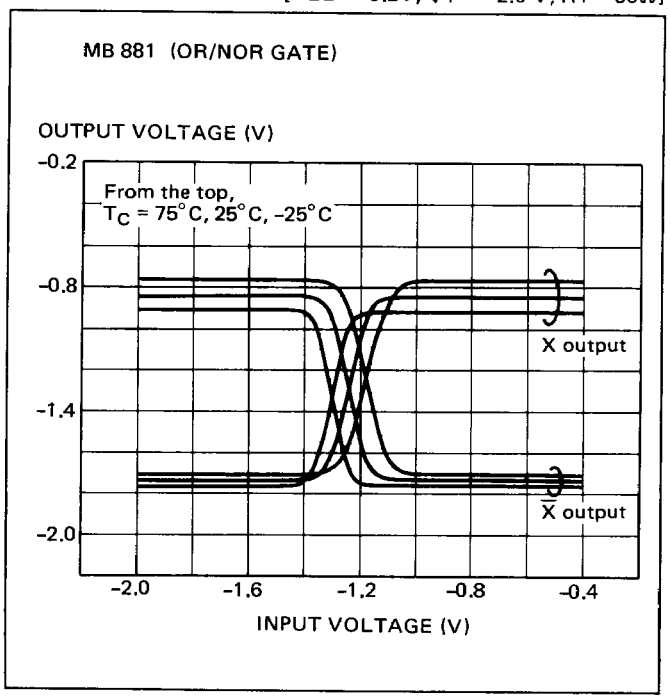
○ INPUT/OUTPUT WAVEFORM OF MB886



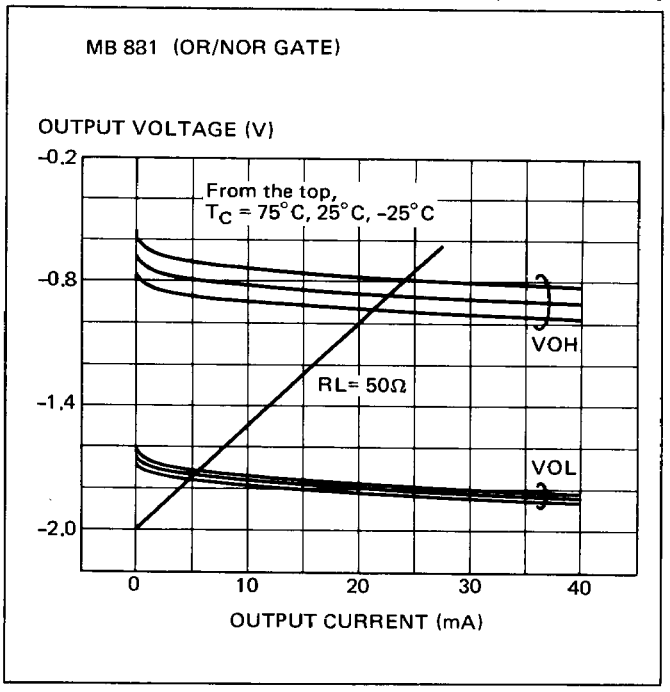
INPUT PULSE CONDITION (T_C = 25°C)
V_{IH} = +1.1V, V_{IL} = +0.3V, $t_{TLH}/t_{THL} \leqq$ 200 ps,
Clock Input: PRR = 500MHz, t_W = 1ns
Data Input: PRR = 250MHz, t_W = 2ns

DC CHARACTERISTICS

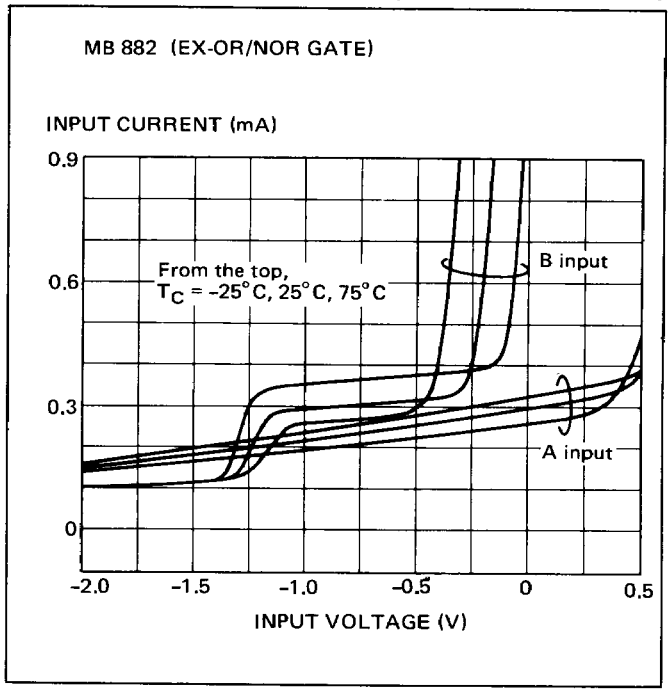
1) OUTPUT VOLTAGE vs. INPUT VOLTAGE [VEE = -5.2V, VT = -2.0 V, RT = 50Ω]



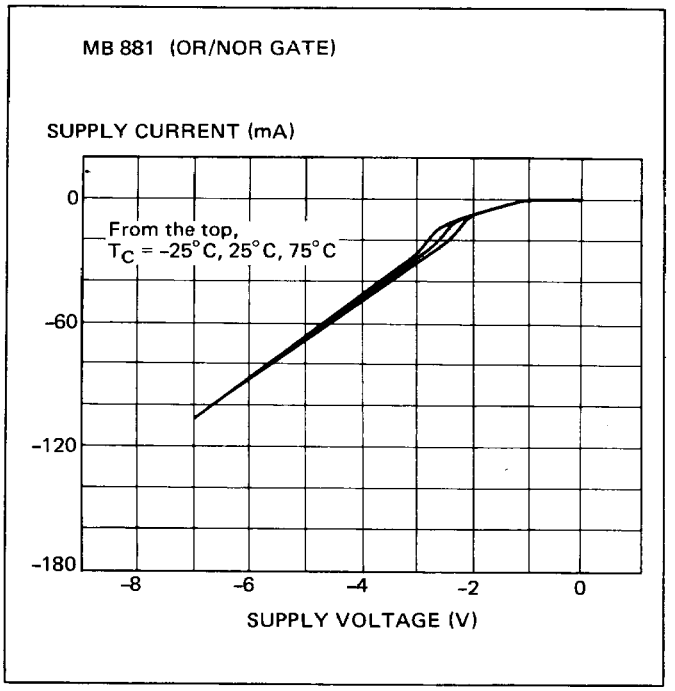
2) OUTPUT VOLTAGE vs. OUTPUT CURRENT [VEE = -5.2V, INPUT = OPEN]



3) INPUT CURRENT vs. INPUT VOLTAGE [VEE = -5.2V, OTHER INPUTS = OPEN]

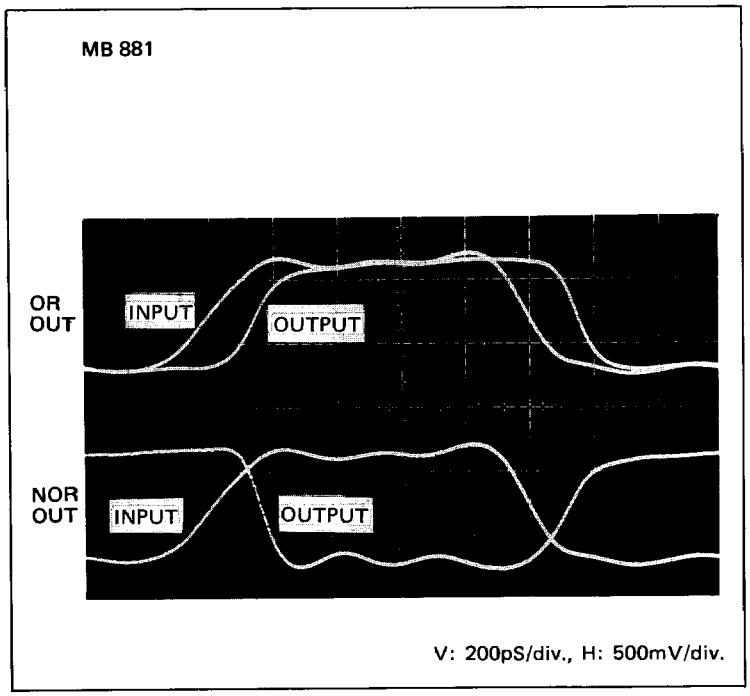


4) SUPPLY CURRENT vs. SUPPLY VOLTAGE [INPUT = OPEN]

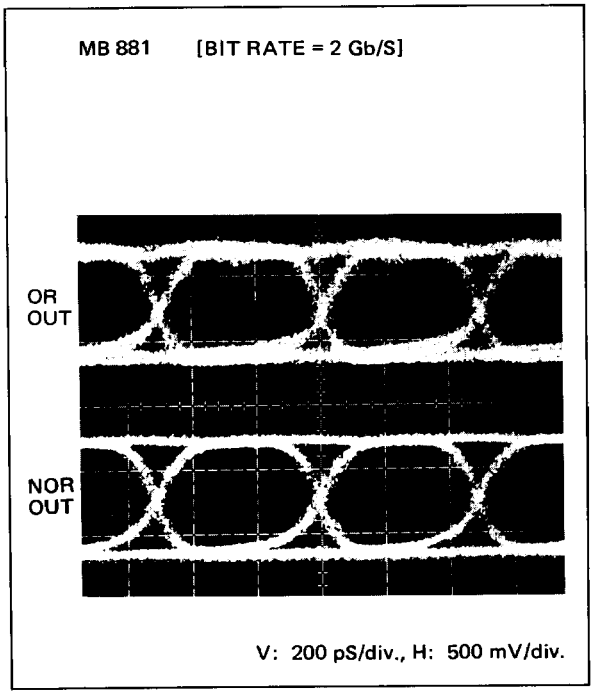


AC CHARACTERISTICS

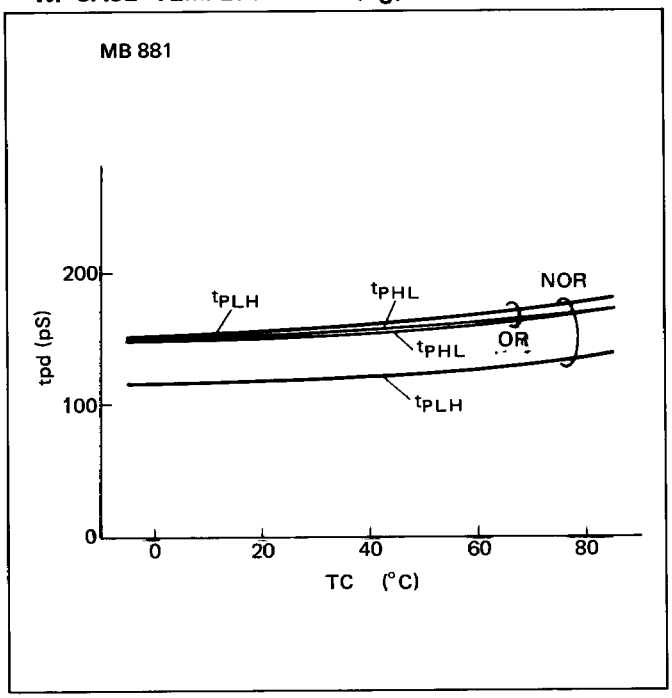
1) SWITCHING WAVEFORM OF GATE



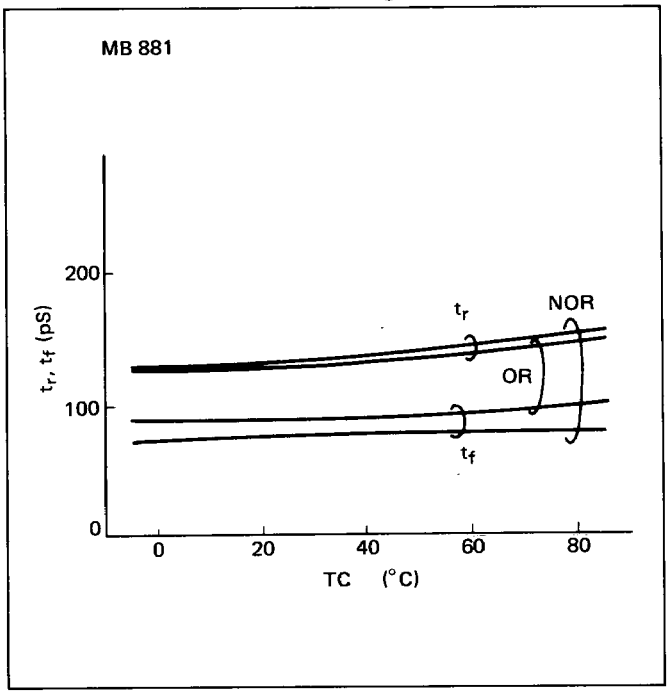
2) EYE PATTERN



3) PROPERGATION DELAY TIME (t_{pd}) vs. CASE TEMPERATURE (T_C)



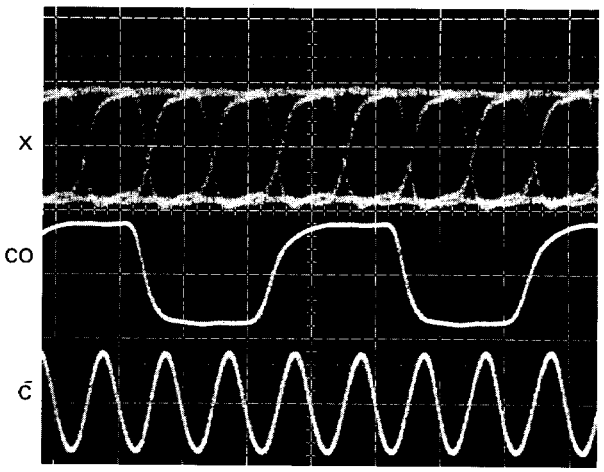
4) RISING/FALLING TIME (t_r, t_f) vs. CASE TEMPERATURE (T_C)



AC CHARACTERISTICS (Continued)

5) MUX EYE PATTERN [f_{CLK} = 2 GHz]

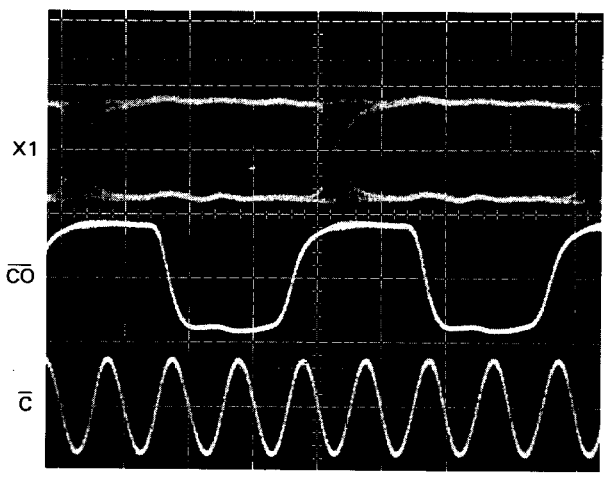
MB885 (X, CO OUTPUT) (4 to 1 MUX)



V: 500pS/div., H: 500mV/div.

6) DEMUX EYE PATTERN [f_{CLK} = 2 GHz]

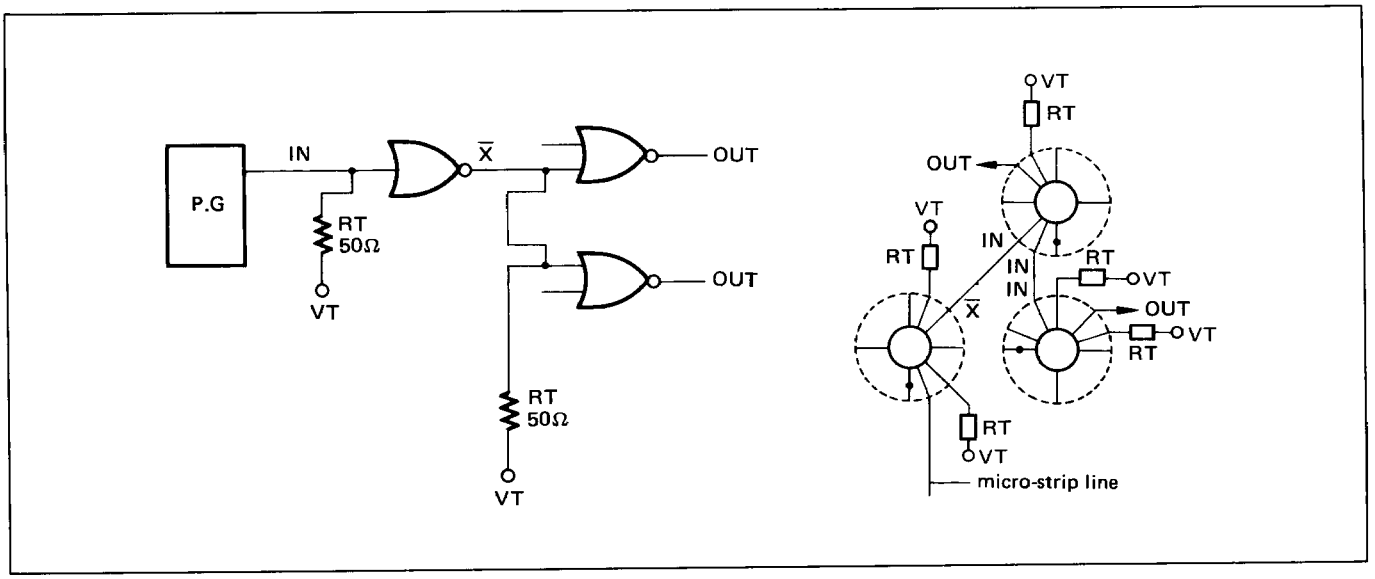
MB886 (X1, $\overline{CO}$ OUTPUT) (1 to 4 DEMUX)



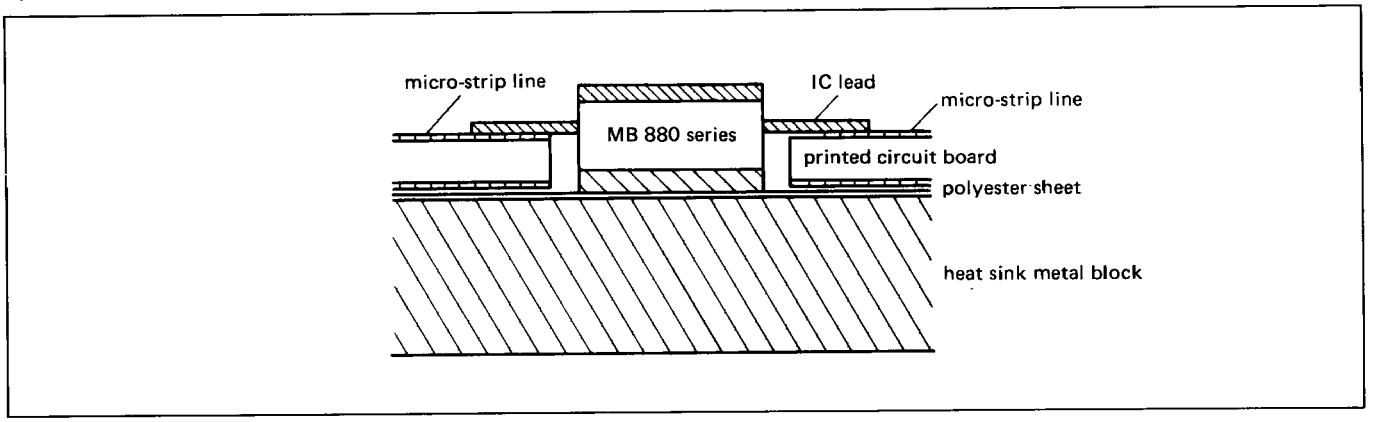
V: 500pS/div., H: 500mV/div.

THE APPLICATION EXAMPLES

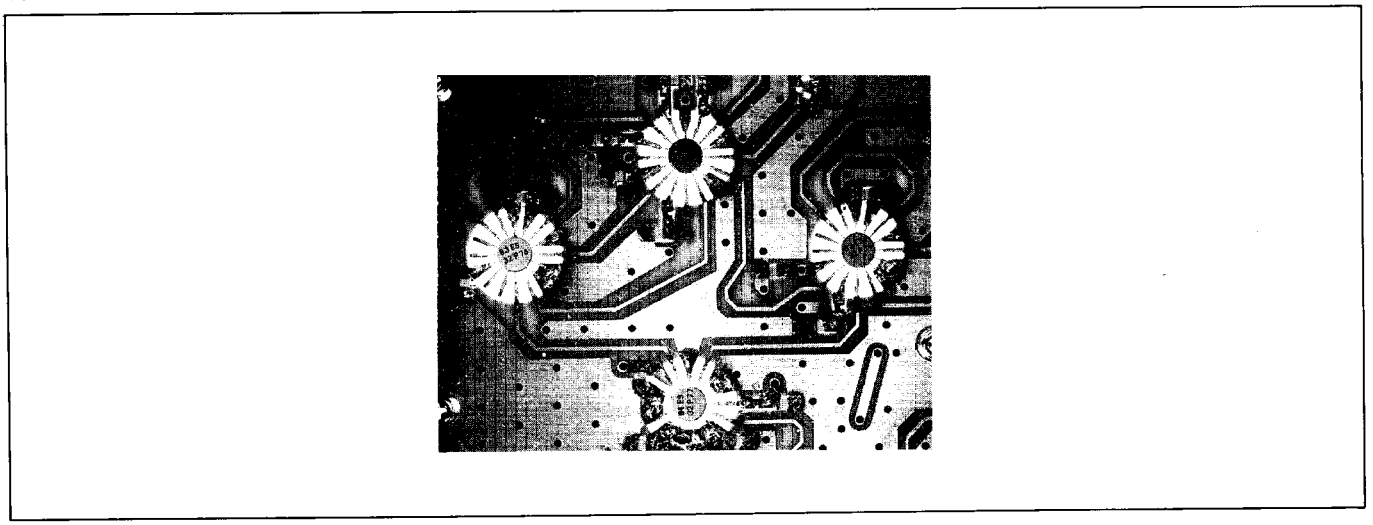
1) PRINTED CIRCUIT BOARD LAYOUT



2) CROSS-SECTION OF PRINTED CIRCUIT BOARD

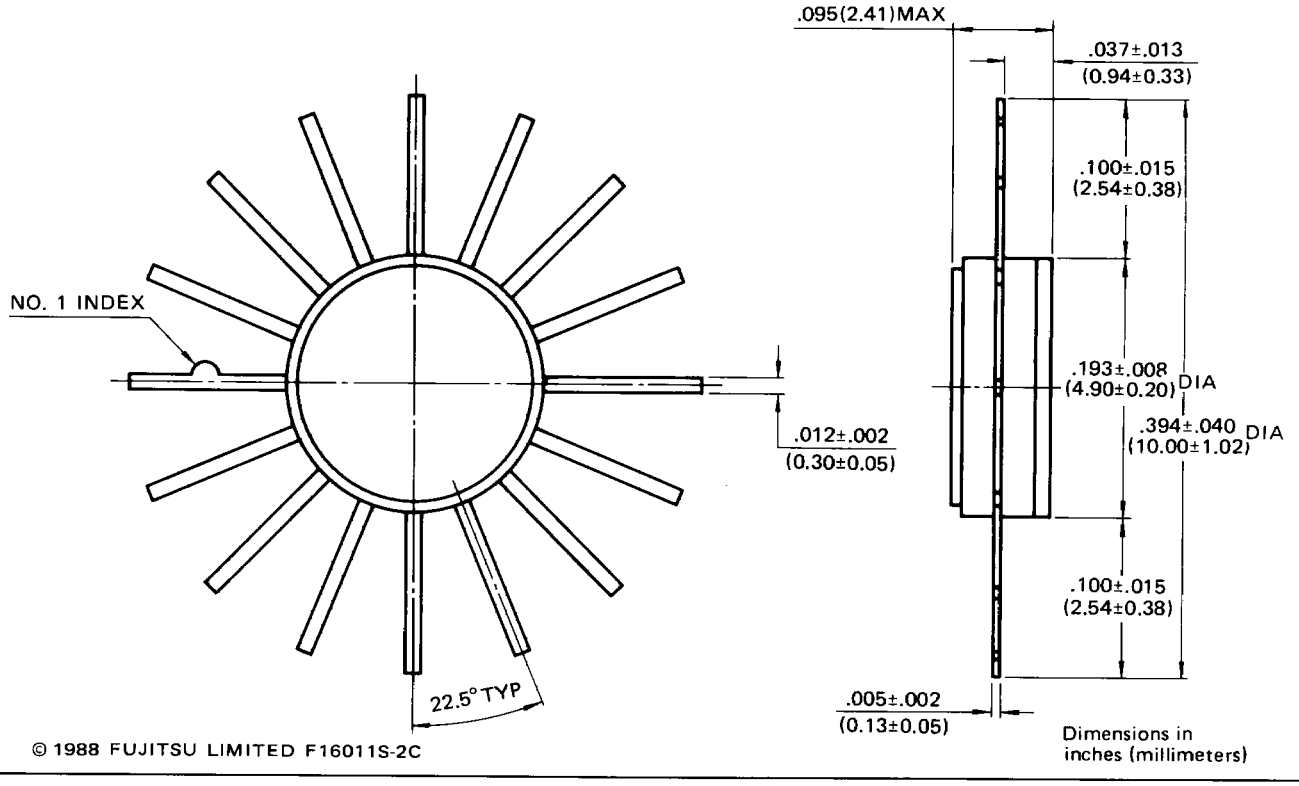


3) MOUNTING EXAMPLE



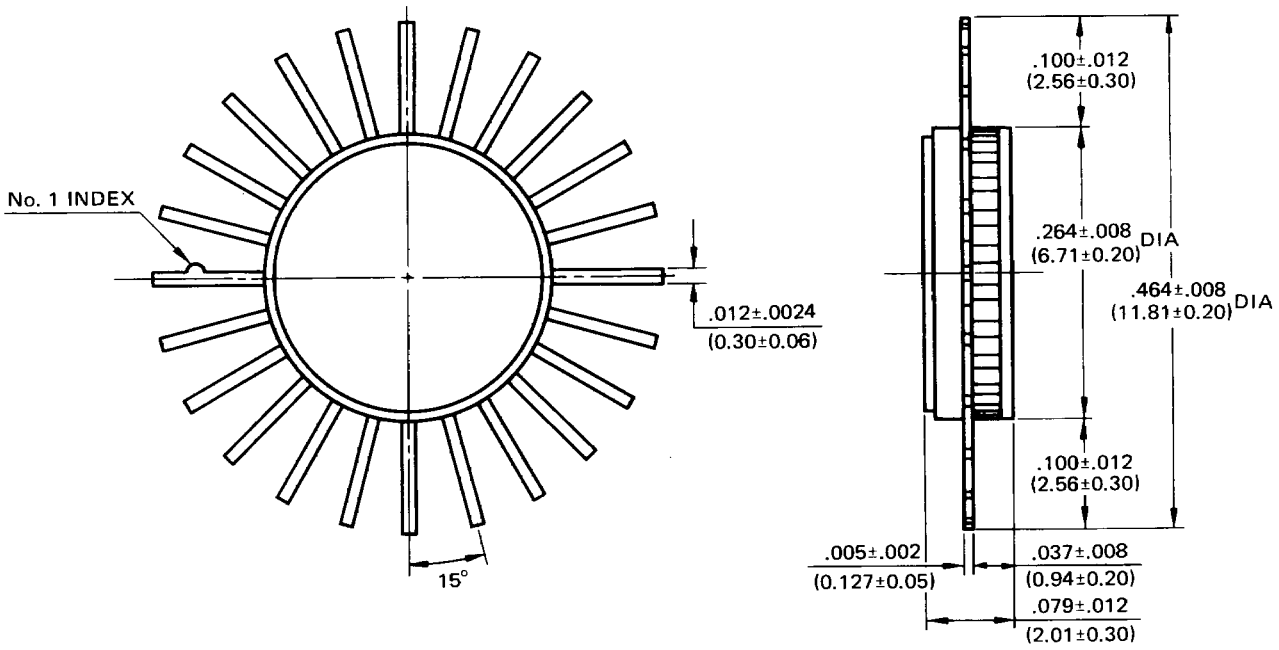
PACKAGE DIMENSIONS

16-LEAD CERAMIC (METAL SEAL) FLAT PACKAGE
(CASE No.: FPT-16C-A01)



PACKAGE DIMENSIONS (continued)

24-LEAD CERAMIC (METAL SEAL) FLAT PACKAGE
(CASE No.: FPT-24C-A03)



Dimensions in
inches (millimeters)

* The back metal is connected to the V_{EE} internally.

FUJITSU LIMITED
Communications and Electronics

6-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo 100, Japan
Phone: National (03) 216-3211 International (Int'l Prefix) 81-3-216-3211 Telex: J22833 Cable: "FUJITSULIMITED TOKYO"

For further information please contact:
FUJITSU LIMITED
Semiconductors Marketing: Furukawa Sogo Bldg., 6-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100, Japan
Phone: National (03) 216-3211 International (Int'l Prefix) 81-3-216-3211 Telex: 2224361FT TOR J
FUJITSU MICROELECTRONICS, INC.:
3545 North First Street, San Jose, CA 95134-1804, U.S.A.
Phone: 408-922-9000 TWX: 910-671-4915
FUJITSU MICROELEKTRONIK GmbH.:
Arabella Center 9, OG./A, Lyoner Straße 44-48 D-6000 Frankfurt 71, F.R. Germany
Phone: 69-66-320 Telex: 411963 FMG D
FUJITSU MICROELECTRONICS PACIFIC ASIA LIMITED:
805 Tism Sha Tsui Centre, West Wing 66 Mody Road, Kowloon, Hong Kong
Phone: 3-732 0100 Telex: 31959 FUJIS HX

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