FAIRCHILD SEMICONDUCTOR®

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FIN1049
LVDS Dual Line Driver with Dual Line Receiver

General Description

This dual Driver-Receiver is designed for high speed interconnects utilizing Low Voltage Differential Signaling (LVDS) technology. The Driver accepts LVTTL inputs and translates them to LVDS outputs. The Receiver accepts LVDS inputs and translates them to LVTTL outputs. The LVDS levels have a typical differential output swing of 350mV which provide for low EMI at ultra low power dissipation even at high frequencies. The FIN1049 can accept LVPECL inputs for translating from LVPECL to LVDS. The En and Enb inputs are ANDed together to enable/disable the outputs. The enables are common to all four outputs. A single line driver and single line receiver function is also available in the FIN1019.

Features

- Greater than 400 Mbps data rate
- 3.3V power supply operation
- Low power dissipation
- Fail safe protection for open-circuit conditions
- Meets or exceeds the TIA/EIA-644-A LVDS standard
- 16-pin TSSOP package saves space
- Flow-through pinout simplifies PCB layout
- Enable/Disable for all outputs
- Industrial operating temperature range: –40°C to +85°C

Ordering Code:

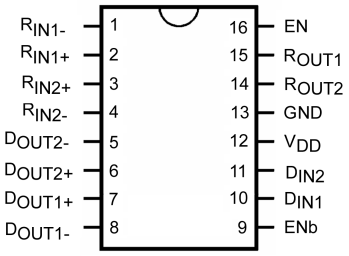
Order Number	Package Number	Package Description
FIN1049MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

Pin Descriptions

Pin Name	Description
R_{IN1+}, R_{IN2+}	Non-Inverting LVDS Inputs
R_{IN1-}, R_{IN2-}	Inverting LVDS Inputs
D_{OUT1+}, D_{OUT2+}	Non-Inverting Driver Outputs
D_{OUT1-}, D_{OUT2-}	Inverting Driver Outputs
EN, ENb	Driver Enable Pins for All Outputs
R_{OUT1}, R_{OUT2}	LVTTL Output Pins for R_{OUT1} and R_{OUT2}
D_{IN2}, D_{IN2}	LVTTL Input Pins for D_{IN1} and D_{IN2}
V_{CC}	Power Supply (3.3V)
GND	Ground

Connection Diagram



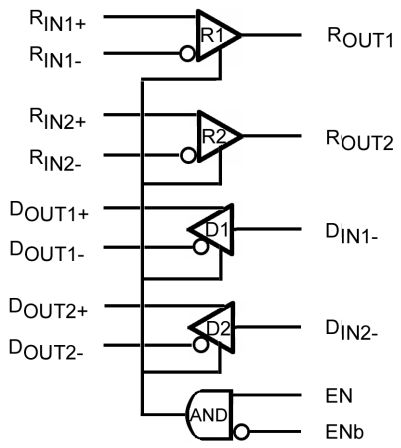
Function Table

Inputs		Outputs (LVTTL)		Inputs (LVDS) (Note 1)		Outputs (LVDS)	
EN	**ENb**	R_{OUT1}	R_{OUT2}	$R_{IN\#+}$	$R_{IN\#-}$	$D_{OUT\#+}$	$D_{OUT\#-}$
H	L	ON	ON			ON	ON
H	H	Z	Z			Z	Z
L	H	Z	Z			Z	Z
L	L	Z	Z			Z	Z
H	L	H	H	Open Current Fail Safe Condition			

H = HIGH Logic Level
L = LOW Logic Level or OPEN
X = Don't Care
Z = High Impedance

Note 1: Any unused Receiver Inputs should be left Open.

Functional Diagram



Absolute Maximum Ratings(Note 2)

Supply Voltage (V_{CC})	–0.5V to +4.6V
LVDS DC Input Voltage (V_{IN})	–0.5V to +4.6V
LVDS DC Output Voltage (V_{OUT})	–0.5V to +4.6V
Driver Short Circuit Current (I_{OSD})	Continuous 10mA
Storage Temperature Range (T_{STG})	–65°C to +150°C
Max Junction Temperature (T_J)	150°C
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C
ESD (Human Body Model)	>7000V
ESD (Machine Model)	>250V

Recommended Operating Conditions

Supply Voltage (V_{CC})	3.0V to 3.6V
Magnitude of Differential Voltage ($\|V_{ID}\|$)	100mV to V_{CC}
Operating Temperature (T_A)	–40°C to +85°C

Note 2: The "Absolute Maximum Ratings": are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature and output/input loading variables. Fairchild does not recommend operation of circuits outside databook specification.

DC Electrical Characteristics

Over supply voltage and operating temperature ranges, unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ (Note 3)	Max	Units
LVDS Input DC Specifications (R_{IN1+}, R_{IN1-}, R_{IN2+}, R_{IN2-}) See Figure 1 and Table 1						
V_{TH}	Differential Input Threshold HIGH	VCM = 1.2V, 0.05V, 2.35V		0.0	35.0	mV
V_{TL}	Differential Input Threshold LOW		–100	0.0		mV
V_{IC}	Common Mode Voltage Range	V_{ID} = 100mV, V_{CC} = 3.3V	$V_{ID}/2$		$V_{CC} - (V_{ID}/2)$	V
I_{IN}	Input Current	V_{CC} = 0V or 3.6V, V_{IN} = 0V or 2.8V			±20.0	mA
CMOS/ LVTTL Input DC Specifications (EN, ENb, D_{IN1}, D_{IN2})						
V_{IH}	Input High Voltage (LVTTL)		2.0		V_{CC}	V
V_{IL}	Input Low Voltage (LVTTL)		GND		0.8	V
I_{IN}	Input Current (EN, ENb, D_{IN1}, D_{IN2}, R_{INx+}, and R_{INx-})	V_{IN} = 0V or V_{CC}			±20.0	µA
V_{IK}	Input Clamp Voltage	V_{IK} = –18mA	–1.5	–0.7		V
LVDS Output DC Specifications (D_{OUT1+}, D_{OUT1-}, D_{OUT2+}, D_{OUT2-})						
V_{OD}	Output Differential Voltage	R_L = 100Ω, Driver Enabled, See Figure 2	250	350	450	mV
ΔV_{OD}	V_{OD} Magnitude Change from Differential LOW-to-HIGH				35.0	mV
V_{OS}	Offset Voltage		1.125	1.25	1.375	V
ΔV_{OS}	Offset Magnitude Change from Differential LOW-to-HIGH				25.0	mV
I_{OS}	Short Circuit Output Current	D_{OUT+} = 0V & D_{OUT-} = 0V, Driver Enabled			–9.0	mA
I_{OSD}		V_{OD} = 0V, Driver Enabled			–9.0	mA
I_{OFF}	Power-Off Input or Output Current	V_{CC} = 0V, V_{OUT} = 0V or V_{CC}			±20.0	µA
I_{OZD}	Disabled Output Leakage Current	Driver Disabled, D_{OUT+} = 0V or V_{CC} or D_{OUT-} = 0V or V_{CC}			±10.0	µA
CMOS/LVTTL Output DC Specifications (R_{OUT1}, R_{OUT2})						
V_{OH}	Output High Voltage	I_{OH} = –2mA, V_{ID} = 200mV	2.7			V
V_{OL}	Output Low Voltage	I_{OL} = 2mA, V_{ID} = 200mV			0.250	V
I_{OZ}	Disabled Output Leakage Current	Driver Disabled, R_{OUTn} = 0V or V_{CC}			±10.0	µA
I_{CC}	Power Supply Current (Note 4)	Drivers Enabled, Any Valid Input Condition			25.0	mA
I_{CCZ}	Power Supply Current	Drivers Disabled			10.0	mA
C_{IND}	Input Capacitance	LVDS Input		3.0		pF
C_{OUT}	Output Capacitance	LVDS Output		4.0		pF
C_{INT}	Input Capacitance	LVTTL Input		3.5		pF

Note 3: All typical values are at T_A = 25°C and with V_{CC} = 3.3V.

Note 4: Both driver and receiver inputs are static. All LVDS outputs have 100Ω load. None of the outputs have any lumped capacitive load.

AC Electrical Characteristics

Over supply voltage and operating temperature ranges, unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ (Note 5)	Max	Units
Switching Characteristics - LVDS Outputs						
t_{PLHD}	Differential Propagation Delay LOW-to-HIGH	See Figures 3, 4			2.0	ns
t_{PHLD}	Differential Propagation Delay HIGH-to-LOW				2.0	ns
t_{TLHD}	Differential Output Rise Time (20% to 80%)		0.2		1.0	ns
t_{THLD}	Differential Output Fall Time (80% to 20%)		0.2		1.0	ns
$t_{SK(P)}$	Pulse Skew $\lvert t_{PLH} - t_{PHL} \rvert$				0.35	ns
$t_{SK(LH)}$, $t_{SK(HL)}$	Channel-to-Channel Skew (Note 6)				0.35	ns
$t_{SK(PP)}$	Part-to-Part Skew (Note 7)				1.0	ns
t_{PZHD}	Differential Output Enable Time from Z-to-HIGH	See Figures 5, 6			6.0	ns
t_{PZLD}	Differential Output Enable Time from A-to-LOW				6.0	ns
t_{PHZD}	Differential Output Disable Time from HIGH-to-Z				3.0	ns
t_{PLZD}	Differential Output Disable Time from LOW-to-Z				3.0	ns
f_{MAXD}	Maximum Frequency (Note 8)	See Figure 3	200			MHz
Switching Characteristics - LVTTL Outputs						
t_{PHL}	Propagation Delay HIGH-to-LOW	Measured from 20% to 80% signal	0.5	1.0	3.5	ns
t_{PLH}	Propagation Delay LOW-to-HIGH	V_{ID} = 200mV;	0.5	1.0	3.5	ns
t_{SK1}	Pulse Skew	Distributed Load	0.0	35.0	400	ps
t_{SK2}	Channel-to-Channel Skew	C_L = 15pF and 50Ω;	0.0	50.0	500	ps
t_{SK3}	Part-to-Part Skew	R_L = 1KΩ;	0.0		1.0	ns
t_{LHR}	Transition Time LOW-to-HIGH	V_{OS} = 1.2V;	0.1	0.25	1.4	ns
t_{HLR}	Transition Time HIGH-to-LOW	See Figures 7, 8	0.1	0.18	1.4	ns
t_{PHZ}	Disable Time HIGH-to-Z	See Figures 9, 10	2.2	4.5	8.0	ns
t_{PLZ}	Disable Time LOW-to-Z		1.3	3.5	8.0	ns
t_{PZH}	Enable Time Z-to-HIGH		1.8	3.0	7.0	ns
t_{PZL}	Enable Time Z-to-LOW		0.9	1.4	7.0	ns
f_{MAXT}	Maximum Frequency (Note 9)	See Figure 7	200			MHz

Note 5: All typical values are at T_A = 25°C and with V_{CC} = 3.3V.

Note 6: $t_{SK(LH)}$, $t_{SK(HL)}$ is the skew between specified outputs of a single device when the outputs have identical loads and are switching in the same direction.

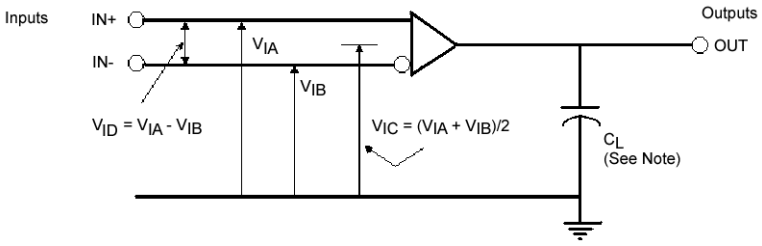
Note 7: $t_{SK(PP)}$ is the magnitude of the difference in propagation delay times between any specified terminals of two devices switching in the same direction (either LOW-to-HIGH or HIGH-to-LOW) when both devices operate with the same supply voltage, same temperature, and have identical test circuits.

Note 8: f_{MAX} generator input conditions: $t_r = t_f < 1$ns (10% to 90%), 50% duty cycle, 0V to 3V. Output criteria: duty cycle = 45% / 55%, $V_{OD} > 250$mV, all channels switch.

Note 9: f_{MAXT} generator input conditions: $t_r = t_f < 1$ns (10% to 90%), 50% duty cycle, V_{ID} = 200mV, V_{CM} = 1.2V. Output criteria: duty cycle = 45% / 55%, $V_{OH} > 2.7$V. $V_{OL} < 0.25$V, all channels switching.

Required Specifications

1. Human Body Model ESD and Machine Model ESD should be measured using MIL-STD-883C method 3015.7 standard.
2. Latch-up immunity should be tested to the EIA/JEDEC Standard Number 78 (EIA/JESD78).

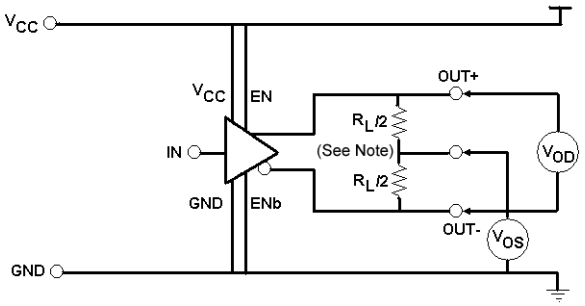


Note: C_L = 15pF, includes all probe and jig capacitances

FIGURE 1. Differential Receiver Voltage Definitions Test Circuit

TABLE 1. Receiver Minimum and Maximum Input Threshold Test Voltages

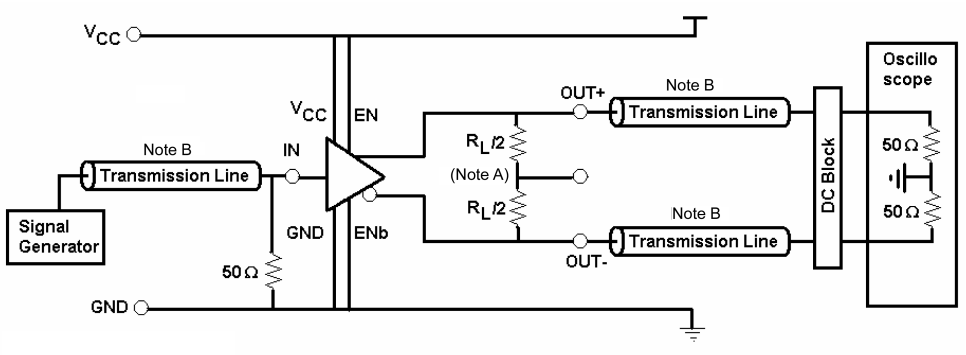
Applied Voltages (V)		Resulting Differential Input Voltage (mV)	Resulting Common Mode Input Voltage (V)
V_{IA}	V_{IB}	V_{ID}	V_{IC}
1.25	1.15	100	1.2
1.15	1.25	−100	1.2
V_{CC}	V_{CC} - 0.1	100	V_{CC} - 0.05
V_{CC} - 0.1	V_{CC}	−100	V_{CC} - 0.05
0.1	0.0	100	0.05
0.0	0.1	−100	0.05
1.75	0.65	1100	1.2
0.65	1.75	−1100	1.2
V_{CC}	V_{CC} - 1.1	1100	V_{CC} - 0.55
V_{CC} - 1.1	V_{CC}	−1100	V_{CC} - 0.55
1.1	0.0	1100	0.55
0.0	1.1	−1100	0.55



Note: R_L = 100Ω

FIGURE 2. LVDS Output Circuit for DC Test

Required Specifications (Continued)



Note A: $R_L = 100\Omega$

Note B: $Z_O = 50\Omega$ and $C_T = 15$ pF Distributed

FIGURE 3. LVDS Output Propagation Delay and Transition Time Test Circuit

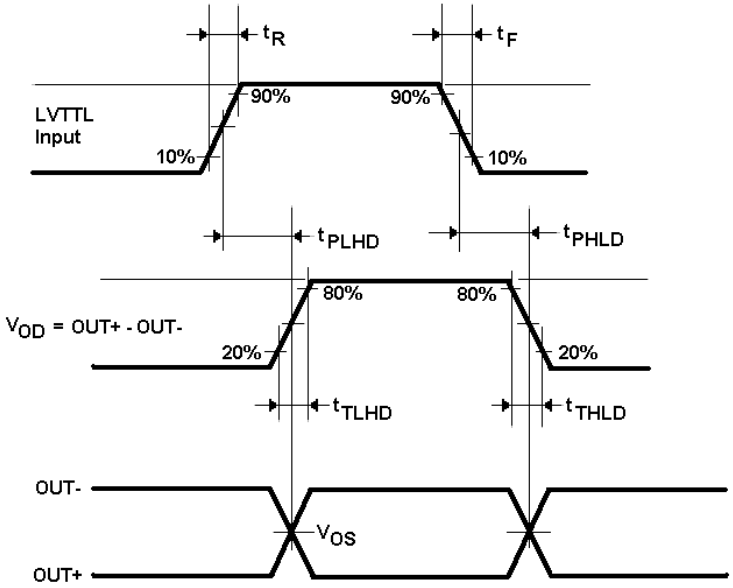
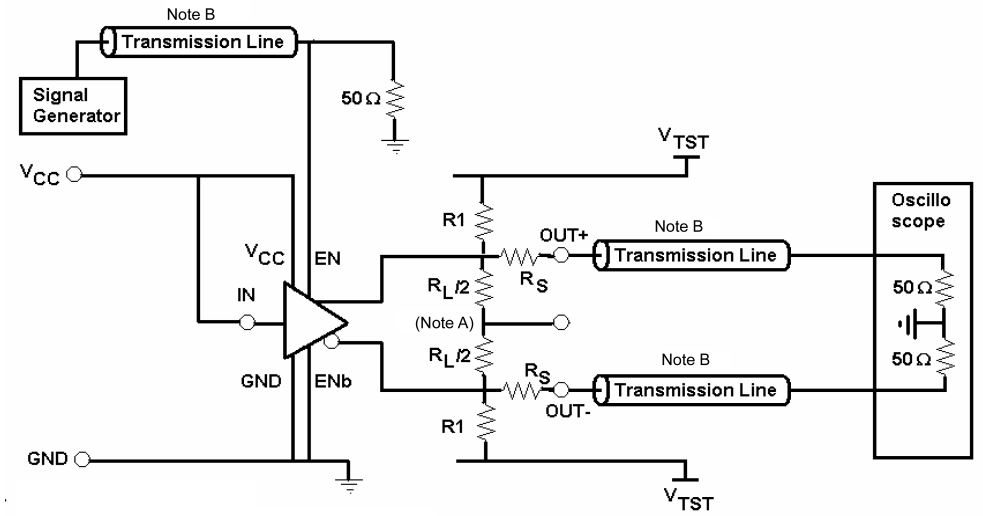


FIGURE 4. LVTTL Input to LVDS Output AC Waveform

Required Specifications (Continued)



Note A: $R_L = 100\Omega$

Note B: $Z_O = 50\Omega$ and $C_T = 15$ pF Distributed

Note: R1 = 1000Ω, $R_S = 950\Omega$

Note: $V_{TST} = 2.4V$

FIGURE 5. LVDS Output Enable / Disable Delay Test Circuit

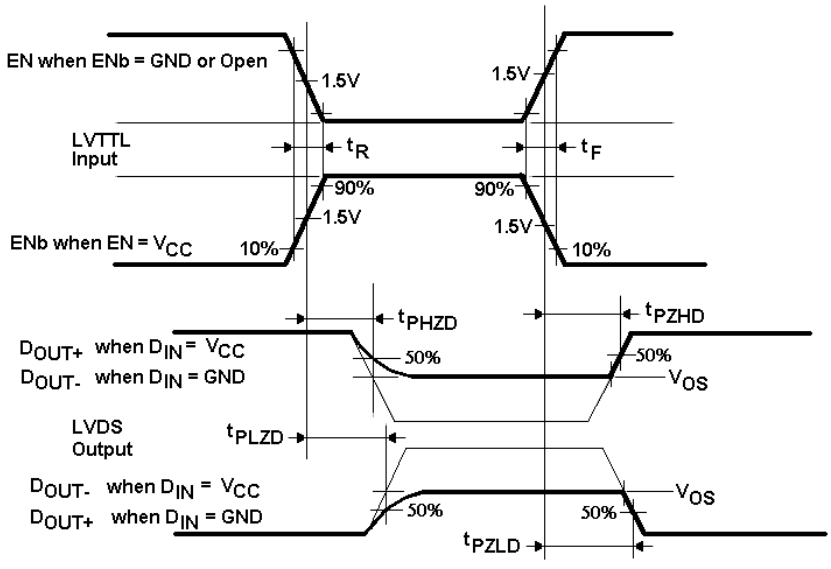
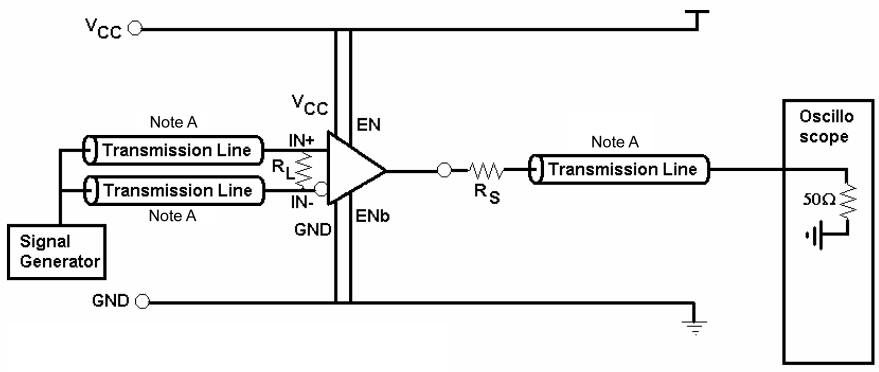


FIGURE 6. LVDS Output Enable / Disable Timing Waveforms

Required Specifications (Continued)



Note A: $Z_O = 50\Omega$ and $C_T = 15$ pF Distributed

Note: $R_L = 100\Omega$ and $R_S = 950\Omega$

FIGURE 7. LVTTL Output Propagation Delay and Transition Time Test Circuit

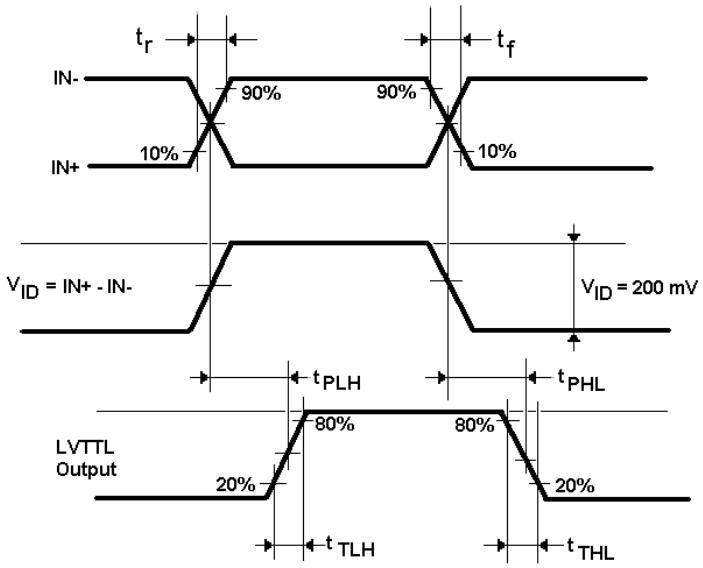
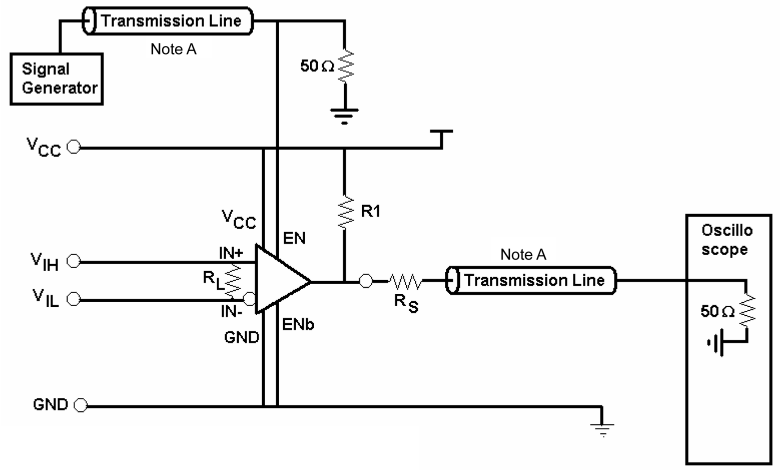


FIGURE 8. LVDS Input to LVTTL Output Propagation Delay and Transition Time Waveforms

Required Specifications (Continued)



Note A: $Z_O = 50\Omega$ and $C_T = 15$ pF Distributed

Note: $R_L = 100\Omega$, R1 = 1000Ω, and $R_S = 950\Omega$

FIGURE 9. LVTTL Output Enable / Disable Test Circuit

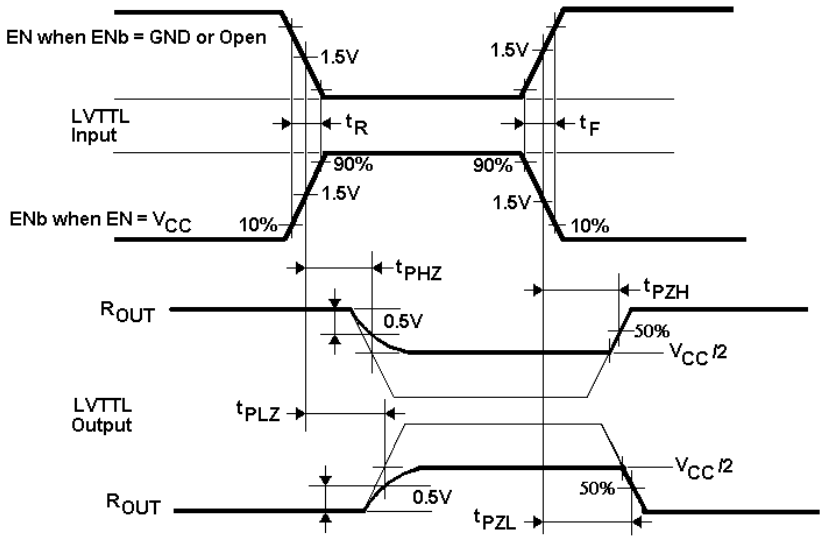
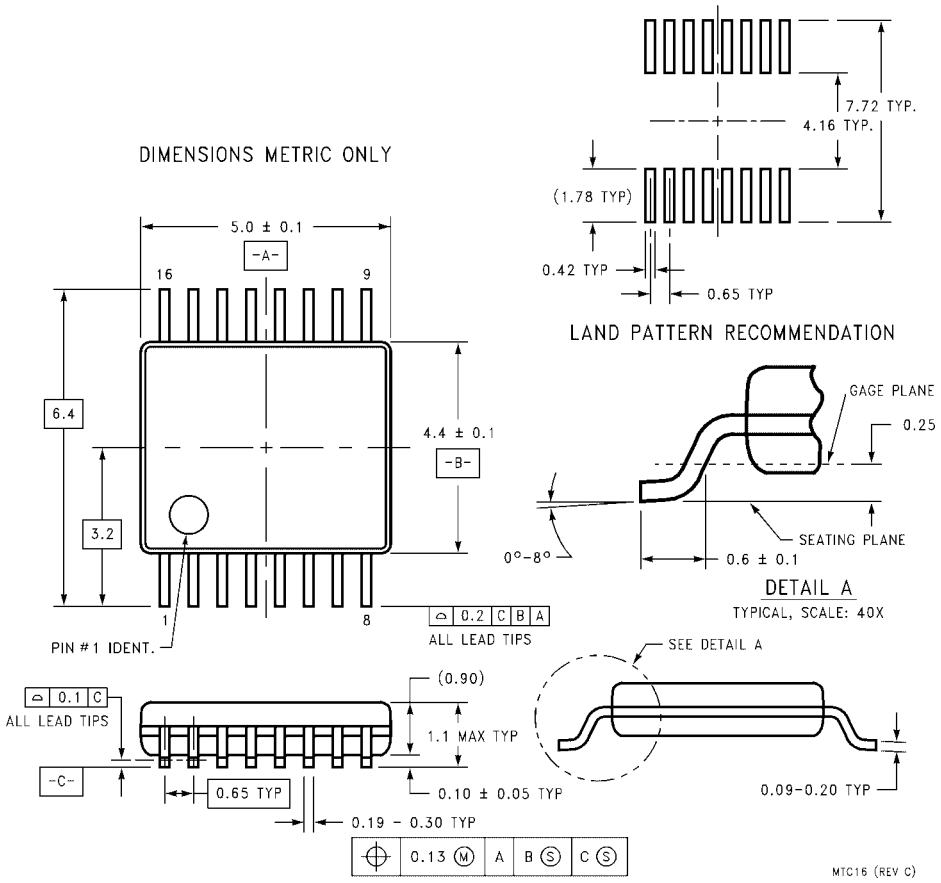


FIGURE 10. LVTTL Output Enable / Disable Timing Waveforms

Physical Dimensions inches (millimeters) unless otherwise noted



16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC16

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