

# 3.3 V LVDS High Speed Differential Driver/Receiver

## FIN1019



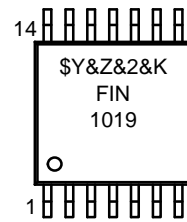
### General Description

This driver and receiver pair are designed for high speed interconnects utilizing Low Voltage Differential Signaling (LVDS) technology. The driver translates LVTTTL signals to LVDS levels with a typical differential output swing of 350 mV and the receiver translates LVDS signals, with a typical differential input threshold of 100 mV, into LVTTTL levels. LVDS technology provides low EMI at ultra low power dissipation even at high frequencies. This device is ideal for high speed clock or data transfer.

### Features

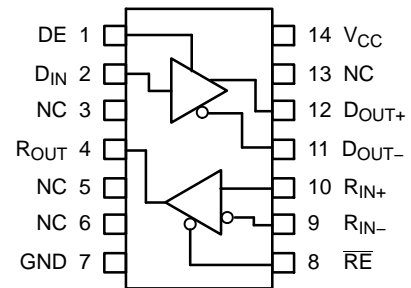
- Greater than 400 Mbs Data Rate
- 3.3 V Power Supply Operation
- 0.5 ns Maximum Differential Pulse Skew
- 2.5 ns Maximum Propagation Delay
- Low Power Dissipation
- Power-Off Protection
- 100 mV Receiver Input Sensitivity
- Fail Safe Protection Open-circuit, Shorted and Terminated Conditions
- Meets or Exceeds the TIA/EIA-644 LVDS Standard
- Flow-through Pinout Simplifies PCB Layout
- 14-Lead TSSOP Package Save Space
- This Device is Pb-Free, Halide Free and is RoHS Compliant

### MARKING DIAGRAM



- \$Y = Logo
- &Z = Assembly Plant Code
- &2 = 2-Digit Date Code
- &K = 2-Digits Lot Run Traceability Code
- FIN1019 = Specific Device Code

### CONNECTION DIAGRAM



### FUNCTION TABLE

R <sub>IN+</sub>	R <sub>IN-</sub>	RE	R <sub>OUT</sub>
L	H	L	L
H	L	L	H
X	X	H	Z
Fail Safe Condition		L	H
D <sub>IN</sub>	DE	D <sub>OUT+</sub>	D <sub>OUT-</sub>
L	H	L	H
H	H	H	L
X	L	Z	Z
Open-Circuit or Z		H	H

H = HIGH Logic Level  
L = LOW Logic Level  
X = Don't Care  
Z = High Impedance  
Fail Safe = Open, Shorted, Terminated

### ORDERING INFORMATION

Order Number	Package	Shipping†
FIN1019MTCX	TSSOP-14 WB (Pb-Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

**PIN DESCRIPTIONS**

Pin Name	Description
D <sub>IN</sub>	LVTTTL Data Input
D <sub>OUT+</sub>	Non-inverting LVDS Output
D <sub>OUT-</sub>	Inverting LVDS Output
DE	Driver Enable (LVTTTL, Active HIGH)
R <sub>IN+</sub>	Non-Inverting LVDS Input
R <sub>IN-</sub>	Inverting LVDS Input
R <sub>OUT</sub>	LVTTTL Receiver Output
$\overline{RE}$	Receiver Enable (LVTTTL, Active LOW)
V <sub>CC</sub>	Power Supply
GND	Ground
NC	No Connect

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Rating
V <sub>CC</sub>	Supply Voltage	-0.5 V to +4.6 V
D <sub>IN</sub> , DE, $\overline{RE}$	LVTTTL DC Input Voltage	-0.5 V to +6 V
R <sub>IN+</sub> , R <sub>IN-</sub>	LVDS DC Input Voltage	-0.5 V to 4.7 V
R <sub>OUT</sub>	LVTTTL DC Output Voltage	-0.5 V to +6 V
D <sub>OUT+</sub> , D <sub>OUT-</sub>	LVDS DC Output Voltage	-0.5 V to 4.7 V
I <sub>OSD</sub>	LVDS Driver Short Circuit Current	Continuous
I <sub>O</sub>	LVTTTL DC Output Current	16 mA
T <sub>STG</sub>	Storage Temperature Range	-65°C to +150°C
T <sub>J</sub>	Max Junction Temperature	150°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 Seconds)	260°C
	ESD (Human Body Model)	≥6500 V
	ESD (Machine Model)	≥300 V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value
V <sub>CC</sub>	Supply Voltage	3.0 V to 3.6 V
V <sub>IN</sub>	Input Voltage	0 to V <sub>CC</sub>
V <sub>ID</sub>	Magnitude of Differential Voltage	100 mV to V <sub>CC</sub>
V <sub>IC</sub>	Common-Mode Input Voltage	0.05 V to 2.35 V
T <sub>A</sub>	Operating Temperature	-40°C to +85°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

# FIN1019

## DC ELECTRICAL CHARACTERISTICS (Over supply voltage and operating temperature ranges, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ (Note 1)	Max	Unit
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### LVDS DIFFERENTIAL DRIVER CHARACTERISTICS

$V_{OD}$	Output Differential Voltage	$R_L = 100 \Omega$ , See Figure 1	250	350	450	mV
$\Delta V_{OD}$	$V_{OD}$ Magnitude Change from Differential LOW-to-HIGH		-	-	25	mV
$V_{OS}$	Offset Voltage		1.125	1.25	1.375	V
$\Delta V_{OS}$	Offset Magnitude Change from Differential LOW-to-HIGH		-	-	25	mV
$I_{OZD}$	Disabled Output Leakage Current	$V_{OUT} = V_{CC}$ or GND, $DE = 0 V$	-	-	$\pm 20$	$\mu A$
$I_{OFF}$	Power Off Output Current	$V_{CC} = 0 V$ , $V_{OUT} = 0 V$ or $3.6 V$	-	-	$\pm 20$	$\mu A$
$I_{OS}$	Short Circuit Output Current	$V_{OUT} = 0 V$ , $DE = V_{CC}$	-	-	-8	mA
		$V_{OD} = 0 V$ , $DE = V_{CC}$	-	-	$\pm 8$	

### LVTTTL DRIVER CHARACTERISTICS

$V_{OH}$	Output HIGH Voltage	$I_{OH} = -100 \mu A$ , $\overline{RE} = 0 V$ , See Figure 6 and Table 1	$V_{CC} - 0.2$	-	-	V
		$I_{OH} = -8 mA$ , $\overline{RE} = 0 V$ , $V_{ID} = 400 mV$ $V_{ID} = 400 mV$ , $V_{IC} = 1.2 V$ , see Figure 6	2.4	-	-	
$V_{OL}$	Output LOW Voltage	$I_{OL} = 100 \mu A$ , $\overline{RE} = 0 V$ , $V_{ID} = -400 mV$ See Figure 6 and Table 1	-	-	0.2	V
		$I_{OL} = -8 mA$ , $\overline{RE} = 0 V$ , $V_{ID} = -400 mV$ $V_{ID} = -400 mV$ , $V_{IC} = 1.2 V$ , see Figure 6	-	-	0.5	
$I_{OZ}$	Disabled Output Leakage Current	$V_{OUT} = V_{CC}$ or GND, $\overline{RE} = V_{CC}$	-	-	$\pm 20$	$\mu A$

### LVDS RECEIVER CHARACTERISTICS

$V_{TH}$	Differential Input Threshold HIGH	See Figure 6 and Table 1	-	-	100	mV
$V_{TL}$	Differential Input Threshold LOW	See Figure 6 and Table 1	-100	-	-	mV
$I_{IN}$	Input Current	$V_{IN} = 0 V$ or $V_{CC}$	-	-	$\pm 20$	$\mu A$
$I_{I(OFF)}$	Power-OFF Input Current	$V_{CC} = 0 V$ , $V_{IN} = 0 V$ or $3.6 V$	-	-	$\pm 20$	$\mu A$

### LVTTTL DRIVER AND CONTROL SIGNALS CHARACTERISTICS

$V_{IH}$	Input HIGH Voltage		2.0	-	$V_{CC}$	V
$V_{IL}$	Input LOW Voltage		GND	-	0.8	V
$I_{IN}$	Input Current	$V_{IN} = 0 V$ or $V_{CC}$	-	-	$\pm 20$	$\mu A$
$I_{I(OFF)}$	Power-OFF Input Current	$V_{CC} = 0 V$ , $V_{IN} = 0 V$ or $3.6 V$	-	-	$\pm 20$	$\mu A$
$V_{IK}$	Input Clamp Voltage	$I_{IK} = -18 mA$	-1.5	-	-	V

### DEVICE CHARACTERISTICS

$I_{CC}$	Power Supply Current	Driver Enabled, Driver Load: $R_L = 100 \Omega$ Receiver Disabled, No Receiver Load	-	-	12.5	mA
		Driver Enabled, Driver Load: $R_L = 100 \Omega$ , Receiver Enabled, ( $R_{IN+} = 1 V$ and $R_{IN-} = 1.4 V$ ) or ( $R_{IN+} = 1.4 V$ and $R_{OUT-} = 1 V$ )	-	-	12.5	
		Driver Disabled, Receiver Enabled, ( $R_{IN+} = 1 V$ and $R_{IN-} = 1.4 V$ ) or ( $R_{IN+} = 1.4 V$ and $R_{IN-} = 1 V$ )	-	-	7.0	
		Driver Disabled, Receiver Disabled	-	-	7.0	
$C_{IN}$	Input Capacitance	Any LVTTTL or LVDS Input	-	4	-	pF
$C_{OUT}$	Output Capacitance	Any LVTTTL or LVDS Output	-	6	-	pF

1. All typical values are at  $T_A = 25^\circ C$  and with  $V_{CC} = 3.3 V$ .

# FIN1019

## AC ELECTRICAL CHARACTERISTICS (Over supply voltage and operating temperature ranges, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ (Note 2)	Max	Unit
<b>DRIVER TIMING CHARACTERISTICS</b>						
t <sub>PLHD</sub>	Differential Propagation Delay LOW-to-HIGH	R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 10 pF, See Figure 2 and Figure 3	0.5	–	1.5	ns
t <sub>PHLD</sub>	Differential Propagation Delay HIGH-to-LOW		0.5	–	1.5	ns
t <sub>TLHD</sub>	Differential Output Rise Time (20% to 80%)		0.4	–	1.0	ns
t <sub>THLD</sub>	Differential Output Fall Time (80% to 20%)		0.4	–	1.0	ns
t <sub>SK(P)</sub>	Pulse Skew  t <sub>PLH</sub> – t <sub>PHL</sub>		–	–	0.5	ns
t <sub>SK(PP)</sub>	Part-to-Part Skew (Note 3)	R <sub>L</sub> = 100 Ω, C <sub>L</sub> = 10 pF, See Figure 4 and Figure 5	–	–	1.0	ns
t <sub>ZHD</sub>	Differential Output Enable Time from Z to HIGH		–	–	5.0	ns
t <sub>ZLD</sub>	Differential Output Enable Time from Z to LOW		–	–	5.0	ns
t <sub>HZD</sub>	Differential Output Disable Time from HIGH to Z		–	–	5.0	ns
t <sub>LZD</sub>	Differential Output Disable Time from LOW to Z		–	–	5.0	ns
<b>RECEIVER TIMING CHARACTERISTICS</b>						
t <sub>PLH</sub>	Propagation Delay LOW-to-HIGH	V <sub>ID</sub>   = 400 mV, C <sub>L</sub> = 10 pF, See Figure 6 and Figure 7	0.9	–	2.5	ns
t <sub>PHL</sub>	Propagation Delay HIGH-to-LOW		0.9	–	2.5	ns
t <sub>TLH</sub>	Output Rise Time (20% to 80%)		–	0.5	–	ns
t <sub>THL</sub>	Output Fall Time (80% to 20%)		–	0.5	–	ns
t <sub>SK(P)</sub>	Pulse Skew  t <sub>PLH</sub> – t <sub>PHL</sub>		–	–	0.5	ns
t <sub>SK(PP)</sub>	Part-to-Part Skew (Note 3)	–	–	1.0	ns	
t <sub>ZH</sub>	LVTTTL Output Enable Time from Z to HIGH	R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 10 pF, See Figure 8	–	–	5.0	ns
t <sub>ZL</sub>	LVTTTL Output Enable Time from Z to LOW		–	–	5.0	ns
t <sub>HZ</sub>	LVTTTL Output Disable Time from HIGH to Z		–	–	5.0	ns
t <sub>LZ</sub>	LVTTTL Output Disable Time from LOW to Z		–	–	5.0	ns

2. All typical values are at T<sub>A</sub> = 25°C and with V<sub>CC</sub> = 5 V.

3. t<sub>SK(PP)</sub> 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.

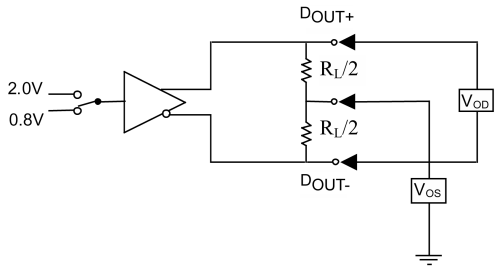
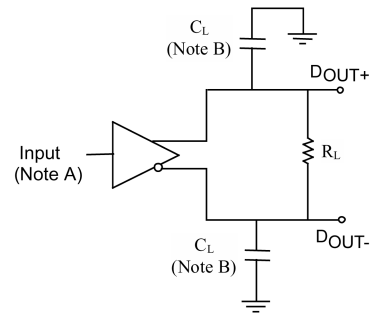


Figure 1. Differential Driver DC Test Circuit



NOTE A: Input pulses have frequency = 10 MHz,  $t_R$  or  $t_F$  = 2 ns  
 NOTE B:  $C_L$  includes all probe and fixture capacitances

Figure 2. Differential Driver Propagation Delay and Transition Time Test Circuit

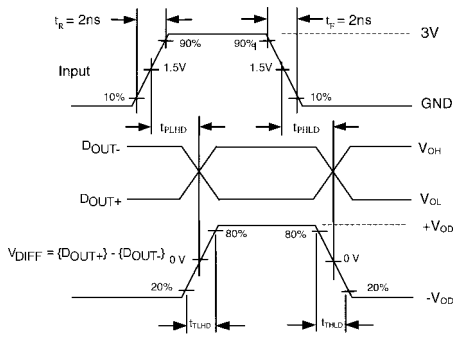
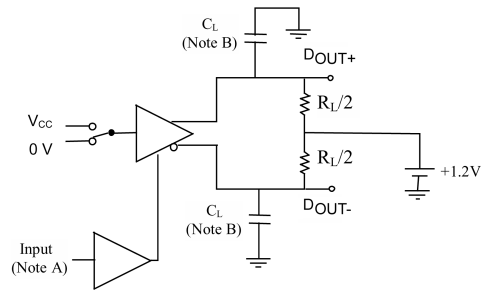


Figure 3. AC Waveforms for Differential Driver



NOTE B: Input pulses have the frequency = 10 MHz,  $t_R$  or  $t_F$  = 2 ns  
 NOTE A:  $C_L$  includes all probe and fixture capacitances

Figure 4. Differential Driver Enable and Disable Test Circuit

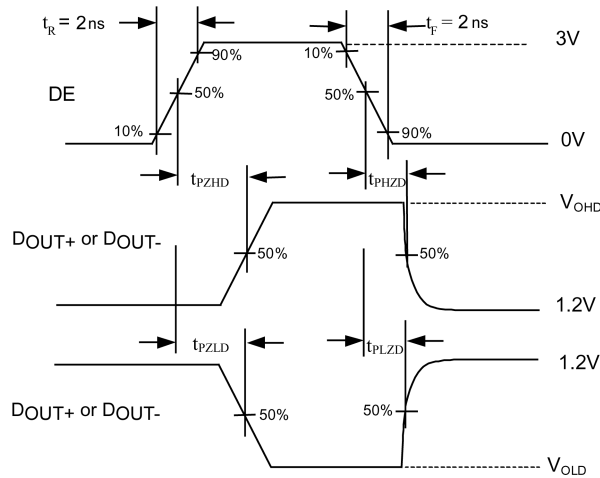
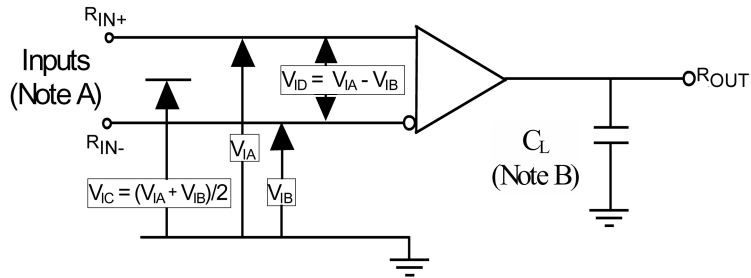


Figure 5. Enable and Disable AC Waveforms

# FIN1019



NOTE A: Input pulses have frequency = 10 MHz,  $t_R$  or  $t_F = 1$  ns  
 NOTE B:  $C_L$  includes all probe and fixture capacitance

**Figure 6. Differential Receiver Voltage Definitions and Propagation Delay and Transition Time 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
2.4	2.3	100	2.35
2.3	2.4	-100	2.35
0.1	0	100	0.05
0	0.1	-100	0.05
1.5	0.9	600	1.2
0.9	1.5	-600	1.2
2.4	1.8	600	2.1
1.8	2.4	-600	2.1
0.6	0	600	0.3
0	0.6	-600	0.3

# FIN1019

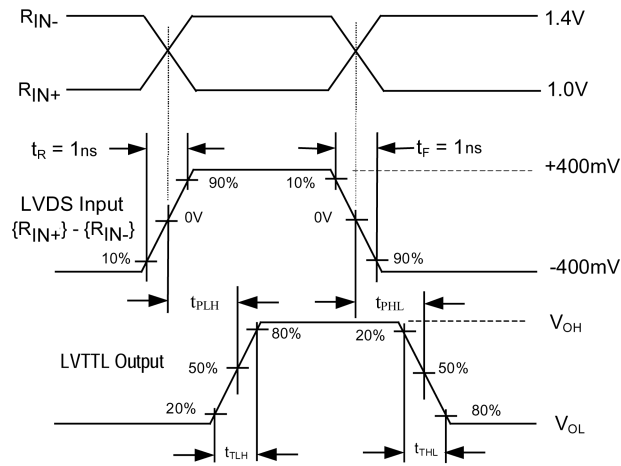
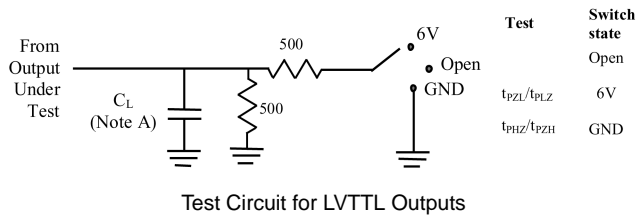


Figure 7. LVDS Input to LVTTTL Output AC Waveforms



Voltage Waveforms Enable and Disable Times

Figure 8. LVTTTL Outputs Test Circuit and AC Waveforms

DC / AC TYPICAL PERFORMANCE CURVES

Drivers

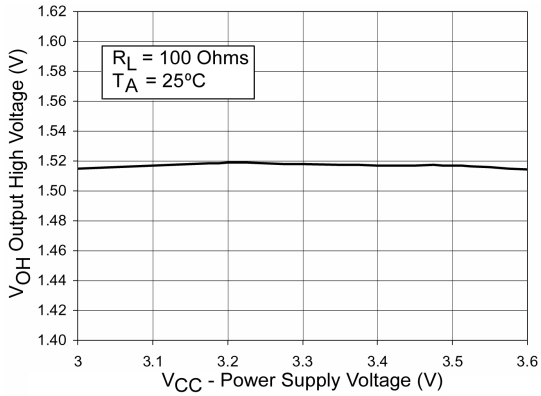


Figure 9. Output High Voltage vs. Power Supply Voltage

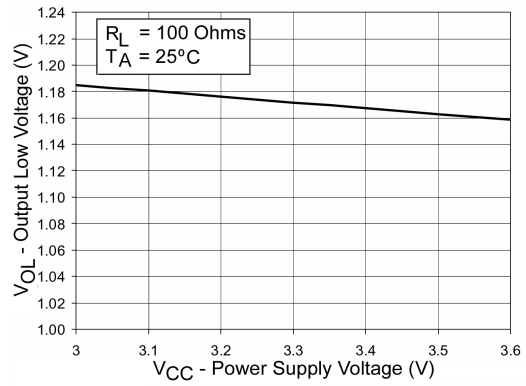


Figure 10. Output Low Voltage vs. Power Supply Voltage

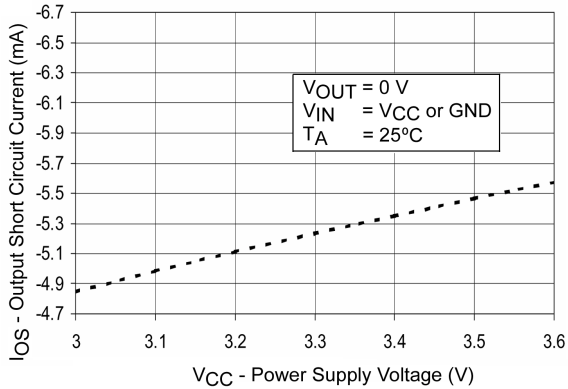


Figure 11. Output Short Circuit Current vs. Power Supply Voltage

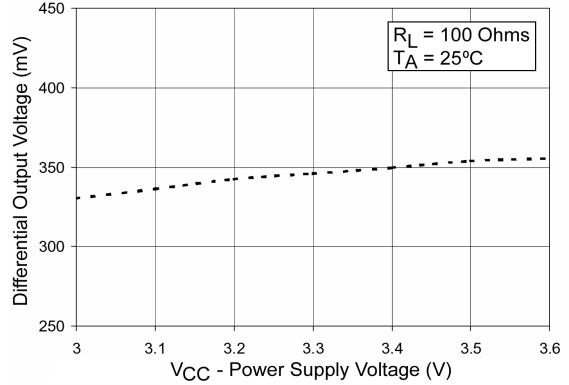


Figure 12. Differential Output Voltage vs. Power Supply Voltage

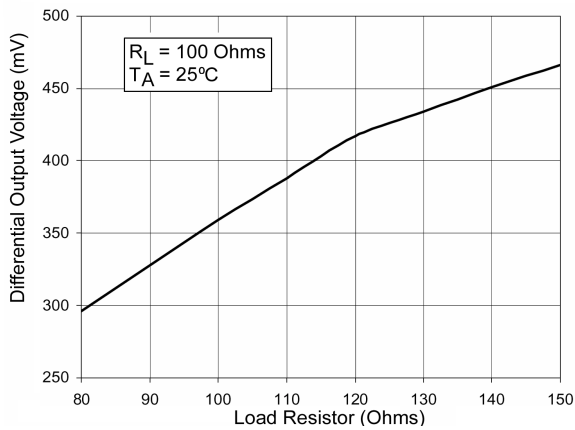


Figure 13. Differential Output Voltage vs. Load Resistor

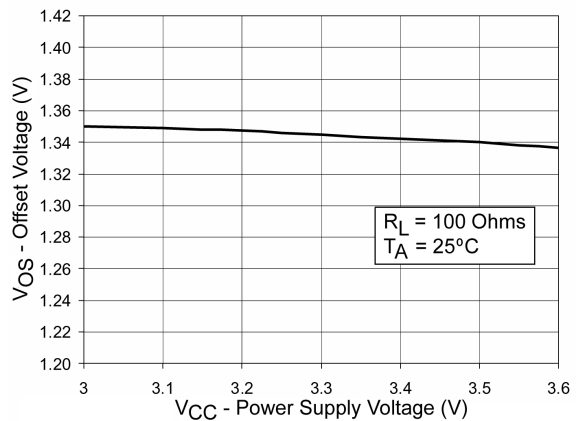


Figure 14. Offset Voltage vs. Power Supply Voltage



DC / AC TYPICAL PERFORMANCE CURVES (continued)

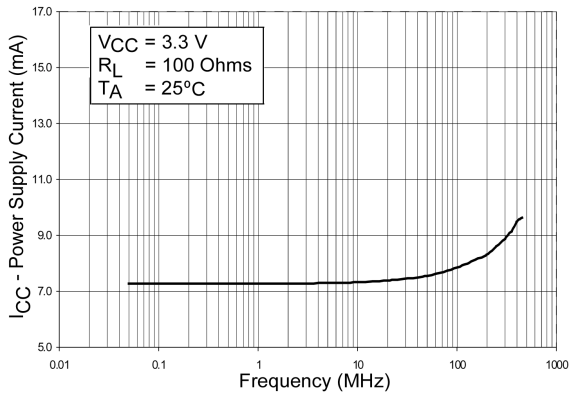


Figure 15. Power Supply Current vs. Frequency

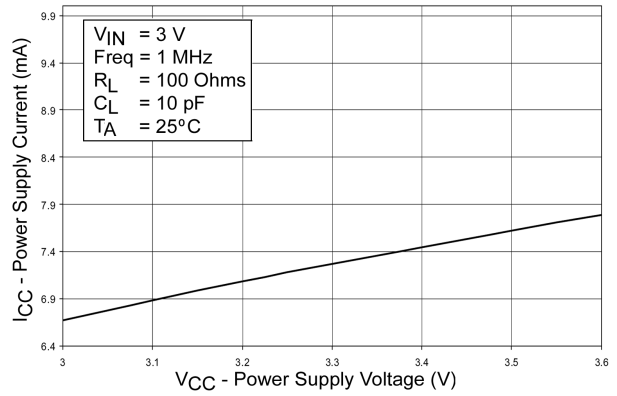


Figure 16. Power Supply Current vs. Power Supply Voltage

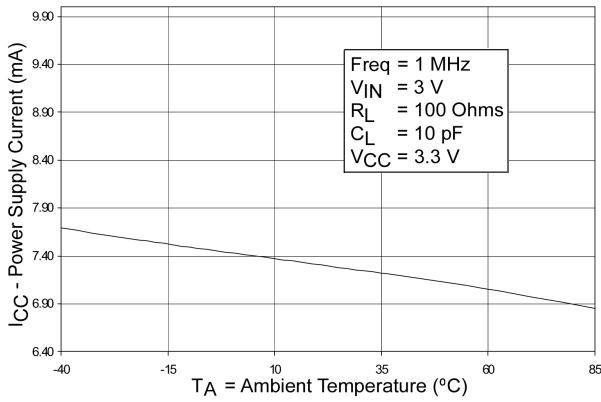


Figure 17. Power Supply Current vs. Ambient Temperature

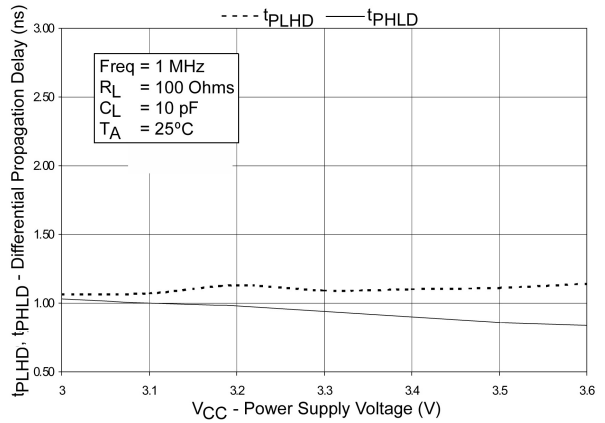


Figure 18. Differential Propagation Delay vs. Power Supply

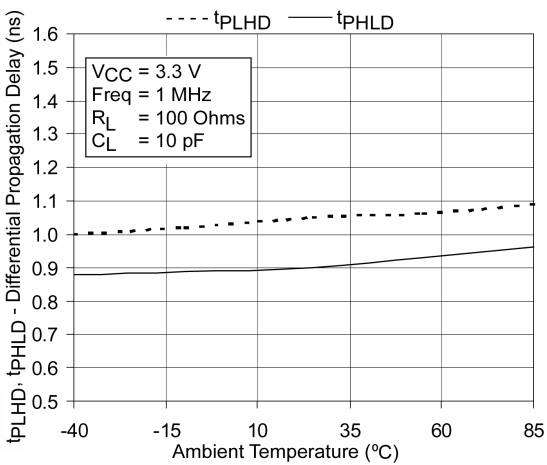


Figure 19. Differential Propagation Delay vs. Ambient Temperature

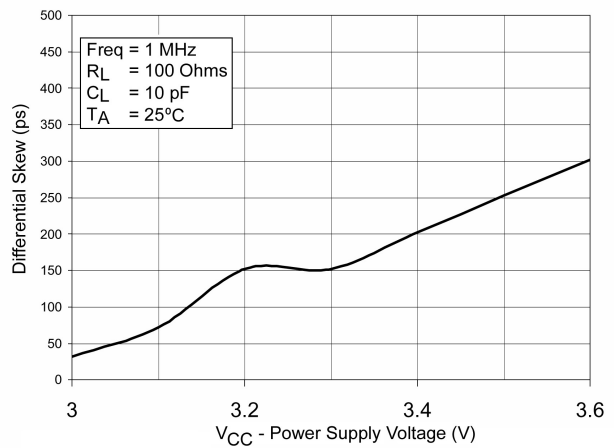


Figure 20. Differential Skew (t<sub>PLH</sub> - t<sub>PHL</sub>) vs. Power Supply Voltage

DC / AC TYPICAL PERFORMANCE CURVES (continued)

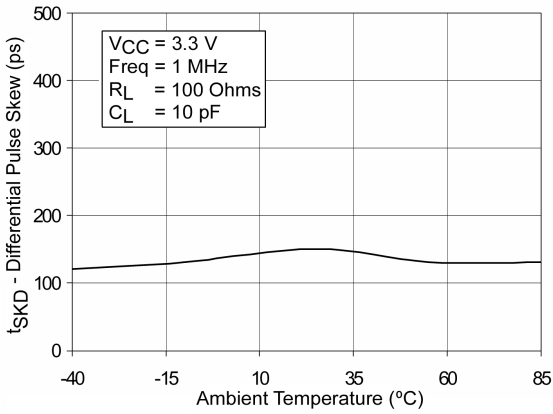


Figure 21. Differential Pulse Skew ( $t_{PLH} - t_{PHL}$ ) vs. Ambient Temperature

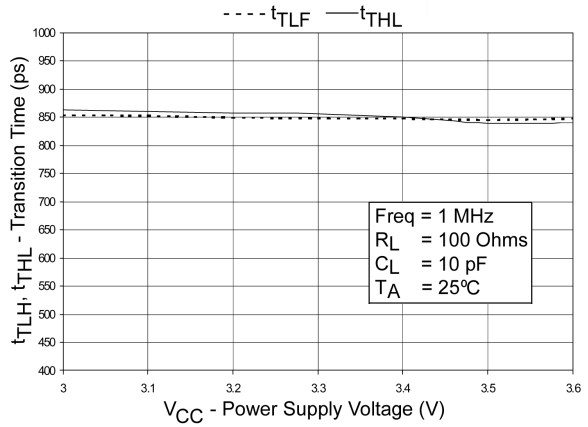


Figure 22. Transition Time vs. Power Supply Voltage

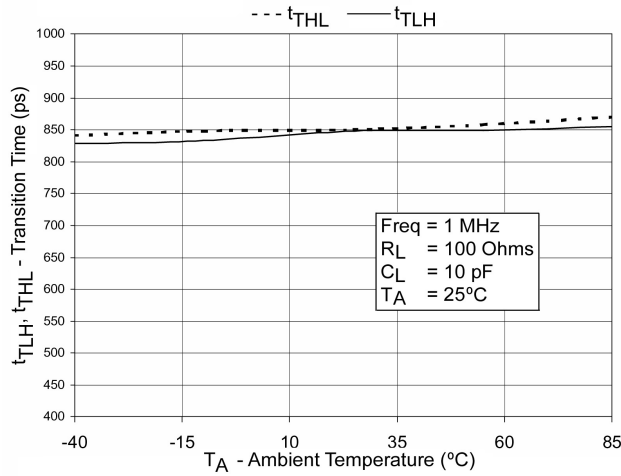


Figure 23. Transition Times vs. Ambient Temperature

DC / AC TYPICAL PERFORMANCE CURVES

Receiver

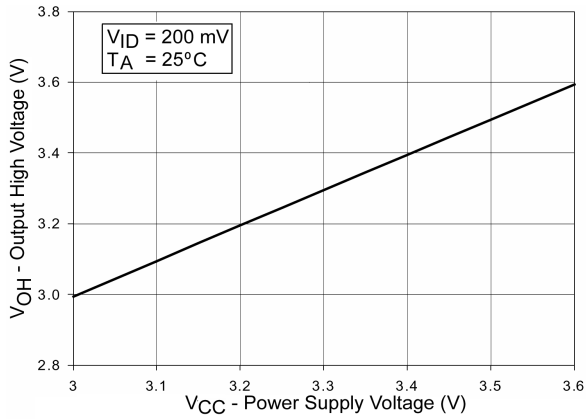


Figure 24. Output High Voltage vs. Power Supply Voltage

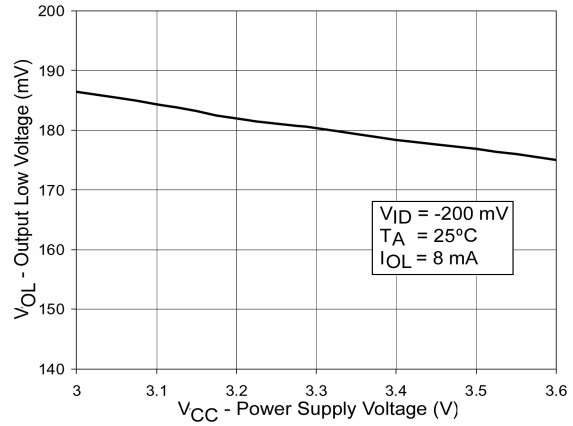


Figure 25. Output Low Voltage vs. Power Supply Voltage

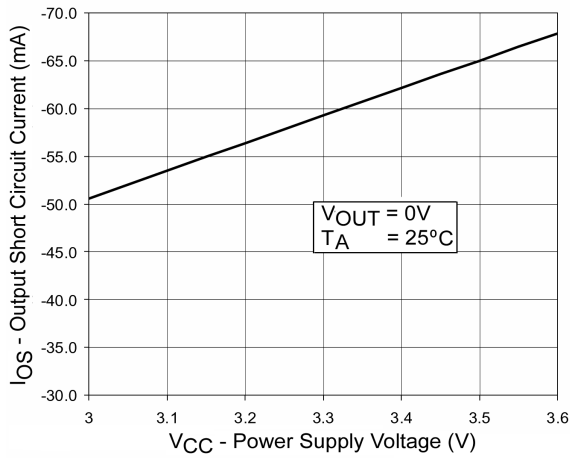


Figure 26. Output Short Circuit Current vs. Power Supply Voltage

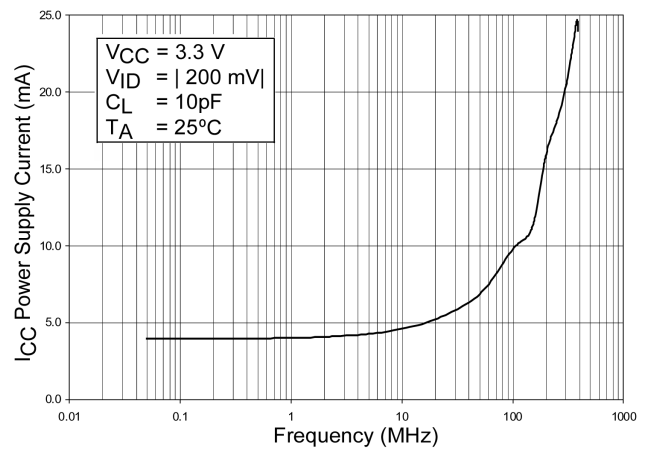


Figure 27. Power Supply Current vs. Frequency

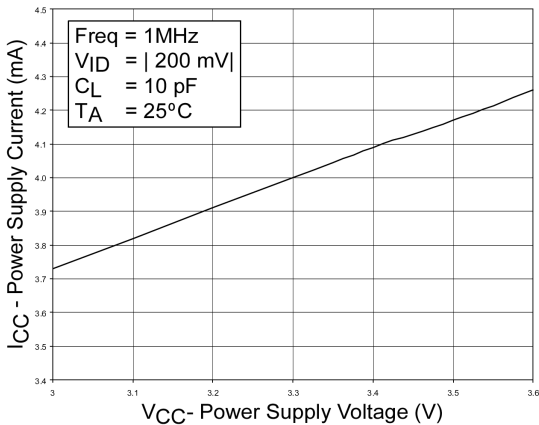


Figure 28. Power Supply Current vs. Power Supply Voltage

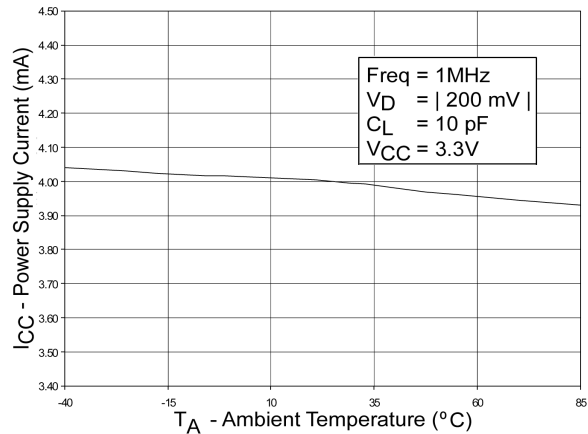


Figure 29. Power Supply Current vs. Ambient Temperature

DC / AC TYPICAL PERFORMANCE CURVES (continued)

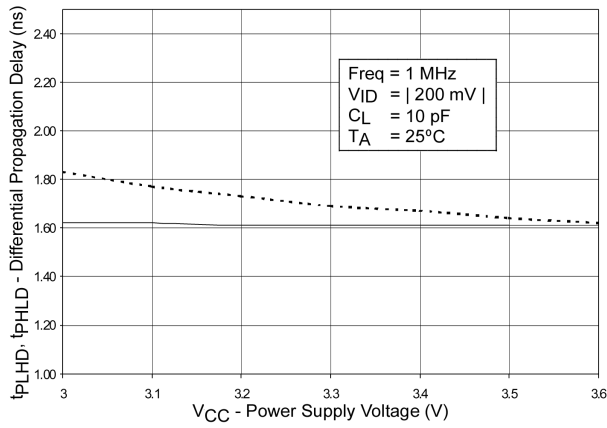


Figure 30. Differential Propagation Delay vs. Power Supply Voltage

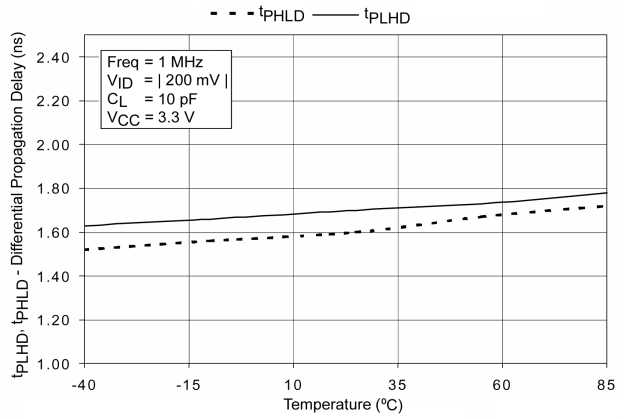


Figure 31. Differential Propagation Delay vs. Ambient Temperature

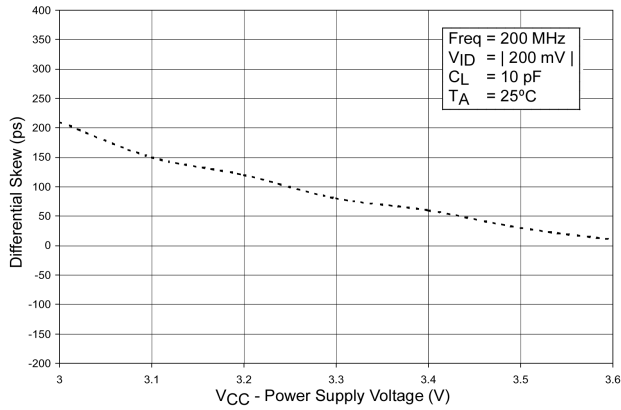


Figure 32. Differential Skew ( $t_{PHL} - t_{PHL}$ ) vs. Power Supply Voltage

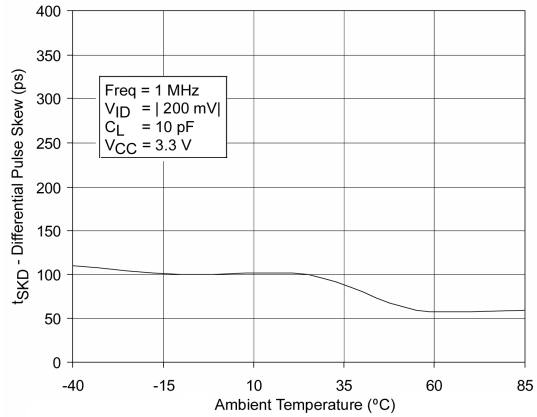


Figure 33. Differential Skew ( $t_{PLH} - t_{PLH}$ ) vs. Ambient Temperature

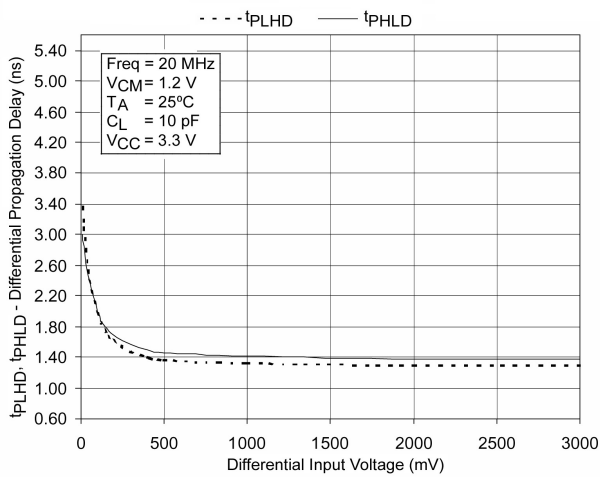


Figure 34. Differential Propagation Delay vs. Differential Input Voltage

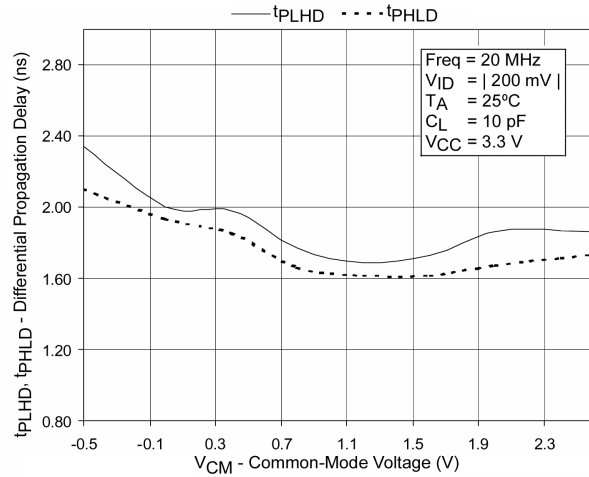


Figure 35. Differential Propagation Delay vs. Common-Mode Voltage

DC / AC TYPICAL PERFORMANCE CURVES (continued)

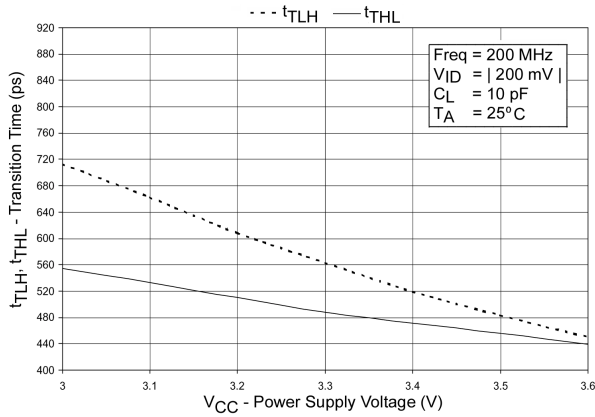


Figure 36. Transition Time vs. Power Supply Voltage

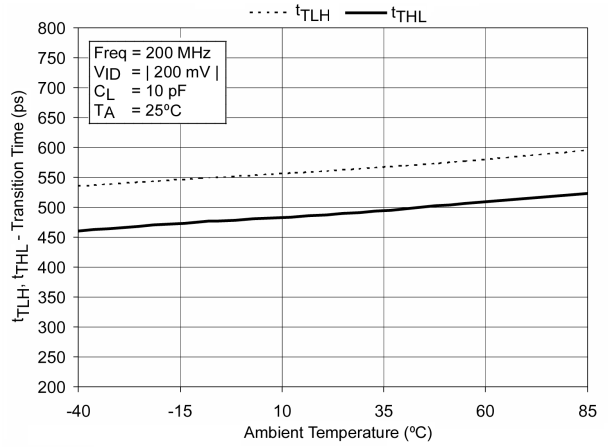


Figure 37. Transition Time vs. Ambient Temperature

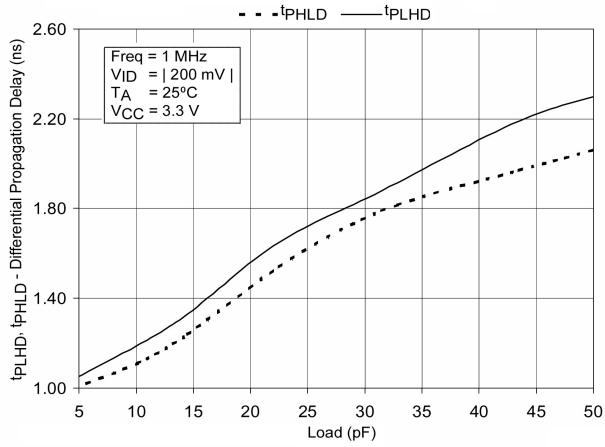


Figure 38. Differential Propagation Delay vs. Load

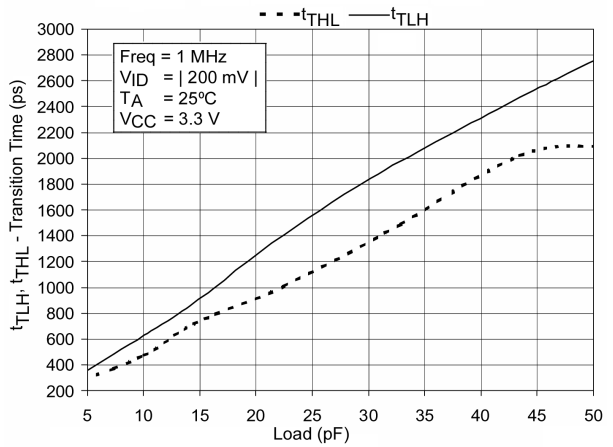


Figure 39. Transition Time vs. Load

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**TSSOP-14 WB**  
CASE 948G  
ISSUE C

DATE 17 FEB 2016

SCALE 2:1



**NOTES:**

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
- TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

**GENERIC MARKING DIAGRAM\***

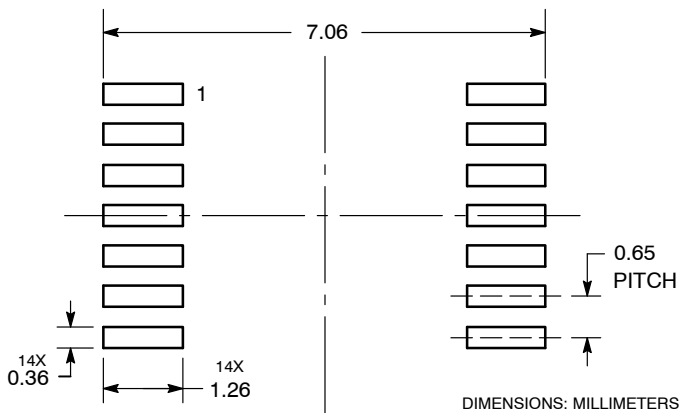


- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

**SOLDERING FOOTPRINT**



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