HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

FEATURES

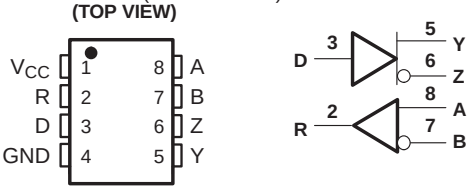
- **Meets or Exceeds the Requirements of ANSI TIA/EIA-644-1995 Standard**
- **Full-Duplex Signaling Rates up to 100 Mbps (See Table 1)**
- **Bus-Terminal ESD Exceeds 12 kV**
- **Operates From a Single 3.3-V Supply**
- **Low-Voltage Differential Signaling With Typical Output Voltages of 350 mV and a 100-Ω Load**
- **Propagation Delay Times**
  - **Driver: 1.7 ns Typ**
  - **Receiver: 3.7 ns Typ**
- **Power Dissipation at 200 MHz**
  - **Driver: 25 mW Typical**
  - **Receiver: 60 mW Typical**
- **LVTTL Input Levels Are 5-V Tolerant**
- **Receiver Maintains High Input Impedance With V_{CC} < 1.5 V**
- **Receiver Has Open-Circuit Fail Safe**

DESCRIPTION

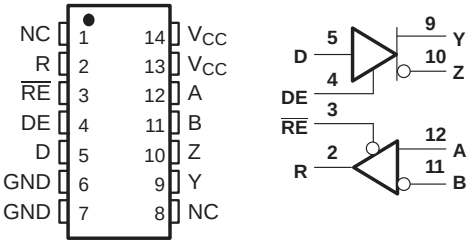
The SN65LVDS179, SN65LVDS180, SN65LVDS050, and SN65LVDS051 are differential line drivers and receivers that use low-voltage differential signaling (LVDS) to achieve signaling rates as high as 400 Mbps (see the *Application Information* section). The TIA/EIA-644 standard compliant electrical interface provides a minimum differential output voltage magnitude of 247 mV into a 100-Ω load and receipt of 50-mV signals with up to 1 V of ground potential difference between a transmitter and receiver.

The intended application of this device and signaling technique is for point-to-point baseband data transmission over controlled impedance media of approximately 100-Ω characteristic impedance. The transmission media may be printed-circuit board traces, backplanes, or cables. (Note: The ultimate rate and distance of data transfer depends on the attenuation characteristics of the media, the noise coupling to the environment, and other application specific characteristics).

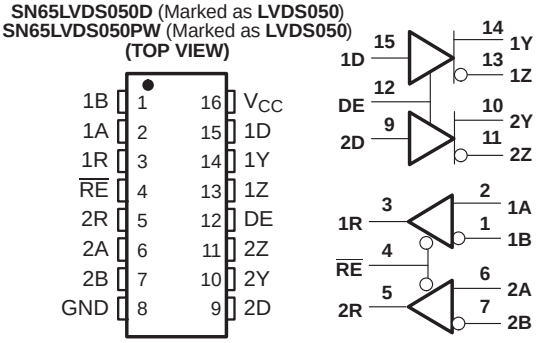
SN65LVDS179D (Marked as **DL179** or **LVD179**)
SN65LVDS179DGK (Marked as **S79**)
(TOP VIEW)



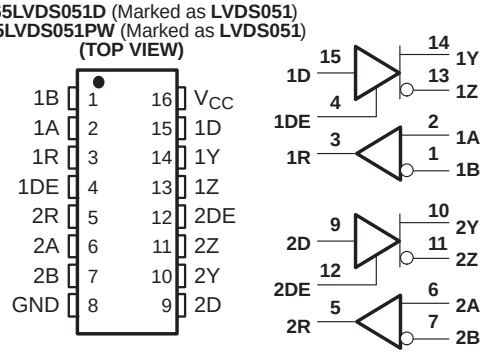
SN65LVDS180D (Marked as **LVDS180**)
SN65LVDS180PW (Marked as **LVDS180**)
(TOP VIEW)



SN65LVDS050D (Marked as **LVDS050**)
SN65LVDS050PW (Marked as **LVDS050**)
(TOP VIEW)



SN65LVDS051D (Marked as **LVDS051**)
SN65LVDS051PW (Marked as **LVDS051**)
(TOP VIEW)



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

DESCRIPTION (CONTINUED)

These devices offer various driver, receiver, and enabling combinations in industry-standard footprints. Because these devices are intended for use in simplex or distributed simplex bus structures, the driver enable function does not put the differential outputs into a high-impedance state but rather disconnects the input and reduces the quiescent power used by the device. (For these functions with a high-impedance driver output, see the SN65LVDM series of devices.) All devices are characterized for operation from -40°C to 85°C.

Table 1. Maximum Recommended Operating Speeds

Part Number	All Buffers Active	Rx Buffer Only	Tx Buffer Only
SN65LVDS179	150 Mbps	150 Mbps	400 Mbps
SN65LVDS180	150 Mbps	150 Mbps	400 Mbps
SN65LVDS050	100 Mbps	100 Mbps	400 Mbps
SN65LVDS051	100 Mbps	100 Mbps	400 Mbps

AVAILABLE OPTIONS(1)

PACKAGE		
SMALL OUTLINE (D)	SMALL OUTLINE (DGK)	SMALL OUTLINE (PW)
SN65LVDS050D	—	SN65LVDS050PW
SN65LVDS051D	—	SN65LVDS051PW
SN65LVDS179D	SN65LVDS179DGK	—
SN65LVDS180D	—	SN65LVDS180PW

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

FUNCTION TABLES

SN65LVDS179 RECEIVER

INPUTS	OUTPUT(1)
$V_{ID} = V_A - V_B$	R
$V_{ID} \geq 50$ mV	H
50 mV < V_{ID} < 50 mV	?
$V_{ID} \leq -50$ mV	L
Open	H

(1) H = high level, L = low level, ? = indeterminate

SN65LVDS179 DRIVER(1)

INPUT	OUTPUTS	
D	Y	Z
L	L	H
H	H	L
Open	L	H

(1) H = high level, L = low level

SN65LVDS180, SN65LVDS050, and SN65LVDS051 RECEIVER(1)

INPUTS		OUTPUT
$V_{ID} = V_A - V_B$	$\overline{RE}$	R
$V_{ID} \geq 50$ mV	L	H
50 mV < V_{ID} < 50 mV	L	?
$V_{ID} \leq -50$ mV	L	L
Open	L	H
X	H	Z

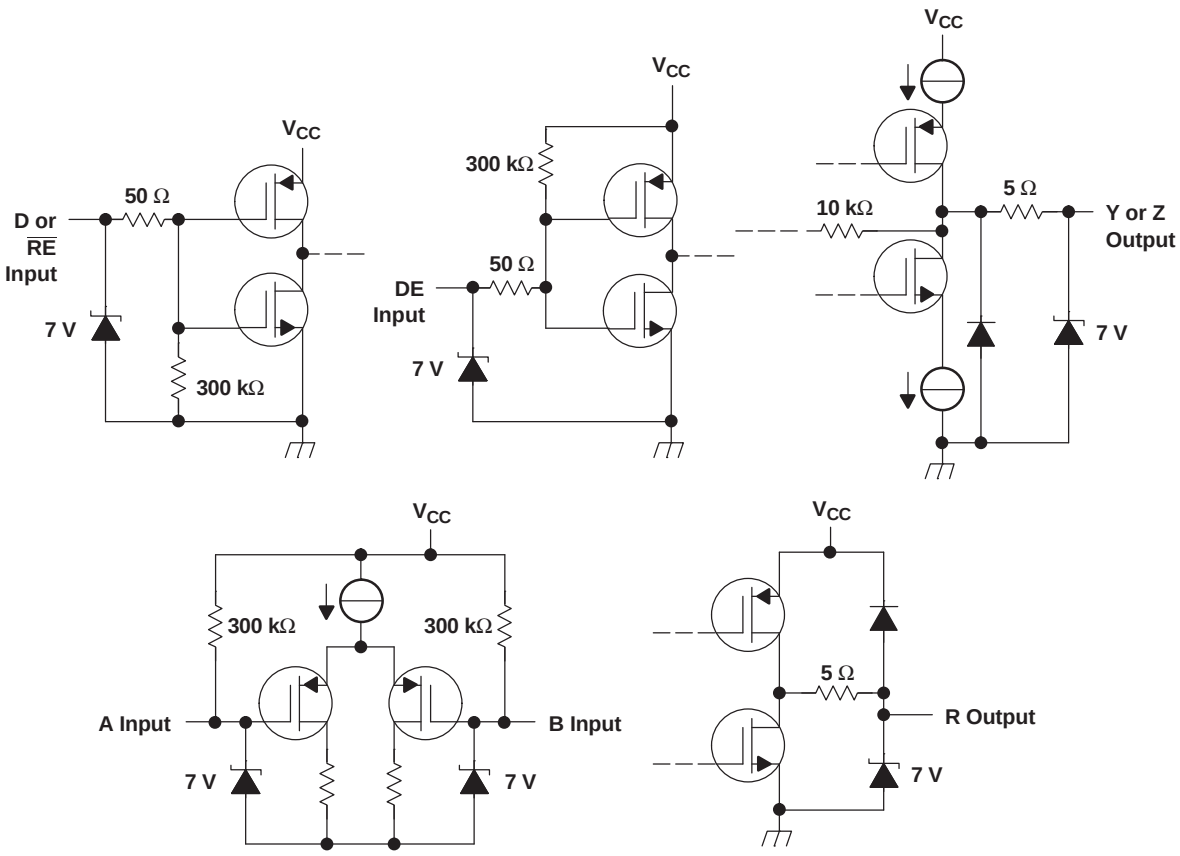
(1) H = high level, L = low level, Z = high impedance, X = don't care, ? = indeterminate

SN65LVDS180, SN65LVDS050, and SN65LVDS051 DRIVER(1)

INPUTS		OUTPUTS	
D	DE	Y	Z
L	H	L	H
H	H	H	L
Open	H	L	H
X	L	Off	Off

(1) H = high level, L = low level, Z = high impedance, X = don't care, Off = no output

EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS



ABSOLUTE MAXIMUM RATINGS(1)

over operating free-air temperature range (unless otherwise noted)

			UNIT
V_{CC} (see (2))	Supply voltage range		–0.5 V to 4 V
	Voltage range:	D, R, DE, $\overline{RE}$	–0.5 V to 6 V
		Y, Z, A, and B	–0.5 V to 4 V
$\|V_{OD}\|$	Differential output voltage:		1 V
	Electrostatic discharge:	Y, Z, A, B , and GND (see (3))	CLass 3, A:12 kV, B:600 V
		All	Class 3, A:7 kV, B:500 V
	Continuous power dissipation		See Dissipation Rating Table
	Storage temperature range		–65°C to 150°C
	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		250°C

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values, except differential I/O bus voltages are with respect to network ground terminal.
(3) Tested in accordance with MIL-STD-883C Method 3015.7.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$(1)	$T_A = 85°C$ POWER RATING
PW(14)	736 mW	5.9 mW/°C	383 mW
PW(16)	839 mW	6.7 mW/°C	437 mW
D(8)	635 mW	5.1 mW/°C	330 mW/°C
D(14)	987 mW	7.9 mW/°C	513 mW/°C
D(16)	1110 mW	8.9 mW/°C	577 mW/°C
DGK	424 mW	3.4 mW/°C	220 mW

(1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no airflow.

RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	3	3.3	3.6	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
$\|V_{ID}\|$	Magnitude of differential input voltage	0.1		0.6	V
$\|V_{OD}(dis)\|$	Magnitude of differential output voltage with disabled driver			520	mV
V_{OY} or V_{OZ}	Driver output voltage	0		2.4	V
V_{IC}	Common-mode input voltage (see Figure 5)	$\frac{\|V_{ID}\|}{2}$		$2.4 - \frac{\|V_{ID}\|}{2}$	V
				V_{CC}-0.8	
T_A	Operating free-air temperature	–40		85	°C

DEVICE ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
I_{CC} Supply current	SN65LVDS179	No receiver load, driver R_L = 100 Ω		9	12	mA
	SN65LVDS180	Driver and receiver enabled, no receiver load, driver R_L = 100 Ω		9	12	mA
		Driver enabled, receiver disabled, R_L = 100 Ω		5	7	
		Driver disabled, receiver enabled, no load		1.5	2	
		Disabled		0.5	1	
	SN65LVDS050	Drivers and receivers enabled, no receiver loads, driver R_L = 100 Ω		12	20	mA
		Drivers enabled, receivers disabled, R_L = 100 Ω		10	16	
		Drivers disabled, receivers enabled, no loads		3	6	
		Disabled		0.5	1	
	SN65LVDS051	Drivers enabled, No receiver loads, driver R_L = 100 Ω		12	20	mA
		Drivers disabled, no loads		3	6	

(1) All typical values are at 25°C and with a 3.3-V supply.

DRIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
$\|V_{OD}\|$	Differential output voltage magnitude		R_L = 100 Ω, See Figure 3 and Figure 2	247	340	454	mV
$\Delta\|V_{OD}\|$	Change in differential output voltage magnitude between logic states			-50		50	
$V_{OC(SS)}$	Steady-state common-mode output voltage		See Figure 3	1.125	1.2	1.375	V
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage between logic states			–50		50	mV
$V_{OC(PP)}$	Peak-to-peak common-mode output voltage				50	150	mV
I_{IH}	High-level input current	DE	V_{IH} = 5 V		–0.5	–20	µA
		D			2	20	
I_{IL}	Low-level input current	DE	V_{IL} = 0.8 V		–0.5	–10	µA
		D			2	10	
I_{OS}	Short-circuit output current		V_{OY} or V_{OZ} = 0 V		3	10	mA
			V_{OD} = 0 V		3	10	
$I_{O(OFF)}$	Off-state output current		DE = OV V_{OY} = V_{OZ} = OV	–1		1	µA
			DE = V_{CC} V_{OY} = V_{OZ} = OV, V_{CC} < 1.5 V				
C_{IN}	Input capacitance				3		pF

RECEIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
V_{IT+}	Positive-going differential input voltage threshold	See Figure 5 and Table 2			50	mV
V_{IT-}	Negative-going differential input voltage threshold		–50			
V_{OH}	High-level output voltage	I_{OH} = -8 mA	2.4			V
		I_{OH} = -4 mA	2.8			
V_{OL}	Low-level output voltage	I_{OL} = 8 mA			0.4	V
I_I	Input current (A or B inputs)	V_I = 0	–2	–11	–20	µA
		V_I = 2.4 V	–1.2	–3		
$I_{I(OFF)}$	Power-off input current (A or B inputs)	V_{CC} = 0			±20	µA
I_{IH}	High-level input current (enables)	V_{IH} = 5 V			±10	µA
I_{IL}	Low-level input current (enables)	V_{IL} = 0.8 V			±10	µA
I_{OZ}	High-impedance output current	V_O = 0 or 5 V			±10	µA
C_I	Input capacitance			5		pF

(1) All typical values are at 25°C and with a 3.3-V supply.

DRIVER SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	R_L = 100 Ω, C_L = 10 pF, See Figure 2		1.7	2.7	ns
t_{PHL}	Propagation delay time, high-to-low-level output			1.7	2.7	ns
t_r	Differential output signal rise time			0.8	1	ns
t_f	Differential output signal fall time			0.8	1	ns
$t_{sk(p)}$	Pulse skew ($\lvert t_{pHL} - t_{pLH} \rvert$)(2)			300		ps
$t_{sk(o)}$	Channel-to-channel output skew(3)			150		ps
t_{en}	Enable time	See Figure 4		4.3	10	ns
t_{dis}	Disable time			3.1	10	ns

(1) All typical values are at 25°C and with a 3.3-V supply.
(2) $t_{sk(p)}$ is the magnitude of the time difference between the high-to-low and low-to-high propagation delay times at an output.
(3) $t_{sk(o)}$ is the magnitude of the time difference between the outputs of a single device with all of their inputs connected together.

RECEIVER SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	C_L = 10 pF, See Figure 6		3.7	4.5	ns
t_{PHL}	Propagation delay time, high-to-low-level output			3.7	4.5	ns
$t_{sk(p)}$	Pulse skew ($\lvert t_{pHL} - t_{pLH} \rvert$)(2)			0.3		ns
t_r	Output signal rise time			0.7	1.5	ns
t_f	Output signal fall time			0.9	1.5	ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	See Figure 7		2.5		ns
t_{PZL}	Propagation delay time, high-impedance-to-low-level output			2.5		ns
t_{PHZ}	Propagation delay time, high-level-to-high-impedance output			7		ns
t_{PLZ}	Propagation delay time, low-level-to-high-impedance output			4		ns

(1) All typical values are at 25°C and with a 3.3-V supply.
(2) $t_{sk(p)}$ is the magnitude of the time difference between the high-to-low and low-to-high propagation delay times at an output.

PARAMETER MEASUREMENT INFORMATION

DRIVER

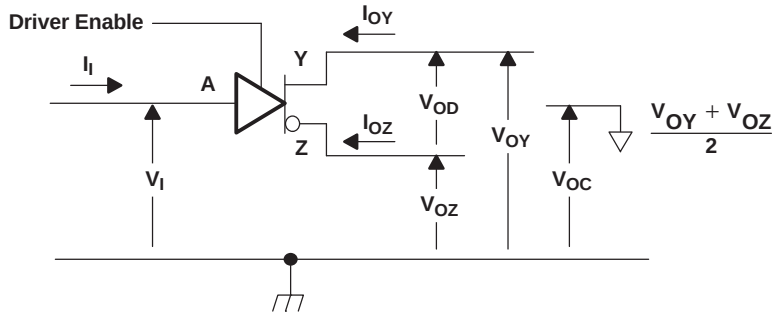
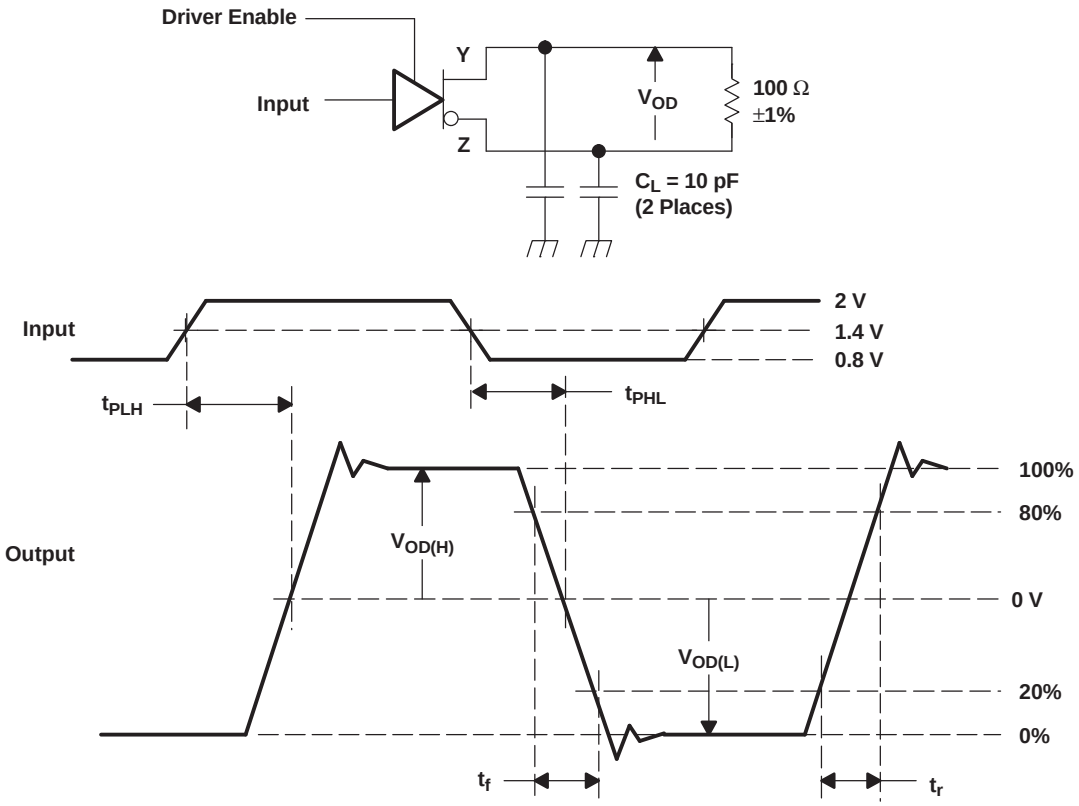


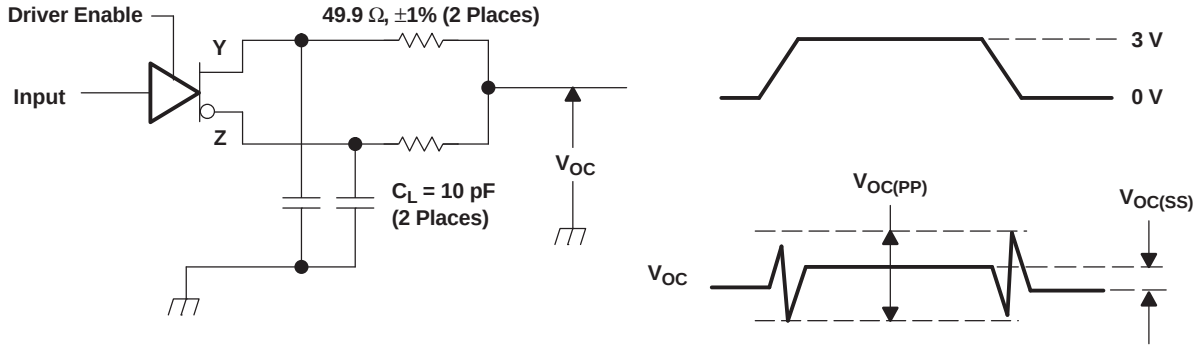
Figure 1. Driver Voltage and Current Definitions



A. All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

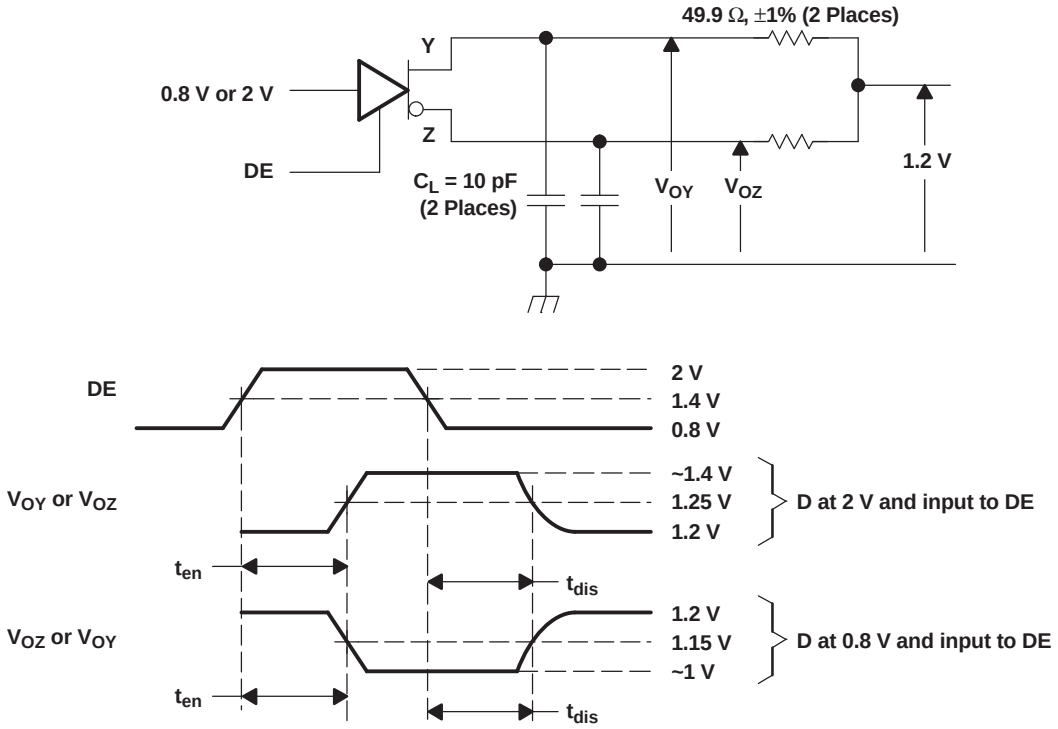
Figure 2. Test Circuit, Timing, and Voltage Definitions for the Differential Output Signal

PARAMETER MEASUREMENT INFORMATION (continued)



A. All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T. The measurement of $V_{OC(PP)}$ is made on test equipment with a –3-dB bandwidth of at least 300 MHz.

Figure 3. Test Circuit and Definitions for the Driver Common-Mode Output Voltage



A. All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 4. Enable and Disable Time Circuit and Definitions

PARAMETER MEASUREMENT INFORMATION (continued)

RECEIVER

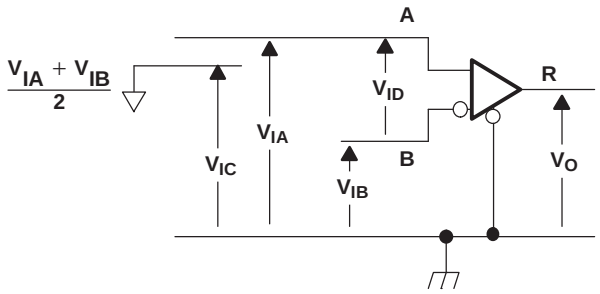
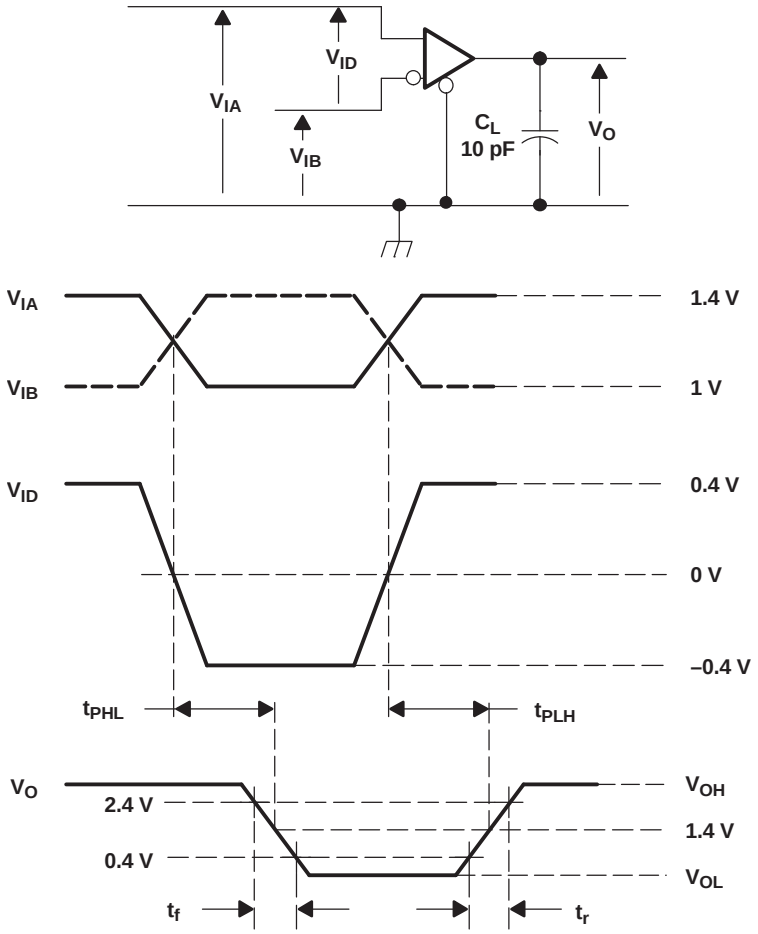


Figure 5. Receiver Voltage Definitions

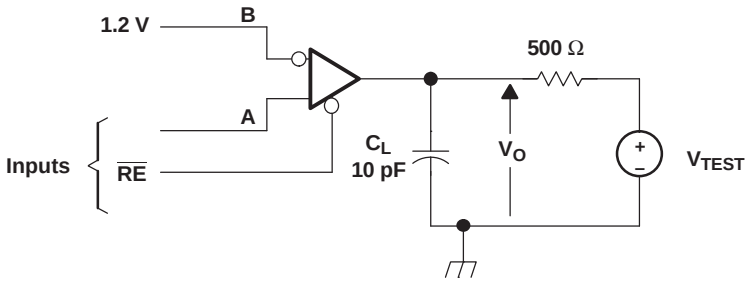
Table 2. Receiver Minimum and Maximum Input Threshold Test Voltages

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



A. All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0,06 m of the D.U.T.

Figure 6. Timing Test Circuit and Waveforms



A. All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 ns. C_L includes instrumentation and fixture capacitance within 0,06 m of the D.U.T.

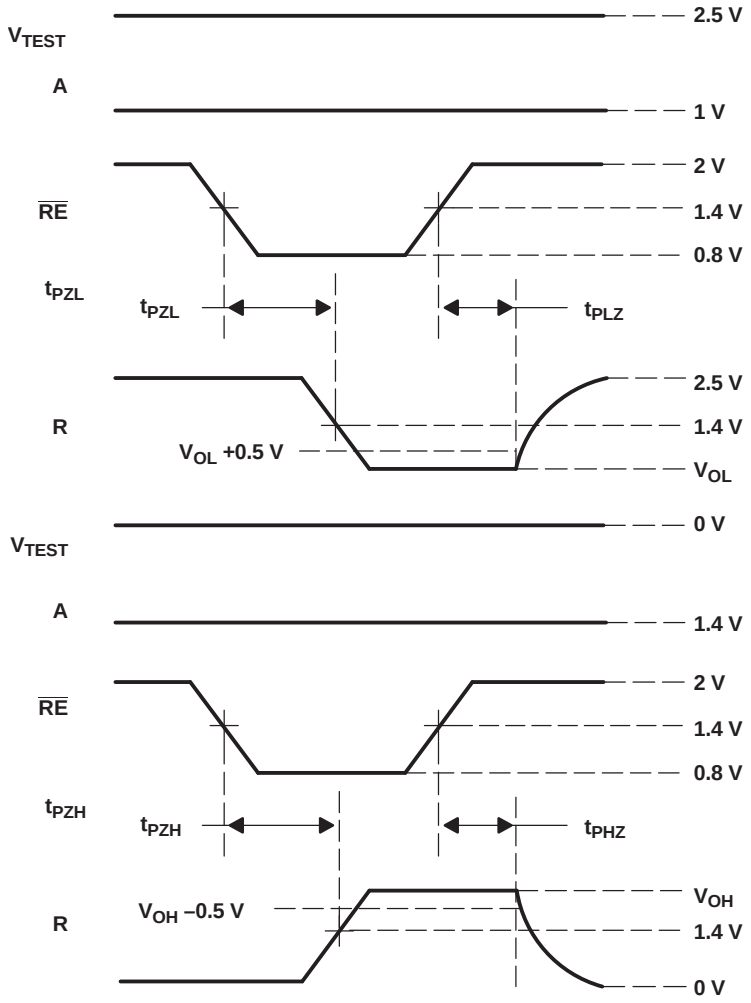


Figure 7. Enable/Disable Time Test Circuit and Waveforms

TYPICAL CHARACTERISTICS

DISABLED DRIVER OUTPUT CURRENT vs OUTPUT VOLTAGE

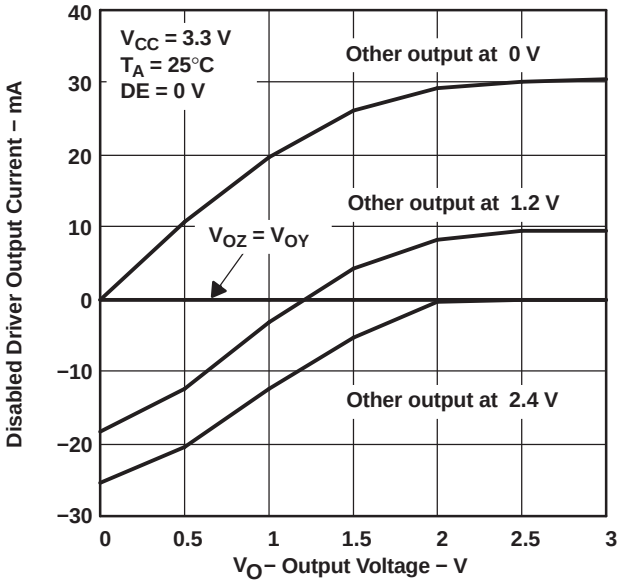


Figure 8.

DRIVER LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

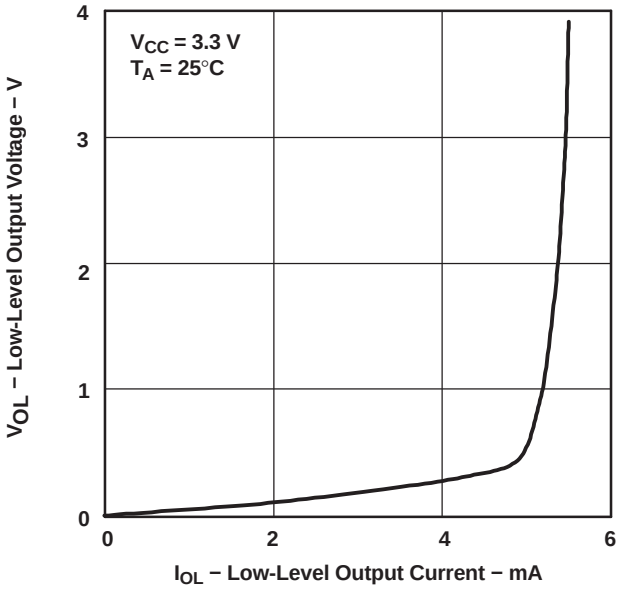


Figure 9.

DRIVER HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

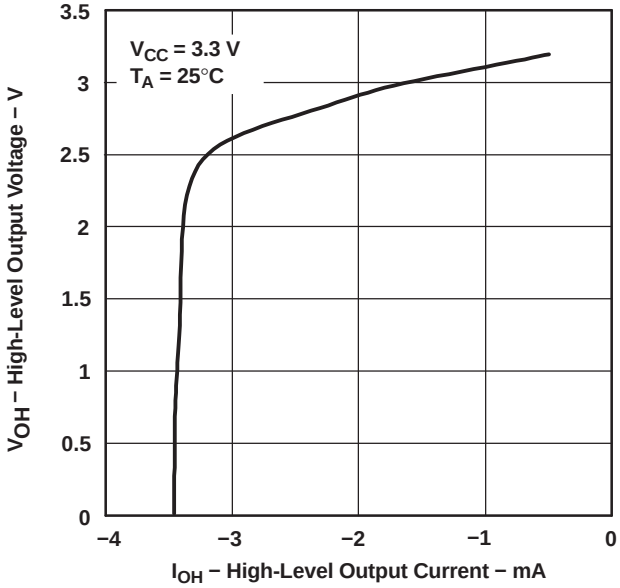


Figure 10.

TYPICAL CHARACTERISTICS (continued)

RECEIVER
LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

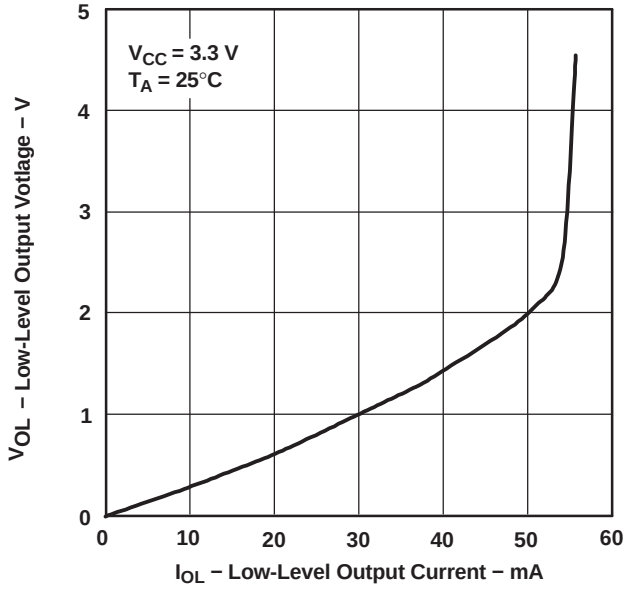


Figure 11.

RECEIVER
HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

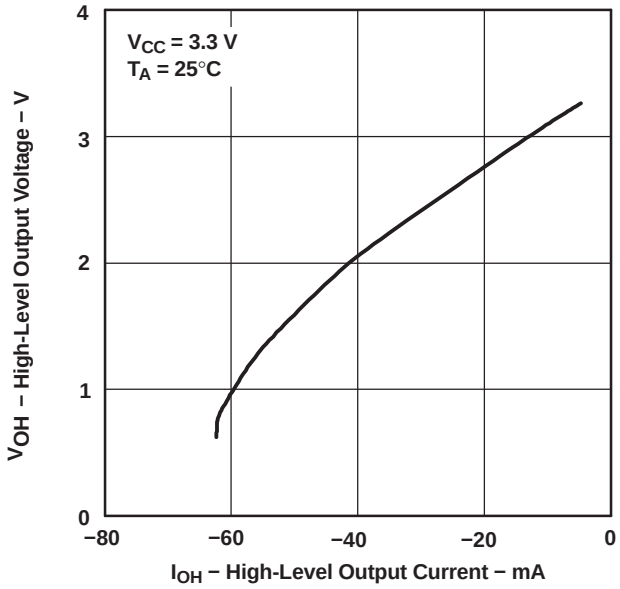


Figure 12.

DRIVER
HIGH-TO-LOW LEVEL PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

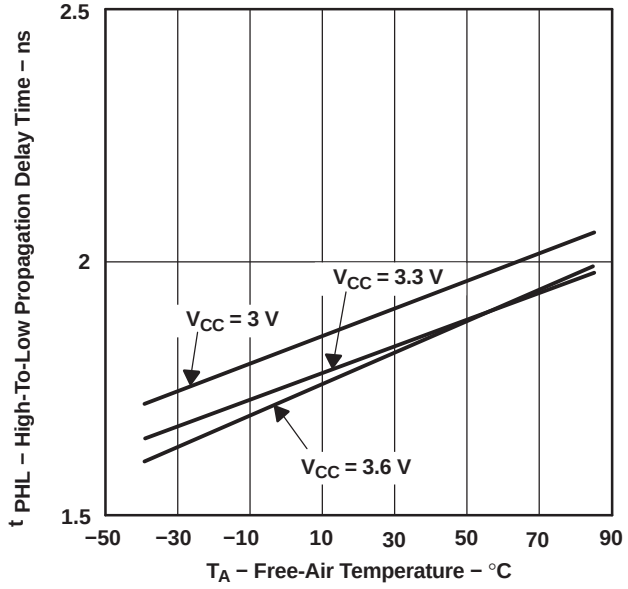


Figure 13.

DRIVER
LOW-TO-HIGH LEVEL PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

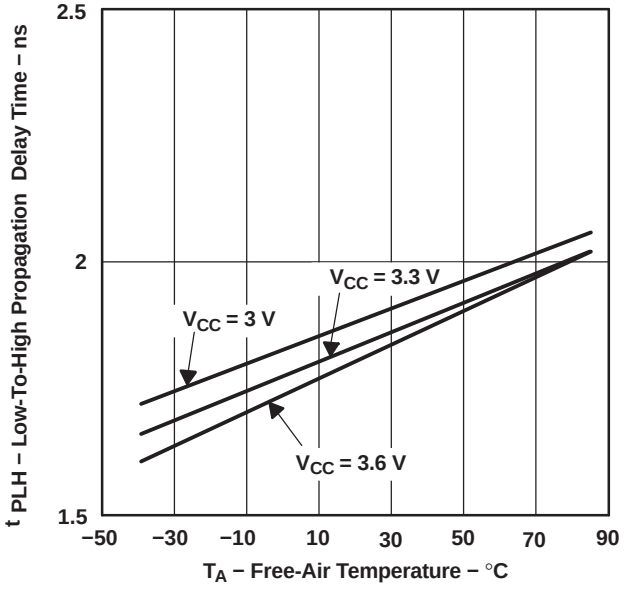


Figure 14.

TYPICAL CHARACTERISTICS (continued)

RECEIVER
HIGH-TO-LOW LEVEL PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

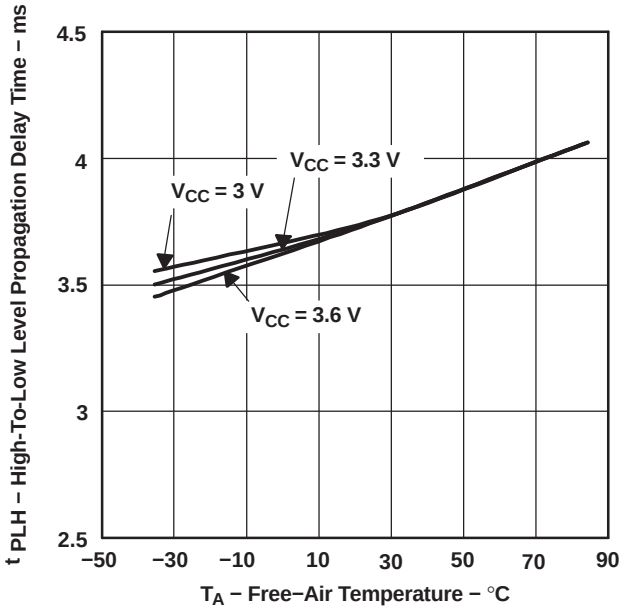


Figure 15.

RECEIVER
LOW-TO-HIGH LEVEL PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

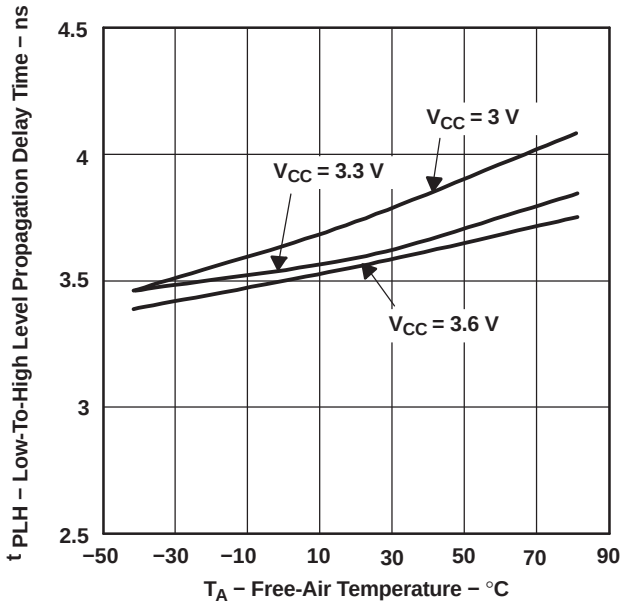


Figure 16.

APPLICATION INFORMATION

Equipment

- Hewlett Packard HP6624A DC power supply
- Tektronix TDS7404 Real Time Scope
- Agilent ParBERT E4832A

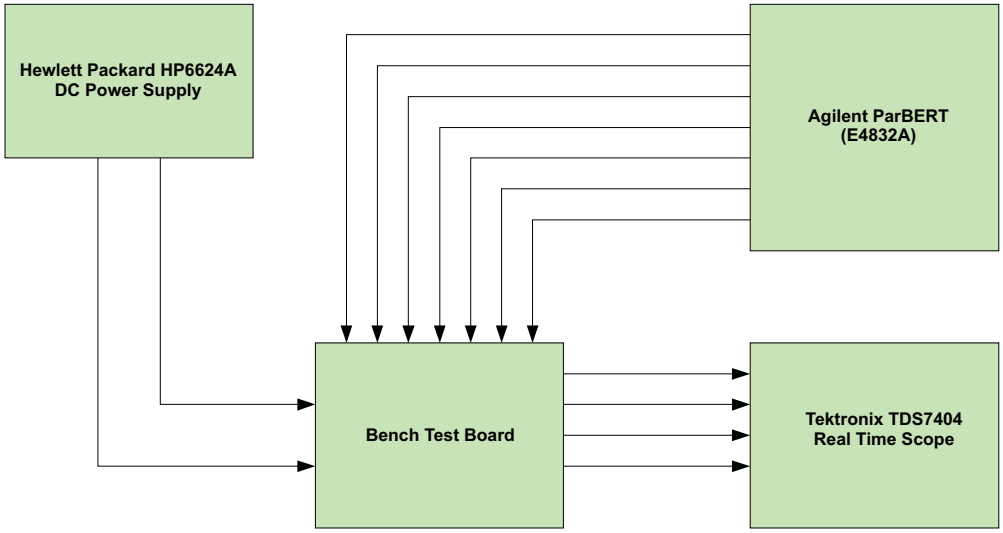
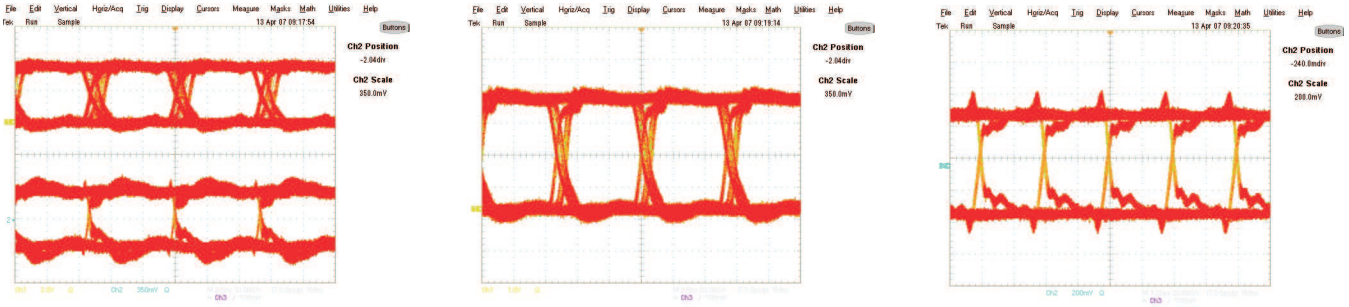


Figure 17. Equipment Setup



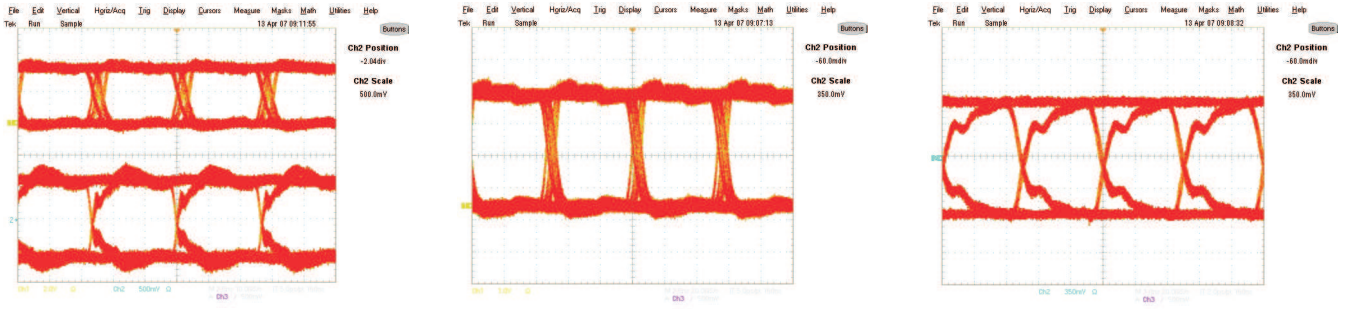
(a) **(b)** **(c)**

a. Tx + Rx running at 150 Mbps; Channel 1: R, Channel 2: Y-Z

b. Rx only running at 150 Mbps; Channel 1: R

c. Tx only running at 400 Mbps; Channel 1: Y-Z

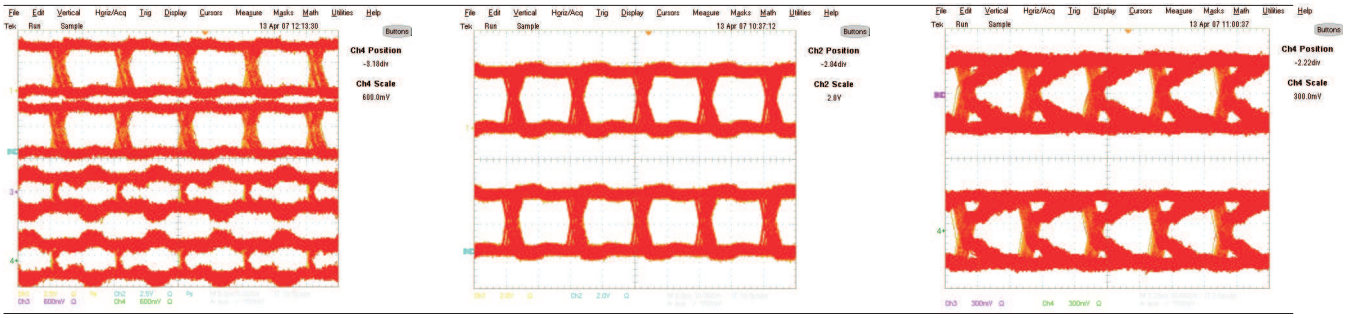
Figure 18. Typical Eye Patterns SN65LVDS179: (T = 25°C; V_{CC} = 3.6 V; PRBS = 2^{23-1})



(a) (b) (c)

a. Tx + Rx running at 150 Mbps; Channel 1: R, Channel 2: Y-Z
b. Rx only running at 150 Mbps; Channel 1: R
c. Tx only running at 400 Mbps; Channel 1: Y-Z

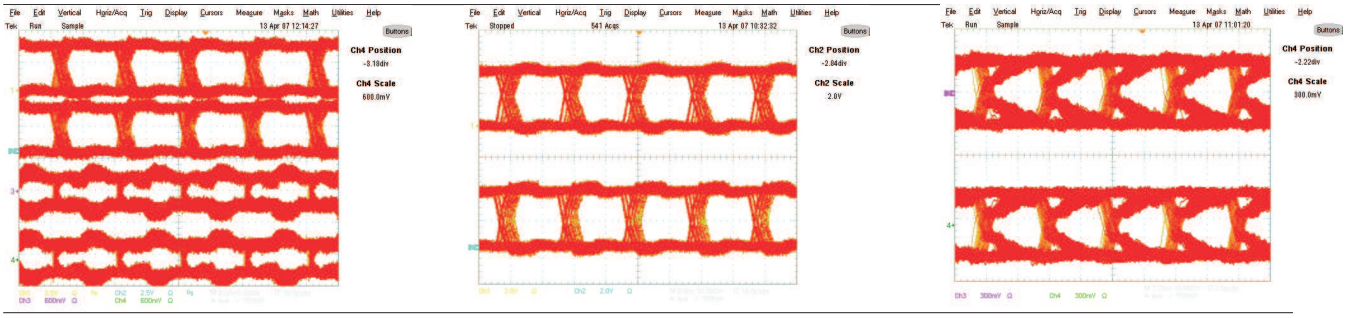
Figure 19. Typical Eye Patterns SN65LVDS180: (T = 25°C; V_{CC} = 3.6 V; PRBS = 2^{23-1})



(a) (b) (c)

a. All buffers running at 100 Mbps; Channel 1: R, Channel 2: 2R, Channel 3: 1Y-1Z, Channel 4: 2Y-2Z,
b. Rx buffers only running at 100 Mbps; Channel 1: R, Channel 2: 2R
c. Tx buffers only running at 400 Mbps; Channel 3: 1Y-1Z, Channel 4: 2Y-2Z,

Figure 20. Typical Eye Patterns SN65LVDS050: (T = 25°C; V_{CC} = 3.6 V; PRBS = 2^{23-1})



(a) (b) (c)

a. All buffers running at 100 Mbps; Channel 1: R, Channel 2: 2R, Channel 3: 1Y-1Z, Channel 4: 2Y-2Z,
b. Rx buffers only running at 100 Mbps; Channel 1: R, Channel 2: 2R
c. Tx buffers only running at 400 Mbps; Channel 3: 1Y-1Z, Channel 4: 2Y-2Z,

Figure 21. Typical Eye Patterns SN65LVDS051: (T = 25°C; V_{CC} = 3.6 V; PRBS = 2^{23-1})

The devices are generally used as building blocks for high-speed point-to-point data transmission. Ground differences are less than 1 V with a low common-mode output and balanced interface for low noise emissions. Devices can interoperate with RS-422, PECL, and IEEE-P1596. Drivers/receivers maintain ECL speeds without the power and dual supply requirements.

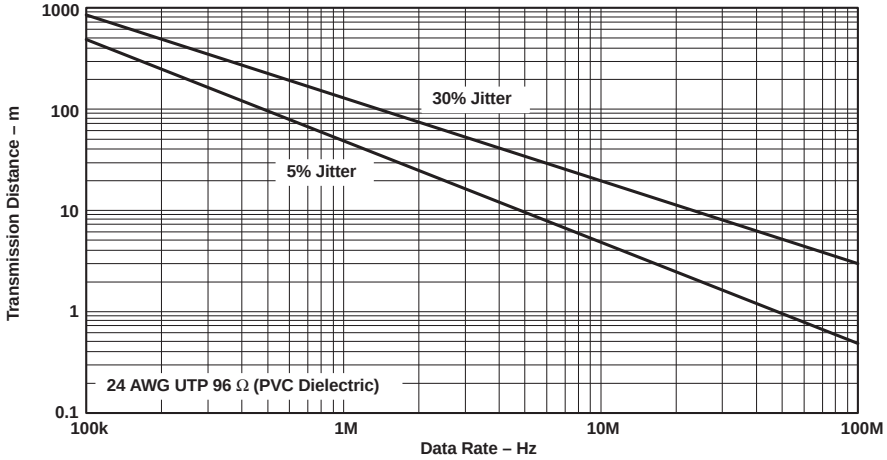


Figure 22. Data Transmission Distance Versus Rate

FAIL SAFE

One of the most common problems with differential signaling applications is how the system responds when no differential voltage is present on the signal pair. The LVDS receiver is like most differential line receivers, in that its output logic state can be indeterminate when the differential input voltage is between -100 mV and 100 mV and within its recommended input common-mode voltage range. TI's LVDS receiver is different in how it handles the open-input circuit situation, however.

Open-circuit means that there is little or no input current to the receiver from the data line itself. This could be when the driver is in a high-impedance state or the cable is disconnected. When this occurs, the LVDS receiver pulls each line of the signal pair to near V_{CC} through 300-kΩ resistors as shown in Figure 11. The fail-safe feature uses an AND gate with input voltage thresholds at about 2.3 V to V_{CC} - 0.4 V to detect this condition and force the output to a high-level regardless of the differential input voltage.

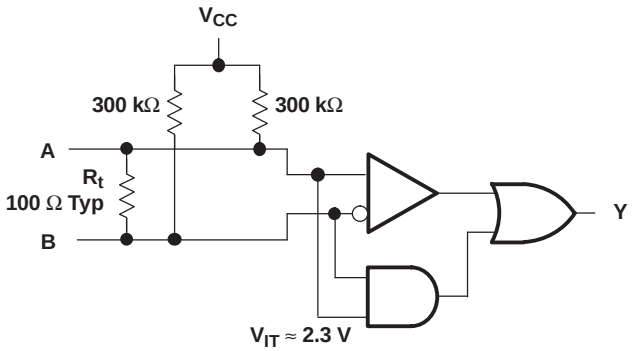


Figure 23. Open-Circuit Fail Safe of the LVDS Receiver

It is only under these conditions that the output of the receiver will be valid with less than a 100-mV differential input voltage magnitude. The presence of the termination resistor, Rt, does not affect the fail-safe function as long as it is connected as shown in the figure. Other termination circuits may allow a dc current to ground that could defeat the pullup currents from the receiver and the fail-safe feature.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65LVDS050D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS050	Samples
SN65LVDS050DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS050	Samples
SN65LVDS050DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS050	Samples
SN65LVDS050DRG4	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	-40 to 85		Samples
SN65LVDS050PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		LVDS050	Samples
SN65LVDS050PWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		LVDS050	Samples
SN65LVDS050PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		LVDS050	Samples
SN65LVDS050PWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		LVDS050	Samples
SN65LVDS051D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS051DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS051DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS051DRG4	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	-40 to 85		Samples
SN65LVDS051PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS051PWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS051PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS051PWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS051	Samples
SN65LVDS179D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	DL179	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65LVDS179DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	DL179	Samples
SN65LVDS179DGK	ACTIVE	VSSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU | CU NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	S79	Samples
SN65LVDS179DGKG4	ACTIVE	VSSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	S79	Samples
SN65LVDS179DGKR	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU | CU NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	S79	Samples
SN65LVDS179DGKRG4	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	S79	Samples
SN65LVDS179DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	DL179	Samples
SN65LVDS179DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	DL179	Samples
SN65LVDS180D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples
SN65LVDS180PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVDS180	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

OTHER QUALIFIED VERSIONS OF SN65LVDS050, SN65LVDS051, SN65LVDS179, SN65LVDS180 :

- Automotive: SN65LVDS050-Q1, SN65LVDS051-Q1, SN65LVDS180-Q1
- Enhanced Product: SN65LVDS179-EP

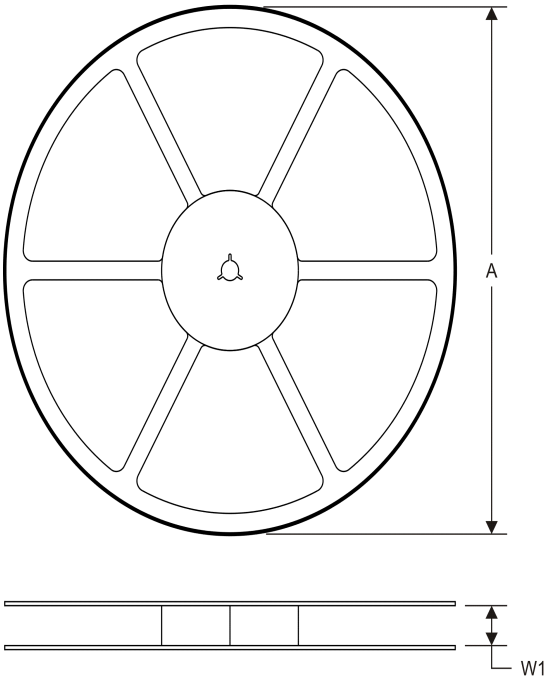
NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

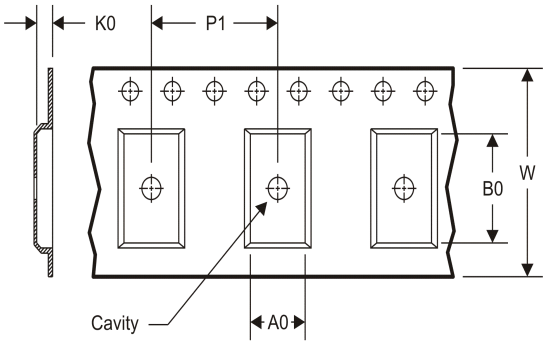
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



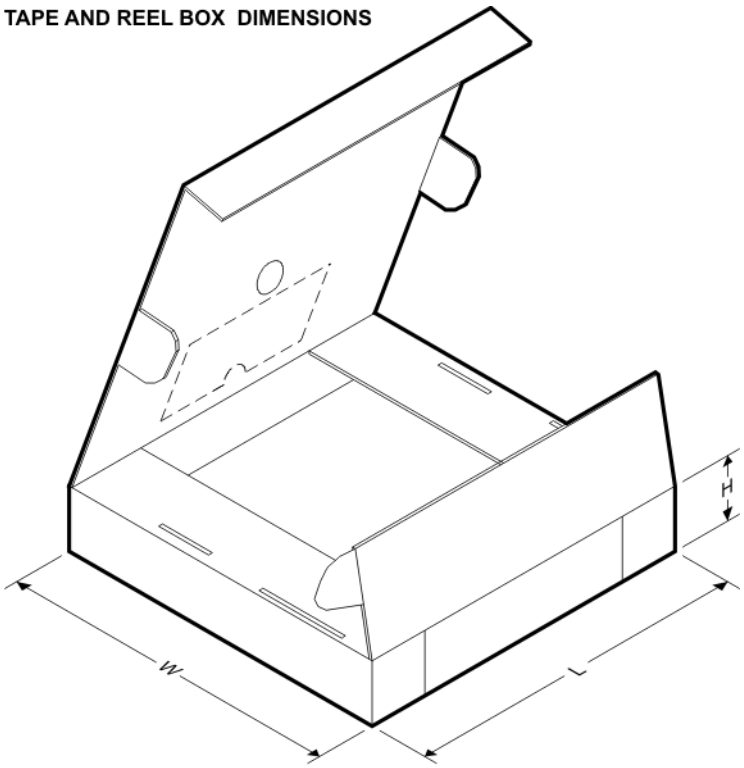
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65LVDS050DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LVDS050PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN65LVDS051DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LVDS051PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN65LVDS179DGKR	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
SN65LVDS179DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
SN65LVDS180DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN65LVDS180PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

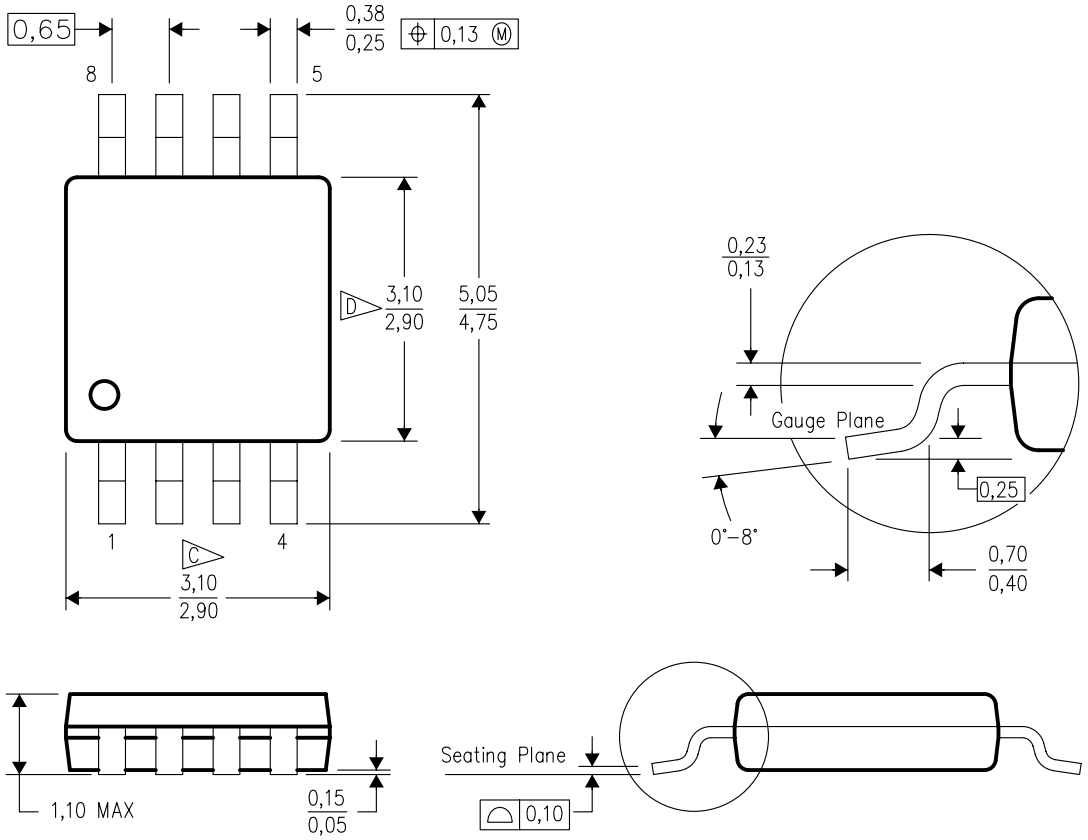
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LVDS050DR	SOIC	D	16	2500	367.0	367.0	38.0
SN65LVDS050PWR	TSSOP	PW	16	2000	367.0	367.0	35.0
SN65LVDS051DR	SOIC	D	16	2500	367.0	367.0	38.0
SN65LVDS051PWR	TSSOP	PW	16	2000	367.0	367.0	35.0
SN65LVDS179DGKR	VSSOP	DGK	8	2500	358.0	335.0	35.0
SN65LVDS179DR	SOIC	D	8	2500	340.5	338.1	20.6
SN65LVDS180DR	SOIC	D	14	2500	367.0	367.0	38.0
SN65LVDS180PWR	TSSOP	PW	14	2000	367.0	367.0	35.0

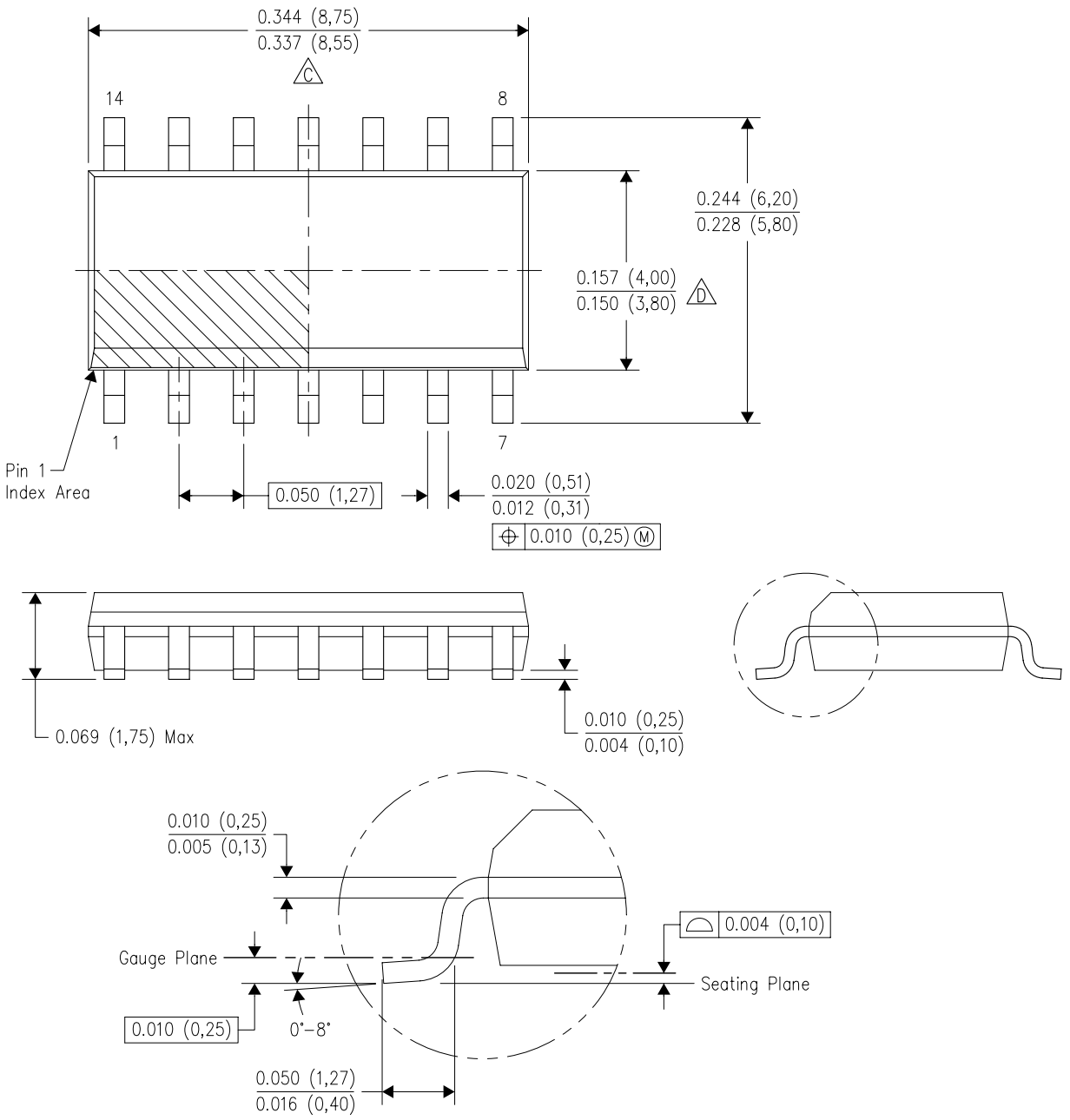
DGK (S–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE



4073329/E 05/06

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
E. Falls within JEDEC MO–187 variation AA, except interlead flash.

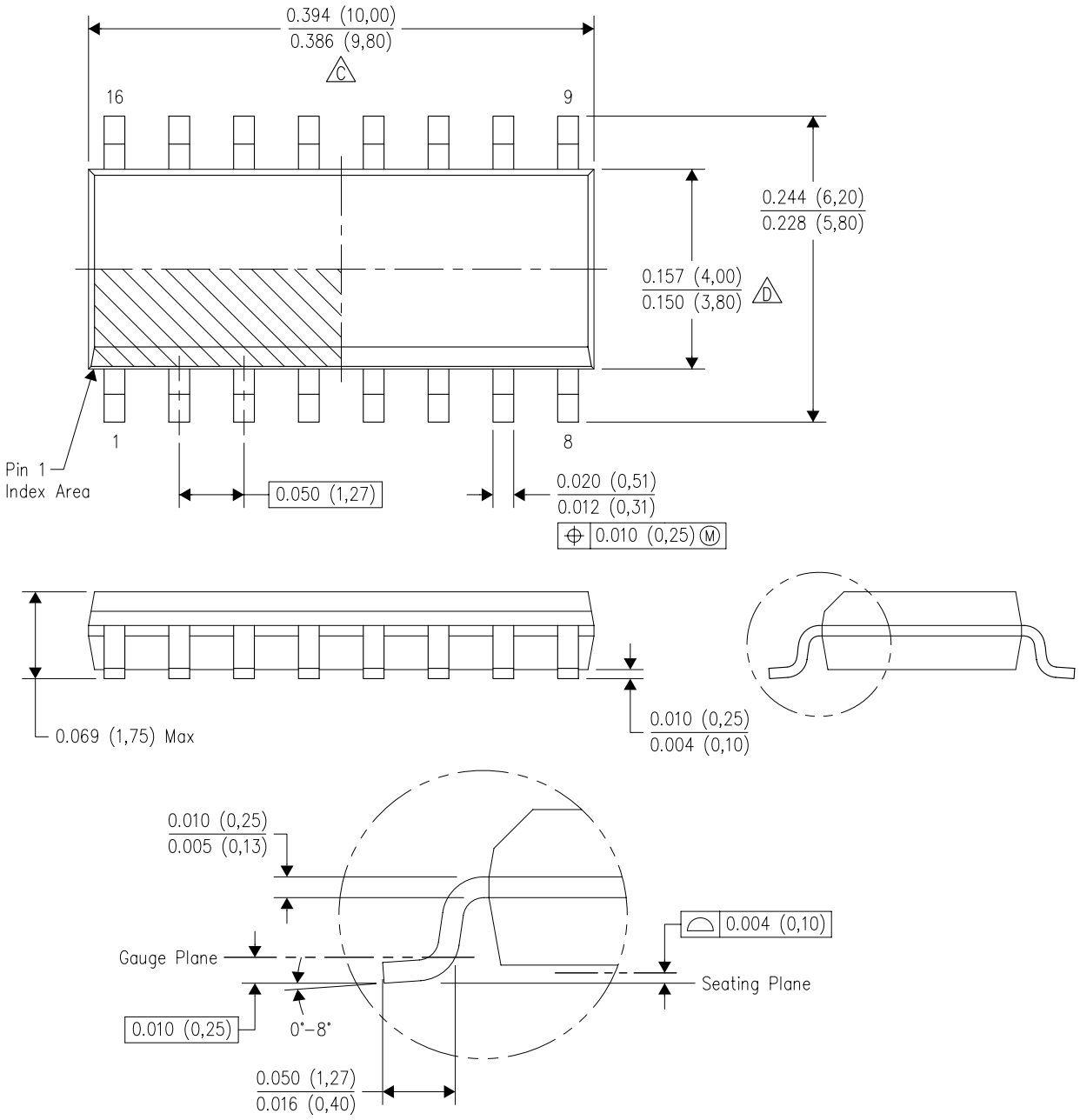
D (R–PDSO–G14) PLASTIC SMALL OUTLINE



4040047–5/M 06/11

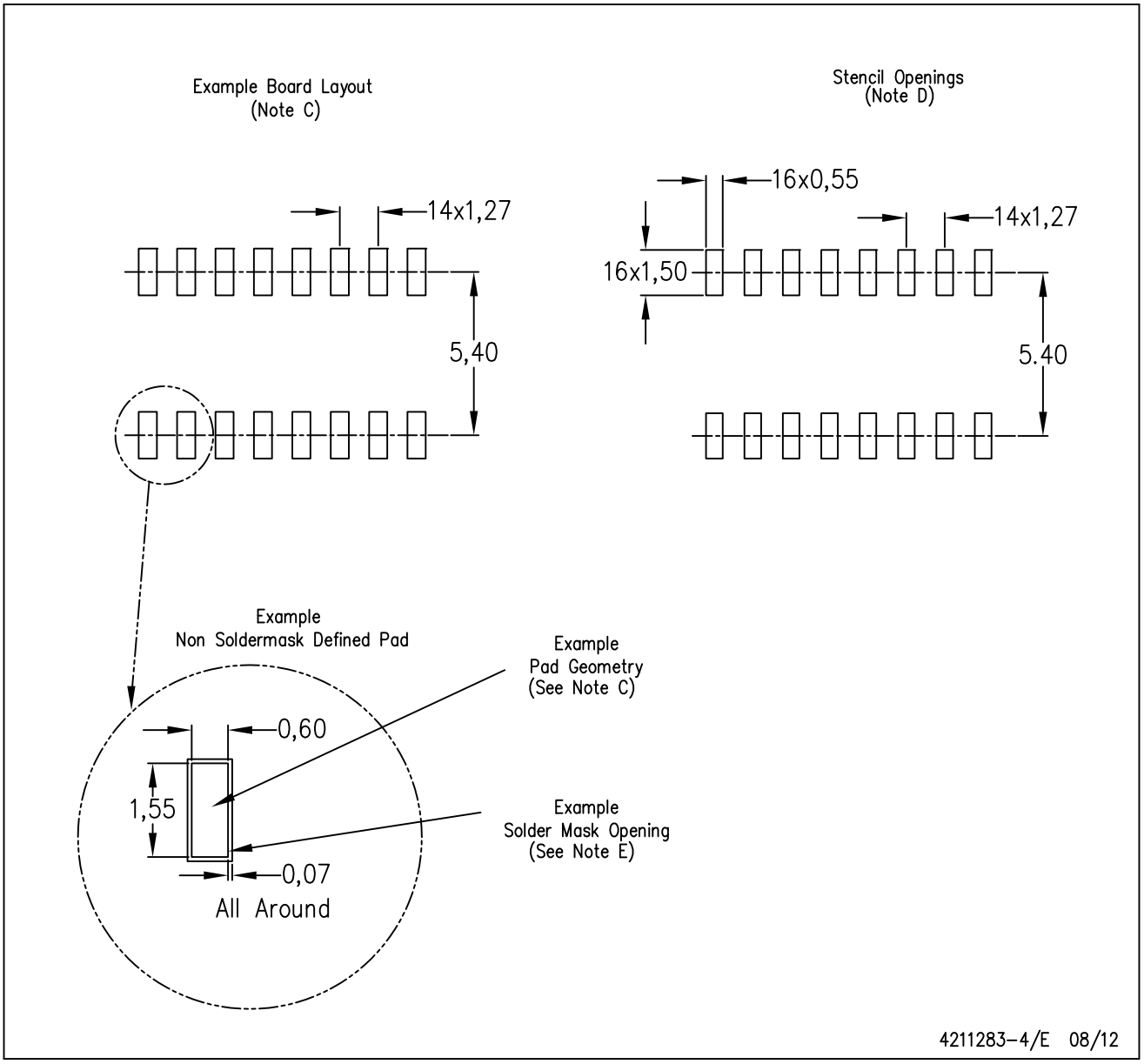
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AB.

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



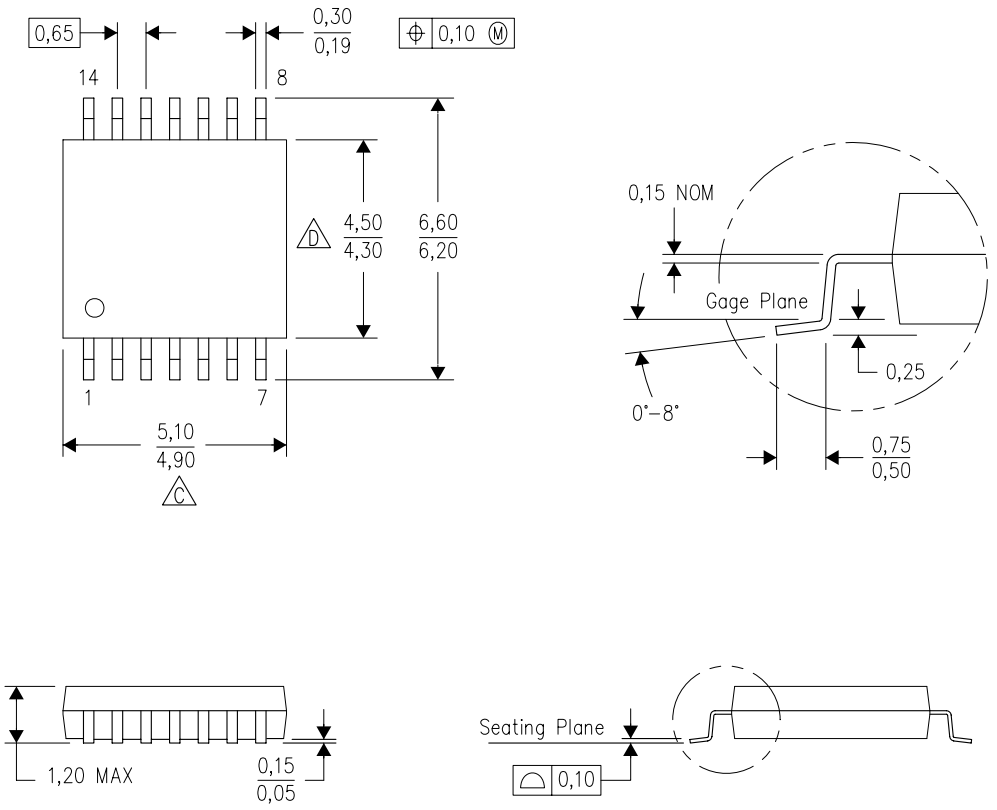
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

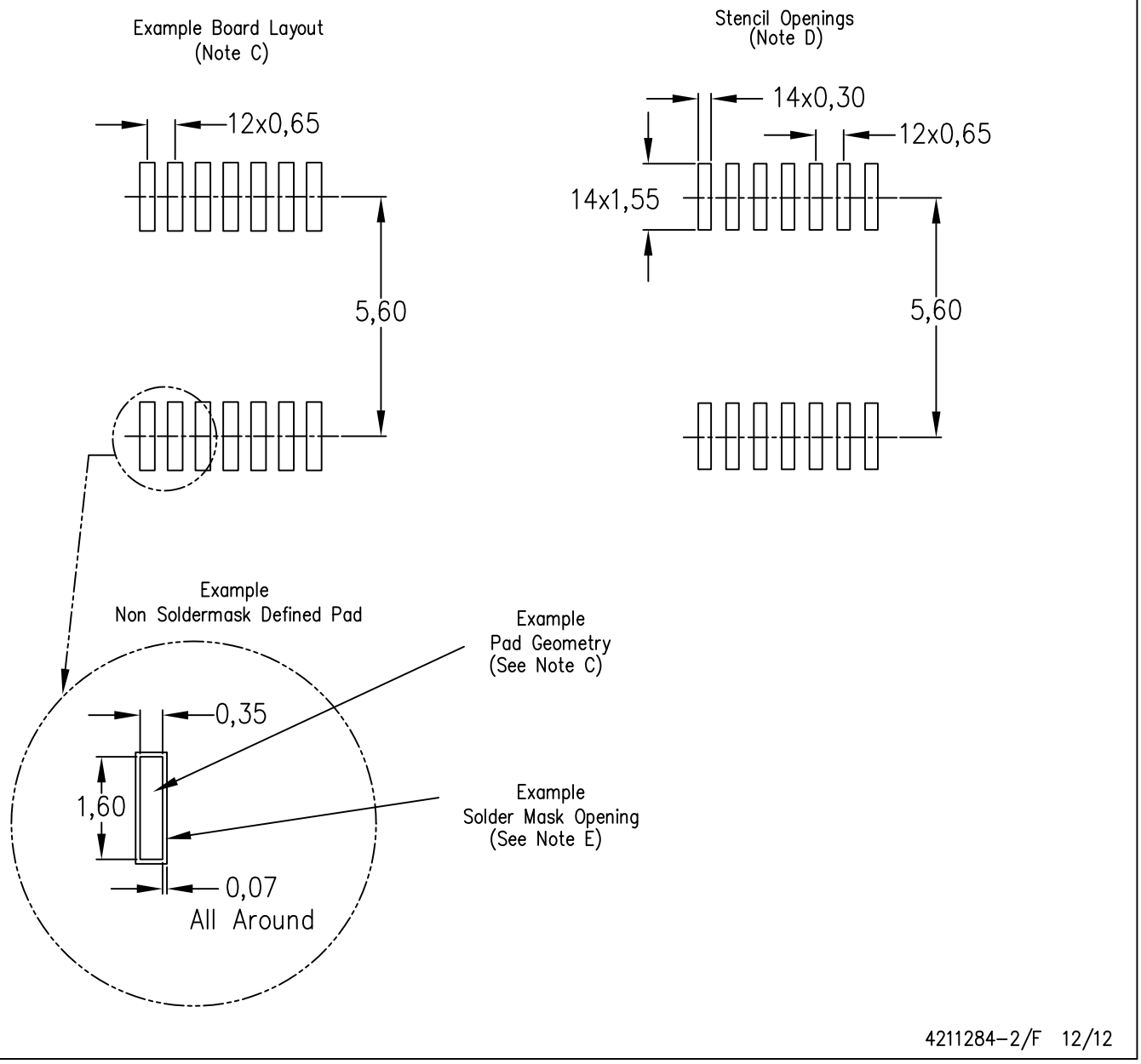
PW (R–PDSO–G14) PLASTIC SMALL OUTLINE



4040064–3/G 02/11

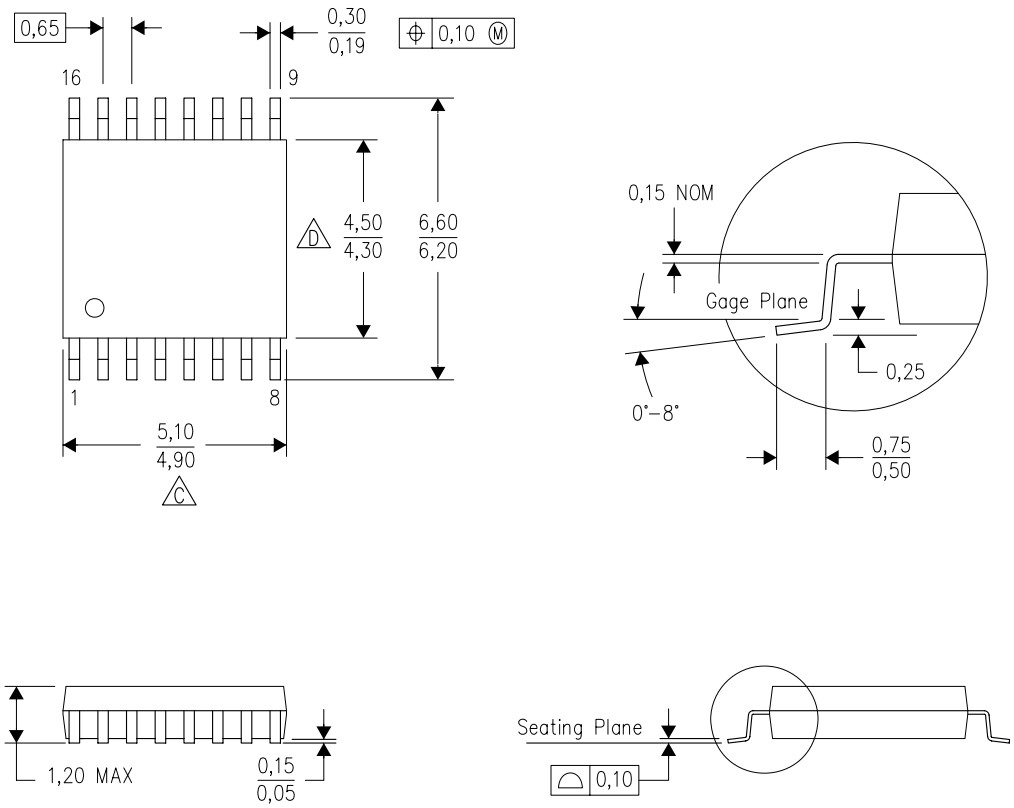
NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

PW (R–PDSO–G14) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

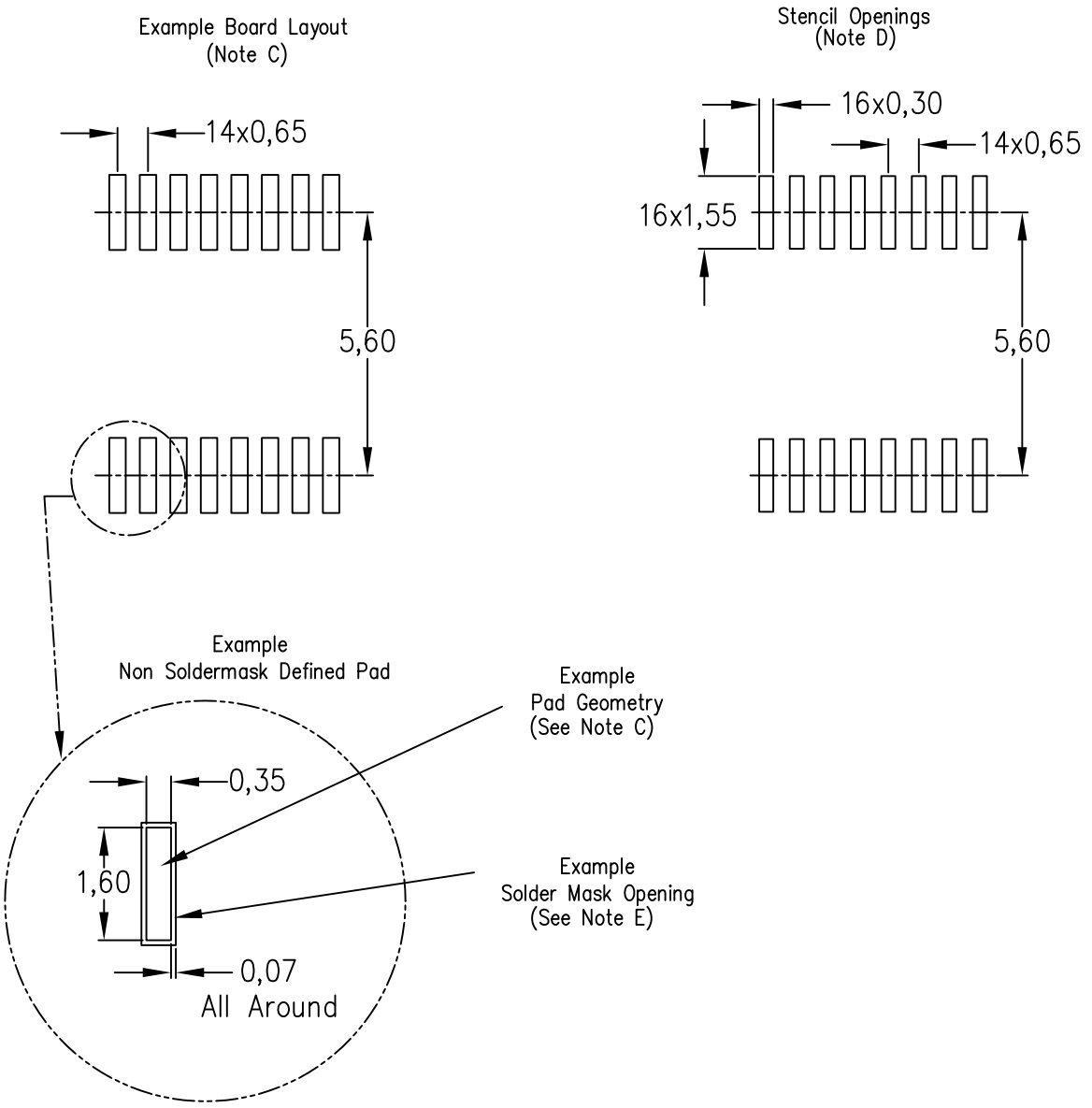
PW (R–PDSO–G16) PLASTIC SMALL OUTLINE



4040064–4/G 02/11

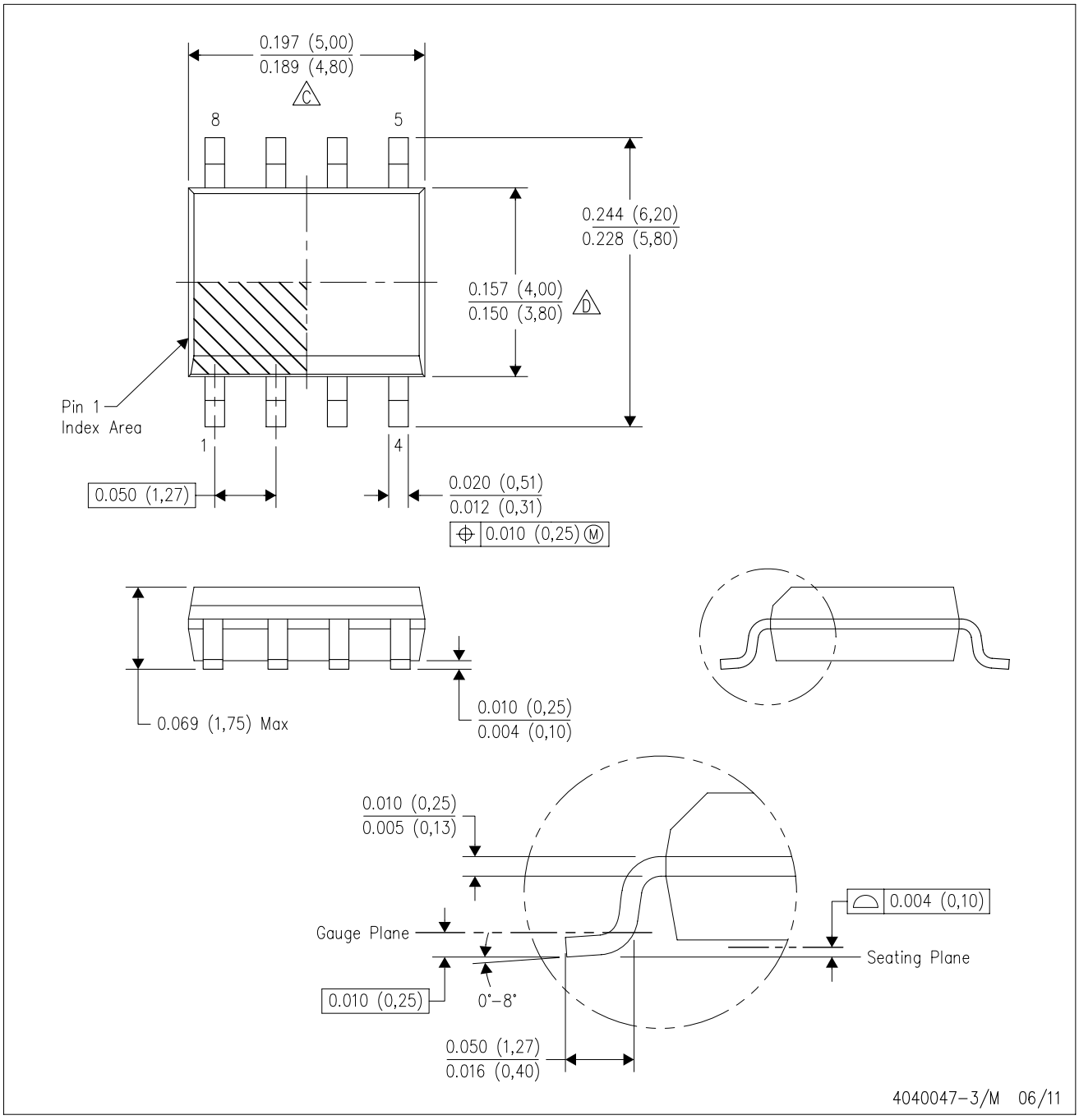
NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

PW (R–PDSO–G16) PLASTIC SMALL OUTLINE



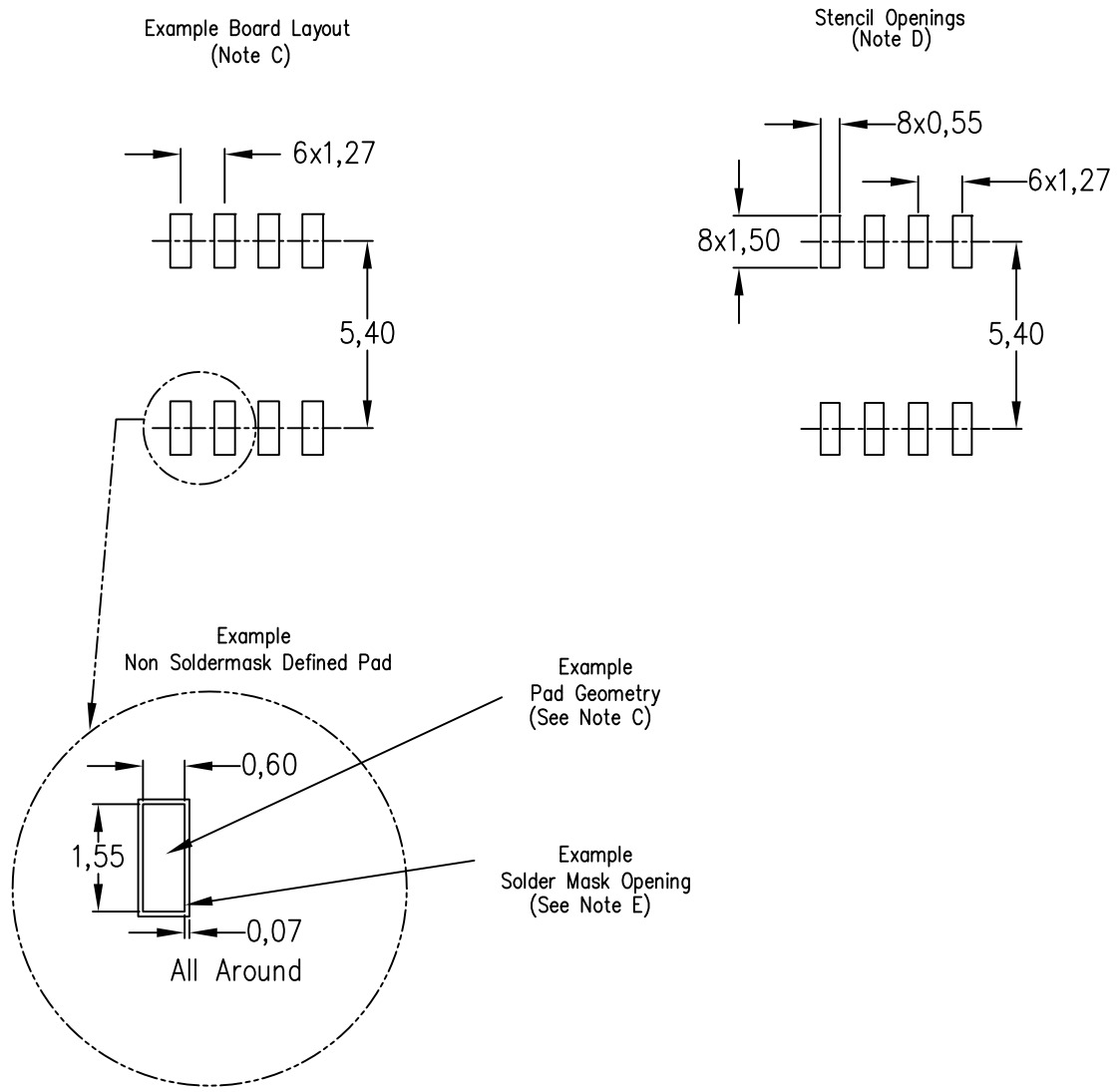
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265