

PROFIBUS RS-485 TRANSCEIVERS

 Check for Samples: [SN65HVD1176](#), [SN75HVD1176](#)

FEATURES

- **Optimized for PROFIBUS Networks**
 - Signaling Rates Up to 40 Mbps
 - Differential Output Exceeds 2.1 V (54 Ω Load)
 - Low Bus Capacitance of 10 pF (Max)
- Meets the Requirements of TIA/EIA-485-A
- ESD Protection Exceeds ±10 kV HBM
- Failsafe Receiver for Bus Open, Short, Idle
- Up to 160 Transceivers on a Bus
- Low Skew During Output Transitions and Driver Enabling / Disabling
- Common-Mode Rejection Up to 50 MHz
- Short-Circuit Current Limit
- Hot Swap Capable
- Thermal Shutdown Protection

APPLICATIONS

- **Process Automation**
 - Chemical Production
 - Brewing and Distillation
 - Paper Mills
- **Factory Automation**
 - Automobile Production
 - Rolling, Pressing, Stamping Machines
 - Networked Sensors
- **General RS-485 Networks**
 - Motor/Motion Control
 - HVAC and Building Automation Networks
 - Networked Security Stations

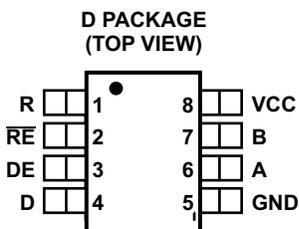
DESCRIPTION

These devices are half-duplex differential transceivers, with characteristics optimized for use in PROFIBUS (EN 50170) applications. The driver output differential voltage exceeds the Profibus requirements of 2.1 V with a 54 Ω load. A signaling rate of up to 40 Mbps allows technology growth to high data transfer speeds. The low bus capacitance provides low signal distortion.

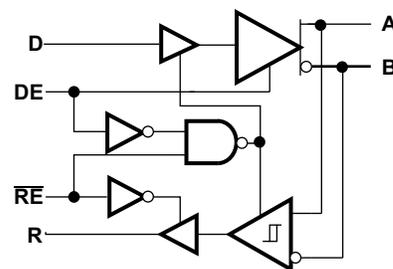
The SN65HVD1176 and SN75HVD1176 meet or exceed the requirements of ANSI standard TIA/EIA-485-A (RS-485) for differential data transmission across twisted-pair networks. The driver outputs and receiver inputs are tied together to form a half-duplex bus port, with one-fifth unit load, allowing up to 160 nodes on a single bus. The receiver output stays at logic high when the bus lines are shorted, left open, or when no driver is active. The driver outputs are in high impedance when the supply voltage is below 2.5 V to prevent bus disturbance during power cycling or during live insertion to the bus. An internal current limit protects the transceiver bus pins in short-circuit fault conditions by limiting the output current to a constant value. Thermal shutdown circuitry protects the device against damage due to excessive power dissipation caused by faulty loading and drive conditions.

The SN75HVD1176 is characterized for operation at temperatures from 0°C to 70°C. The SN65HVD1176 is characterized for operation at temperatures from -40°C to 85°C.

For an isolated version of this device, see the ISO1176 ([SLLS897](#)) with integrated digital isolators.



LOGIC DIAGRAM (POSITIVE LOGIC)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



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.

Table 1. AVAILABLE OPTIONS

T _A	PACKAGED DEVICES ⁽¹⁾	PACKAGE MARKING ⁽²⁾
0°C to 70°C	SN75HVD1176D	VN1176
-40°C to 85°C	SN65HVD1176D	VP1176

- (1) The D package is available taped and reeled. Add an R suffix to the device type (for example, SN65HVD1176DR).
 (2) For the most current package and ordering information, see the Package Option Addendum located at the end of this datasheet or see the TI website at www.ti.com.

ABSOLUTE MAXIMUM RATINGS

over operating junction temperature range unless otherwise noted⁽¹⁾

			SN65HVD1176 SN75HVD1176	UNIT	
V _{CC}	Supply voltage ⁽²⁾		-0.5 to 7	V	
	Voltage at any bus I/O terminal		-9 to 14	V	
	Voltage input, transient pulse, A and B, (through 100 Ω, see Figure 15)		-40 to 40	V	
	Voltage input at any D, DE or \overline{RE} terminal		-0.5 to 7	V	
I _O	Receiver output current		-10 to 10	mA	
	Electrostatic discharge	Human Body Model, (HBM) ⁽³⁾	All pins	4	kV
			Bus terminals and GND	10	kV
T _J	Junction temperature		150	°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. All voltage values are with respect to the network ground terminal unless otherwise noted.
 (2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminal..
 (3) Tested in accordance with JEDEC standard 22. test method A114-A..

RECOMMENDED OPERATING CONDITIONS

			MIN	TYP	MAX	UNIT
V _{CC}	Supply voltage		4.75	5	5.25	V
	Voltage at either bus I/O terminal	A, B	-7		12	V
V _{IH}	High-level input voltage	D, DE, \overline{RE}	2		V _{CC}	V
V _{IL}	Low-level input voltage		0		0.8	V
V _{IL}	Differential input voltage	A with respect to B	-12		12	V
I _O	Output current	Driver	-70		70	mA
		Receiver	-8		8	mA
T _J	Junction temperature ⁽¹⁾	SN65HVD1176	-40		130	°C
		SN75HVD1176	0		130	°C
R _L	Differential load resistance		54			Ω
1/t _{U1}	Signaling rate				40	Mbps

- (1) See the [Thermal Characteristics](#) table for more information on maintenance of this requirement.

ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP ⁽¹⁾	MAX	UNIT	
DRIVER								
V_O	Open-circuit output voltage	A or B,	No load	0		V_{CC}	V	
$ V_{OD(SS)} $	Steady-state differential output voltage magnitude	$R_L = 54 \Omega$	See Figure 1	2.1	2.9		V	
		With common-mode loading, (V_{TEST} from -7 V to 12 V) See Figure 2		2.1	2.7		V	
$\Delta V_{OD(SS)} $	Change in steady-state differential output voltage between logic states	See Figure 1 and Figure 6		-0.2	0	0.2	V	
$V_{OC(SS)}$	Steady-state common-mode output voltage			2	2.5	3	V	
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage	See Figure 5		-0.2	0	0.2	V	
$V_{OC(PP)}$	Peak-to-peak common-mode output voltage			0.5			V	
$V_{OD(RING)}$	Differential output voltage over and under shoot	$R_L = 54 \Omega$, $C_L = 50$ pF, See Figure 6				10%	$V_{OD(PP)}$	
I_I	Input current	D, DE		-50		50	μA	
$I_{O(OFF)}$	Output current with power off	$V_{CC} \leq 2.5$ V		See receiver line input				
I_{OZ}	High impedance state output current	DE at 0 V						
$I_{OS(P)}$	Peak short-circuit output current			$V_{OS} = -7$ V to 12 V		-250	250	mA
$I_{OS(SS)}$	Steady-state short-circuit output current	DE at V_{CC} , See Figure 8	$V_{OS} > 4$ V, Output driving low		60	90	135	mA
			$V_{OS} < 1$ V, Output driving high		-135	-90	-60	mA
C_{OD}	Differential output capacitance			See receiver C_{ID}			pF	
RECEIVER								
$V_{IT(+)}$	Positive-going differential input voltage threshold	See Figure 9	$V_O = 2.4$ V, $I_O = -8$ mA		-80	-20	mV	
$V_{IT(-)}$	Negative-going differential input voltage threshold		$V_O = 0.4$ V, $I_O = 8$ mA	-200	-120		mV	
V_{HYS}	Hysteresis voltage ($V_{IT+} - V_{IT-}$)			40			mV	
V_{OH}	High-level output voltage	$V_{ID} = 200$ mV, $I_{OH} = -8$ mA, See Figure 9		4	4.6		V	
V_{OL}	Low-level output voltage	$V_{ID} = -200$ mV, $I_{OL} = 8$ mA, See Figure 9		0.2		0.4	V	
I_A, I_B	Bus pin input current	$V_I = -7$ V to 12 V, Other input = 0 V	$V_{CC} = 4.75$ V to 5.25 V		-160	200	μA	
$I_{A(OFF)}, I_{B(OFF)}$			$V_{CC} = 0$ V					
I_I	Receiver enable input current	\overline{RE}		-50		50	μA	
I_{OZ}	High-impedance - state output current	$\overline{RE} = V_{CC}$		-1		1	μA	
R_I	Input resistance			60			k Ω	
C_{ID}	Differential input capacitance	Test input signal is a 1.5 MHz sine wave with amplitude 1 V_{PP} , capacitance measured across A and B			7	10	pF	
C_{MR}	Common mode rejection	See Figure 11			4		V	

(1) All typical values are at $V_{CC} = 5$ V and 25°C.

SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
DRIVER						
t_{PLH}	Propagation delay time low-level-to-high-level output	$R_L = 54 \Omega$, $C_L = 50 \text{ pF}$, See Figure 3	4	7	10	ns
t_{PHL}	Propagation delay time high-level-to-low-level output		4	7	10	ns
$t_{sk(p)}$	Pulse skew $ t_{PLH} - t_{PHL} $		0		2	ns
t_r	Differential output rise time		2	3	7.5	ns
t_f	Differential output fall time		2	3	7.5	ns
$t_{i(MLH)}$, $t_{i(MHL)}$	Output transition skew	See Figure 4	0.2		1	ns
$t_{p(AZH)}$, $t_{p(BZH)}$ $t_{p(AZL)}$, $t_{p(BZL)}$	Propagation delay time, high-impedance-to-active output	$R_L = 110 \Omega$, $C_L = 50 \text{ pF}$ See Figure 7	\overline{RE} at 0 V	10	20	ns
$t_{p(AHZ)}$, $t_{p(BHZ)}$ $t_{p(ALZ)}$, $t_{p(BLZ)}$	Propagation delay time, active-to- high-impedance output			10	20	ns
$ t_{p(AZL)} - t_{p(BZH)} $ $ t_{p(AZH)} - t_{p(BZL)} $	Enable skew time			0.55	1.5	ns
$ t_{p(ALZ)} - t_{p(BHZ)} $ $ t_{p(AHZ)} - t_{p(BLZ)} $	Disable skew time				2.5	ns
$t_{p(AZH)}$, $t_{p(BZH)}$ $t_{p(AZL)}$, $t_{p(BZL)}$	Propagation delay time, high-impedance-to-active output (from sleep mode)	\overline{RE} at 5 V	1	4		μs
$t_{p(AHZ)}$, $t_{p(BHZ)}$ $t_{p(ALZ)}$, $t_{p(BLZ)}$	Propagation delay time, active-output-to high-impedance (to sleep mode)		30	50		ns
$t_{(CFB)}$	Time from application of short-circuit to current foldback	See Figure 8	0.5			μs
$t_{(TSD)}$	Time from application of short-circuit to thermal shutdown	$T_A = 25^\circ\text{C}$, See Figure 8	100			μs
RECEIVER						
t_{PLH}	Propagation delay time, low-to-high level output	See Figure 10	20	25		ns
t_{PHL}	Propagation delay time, high-to-low level output		20	25		ns
$t_{sk(p)}$	Pulse skew $ t_{PLH} - t_{PHL} $		1	2		ns
t_r	Receiver output voltage rise time		2	4		ns
t_f	Receiver output voltage fall time		2	4		ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	DE at V_{CC} , See Figure 13		20		ns
t_{PHZ}	Propagation delay time, high-level-to-high-impedance output			20		ns
t_{PZL}	Propagation delay time, high-impedance-to-low-level output	DE at V_{CC} , See Figure 14		20		ns
t_{PLZ}	Propagation delay time, low-level-to-high-impedance output			20		ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output (standby to active)	DE at 0 V, See Figure 12	1	4		μs
t_{PHZ}	Propagation delay time, high-level-to-high-impedance output (active to standby)		13	20		ns
t_{PZL}	Propagation delay time, high-impedance-to-low-level output (standby to active)	DE at 0 V, See Figure 12	2	4		μs
t_{PLZ}	Propagation delay time, low-level-to-high-impedance output (active to standby)		13	20		ns

(1) All typical values are at $V_{CC} = 5 \text{ V}$ and 25°C .

Table 2. SUPPLY CURRENT

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC} Supply Current ⁽¹⁾	Driver and receiver, \overline{RE} at 0 V, DE at V_{CC} , All other inputs open, no load		4	6	mA
	Driver only, \overline{RE} at V_{CC} , DE at V_{CC} , All other inputs open, no load		3.8	6	mA
	Receiver only, \overline{RE} at 0 V, DE at 0 V, All other inputs open, no load		3.6	6	mA
	Standby only, \overline{RE} at V_{CC} , DE at 0 V, All other inputs open		0.2	5	μ A

(1) Over recommended operating conditions

THERMAL CHARACTERISTICS⁽¹⁾

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
θ_{JA} Junction-to-ambient thermal resistance ⁽³⁾	Low-K board ⁽⁴⁾ , no air flow		208.3		$^{\circ}$ C/W
	High-K board ⁽⁵⁾ , no air flow		128.7		$^{\circ}$ C/W
θ_{JB} Junction-to-board thermal resistance	High-K board		77.6		$^{\circ}$ C/W
θ_{JC} Junction-to-case thermal resistance			43.9		$^{\circ}$ C/W
P_D Device power dissipation	$R_L = 54 \Omega$, $C_L = 50$ pF, 0 V to 3 V, 15 MHz, 50% duty cycle square wave input, driver and receiver enabled		277	318	mW
T_A Ambient air temperature	SN65HVD1176 Low-K board, no air flow, $P_D = 318$ mW	-40		64	$^{\circ}$ C
	SN75HVD1176	0			$^{\circ}$ C
	SN65HVD1176 High-K board, no air flow, $P_D = 318$ mW	-40		89	$^{\circ}$ C
	SN75HVD1176	0			$^{\circ}$ C
T_{SD} Thermal shut down junction temperature			150		$^{\circ}$ C

- (1) See [Application Information](#) section for an explanation of these parameters.
- (2) All typical values are with $V_{CC} = 5$ V and $T_A = 25^{\circ}$ C.
- (3) The intent of θ_{JA} specification is solely for a thermal performance comparison of one package to another in a standardized environment. This methodology is not meant to and will not predict the performance of a package in an application-specific environment.
- (4) JESD51-3, Low Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages.
- (5) JESD51-7, High Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages.

PARAMETER MEASUREMENT INFORMATION

NOTE

Test load capacitance includes probe and jig capacitance (unless otherwise specified).

Signal generator characteristics: rise and fall time < 6 ns, pulse rate 100 kHz, 50% duty cycle, $Z_o = 50 \Omega$ (unless otherwise specified).

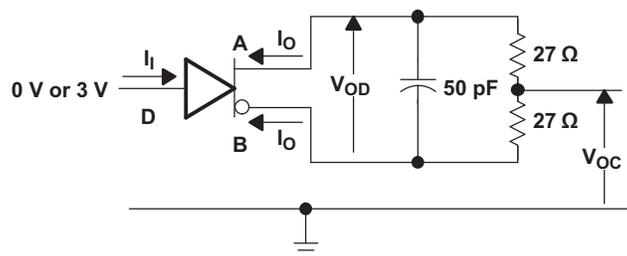


Figure 1. Driver Test Circuit, V_{OD} and V_{OC} Without Common-Mode Loading

PARAMETER MEASUREMENT INFORMATION (continued)

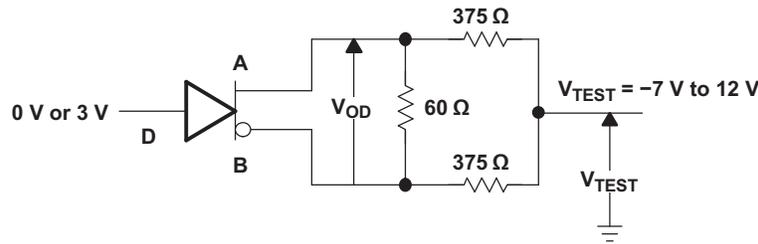


Figure 2. Driver Test Circuit, V_{OD} With Common-Mode Loading

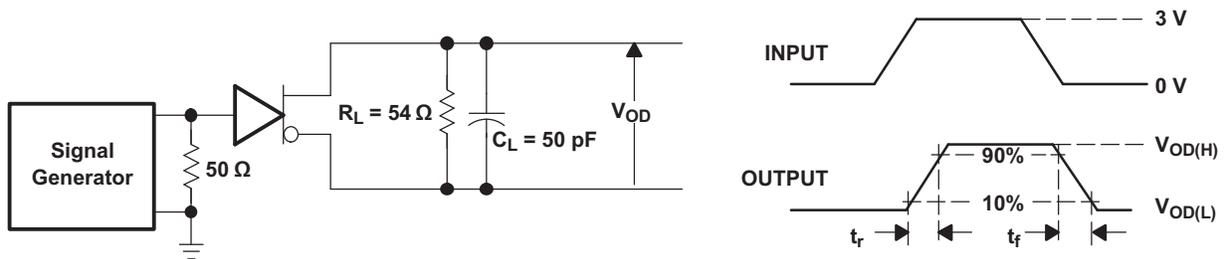


Figure 3. Driver Switching Test Circuit and Rise/Fall Time Measurement

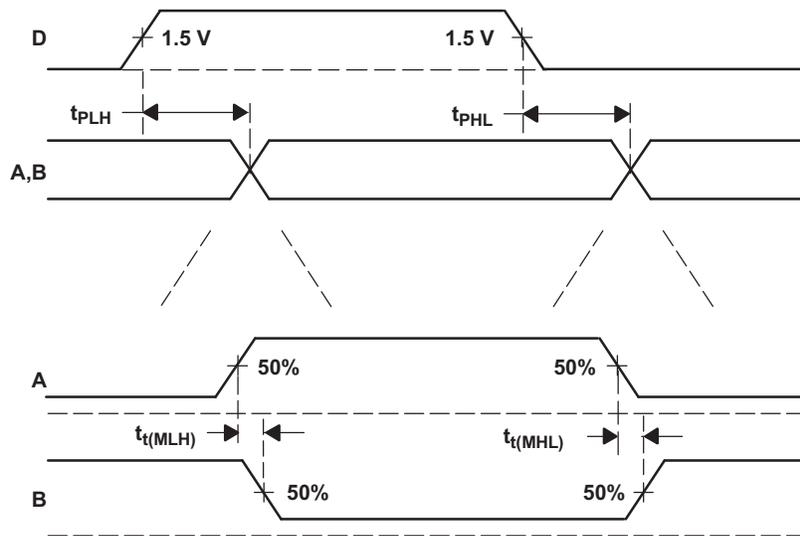


Figure 4. Driver Switching Waveforms for Propagation Delay and Output Midpoint Time Measurements

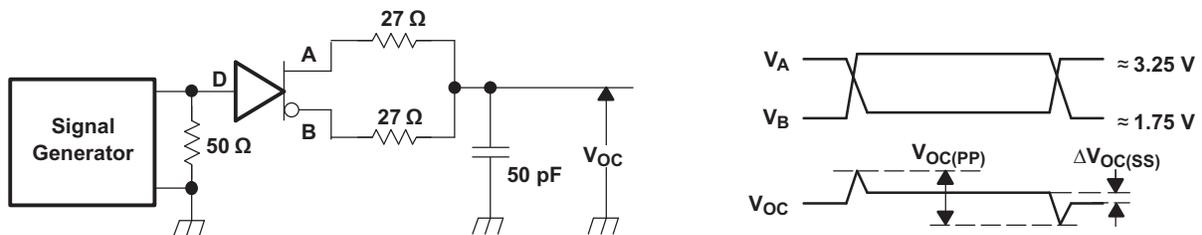
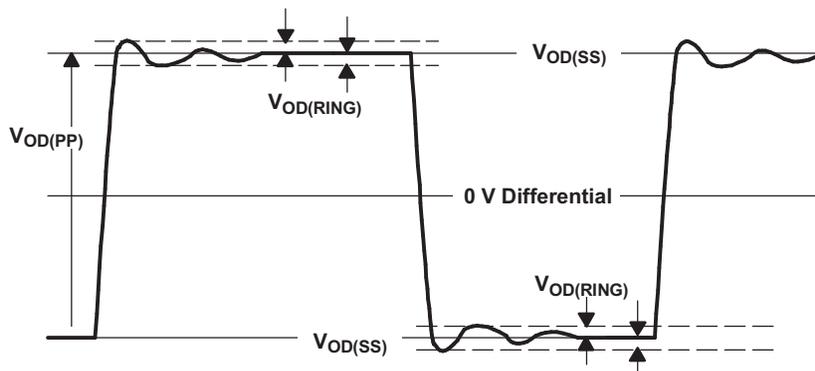


Figure 5. Driver V_{OC} Test Circuit and Waveforms

PARAMETER MEASUREMENT INFORMATION (continued)



- (1) $V_{OD(RING)}$ is measured at four points on the output waveform, corresponding to overshoot and undershoot from the $V_{OD(H)}$ and $V_{OD(L)}$ steady state values.

Figure 6. $V_{OD(RING)}$ Waveform and Definitions

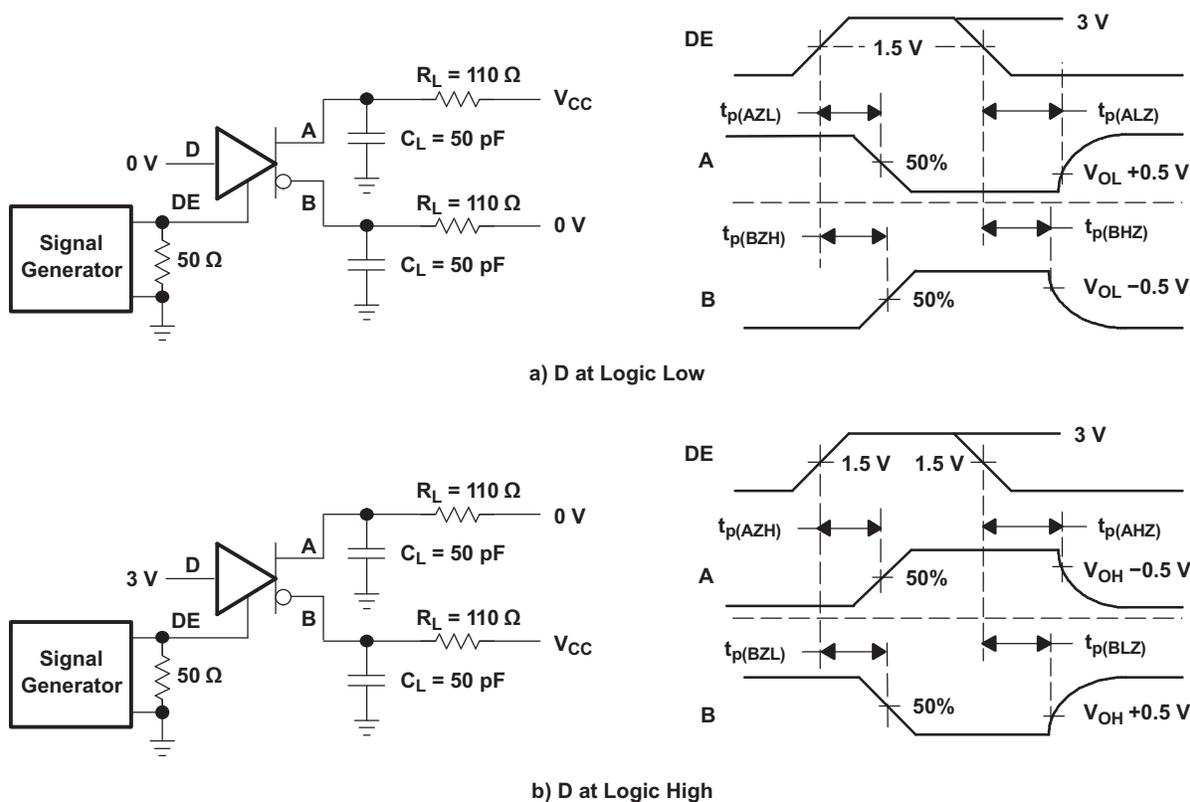


Figure 7. Driver Enable/Disable Test

PARAMETER MEASUREMENT INFORMATION (continued)

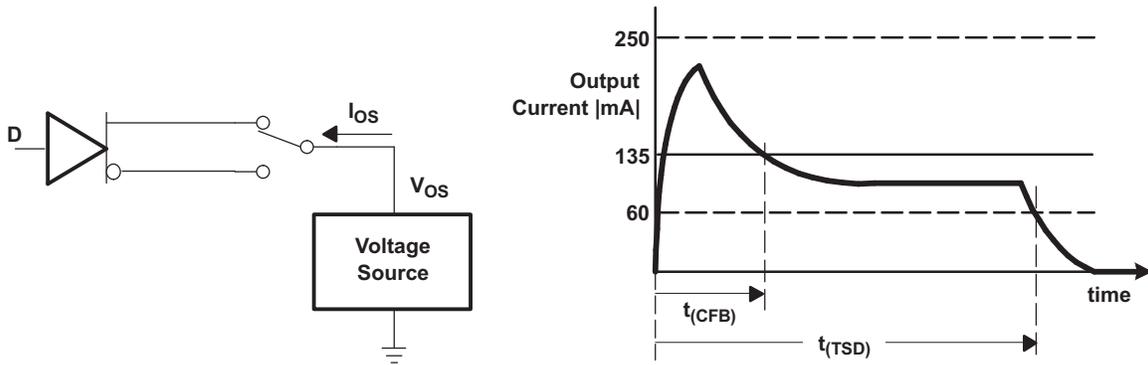


Figure 8. Driver Short-Circuit Test Circuit and Waveforms (Short Circuit applied at Time t = 0)

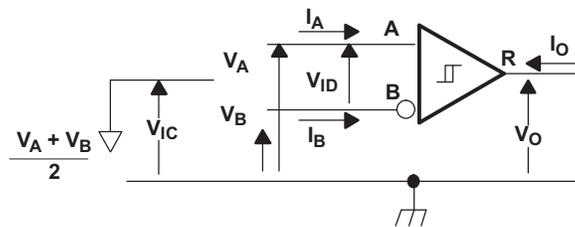


Figure 9. Receiver DC Parameter Definitions

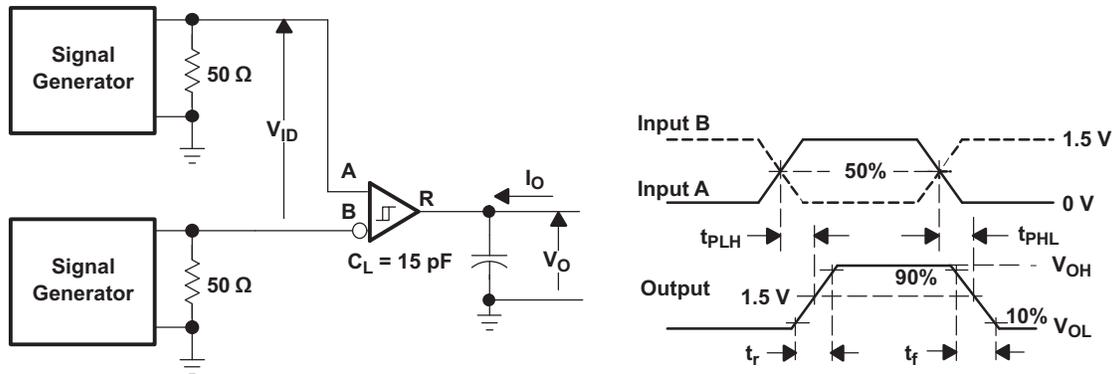


Figure 10. Receiver Switching Test Circuit and Waveforms

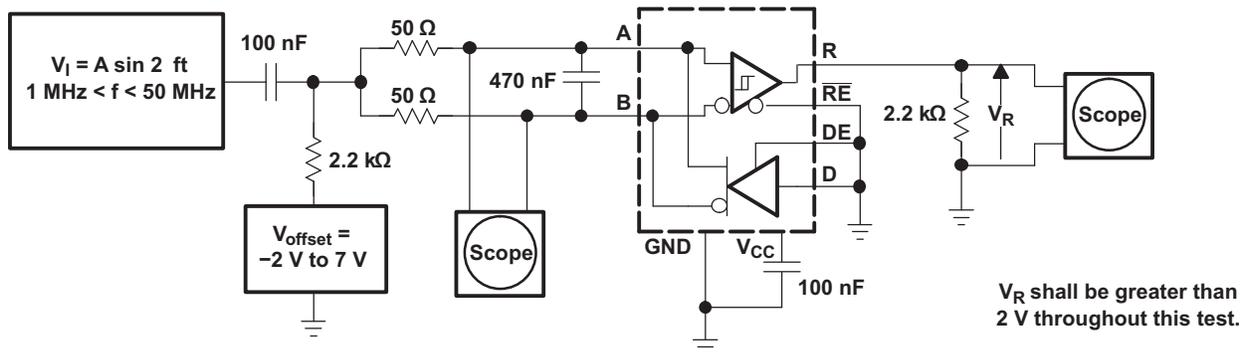


Figure 11. Receiver Common-Mode Rejection Test Circuit

PARAMETER MEASUREMENT INFORMATION (continued)

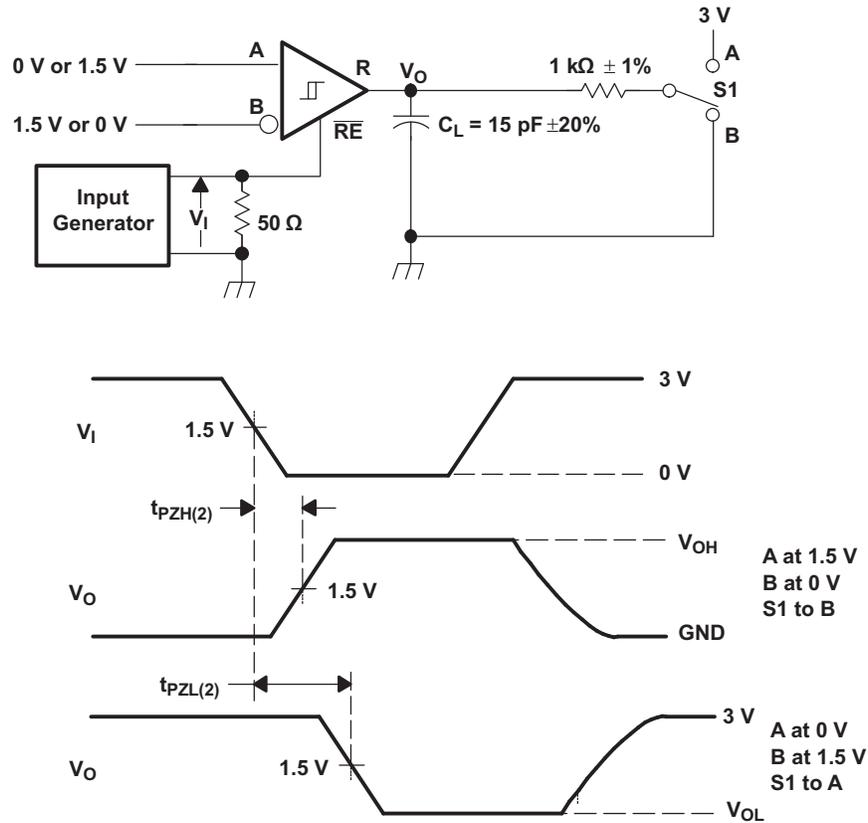


Figure 12. Receiver Enable Time From Standby (Driver Disabled)

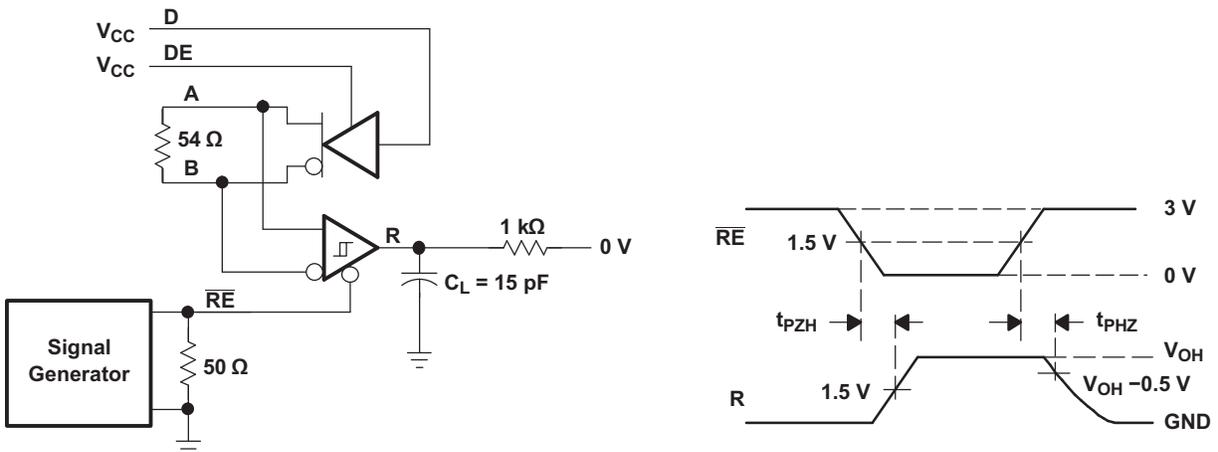


Figure 13. Receiver Enable Test Circuit and Waveforms, Data Output High (Driver Active)

PARAMETER MEASUREMENT INFORMATION (continued)

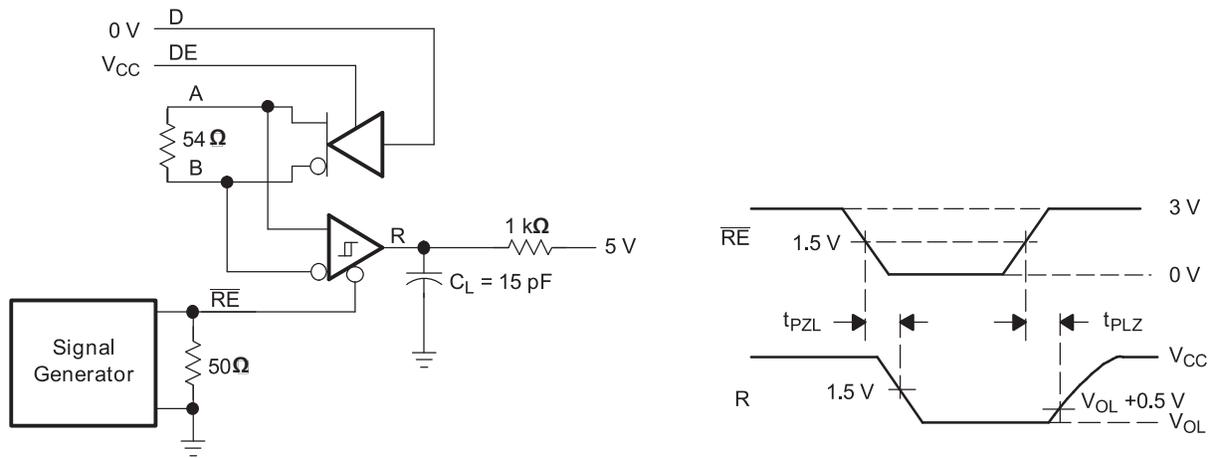


Figure 14. Receiver Enable Test Circuit and Waveforms, Data Output Low (Driver Active)

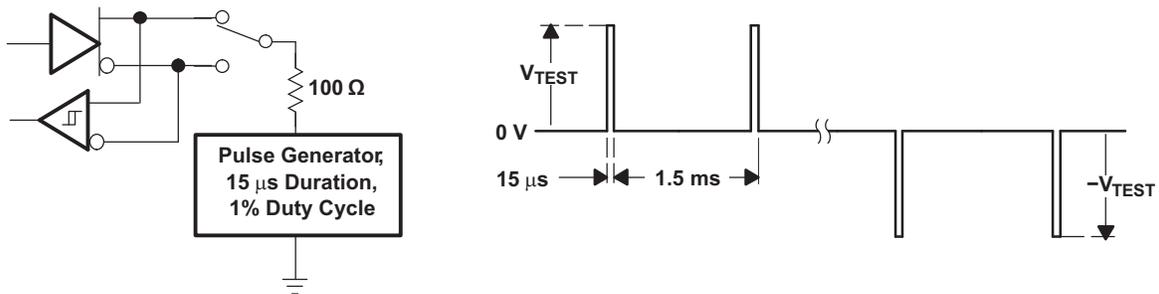


Figure 15. Test Circuit and Waveforms, Transient Overvoltage Test

DEVICE INFORMATION

Table 3. Driver Function Table⁽¹⁾

INPUT	ENABLE	OUTPUTS	
		A	B
H	H	H	L
L	H	L	H
X	L	Z	Z
X	OPEN	Z	Z
OPEN	H	H	L

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

Table 4. Receiver Function Table⁽¹⁾

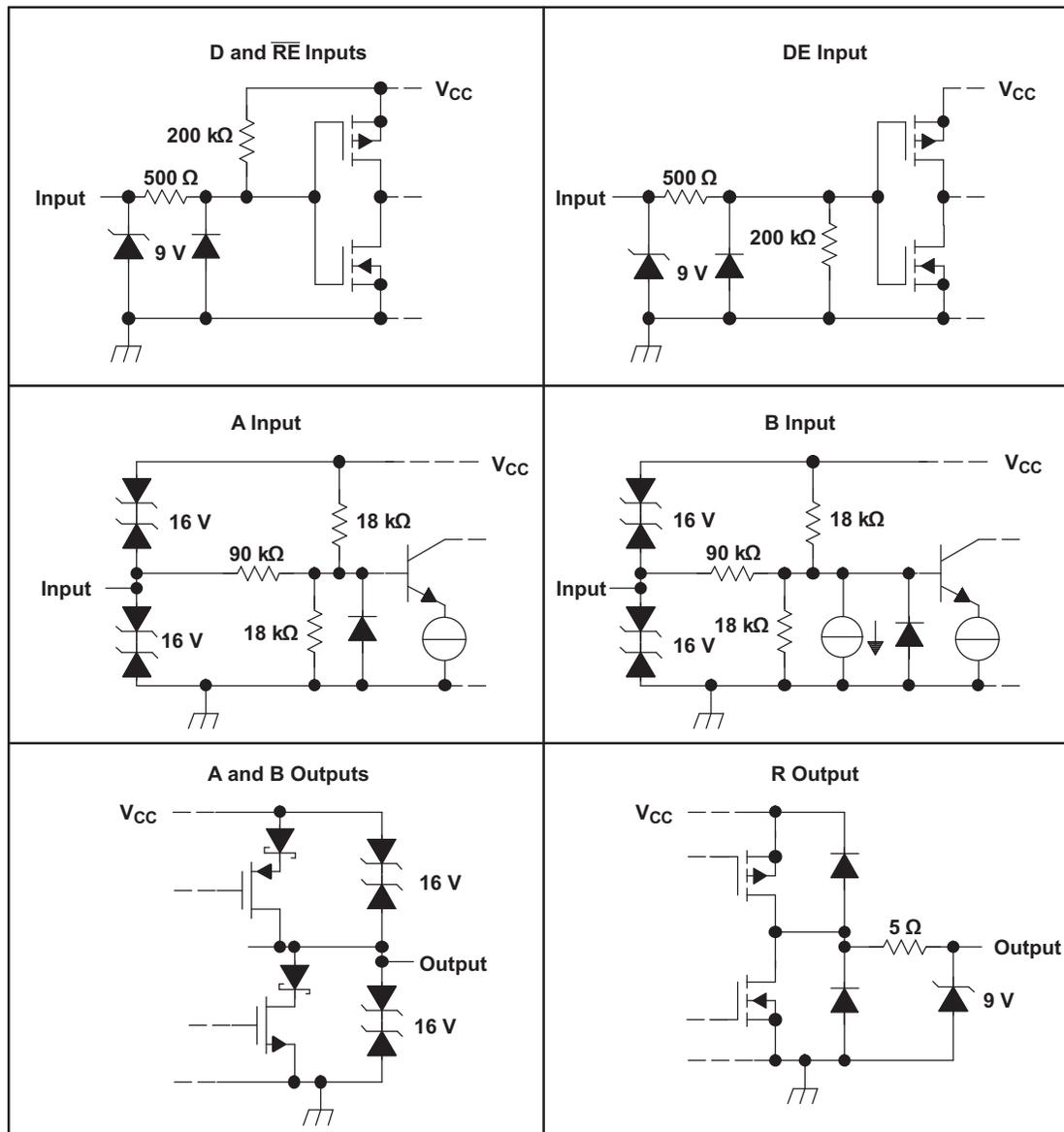
DIFFERENTIAL INPUT $V_{ID} = (V_A - V_B)$	ENABLE \overline{RE}	OUTPUT R
$V_{ID} \geq 0.02 \text{ V}$	L	H
$-0.2 \text{ V} < V_{ID} < -0.02 \text{ V}$	L	?

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

Table 4. Receiver Function Table⁽¹⁾ (continued)

DIFFERENTIAL INPUT $V_{ID} = (V_A - V_B)$	ENABLE RE	OUTPUT R
$V_{ID} \leq -0.2$ V	L	L
X	H	Z
X	OPEN	Z
Open Circuit	L	H
Short Circuit	L	H
Idle (terminated) bus	L	H

EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS



TYPICAL CHARACTERISTICS

DIFFERENTIAL OUTPUT VOLTAGE
vs
LOAD CURRENT

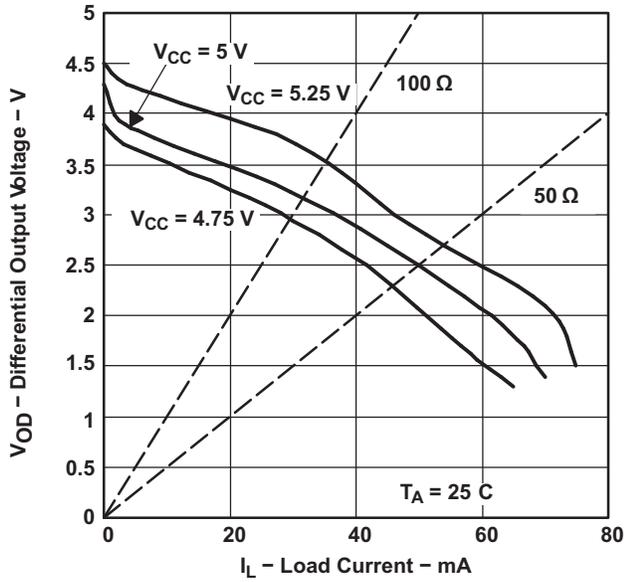


Figure 16.

DRIVER SUPPLY CURRENT
vs
SIGNALING RATE

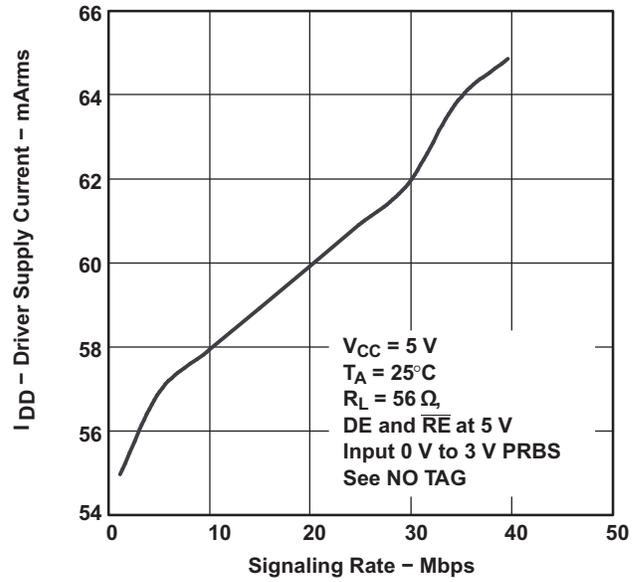


Figure 17.

DRIVER OUTPUT TRANSITION SKEW
vs
FREE-AIR TEMPERATURE

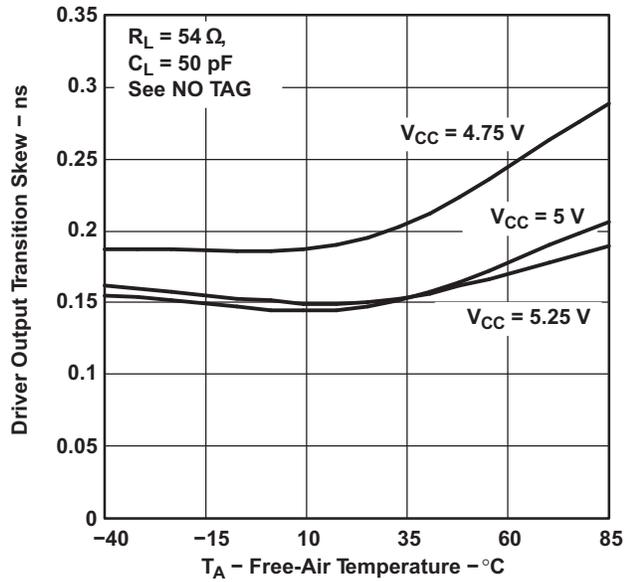


Figure 18.

DRIVER RISE, FALL TIME
vs
FREE-AIR TEMPERATURE

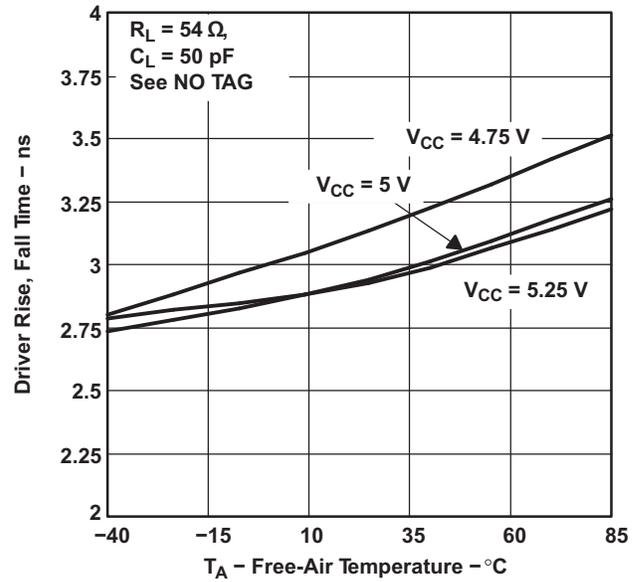


Figure 19.

TYPICAL CHARACTERISTICS (continued)
DRIVER ENABLE SKEW
vs
FREE-AIR TEMPERATURE

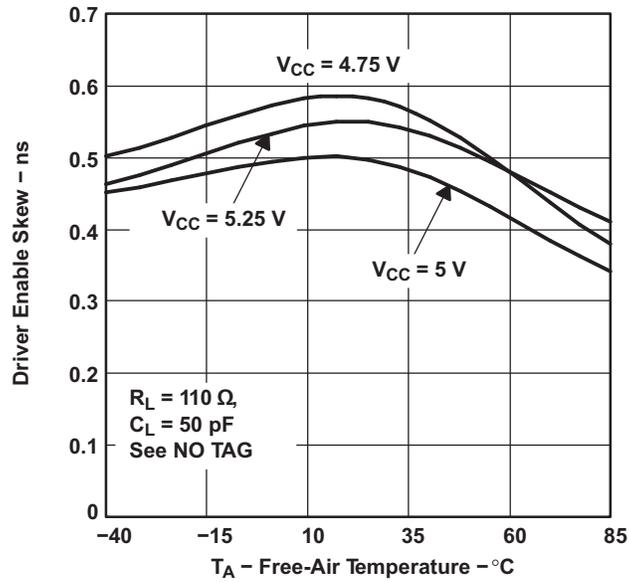


Figure 20.

APPLICATION INFORMATION

Thermal Characteristics of IC Packages

θ_{JA} (**Junction-to-Ambient Thermal Resistance**) is defined as the difference in junction temperature to ambient temperature divided by the operating power.

θ_{JA} is *not* a constant and is a strong function of:

- PCB design (50% variation)
- altitude (20% variation)
- device power (5% variation)

θ_{JA} can be used to compare the thermal performance of packages if the specific test conditions are defined and used. Standardized testing includes specification of PCB construction, test chamber volume, sensor locations, and the thermal characteristics of holding fixtures. θ_{JA} is often misused when it is used to calculate junction temperatures for other installations.

TI uses two test PCBs as defined by JEDEC specifications. The low-k board gives *average* in-use condition thermal performance, and it consists of a single copper trace layer 25 mm long and 2-oz thick. The high-k board gives *best case* in-use condition, and it consists of two 1-oz buried power planes with a single copper trace layer 25 mm long and 2-oz thick. A 4% to 50% difference in θ_{JA} can be measured between these two test cards

θ_{JC} (**Junction-to-Case Thermal Resistance**) is defined as difference in junction temperature to case divided by the operating power. It is measured by putting the mounted package up against a copper block cold plate to force heat to flow from die, through the mold compound into the copper block.

θ_{JC} is a useful thermal characteristic when a heatsink is applied to package. It is not a useful characteristic to predict junction temperature because it provides pessimistic numbers if the case temperature is measured in a nonstandard system and junction temperatures are backed out. It can be used with θ_{JB} in 1-dimensional thermal simulation of a package system.

θ_{JB} (**Junction-to-Board Thermal Resistance**) is defined as the difference in the junction temperature and the PCB temperature at the center of the package (closest to the die) when the PCB is clamped in a cold-plate structure. θ_{JB} is only defined for the high-k test card. θ_{JB} provides an overall thermal resistance between the die and the PCB. It includes a bit of the PCB thermal resistance (especially for BGA's with thermal balls) and can be used for simple 1-dimensional network analysis of package system (see [Figure 21](#)).

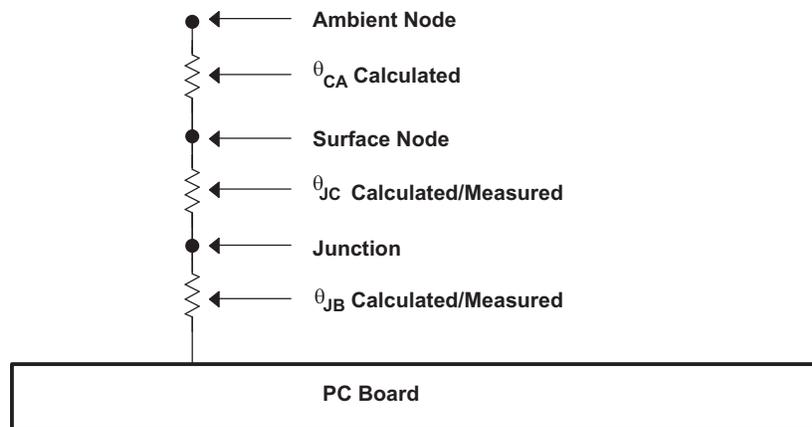


Figure 21. Thermal Resistance

REVISION HISTORY

Changes from Revision E (August 2008) to Revision F	Page
• Changed RE to \overline{RE} in the pinout and Logic Diagram	1

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65HVD1176D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VP1176	Samples
SN65HVD1176DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VP1176	Samples
SN65HVD1176DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VP1176	Samples
SN65HVD1176DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VP1176	Samples
SN75HVD1176D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	VN1176	Samples
SN75HVD1176DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	VN1176	Samples
SN75HVD1176DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	VN1176	Samples
SN75HVD1176DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	VN1176	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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

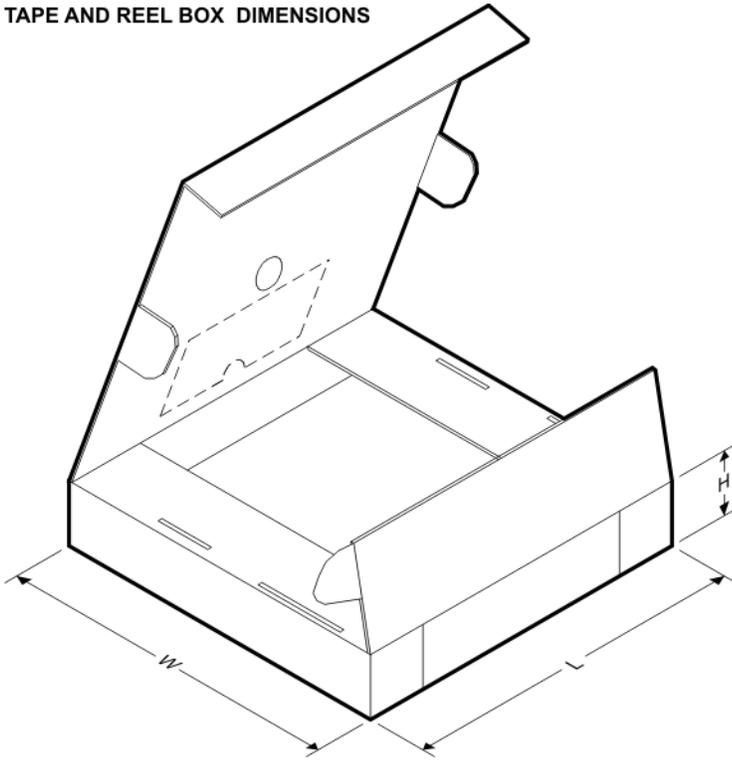


QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN65HVD1176DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
SN75HVD1176DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

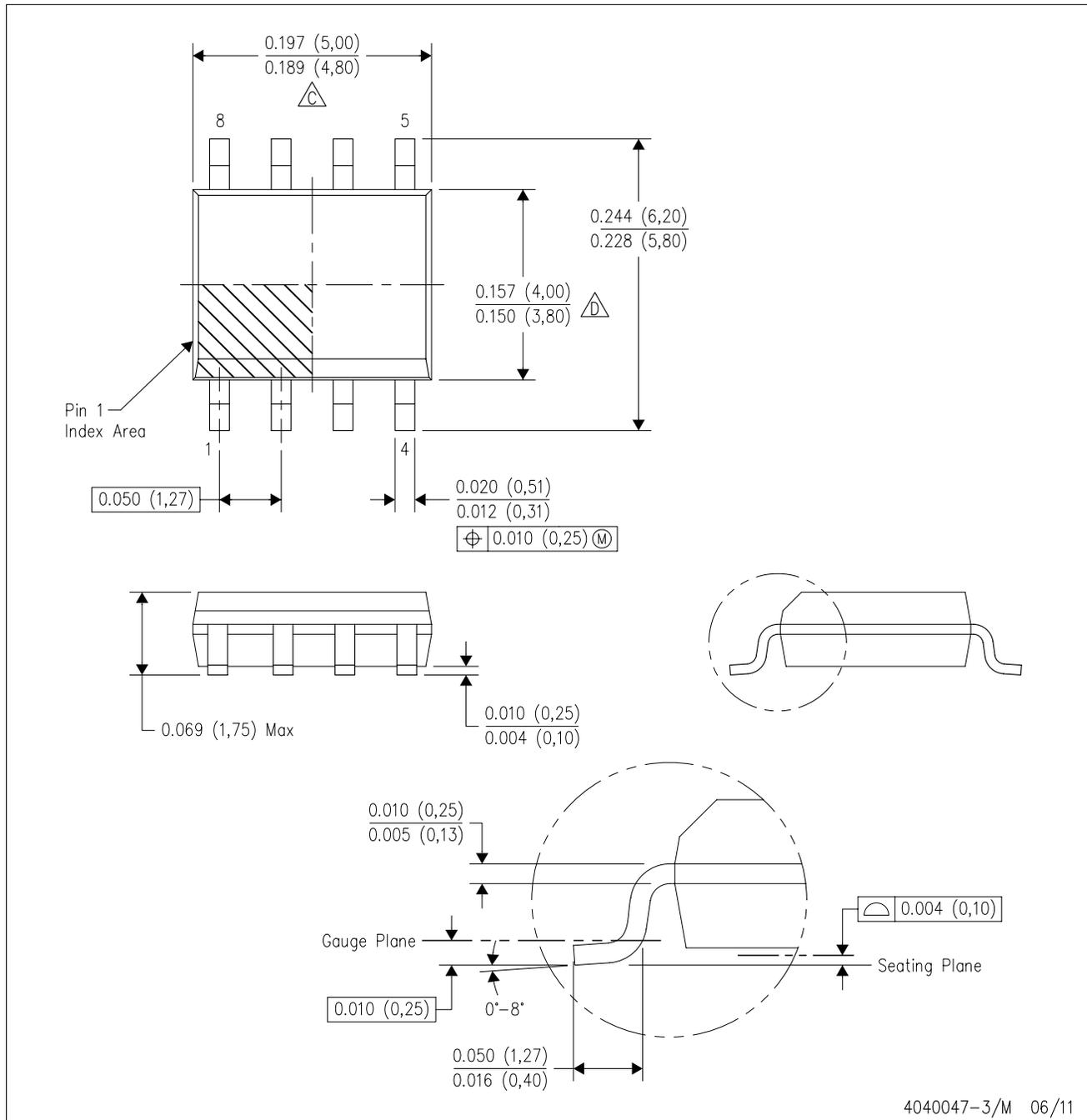
TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65HVD1176DR	SOIC	D	8	2500	340.5	338.1	20.6
SN75HVD1176DR	SOIC	D	8	2500	340.5	338.1	20.6

D (R-PDSO-G8)

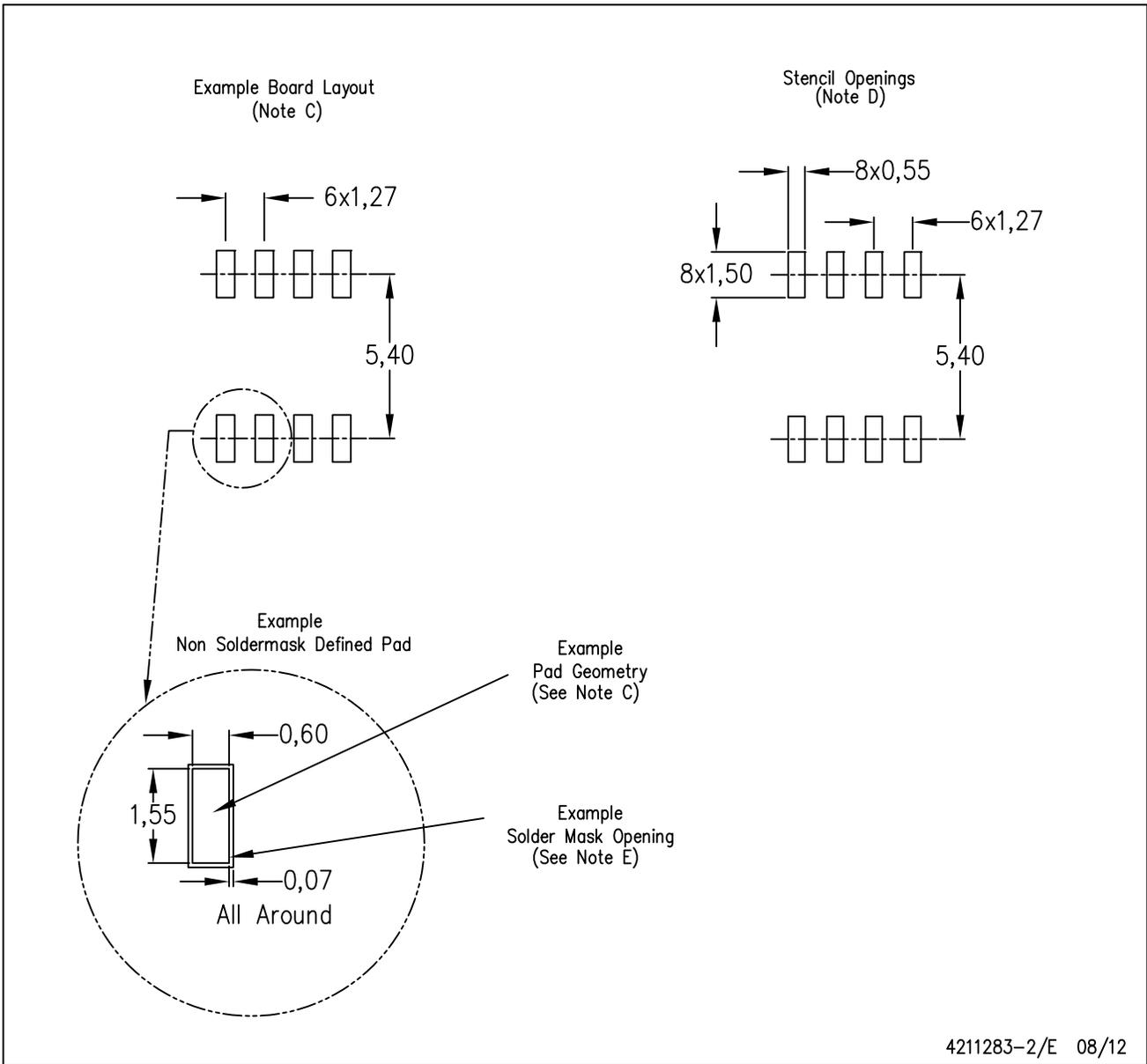
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - 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.
 - 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

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com