

3.3V LVDS High-Speed Differential Line Drivers and Receivers

Features

- Signaling Rates >660 Mbps (330 MHz)
- Single 3.3V Power Supply Design
- Driver:
 - $\pm 350\text{mV}$ Differential Swing into a 100-ohm load
 - Propagation Delay of 1.5ns Typ.
 - Low Voltage TTL (LVTTTL) Inputs are 5V Tolerant
- Receiver:
 - Accepts $\pm 50\text{mV}$ (min.) Differential Swing with up to 2.0V ground potential difference
 - Propagation Delay of 3.3ns Typ.
 - Low Voltage TTL (LVTTTL) Outputs
 - Open, Short, and Terminated Fail Safe
- Industrial Temperature Operating Range: -40°C to 85°C
- Meets or Exceeds IEEE 1596.3 SCI Standard
- Meets or Exceeds ANSI/TIA/EIA-644 LVDS Standard
- Bus-Terminal ESD exceeds 12kV
- Packaging (Pb-free & Green available):
 - 8-pin, 14-pin, or 16-pin SOIC, TSSOP, or MSOP

Description

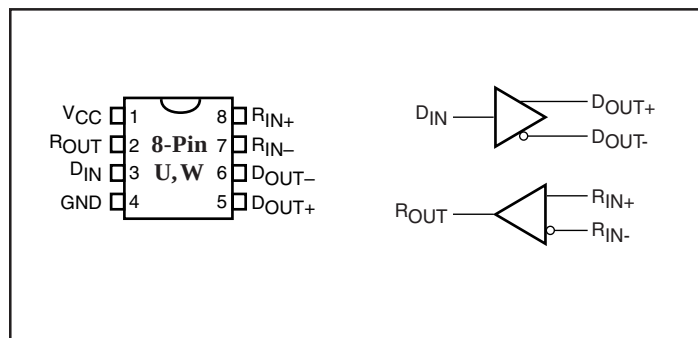
The PI90LV179, PI90LV180, PI90LV050, and PI90LV051 are differential line drivers and receivers (transceivers) that are compliant with the IEEE 1596.3 SCI and ANSI/TIA/EIA-644 LVDS standards. These devices use low-voltage differential signaling (LVDS) to achieve data rates in excess of 660 Mbps while being less susceptible to noise than single-ended transmission.

The drivers translate a low-voltage TTL/CMOS input into a low-voltage (350mV typical) differential output signal. The receivers translate a differential 350mV input signal to a 3V CMOS output level. The driver section can be independently set to a power-down and high-impedance output mode with the DEN pin (active HIGH). The receiver section is controlled by the REN* pin (active LOW).

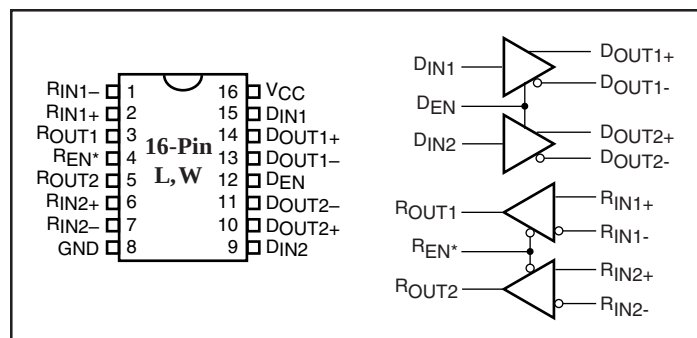
Applications

Applications include point-to-point and multidrop baseband data transmission over a controlled impedance media of approximately 100 ohms. These include intra-system connections via printed circuit board traces or cables, hubs and routers for data communications; PBXs, switches, repeaters and base stations for telecommunications and other applications such as digital cameras, printers and copiers.

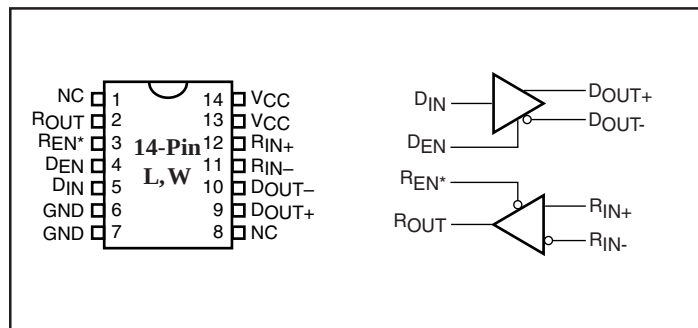
PI90LV179



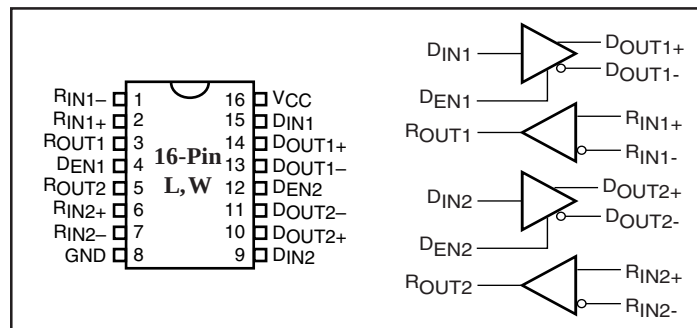
PI90LV050



PI90LV180



PI90LV051



Function Tables

PI90LV179 Receiver

Inputs	Output
$V_{ID} = V_{RIN+} - V_{RIN-}$	R_{OUT}
$V_{ID} \geq 50\text{mV}$	H
$-50\text{mV} < V_{ID} < 50\text{mV}$	?
$V_{ID} \leq -50\text{mV}$	L
open	H

PI90LV179 Driver

Input	Output	
D_{IN}	D_{OUT+}	D_{OUT-}
L	L	H
H	H	L
open	L	H

PI90LV180/PI90LV050/PI90LV051 Receivers

Inputs	Output	
$V_{ID} = V_{RIN+} - V_{RIN-}$	R_{EN*}	R_{OUT}
$V_{ID} \geq 50\text{mV}$	L	H
$-50\text{mV} < V_{ID} < 50\text{mV}$	L	?
$V_{ID} \leq -50\text{mV}$	L	L
open	L	H
X	H	Z

PI90LV180/PI90LV050/PI90LV051 Drivers

Inputs		Output	
D_{IN}	D_{EN}	D_{OUT+}	D_{OUT-}
L	H	L	H
H	H	H	L
open	H	L	H
X	L	Z	Z

Notes:

H = High Level, L = Low Level, ? = Indeterminate,
Z = High-Impedance, X = Don't Care

Pin Descriptions

Name	Description
D_{IN}	TTL/CMOS driver input pins
D_{OUT+}	Non-inverting driver output pins
D_{OUT-}	Inverting driver output pins
R_{OUT}	TTL/CMOS receiver output pins
R_{IN+}	Non-inverting receiver input pins
R_{IN-}	Inverting receiver input pins
V_{ID}	Input Differential Signal Voltage
GND	Ground pin
V_{CC}	Positive power supply pin, +3.3V $\pm 10\%$

Absolute Maximum Ratings

Supply Voltage (V_{CC})	 -0.5V to +4.0V
Driver	
Input Voltage (D_{IN})	 -0.3V to ($V_{CC} + 0.3\text{V}$)
Output Voltage (D_{OUT+} , D_{OUT-})	 -0.3V to +3.9V
Short Circuit Duration (D_{OUT+} , D_{OUT-})	 Continuous
Enable Input Voltage (D_{EN})	 -0.3V to ($V_{CC} + 0.3\text{V}$)
Receiver	
Input Voltage (R_{IN+} , R_{IN-})	 -0.3V to +3.9V
Output Voltage (R_{OUT})	 -0.3V to ($V_{CC} + 0.3\text{V}$)
Enable Input Voltage (R_{EN*})	 -0.3V to ($V_{CC} + 0.3\text{V}$)
Storage Temperature Range	 -65°C to +150°C
Lead Temperature Range Soldering (4s)	 +260°C
Maximum Junction Temperature	 +150°C
ESD Rating	 >12kV

Recommended Operating Conditions

	Min.	Typ.	Max.	Units
Supply Voltage (V_{CC})	3	3.3	3.6	V
High Level Input Voltage, V_{IH}	2			
Low Level Input Voltage, V_{IL}			0.8	
Magnitude of Differential Input Voltage V_{ID}	0.1		0.6	
Common-mode Input Voltage, V_{IC} (Fig 5)	$ V_{ID} / 2$		2.4 - $ V_{ID} / 2$ $V_{CC} - 0.8$	
Operating Free Air Temperature T_A	-40		85	°C

Electrical Characteristics (Over recommended operating conditions unless otherwise noted).

Parameter		Test Condition	Min.	Typ. [†]	Max.	Units
I _{CC} * Supply Current	PI90LV179	No receiver load, Driver R _L = 100 ohms		8.0	10.8	mA
	PI90LV180	Driver and receiver enabled. No receiver load, Driver R _L = 100 ohms		8.0	10.8	
		Driver enabled, Receiver disabled, R _L = 100 ohms		6.4	9	
		Driver disabled, Receiver enabled, No load		3.4	5	
		Disabled		0.76	1.2	
	PI90LV050	Driver and receivers enabled. No receiver loads, Driver R _L = 100 ohms		15	20.0	
		Drivers enabled, Receivers disabled, R _L = 100 ohms		10	14	
		Drivers disabled, Receivers enabled, No loads		6	8	
		Disabled		0.9	1.2	
	PI90LV051	Drivers enabled, No receiver loads, Driver R _L = 100 ohms		17.8	23.3	
		Drivers disabled, No loads		6.5	9.1	

[†]All typical values are at 25°C with a 3.3V supply

*I_{CC} measured with all TTL input. V_{IN} = V_{CC} or GND.

Electrical Characteristics (Over recommended operating conditions unless otherwise noted).

Parameter			Test Conditions	Min.	Typ.	Max.	Units
V _{OD}	Differential output voltage magnitude		R _L = 100 ohms See Figures 1 and 2	247	390	470	mV
Δ 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	1.25	1.375	V
ΔV _{OC(SS)}	Change in steady-state common-mode output voltage between logic states			–50		50	
V _{OC(PP)}	Peak-to-peak common-mode output voltage				50	150	
I _{IH}	High-level input current	DE	V _{IH} = 5V		–0.5	–20	μA
		D _{IN}			2	20	
I _{IL}	Low-level input current	DE	V _{IL} = 0.8V		–0.5	–10	
		D _{IN}			2	10	
I _{OS}	Short-circuit output current		V _{OY} or V _{OZ} = 0V		–6	–9	mA
			V _{OD} = 0V		–8	–11	
I _{OZ}	High-impedance output current		V _{OD} = 600mV			±1	μA
			V _O - 0V or V _{CC}			±1	
I _{O(OFF)}	Power-off output current		V _{CC} = 0V, V _O = 3.6V			±1	
C _{IN}	Input capacitance				7		pF

Receiver Electrical Characteristics (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ.	Max.	Units
V _{ITH+}	Positive-going differential input voltage threshold	See Figures 5 & Table 1			50	mV
V _{ITH-}	Negative-going differential input voltage threshold		-50			
V _{OH}	High-level output voltage	I _{OH} = -8mA	2.4			V
V _{OL}	Low-level output voltage	I _{OL} = 8mA			0.4	V
I _I	Input current (R _{IN+} or R _{IN-})	V _I = 0	-2	-11	-20	μA
		V _I = 2.4V	-1.2	-3		
I _{I (OFF)}	Power-off input current (R _{IN+} or R _{IN-})	V _{CC} = 0			±20	
I _H	High-level input current (enables)	V _{IH} = 2V			±10	
I _L	Low-level input current (enables)	V _{IL} = 0.8V			±10	
I _{OZ}	High-impedance output current	V _O = 0 or 5V			±10	
C _I	Input capacitance			5		pF

†All typical values are at 25°C with a 3.3V supply

Driver Switching Characteristics (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ.†	Max.	Units
t _{PLH}	Propagation delay time, low-to-high-level output	R _L = 100 ohms C _L = 10pF See Figure 2		1.9	2.5	ns
t _{PHL}	Propagation delay time, high-to-low-level output			1.9	2.5	
t _r	Differential output signal rise time			0.6	1.1	
t _f	Differential output signal fall time			0.6	1.1	
t _{sk(p)}	Pulse skew (t _{PHL} - t _{PLH})	See Figure 7		270		ps
t _{sk(o)}	Channel-to-channel output skew‡			80		
t _{sk(pp)}	Part-part-part skew**				0.9	ns
t _{PZH}	Propagation delay time, high-impedance-to-high-level output			2.7	4	
t _{PZL}	Propagation delay time, high-impedance-to-low-level output			1.8	4	
t _{PHZ}	Propagation delay time, high-level-to-high-impedance output			3.0	4	
t _{PLZ}	Propagation delay time, low-level-to-high-impedance output			3.0	4	

† All typical values are at 25°C with a 3.3V supply.

‡ t_{sk(o)}: maximum delay time difference between drivers on the same device.

** t_{sk(pp)}: magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal).

Receiver Switching Characteristics (Over recommended operating conditions unless otherwise noted).

Parameter		Test Conditions	Min.	Typ. [†]	Max.	Units
t _{PLH}	Propagation delay time, low-to-high-level output	C _L = 10pF See Figure 6		2.0	3.1	ns
t _{PHL}	Propagation delay time, high-to-low-level output			2.2	3.1	
t _{sk(pp)**}	Part-part skew**				1.3	
t _{sk(p)}	Pulse skew (t _{PHL} – t _{PLH})			300	500	ps
t _{sk(o)}	Channel-to-channel skew			30	120	
t _r	Output signal rise time			0.9	1.5	
t _f	Output signal fall time			1.0	1.8	
t _{PZH}	Propagation delay time, high-level-to-high-impedance output	See Figure 7		1.5	3.1	ns
t _{PZL}	Propagation delay time, low-level-to-low-impedance output			4.0	6.0	
t _{PHZ}	Propagation delay time, high-impedance-to-high-level output			2.5	3.5	
t _{PLZ}	Propagation delay time, low-impedance-to-high-level output			6.0	7.6	

[†]All typical values are at 25°C with a 3.3V supply

**t_{sk(pp)}: magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal)

Parameter Measurement Information

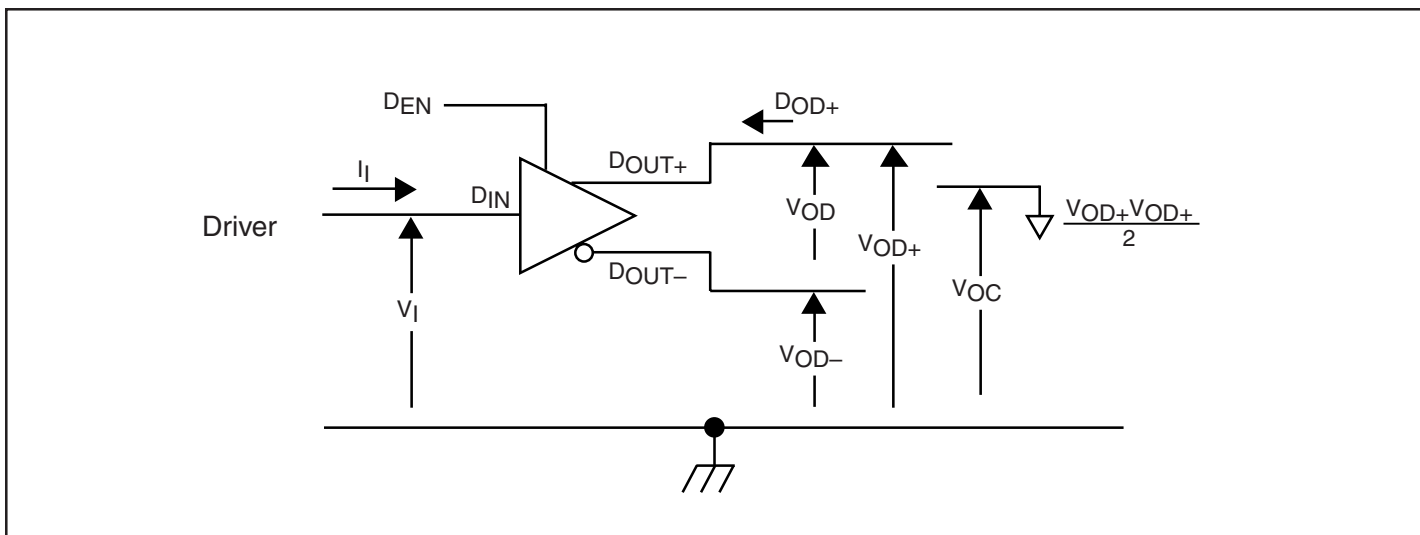


Figure 1. Driver Voltage and Current Definitions

Parameter Measurement Information

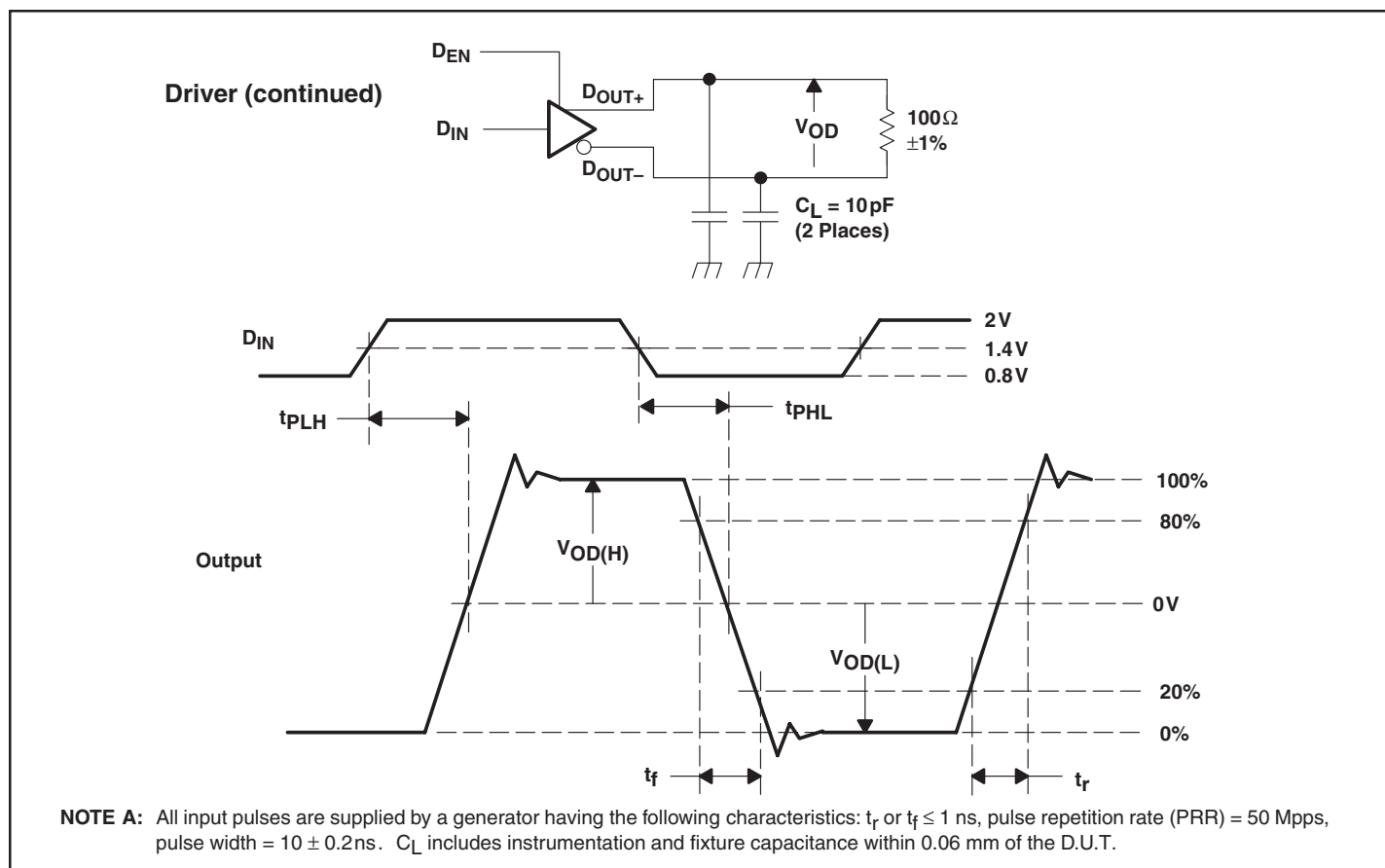


Figure 2. Test Circuit, Timing, and Voltage Definitions for the Differential Output Signal

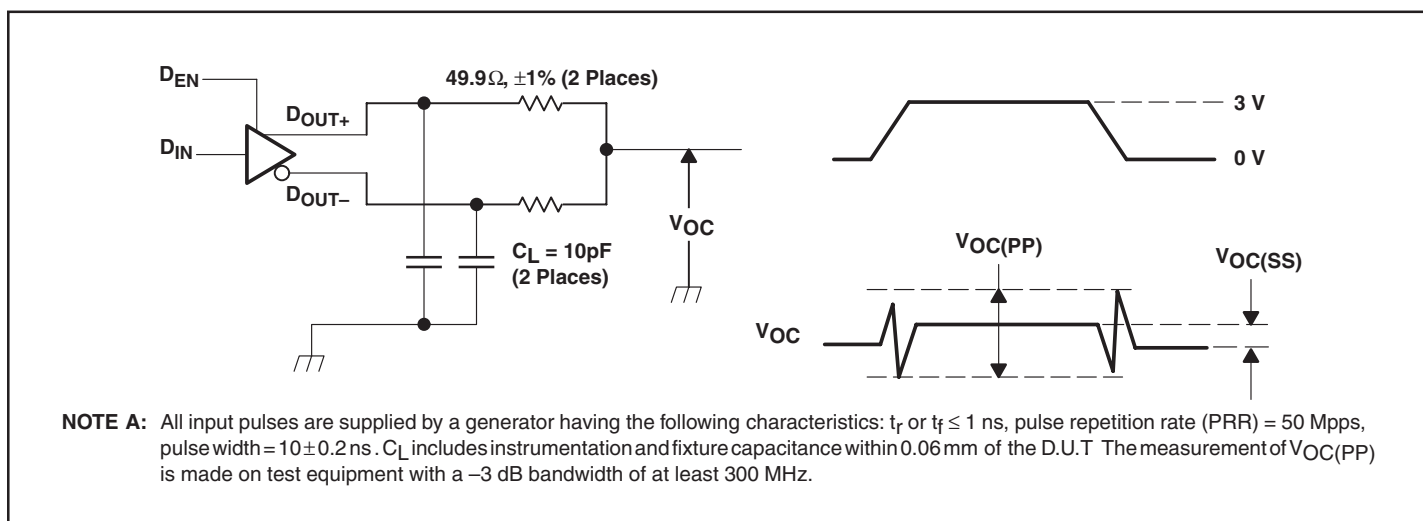
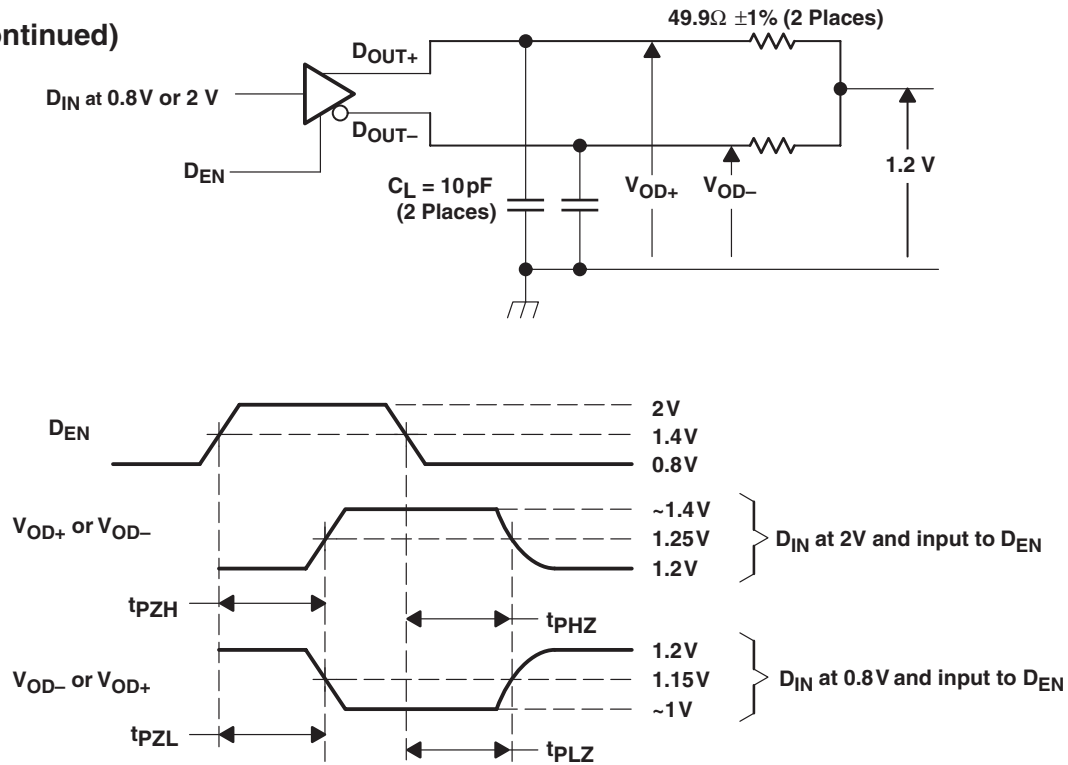


Figure 3. Test Circuit and Definitions for the Driver Common-Mode Output Voltage

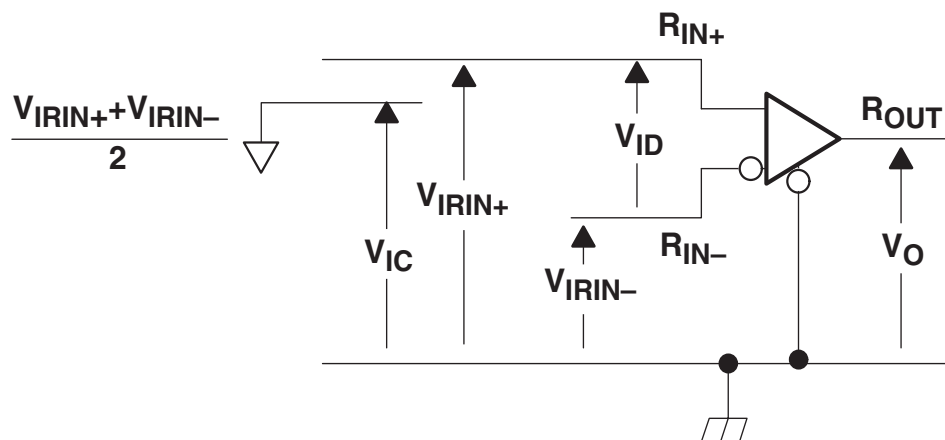
Parameter Measurement Information (continued)

Driver (continued)

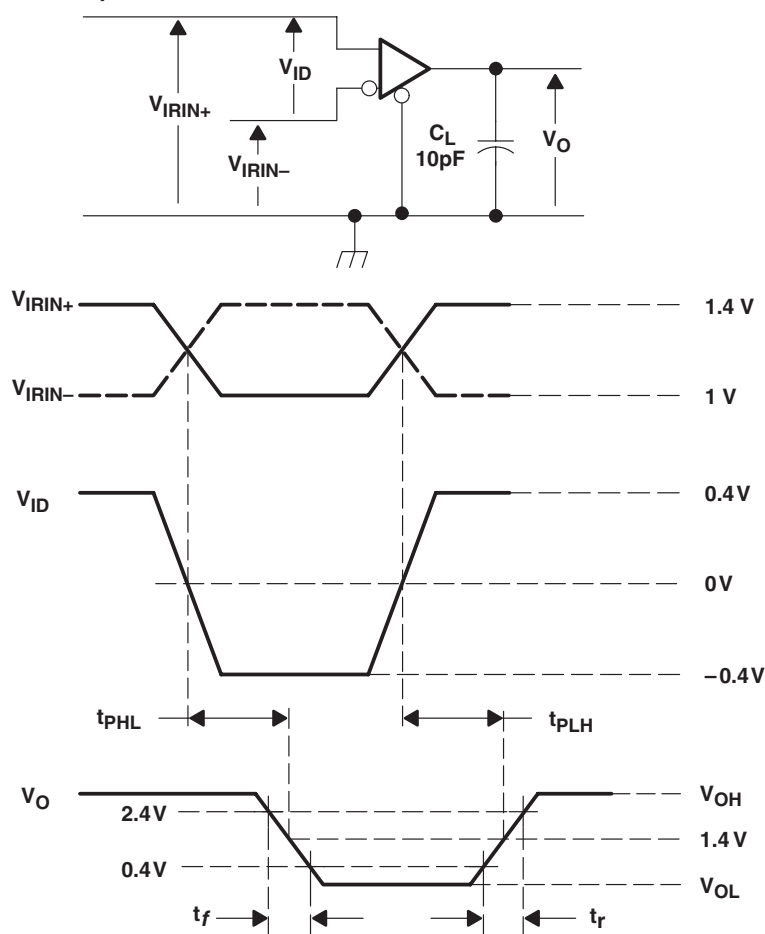


NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1\text{ns}$, pulse repetition rate (PRR) = 0.5 Mpps, pulse width = $500 \pm 10\text{ ns}$. C_L includes instrumentation and fixture capacitance within 0.06mm of the D.U.T.

Figure 4. Enable and Disable Timing Circuit and Definitions

Parameter Measurement Information (continued)
Receiver

Figure 5. Receiver Voltage Definitions
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_{IRIN+}	V_{IRIN-}	V_{ID}	V_{IC}
1.225	1.175	50	1.2
1.175	1.225	-50	1.2
2.375	2.325	50	2.35
2.325	2.375	-50	2.35
0.1	0	50	0.05
0	0.05	-50	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

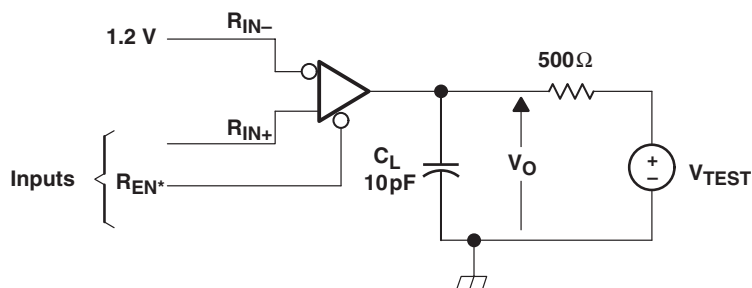
Parameter Measurement Information (continued)
Receiver (continued)


Note A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1\text{ns}$, pulse repetition rate (PRR) = 50 Mpps, pulse width = $10 \pm 0.2\text{ns}$. C_L includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

Figure 6. Timing Test Circuit and Waveforms

Parameter Measurement Information

Receiver (continued)



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1\text{ns}$, pulse repetition rate (PRR) = 0.5 Mpps, pulse wide = $500 \pm 10\text{ns}$. C_L includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

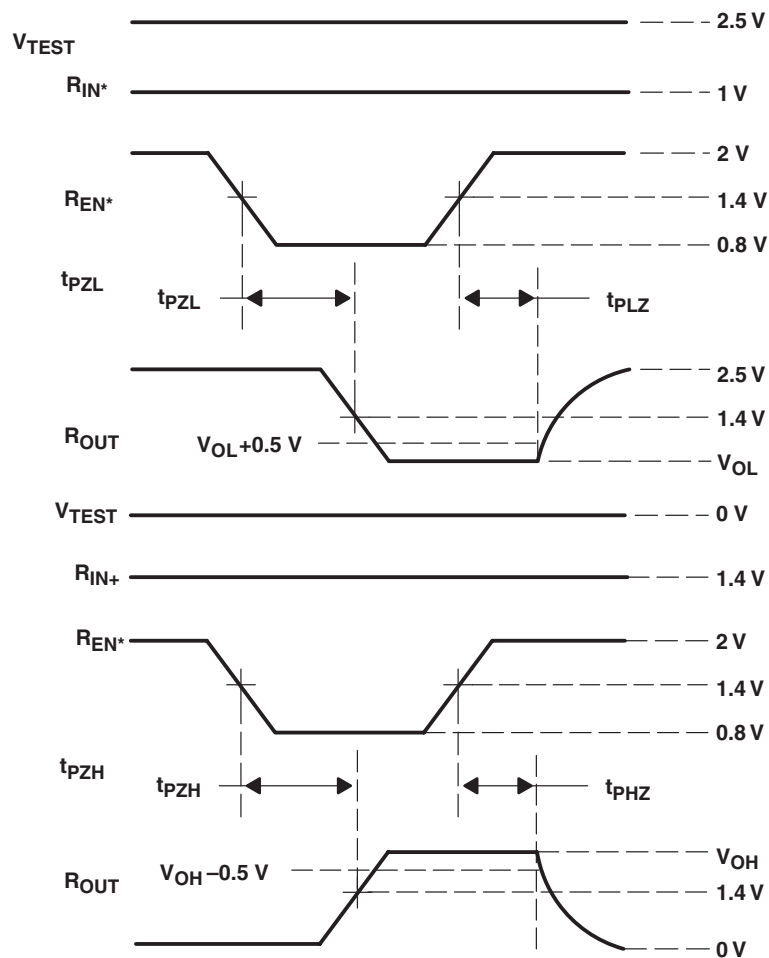
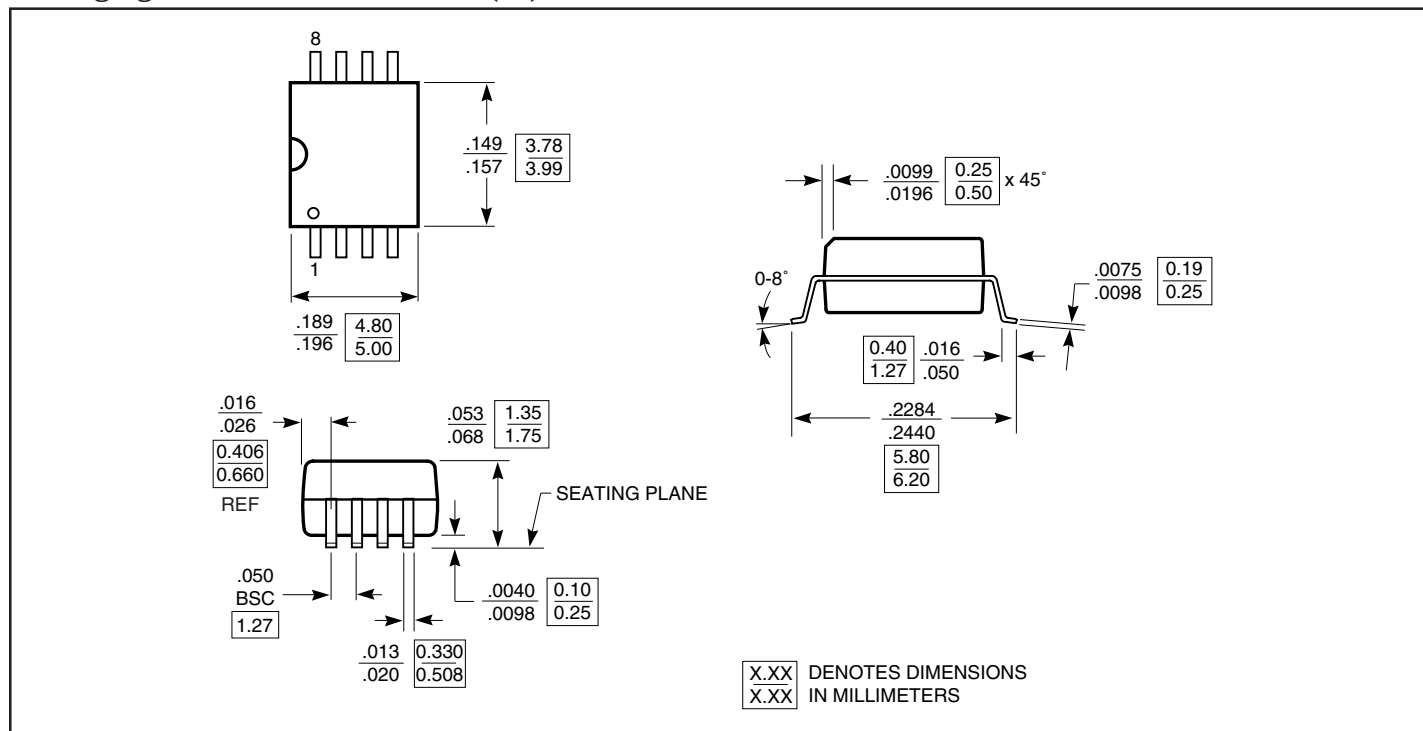
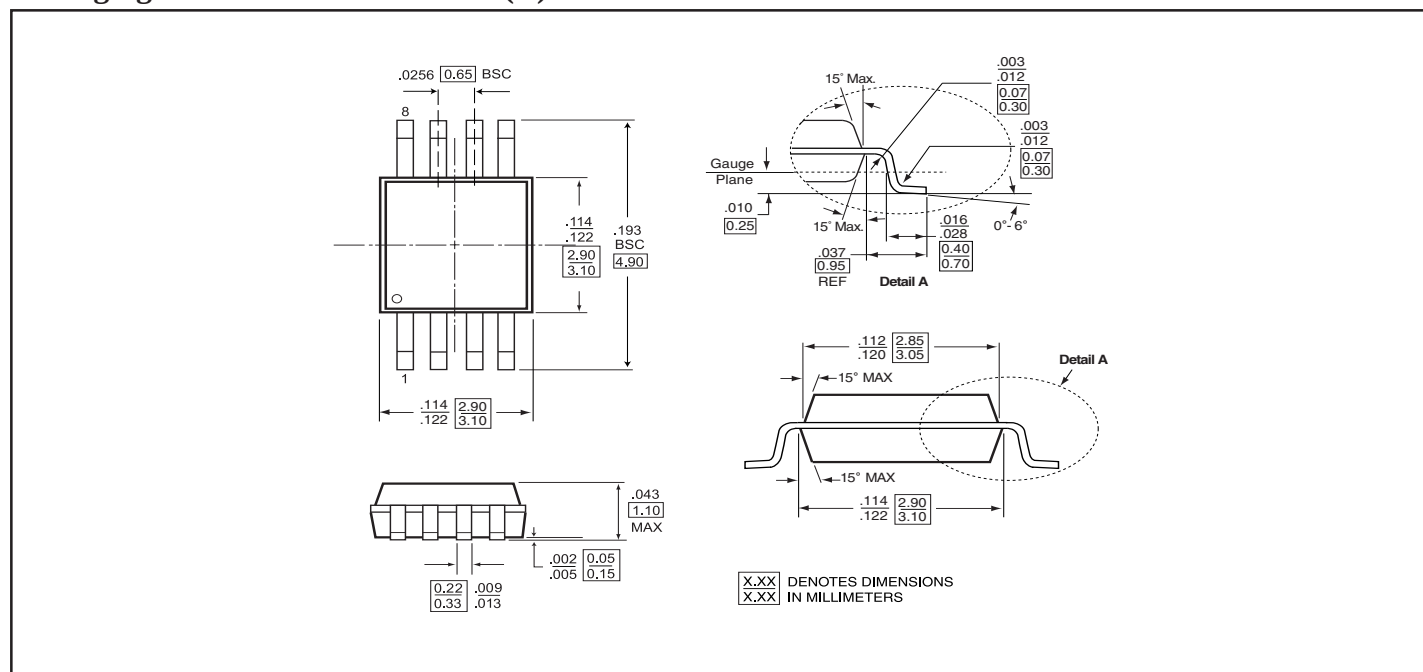


Figure 7. Enable/Disable Time Test Circuit and Waveforms

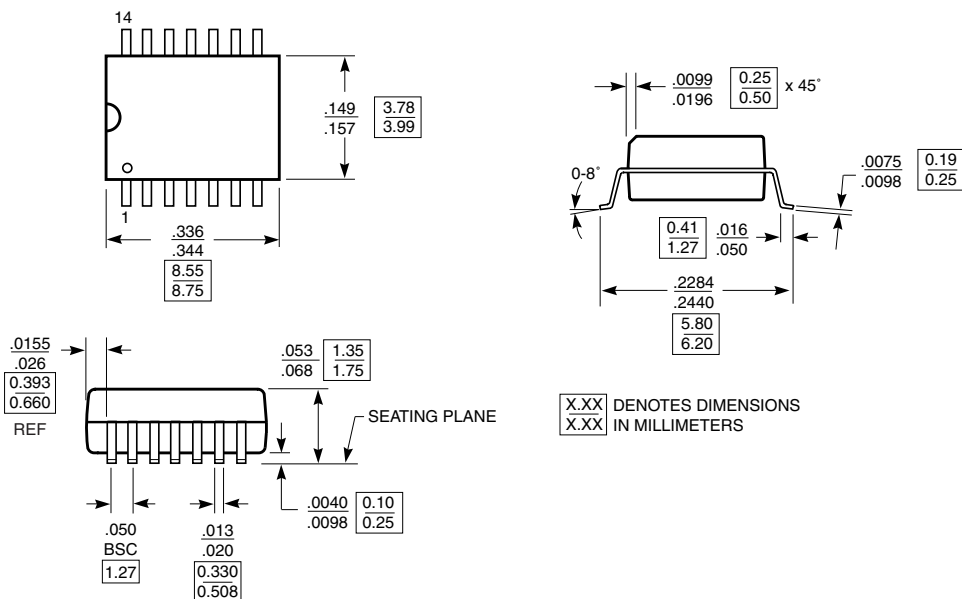
Packaging Mechanical: 8-Pin SOIC (W)



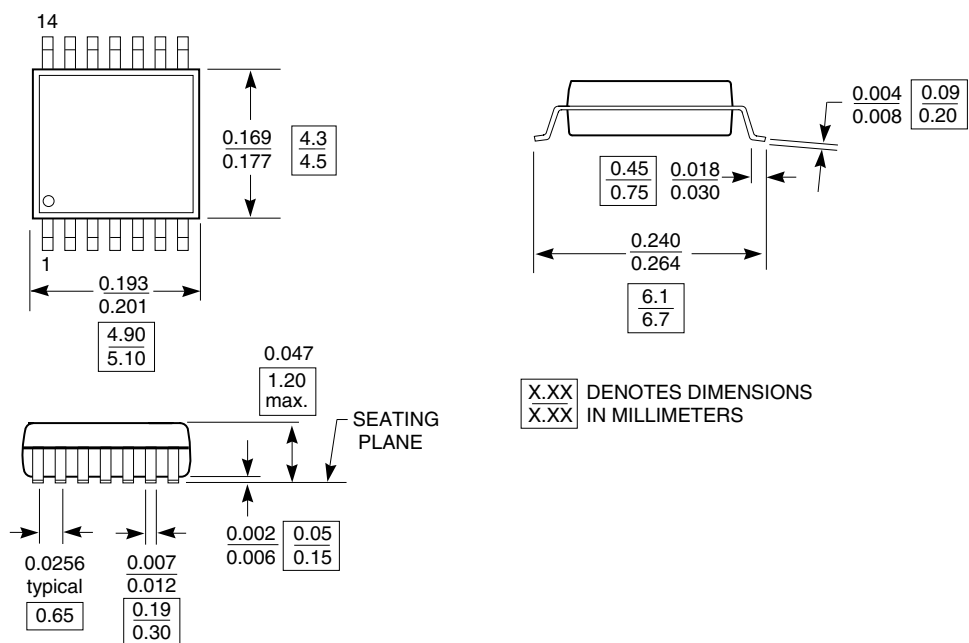
Packaging Mechanical: 8-Pin MSOP (U)



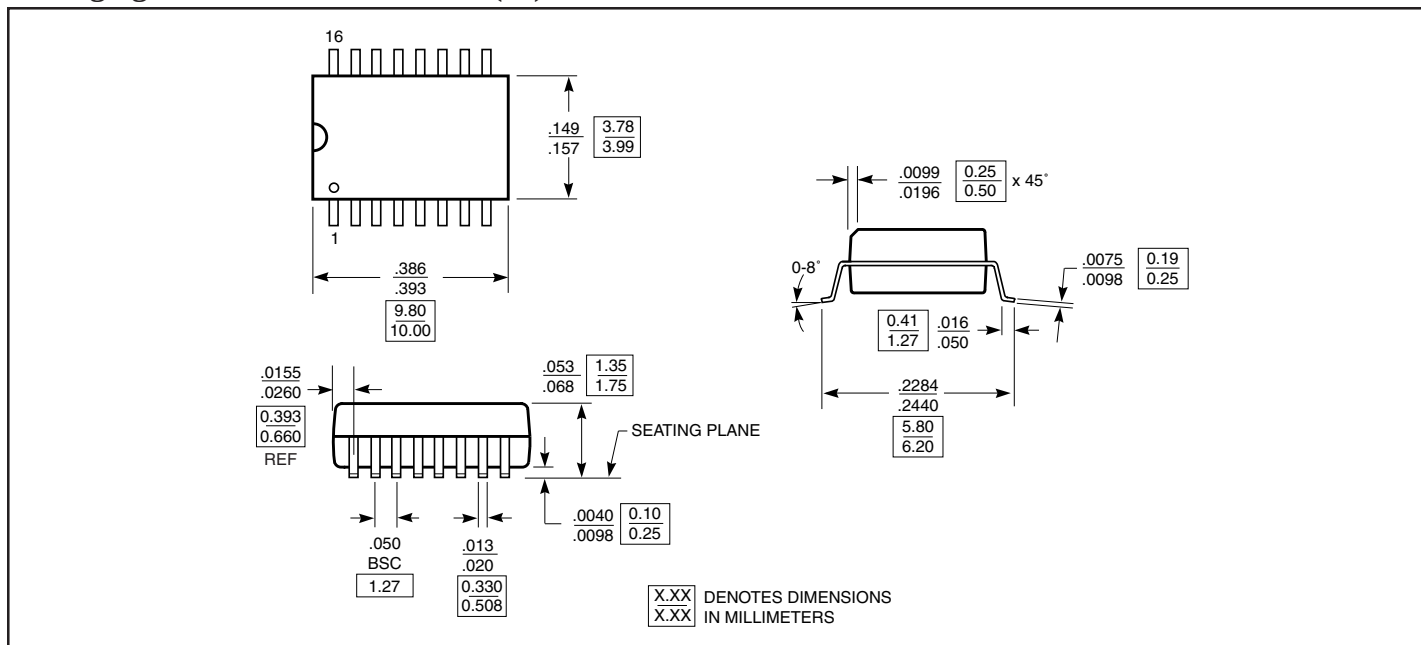
Packaging Mechanical: 14-Pin SOIC (W)



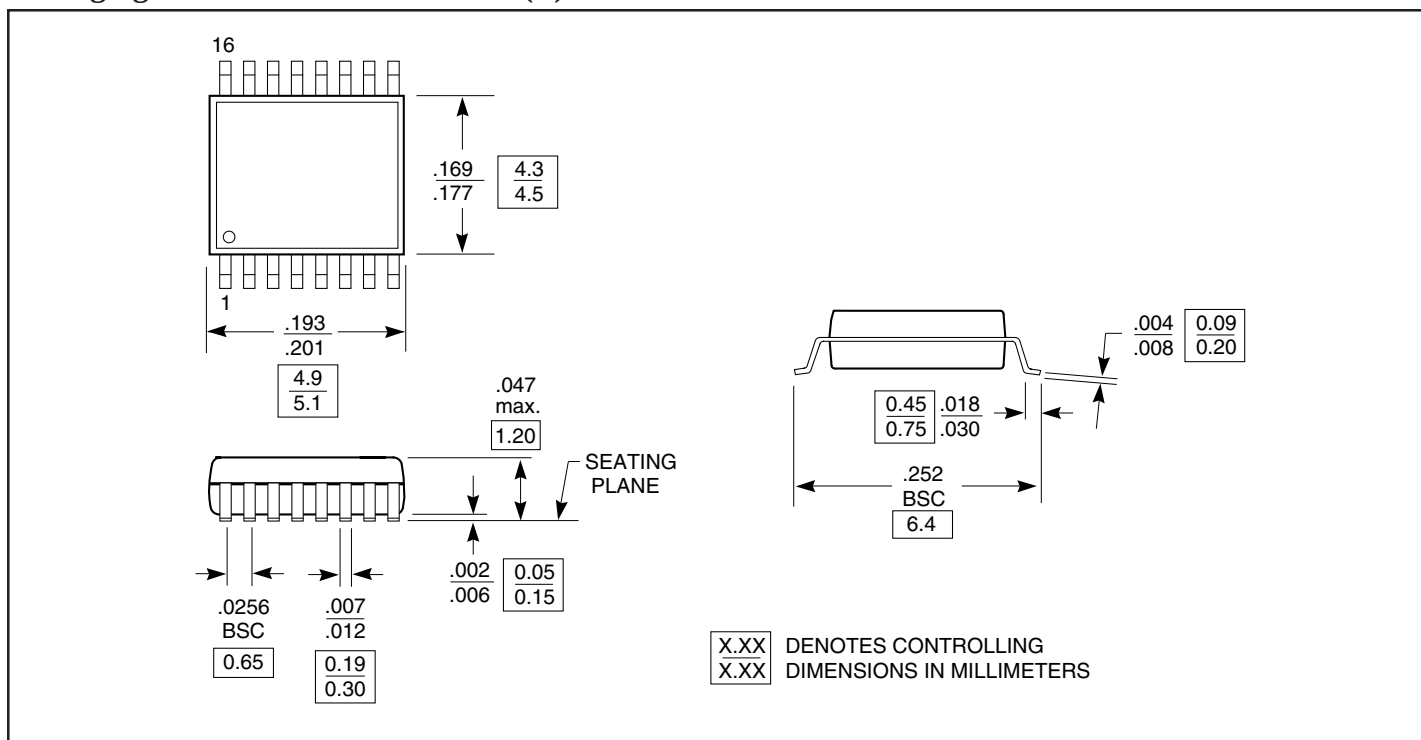
Packaging Mechanical: 14-Pin TSSOP(L)



Packaging Mechanical: 16-Pin SOIC(W)



Packaging Mechanical: 16-Pin TSSOP (L)





Ordering Information

Ordering Code	Package Code	Package Description
PI90LV179U	U	8-pin MSOP
PI90LV179UE	U	Pb-free & Green, 8-pin MSOP
PI90LV179W	W	8-pin SOIC
PI90LV179WE	W	Pb-free & Green, 8-pin SOIC
PI90LV180W	W	14-pin SOIC
PI90LV180WE	W	Pb-free & Green, 14-pin SOIC
PI90LV180L	L	14-pin TSSOP
PI90LV180LE	L	Pb-free & Green, 14-pin TSSOP
PI90LV050L	L	16-pin TSSOP
PI90LV050LE	L	Pb-free & Green, 16-pin TSSOP
PI90LV050W	W	16-pin SOIC
PI90LV050WE	W	Pb-free & Green, 16-pin SOIC
PI90LV051L	L	16-pin TSSOP
PI90LV051LE	L	Pb-free & Green, 16-pin TSSOP
PI90LV051W	W	16-pin SOIC
PI90LV051WE	W	Pb-free & Green, 16-pin SOIC

Notes:

1. Thermal characteristics can be found on the company web site at www.pericom.com/packaging/