PI90LVB179/PI90LVB180/ PI90LVB050/PI90LVB051

3.3V Boost LVDS High-Speed Differential Line Drivers and Receivers

Product Features

- Signaling Rates >660 Mbps (330 MHz)
- Single 3.3V Power Supply Design
- Driver:
  - — ±350mV Differential Swing into a 50-ohm load
  - — Propogation Delay of 1.5ns Typ.
  - — Low Voltage TTL (LVTTL) Inputs are 5V Tolerant
  - — Driver is High Impedance when Disabled or V_{CC} < 1.5V
- Receiver:
  - — Accepts ±50mV (min.) Differential Swing with up to 2.0V ground potential difference
  - — Propagation Delay of 3.3ns Typ.
  - — Low Voltage TTL (LVTTL) Outputs
  - — Open, Short, and Terminated Fail Safe
- Industrial Temperature Operating Range: –40°C to 85°C
- Package Options: SOIC, TSSOP, MSOP
- Bus-Terminal ESD≥12kV

Product Description

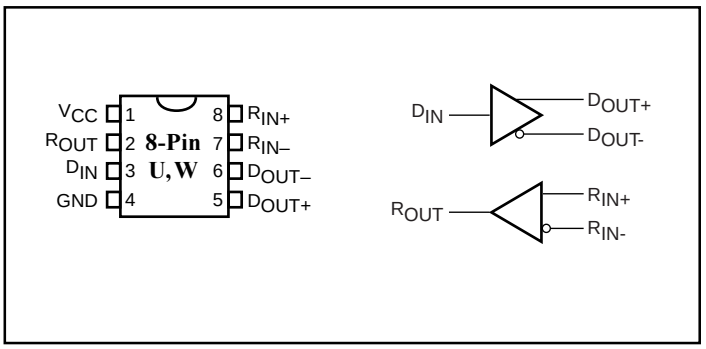
The PI90LVB179, PI90LVB180, PI90LVB050, and PI90LVB051 are differential line drivers and receivers (transceivers) that are similar to the IEEE 1596.3 SCI and ANSI/TIA/EIA-644 LVDS standards (the difference is that the driver output current is doubled). This modification enables true half-duplex operation with more than one LVDS driver or with two line transmission resistors over a 50-ohm differential transmission line. 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 into a 50-ohm load. The receivers translate a differential 350mV input signal to a 3V CMOS output level. Driver section can be independently set to a power-down & high-impedance output mode with the D_{EN} pin (active HIGH). Receiver section is controlled by the R_{EN*} pin (active LOW).

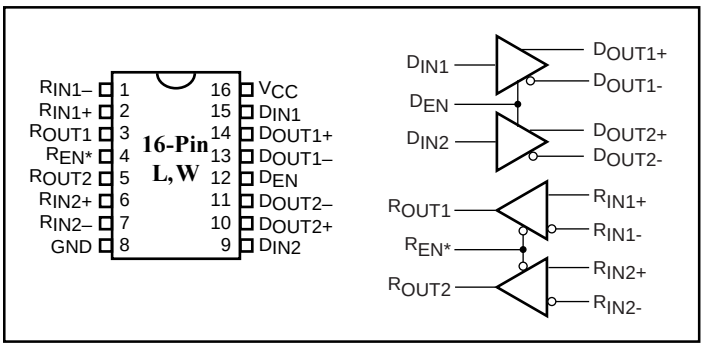
Applications

Applications include point-to-point and multidrop baseband data transmission over a controlled impedance media of approximately 50 ohms. These include intra-system connections via printed circuit board traces or cables, hubs and routers for data communications; PBXs, switches, repeaters & base stations for telecommunications and other applications such as digital cameras, printers and copiers.

PI90LVB179



PI90LVB050



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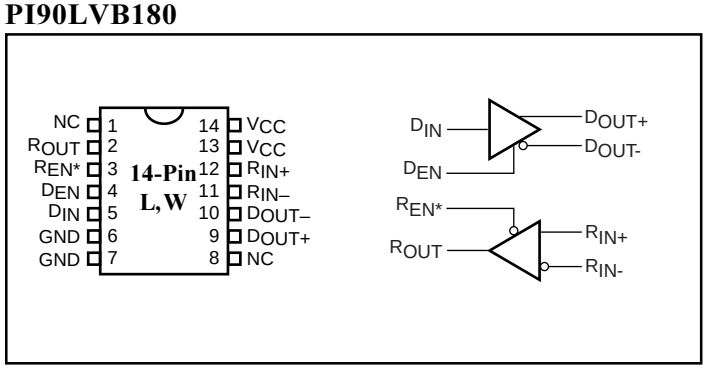

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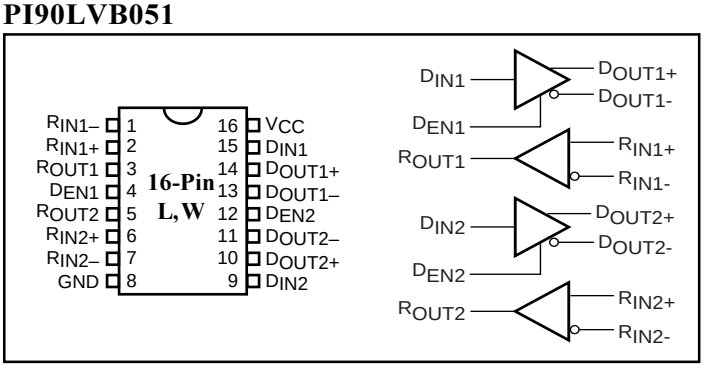


Function Tables

PI90LVB179 Receiver

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

PI90LVB179 Driver

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

PI90LVB180/ PI90LVB050/PI90LVB051 Receivers

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

PI90LVB180/PI90LVB050/PI90LVB051 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 ±10%

Absolute Maximum Ratings

Supply Voltage (V_{CC}) ..... –0.5V to +4.0V
Driver
Input Voltage (D_{IN}) ..... –0.3V to (Vcc + 0.3V)
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} + 0.3V)
Receiver
Input Voltage (R_{IN+}, R_{IN-}) ..... –0.3V to +3.9V)
Output Voltage (R_{OUT}) ..... –0.3V to (V_{CC} + 0.3V)
Enable Input Voltage (R_{EN*}) ..... –0.3V to (V_{CC} + 0.3V)
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	PI90LVB179	No receiver load, Driver R_L = 50 ohms		14	19.5	mA
	PI90LVB180	Driver and receiver enabled. No receiver load, Driver R_L = 50 ohms		12.5	16.4	
		Driver enabled, Receiver disabled, R_L = 50 ohms		10.2	14	
		Driver disabled, Receiver enabled, No load		3.4	5	
		Disabled		0.8	1.5	
	PI90LVB050	Driver and receivers enabled. No receiver loads, Driver R_L = 50 ohms		25	30	
		Drivers enabled, Receivers disabled, R_L = 50 ohms		14.8	20	
		Drivers disabled, Receivers enabled, No loads		6	8	
		Disabled		0.8	1.3	
	PI90LVB051	Drivers enabled, No receiver loads, Driver R_L = 50 ohms		27	33	
		Drivers disabled, No loads		6.5	8.8	

†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.

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

Parameter			Test Conditions	Min.	Typ.	Max.	Units
$\lvert V_{OD} \rvert$	Differential output voltage magnitude		R_L = 50 ohms See Figures 1 and 2	247	380	475	mV
$\Delta\lvert V_{OD} \rvert$	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
$\Delta V_{OC(SS)}$	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	
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		–11	–15	mA
			V_{OD} = 0V		–12	–15	
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			6.6		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 = 50 ohms C_L = 10pF See Figure 2		1.7	2.6	ns
t_{PHL}	Propagation delay time, lhigh-to-low-level output			1.7	2.6	
t_r	Differential output signal rise time			0.4	0.8	
t_f	Differential output signal fall time			0.4	0.8	
$t_{sk(p)}$	Pulse skew ($t_{PHL} – t_{PLH}$)			250	360	ps
$t_{sk(o)}$	Channel-to-channel output skew‡			90	160	
$t_{sk(pp)}$	Part-part-part skew**				0.9	ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	See Figure 7		3	5	
t_{PZL}	Propagation delay time, high-impedance-to-low-level output			3	5	
t_{PHZ}	Propagation delay time, high-level-to-high-impedance output			3	5	
t_{PLZ}	Propagation delay time, low-level-to-high-impedance output			3	5	

† All typical values are at 25°C with a 3.3V supply
‡ $t_{sk(o)}$: the 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)

Receiving 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	3.0	ns
t_{PHL}	Propagation delay time, lhigh-to-low-level output			2.1	3.0	
$t_{sk(pp)}$**	Part-part-part skew**				1.0	
$t_{sk(p)}$	Pulse skew ($t_{PHL} - t_{PLH}$)			300	750	ps
$t_{sk(o)}$	Channel-to-channel skew			60		
t_r	Output signal rise time			1.0	1.5	ns
t_f	Output signal fall time			1.2	1.8	
t_{PZH}	Propagation delay time, high-level-to-high-impedance output	See Figure 7		1.7	2.3	
t_{PZL}	Propagation delay time, low-level-to-low-impedance output			4.5	5.7	
t_{PHZ}	Propagation delay time, high-impedance-to-high-level output			2.5	3.2	
t_{PLZ}	Propagation delay time, low-impedance-to-high-level output			6.0	7.8	

† All typical values are at 25°C with a 3.3V supply.
** $t_{sk(pp)}$ is magnitude of difference in propagation delay times between any specific terminals of two devices (all things being equal).

Parameter Measurement Information

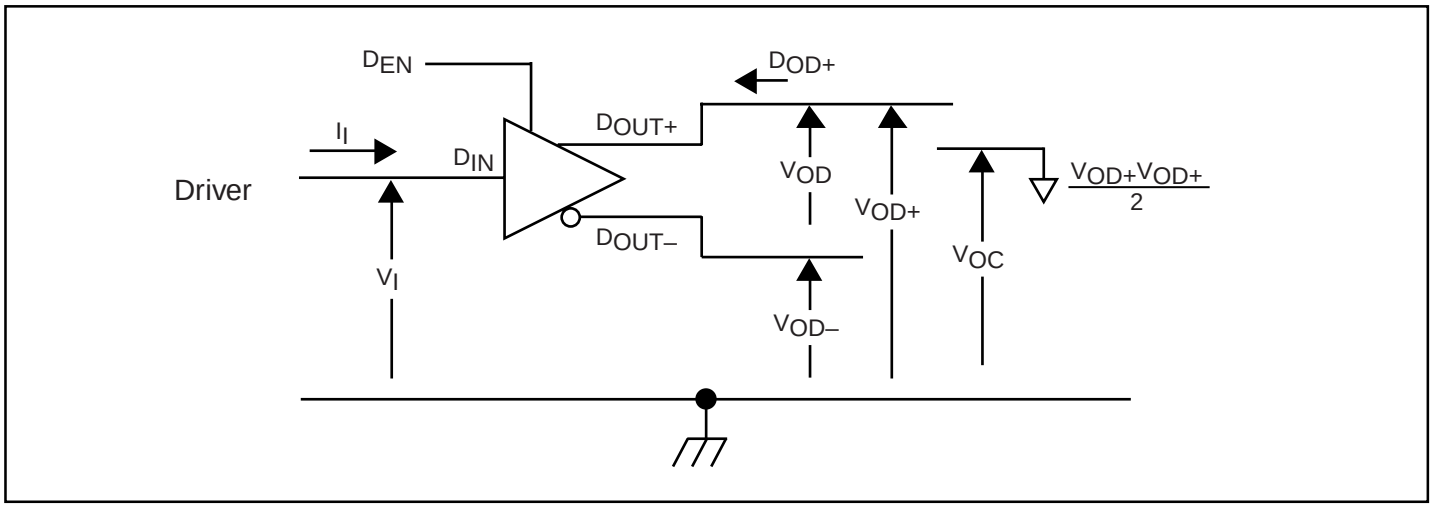
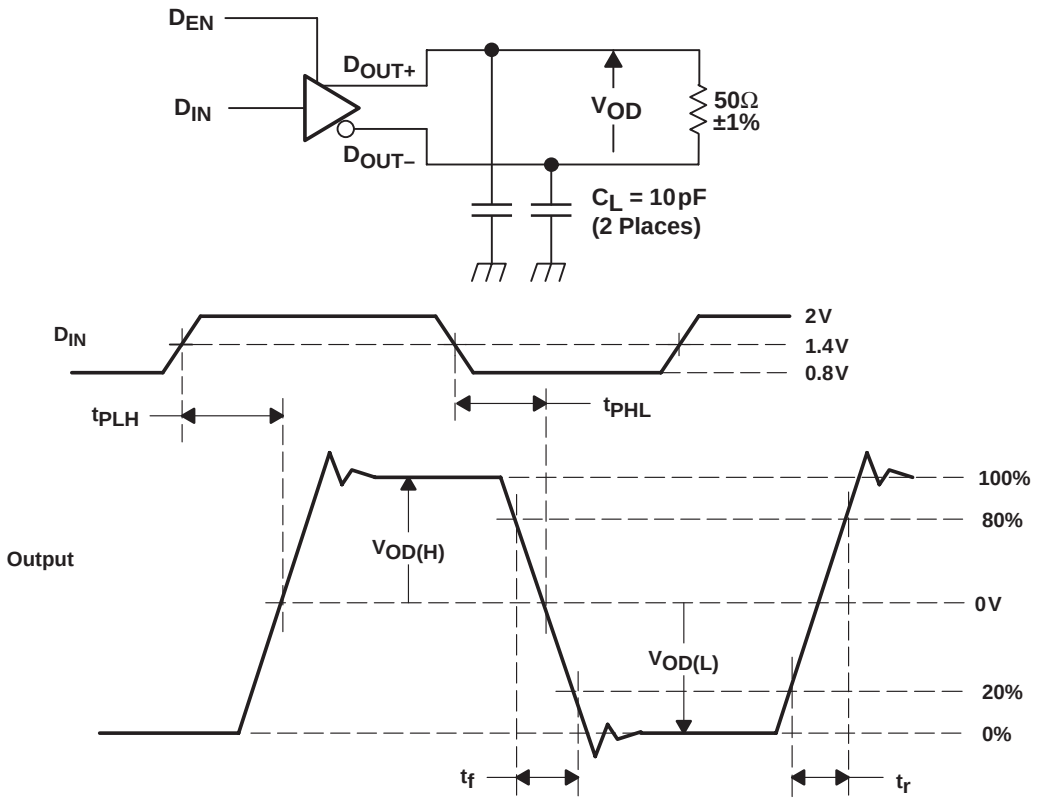


Figure 1. Driver Voltage and Current Definitions

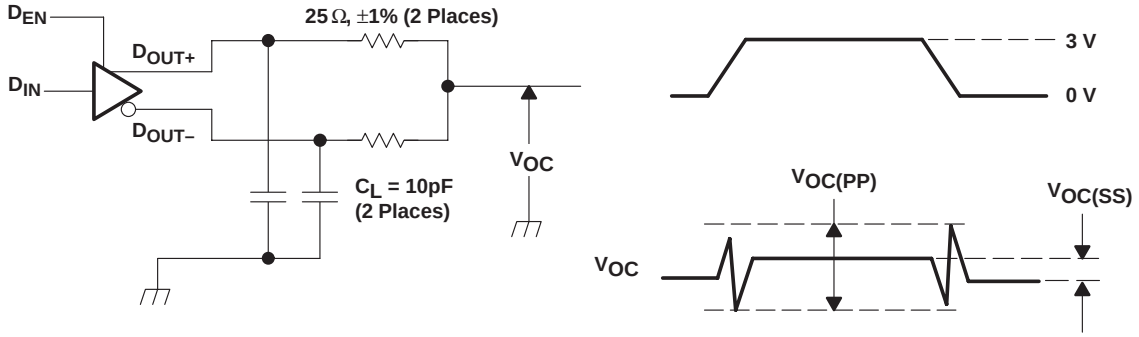
Parameter Measurement Information

Driver (continued)



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \le 1$ 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

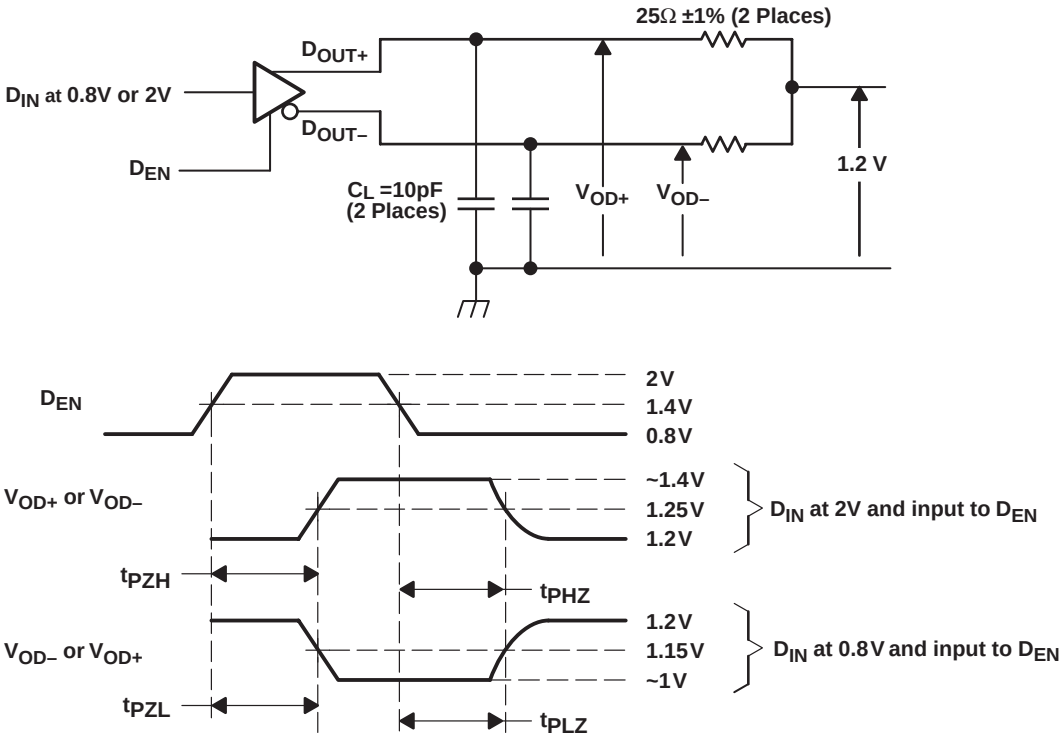


NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \le 1$ ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0.06 mm of the D.U.T. The measurement of $V_{OC(PP)}$ is made 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

Parameter Measurement Information (continued)

Driver (continued)



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 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)

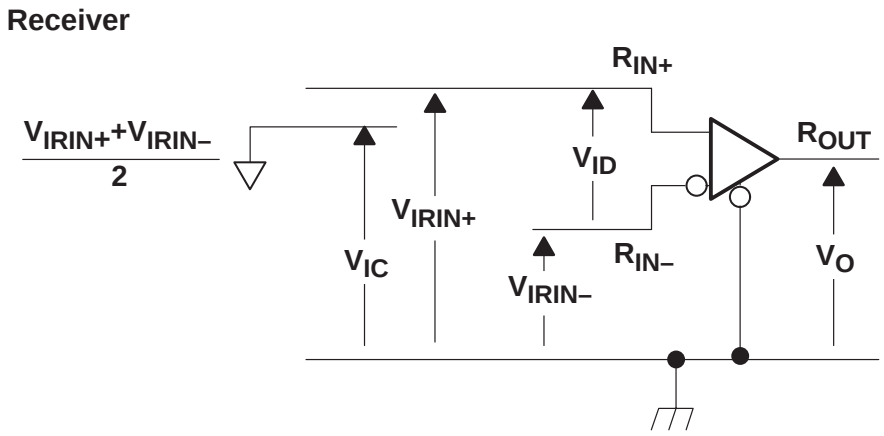


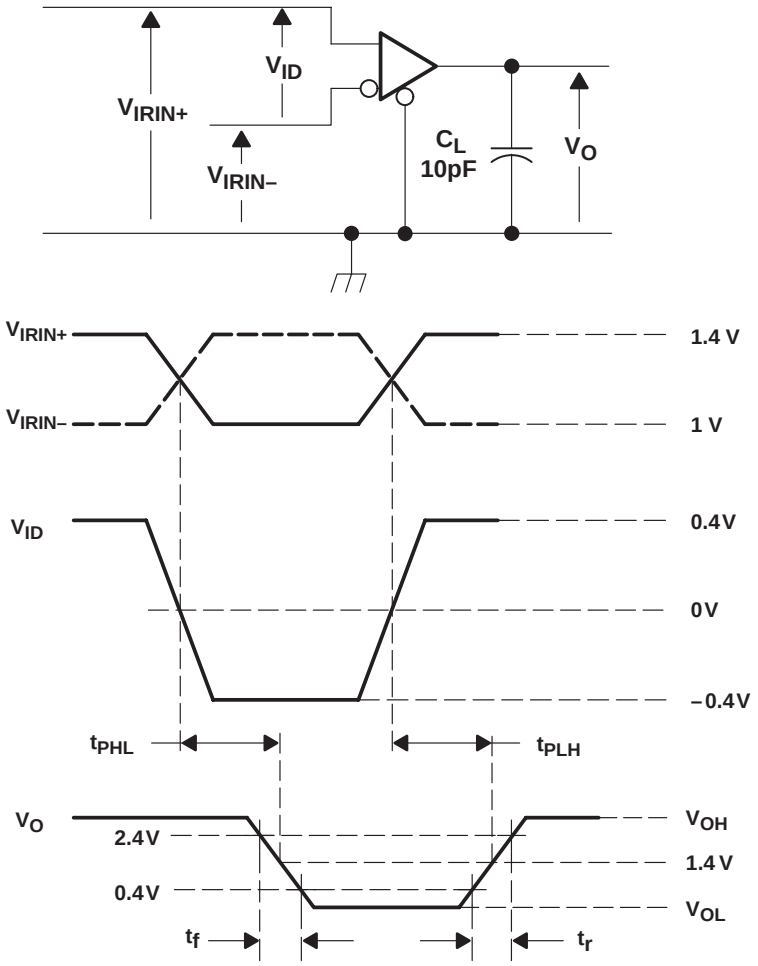
Figure 5. Receiver Voltage Definitions

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)

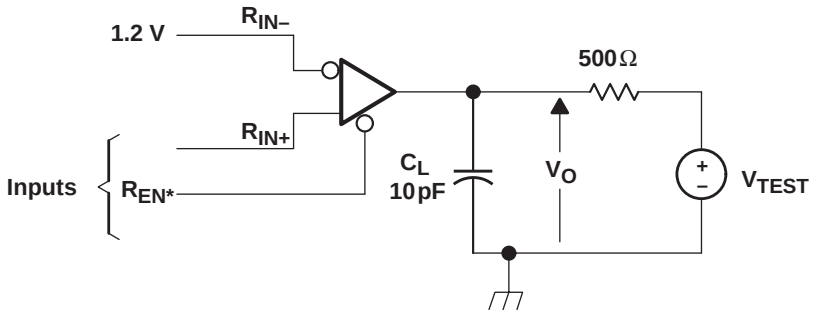


NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0.06 m of the D.U.T.

Figure 6. Timing Test Circuit and Waveforms

Parameter Measurement Information (continued)

Receiver (continued)



NOTE A: All input pulses are supplied by a genertor having the following characteristics: tr or tf ≤ 1ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse wide = 500 ±10ns. CL includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

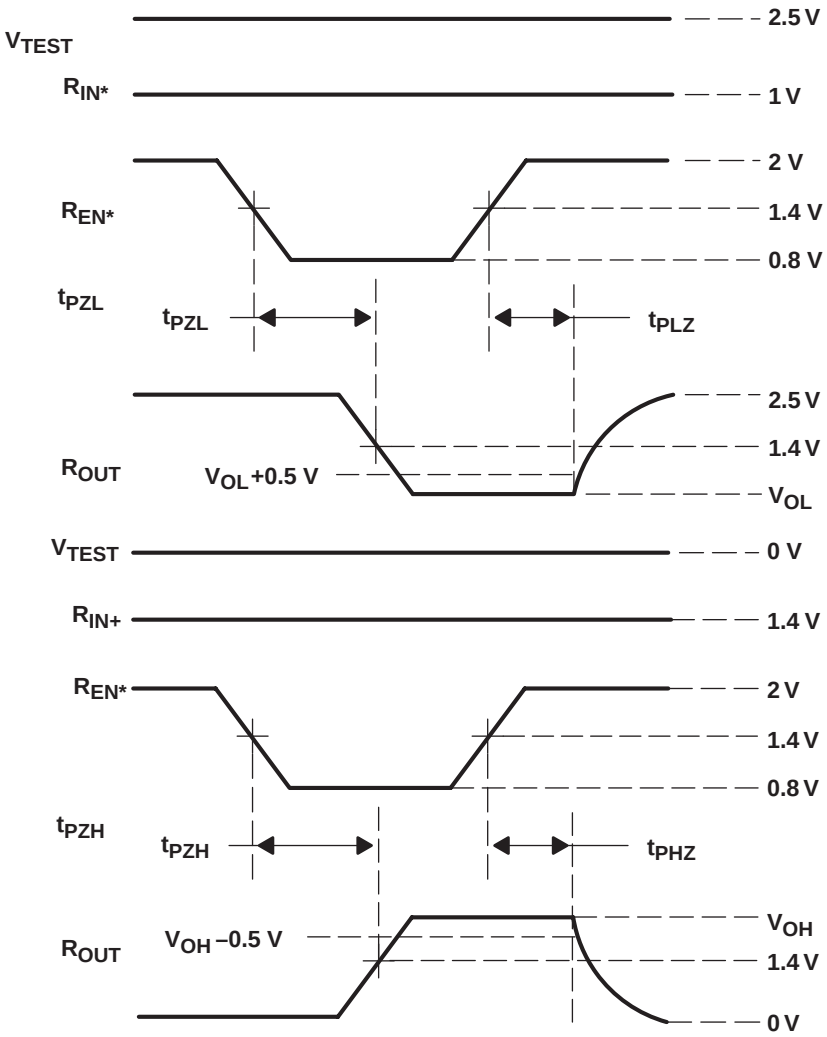
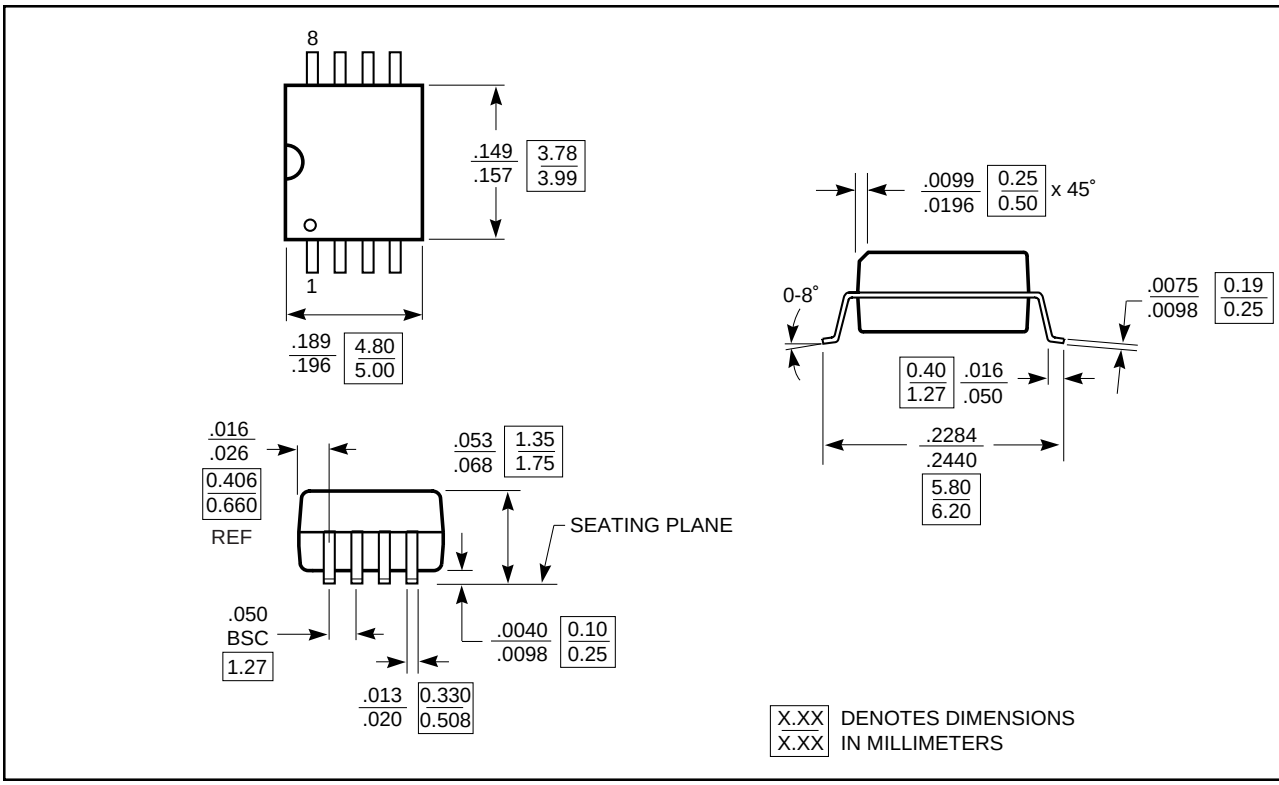
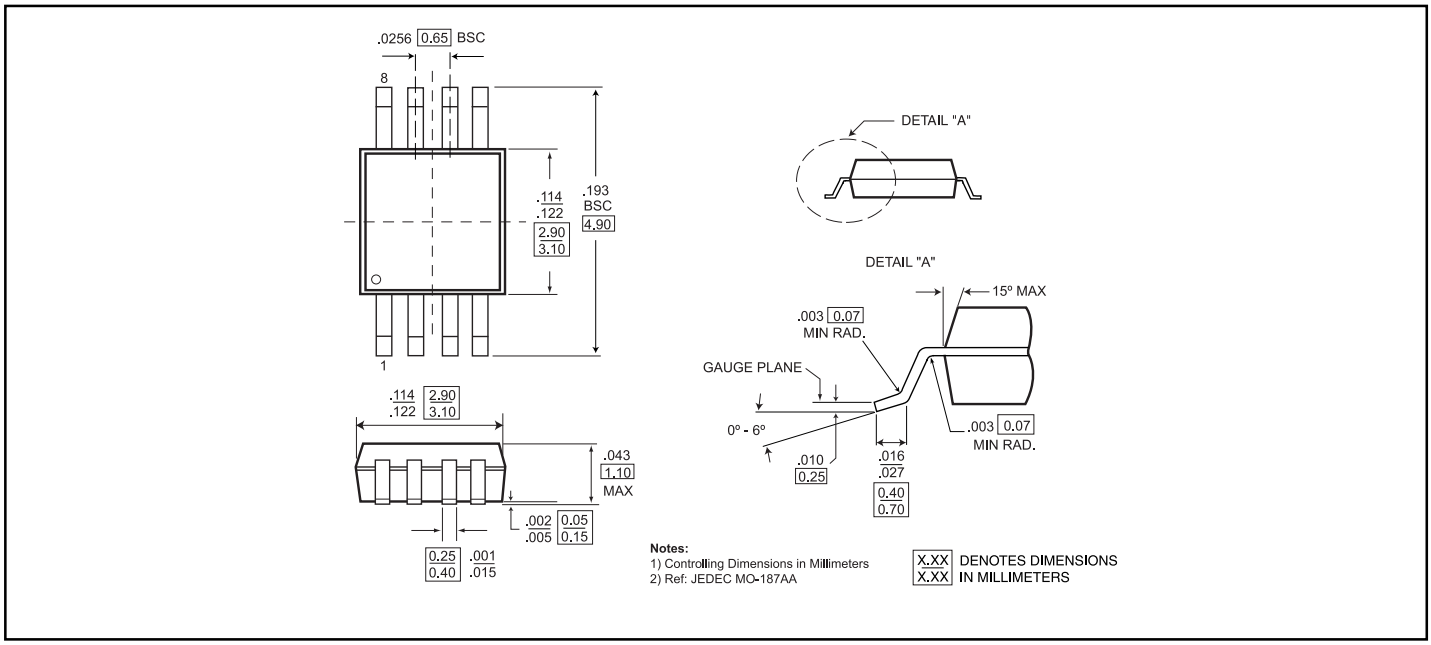


Figure 7. Enable/Disable Time Test Circuit and Waveforms

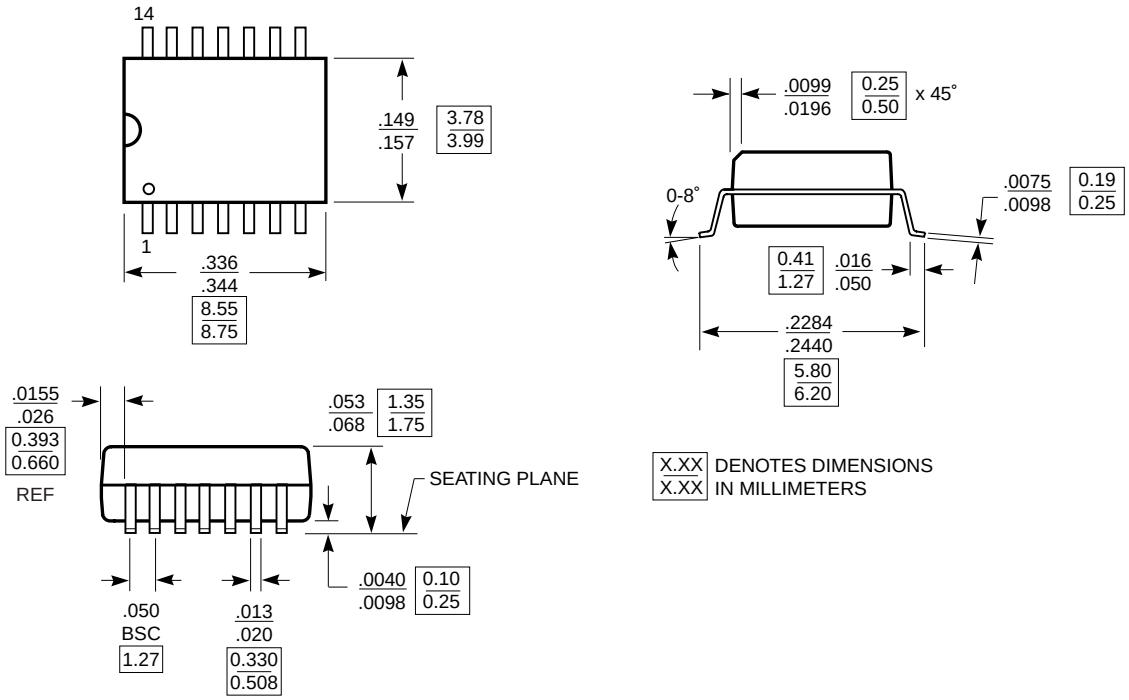
8-Pin SOIC W Package



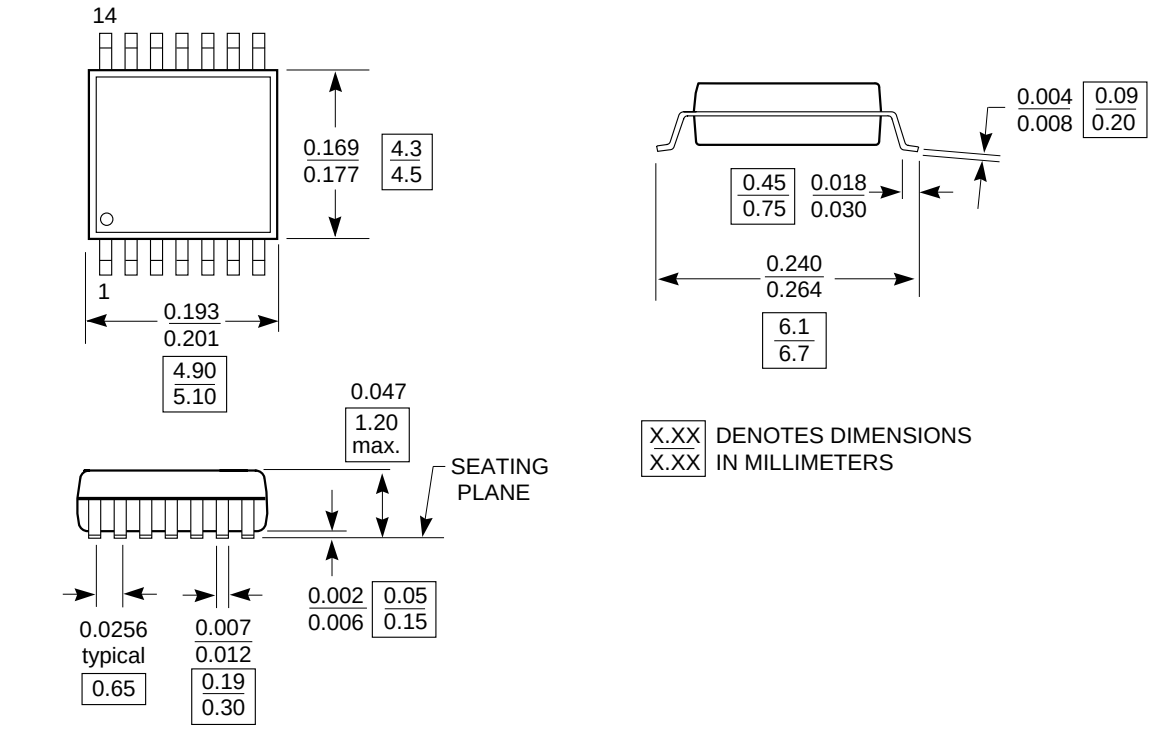
8-Pin Mini Small Outline U Package (MSOP)



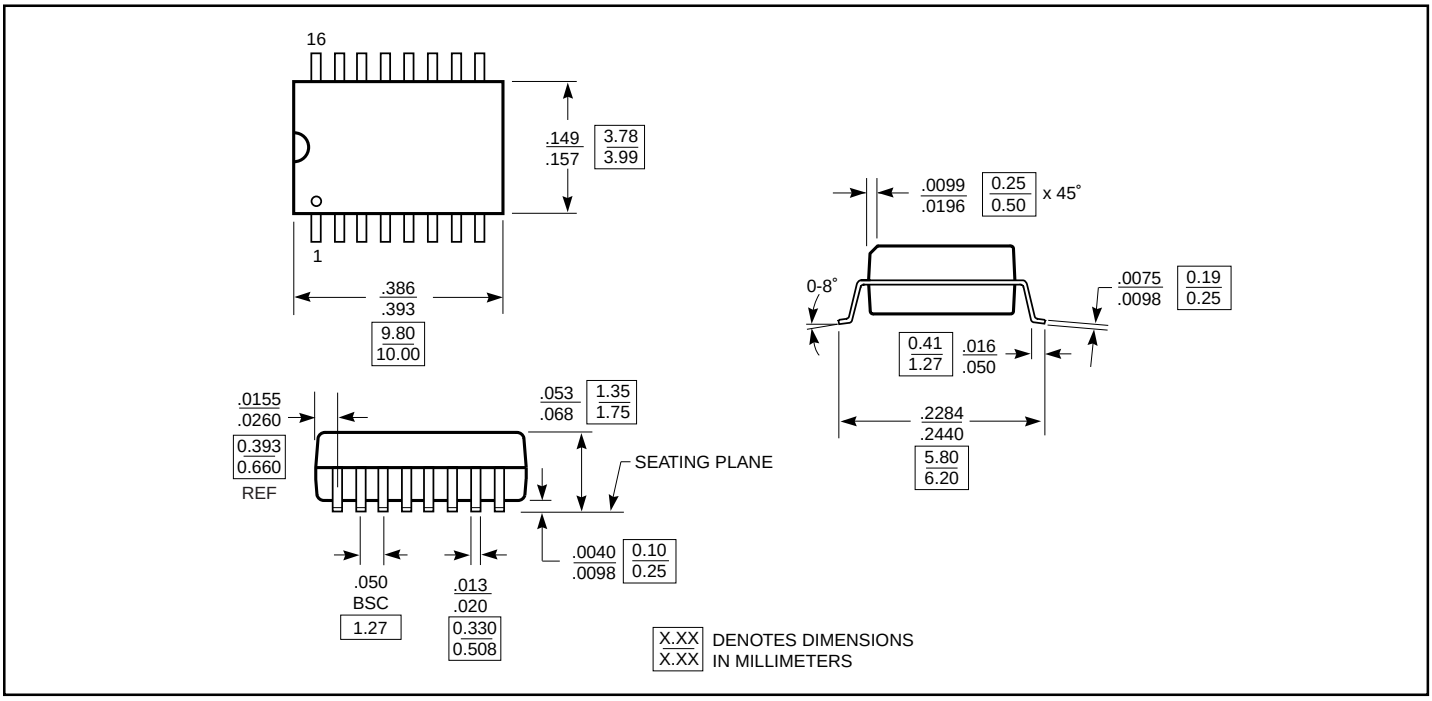
14-Pin SOIC (150 Mil) W Package



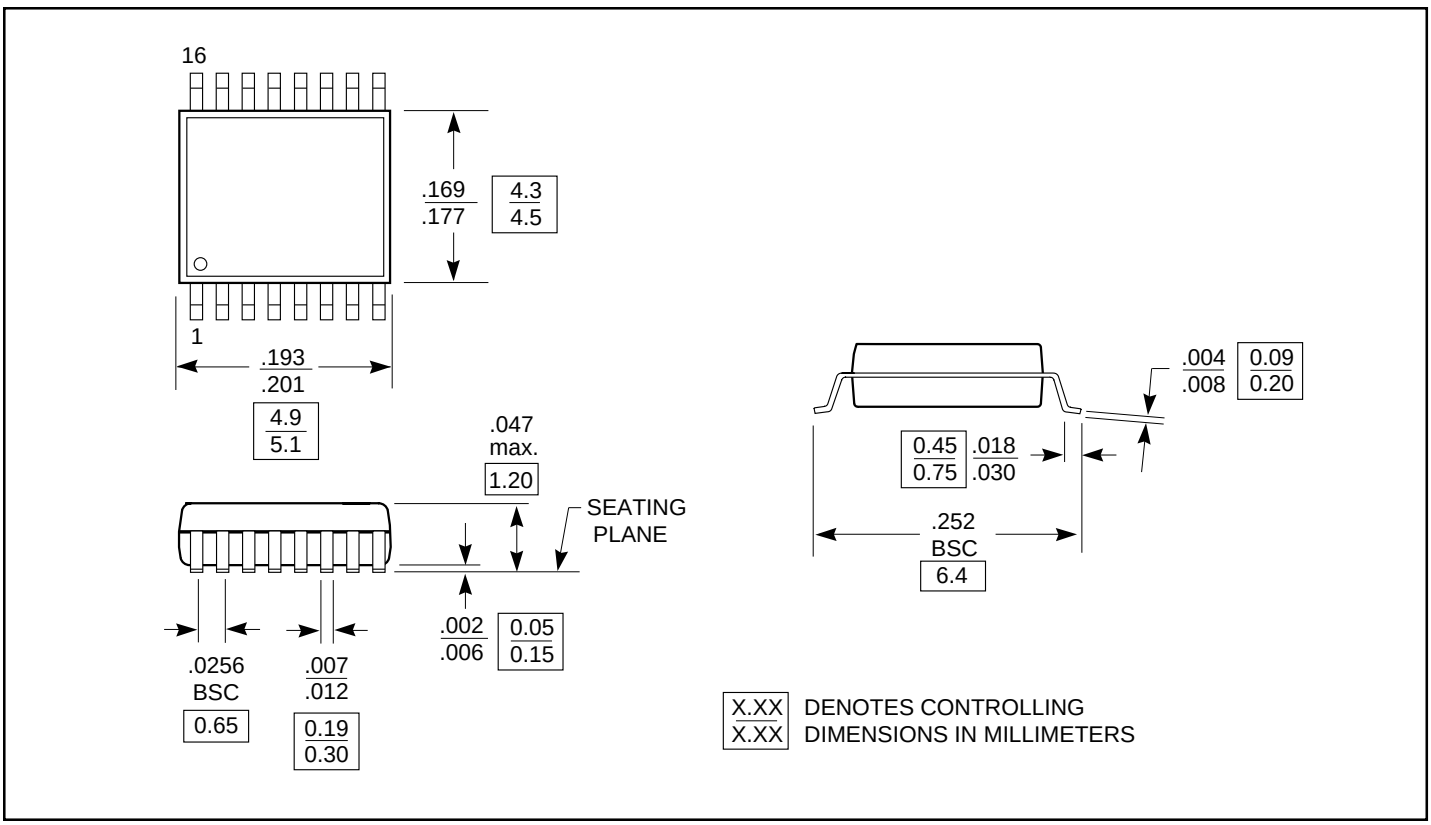
14-Pin TSSOP (4.4mm wide) L Package



16-Pin SOIC (150 Mil) W Package



16-Pin TSSOP (4.4mm wide) L Package



Ordering Information

Part	Pin - Package	Temperature
PI90LVB179W	8-SOIC	–40°C to +85°C
PI90LVB180W	14-SOIC	–40°C to +85°C
PI90LVB050W	16-SOIC	–40°C to +85°C
PI90LVB051W	16-SOIC	–40°C to +85°C
PI90LVB179U	8-MSOP	–40°C to +85°C
PI90LVB180L	14-TSSOP	–40°C to +85°C
PI90LVB050L	16-TSSOP	–40°C to +85°C
PI90LVB051L	16-TSSOP	–40°C to +85°C