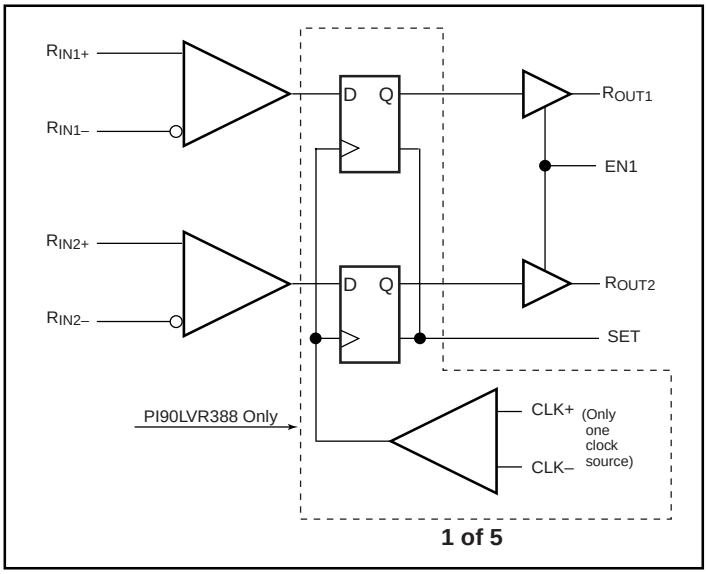
PI90LV388/PI90LVR388
PI90LV386/PI90LVT386

High-Speed Differential Line Receivers

Features

- Ten line receivers meet or exceed the requirements of the ANSI TIA/EIA-644-1995 Standard
- Designed for signaling rates up to 660 Mbps
- 0V to 3V common-mode input voltage range
- Operates from a single 3.3V supply
- Typical propagation delay time: 2.6ns (PI90LV388)
- Output skew 100ps (typical)
- Part-to-part skew is less than 1ns
- Integrated 110-ohm termination on PI90LVTxxx products
- PI90LVR388
  Setup time: typical 1ns
  Max. clock to output: 1ns
- Low Voltage TTL (LVTTL) levels are 5V tolerant
- Open-circuit fail safe
- Flow-through pin out
- Packages:
  48-Pin Thin Shrink Small Output TSSOP (A)
  64-Pin Thin Shrink Small Output TSSOP (A)

PI90LVR388



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Description

The PI90LVx388 family consists of ten differential line receivers and the PI90LVx386 family consists of 16 differential line receivers. Both have 3-state outputs that implement Low-Voltage Differential Signaling (LVDS). The PI90LVR388 has integrated edge-triggered D-type flip-flops. For both families, any of the differential receivers will provide a valid logical output state with a ±100mV differential input voltage within the input common-mode voltage range that allows 0 to 3V of ground potential difference between two LVDS nodes. The independent EN pins can be used to place the outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In high-impedance state, outputs neither load nor drive the bus lines.

The intended application of these devices, and their signaling techniques, is for point-to-point baseband data transmission over controlled impedance media of approximately 100 ohms with a 100-ohm termination resistor. The transmission media may be printed circuit board traces, backplanes, or cables. PI90LV388's ten receivers and PI90LV386's 16 receivers integrated into the same substrate allow precise timing alignment. In addition, the PI90LVR388's integrated registers resynchronize the data to the system clock, for additional signal deskew.

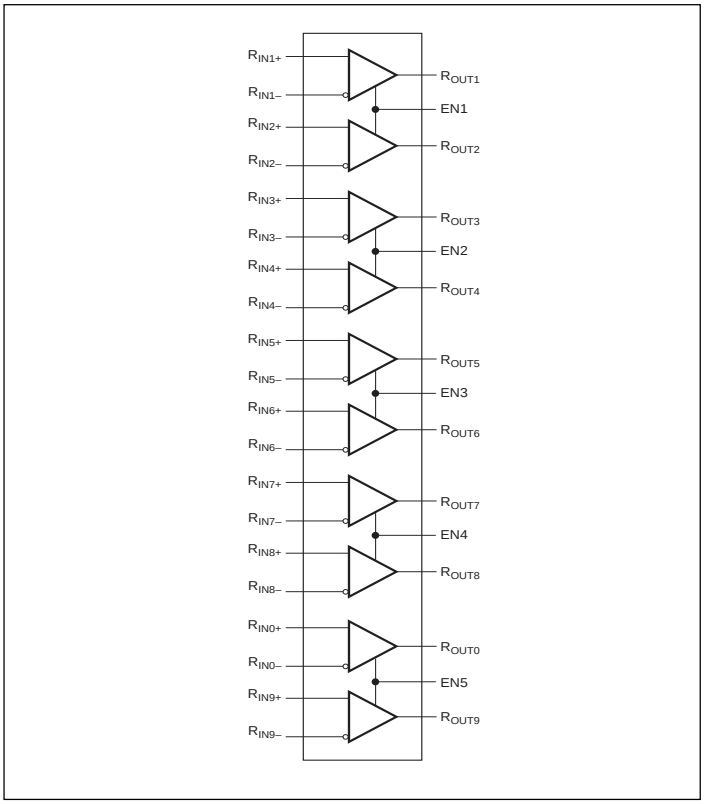
The integrated registers in the PI90LVR388 are particularly suitable for interfacing with LVDS drivers such as the PI90LV389 over long distances where signal-to-signal skew may be a problem. On the positive transition of the differential clock (CLK±) input, the Q outputs of the flip-flop take on the logic levels set up at the differential data (RIN±) inputs. Old data can be retained or new data can be entered while the outputs are in the high-impedance state. The EN pins do not affect the internal operation of the flip-flops.

The has an integrated termination resistor (Zt).

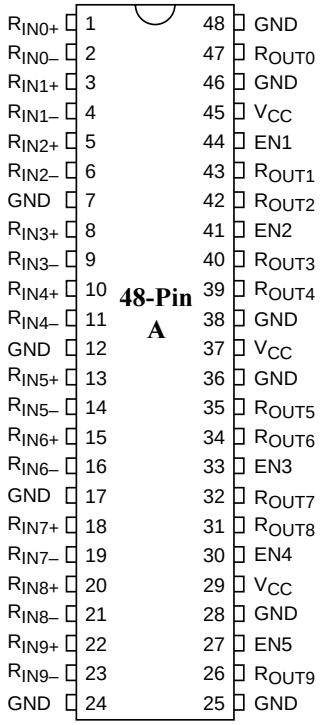
PI90LVR388 Truth Table

SET	R_{OUT}
0	Q = D
1	Q = 1

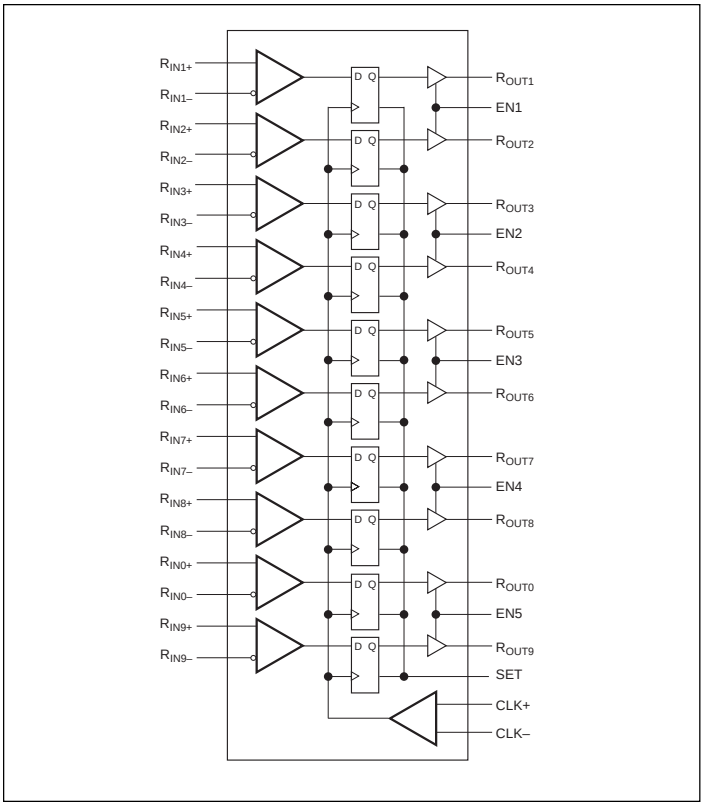
PI90LV388 Block Diagram



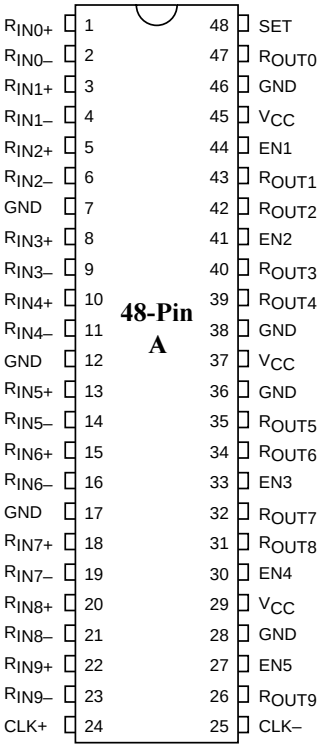
PI90LV388 Pin Configuration



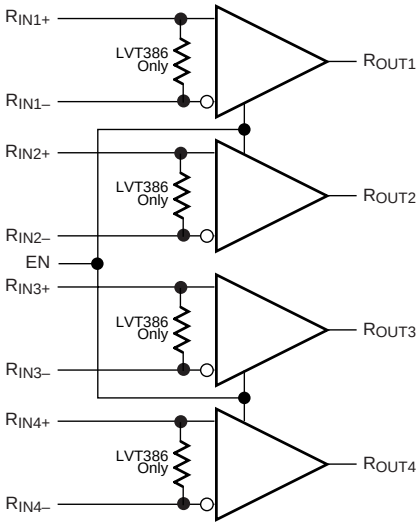
PI90LVR388 Block Diagram



PI90LVR388 Pin Configuration



PI90LV386/PI90LVT386 Block Diagram



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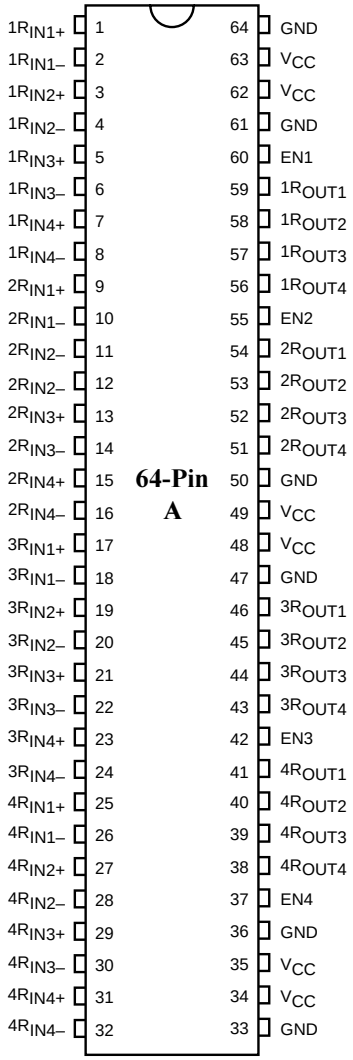
PI90LV386/PI90LVT386 Pin Configuration



16 Receivers

Absolute Maximum Ratings Over Operating Free-Air Temperature

(unless otherwise noted)†

Supply Voltage Range, V_{DD}(1) ..... –0.5V to 4V
Voltage Range: ..... Enables or R_{OUT}
–0.5V to V_{DD} +2V
R_{IN+} or R_{IN-} ..... –0.5V to 4V
Electrostatic Discharge(2):
R_{IN+}, R_{IN-}, and GND ..... Class 3, A: 10kV, B:700V
All Pins ..... Class 3, A: 8kV, B:600V
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature 1,6mm (1/16 inch)
from case for 10 seconds ..... 260°C

† 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.

Notes:
1. All voltage values, except differential I/O bus voltages, are with respect to ground terminal.
2. Tested in accordance with MIL-STD-883C Method 3015.7

Function Table

Differential Input		Enables	Output
$R_{IN}\pm$	CLK± R388 only	EN	R_{OUT}
$V_{ID} \geq 100mV$	↑	H	H
$-100mV < V_{ID} \leq 100mV$	↑	H	?
$V_{ID} \leq -100mV$	↑	H	L
X	X	L	Z
Open	↑	H	H
X	H or L	H	R_{OUT_0}

H = high level, L = low level, X = irrelevent
Z = high impedance (off), ? = indeterminate
↑ = Rising edge of clock

Recommended Operating Conditions

	Min.	Nom.	Max.	Units
Supply Voltage, V_{CC}	3.0	3.3	3.6	V
High-Level Input Voltage, V_{IH}	2.0			
Low-Level Input Voltage, V_{IL}			0.8	
Magnitude of Differential Input Voltage $\lvert V_{ID} \rvert$	0.1		0.6	
Common-Mode input Voltage, V_{IC} (see Figure 4)	$\frac{\lvert V_{ID} \rvert}{2}$		$2.4 - \frac{\lvert V_{ID} \rvert}{2}$	
			V_{CC} –0.8	
Operating free-air temperature, T_A	–40		85	°C

Electrical Characteristics Over Recommended Operating Conditions (unless otherwise noted)

Symbol	Parameter		Test Conditions	Min.	Typ.(1)	Max.	Units
V_{ITH+}	Positive-going differential input voltage threshold					100	mV
V_{ITH-}	Negative-going differential input voltage threshold			–100			
V_{OH}	High-level output voltage		I_{OH} = –8mA	2.4	3		V
V_{OL}	Low-level output voltage		I_{OL} = 8mA		0.2	0.4	
I_{CC}	Supply Current	PI90LVx386	Enabled, No load		50	70	mA
		PI90LVx388			22	40	
		PI90LVx386	Disabled			3	
		PI90LVx388				3	
I_I	Input Current (R_{IN+} or R_{IN-} inputs)	PI90LV	V_I = 0V		–13	–20	µA
			V_I = 2.4V	–1.2	–3		
		PI90LVT	V_I = 0V, other input open			–40	
			V_I = 2.4V, other input open	–2.4			
$I_{I(OFF)}$	Power-off input current (R_{IN+} or R_{IN-} inputs)		V_{CC} = 0V, V_I = 2.4V		12	±20	µA
I_{IH}	High-level input current (enables)		V_{IH} =2V			10	
I_{IL}	Low-level input current (enables)		V_{IL} =0.8V				
I_{OZ}	High-impedance output current		V_O = 0V			±1	
			V_O = 3.6V			10	
C_{IN}	Input capacitance (R_{IN+} or R_{IN-} inputs to GND)		V_{ID} = 0.4 sin 2.5E09 t V		5	10	pF
$Z_{(t)}$	Termination impedance (PI90LVTxxx)			88	110	132	Ω

Note:
1. All typical values are at 25°C and with a 3.3V supply.

Switching Characteristics Over Recommended Operating Conditions (unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.(1)	Max.	Units
t_{PLH}	Propagation delay time, low-to-high-level output	See Figure 2 (PI90LV388)	1	2.6	4	ns
t_{PHL}	Propagation delay time, high-to-low-level output			2.5		
t_r	Differential output signal rise time		500	800	1200	ps
t_f	Differential output signal fall time					
$t_{sk(p)}$	Pulse skew ($t_{PHL} - t_{PLH}$)			150	600	
$t_{sk(o)}$	Output skew(2)			100	400	
$t_{sk(pp)}$	Part-to-part skew(3)				1	ns
t_{PZH}	Propagation delay time, high-impedance-to-high-level output	See Figure 3(4)		7	15	
t_{PZL}	Propagation delay time, high-impedance-to-low-level output					
t_{PHZ}	Propagation delay time, high-level-to-high-impedance output					
t_{PLZ}	Propagation delay time, low-level-to-high-impedance output					
t_{SU}	Set-up time, data before CLK↑	PI90LVR388	1.2			
t_H	Hold-up time, data after CLK↑		1.0			
t_W	Pulse Duration, CLK HIGH or LOW		1.2			
t_{PLH}, t_{PHL}	Propagation delay time, CLK to R_{OUT}		0.5		3.5	
f_{MAX}	Maximum Clock frequency		300			MHz

Notes:

1. All typical values are at 25°C and with a 3.3V supply
2. $t_{sk(o)}$ is the magnitude of the time difference between the t_{PLH} or t_{PHL} of all drivers of a single device with all of their inputs connected together.
3. $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified terminals of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.
4. R_{OUT0} disable time is 1 nanosecond greater.

Parameter Measurement Information

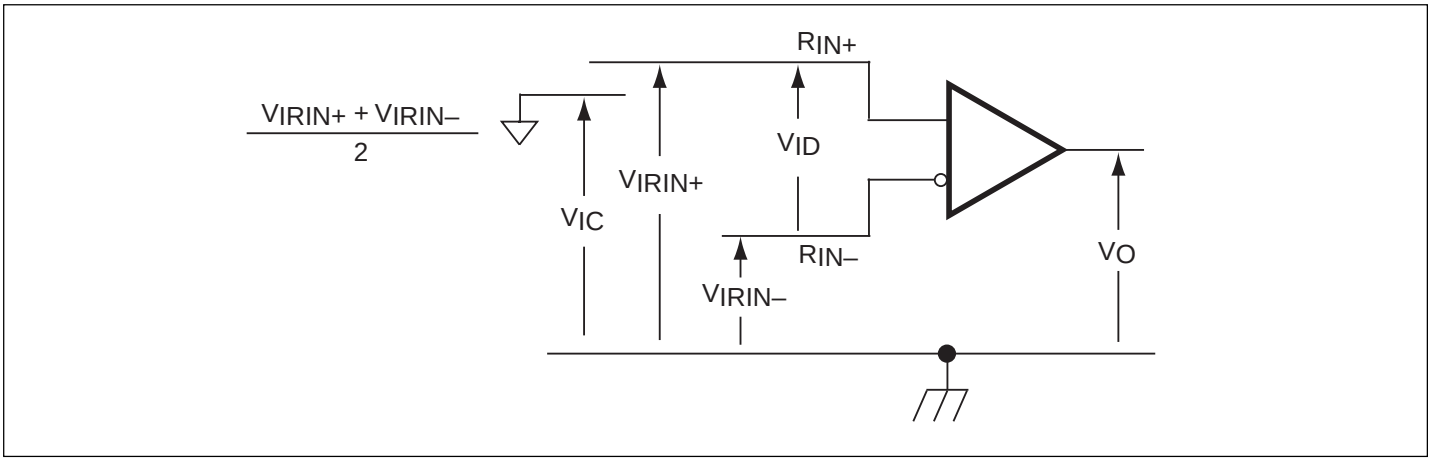
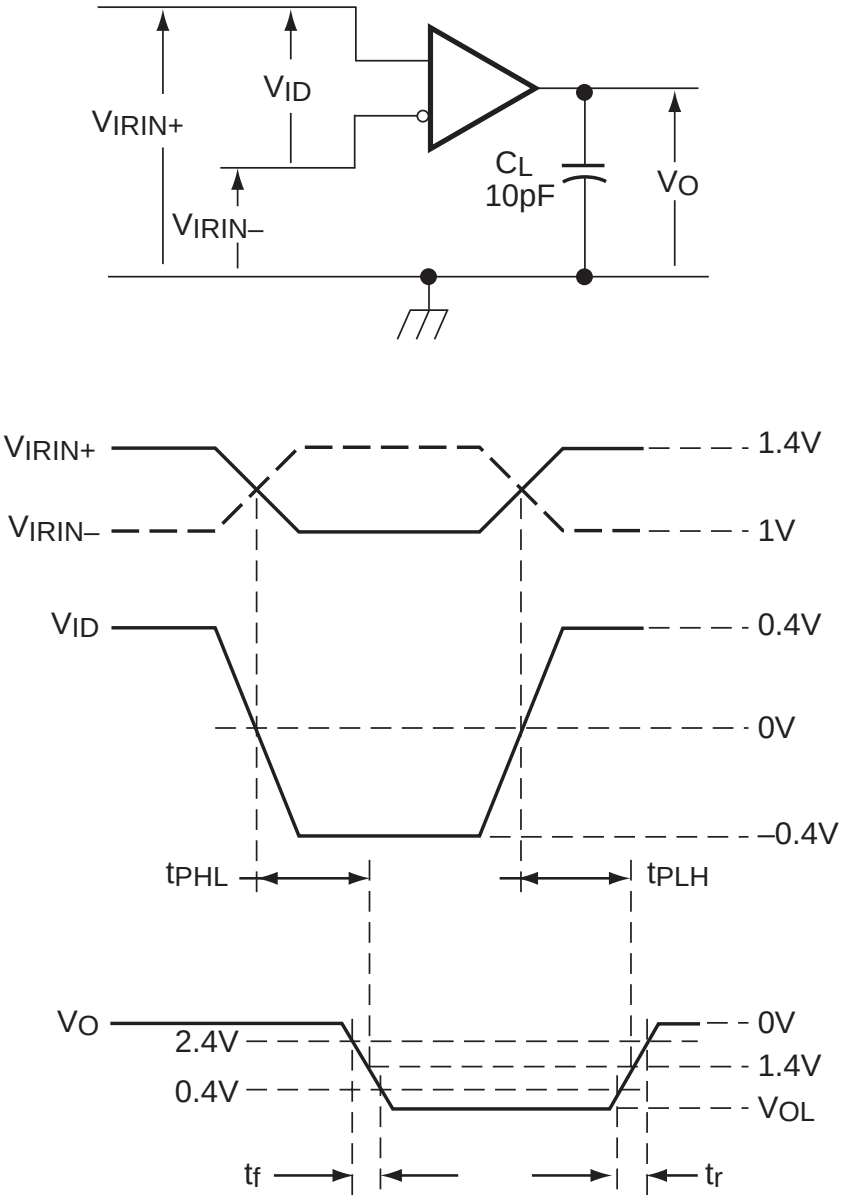


Figure 1. Voltage Definitions

Table 1. Receiver Minimum and Maximum Input Threshold Test Voltages

Applied Voltages		Resulting Differential Input Voltage	Resulting Common-Mode Input Voltage
V_{IRIN+}	V_{IRIN-}	V_{ID}	V_{IC}
1.25V	1.15V	100mV	1.2V
1.15V	1.25V	–100mV	1.2V
2.4V	2.3V	100mV	2.35V
2.3V	2.4V	–100mV	2.35V
0.1V	0V	100mV	0.05V
0V	0.1V	–100mV	0.05V
1.5V	0.9V	600mV	1.2V
0.9V	1.5V	–600mV	1.2V
2.4V	1.8V	600mV	2.1V
1.8V	2.4V	–600mV	2.1V
0.6V	0V	600mV	0.3V
0V	0.6V	–600mV	0.3V

Parameter Measurement Information (PI90LV388 only)

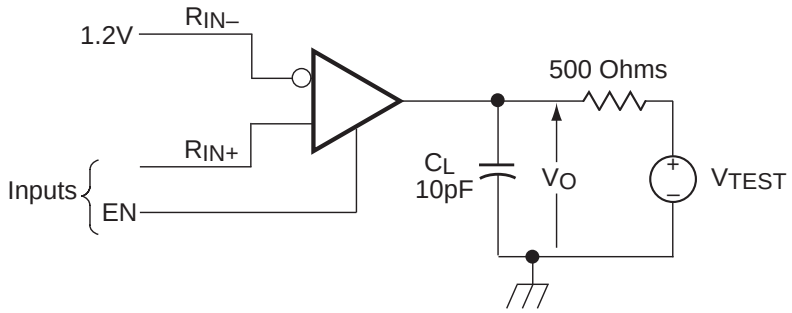


Note:

1. 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 ±0.2ns. C_L includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

Figure 2. Timing Test Circuit and Waveforms

Parameter Measurement Information



Note:

1. 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 ±10ns. C_L includes instrumentation and fixture capacitance within 0.06m of the D.U.T.

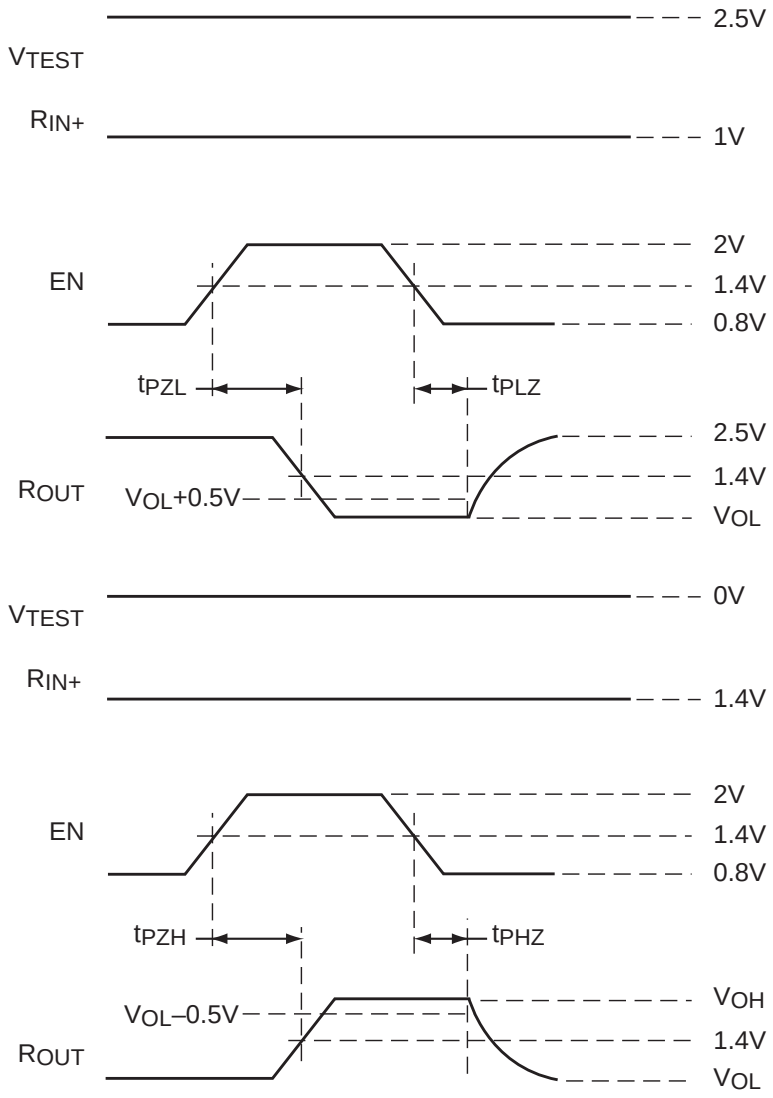


Figure 3. Enable/Disable Test Circuit and Waveforms

Typical Characteristics

Figure 4. Common-Mode Input Voltage vs. Differential Input Voltage

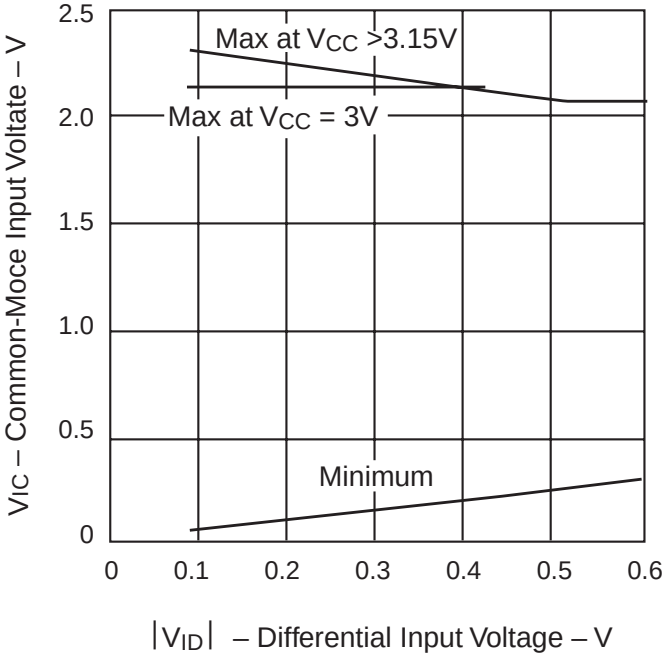


Figure 5. Supply Current vs. Switching Frequency

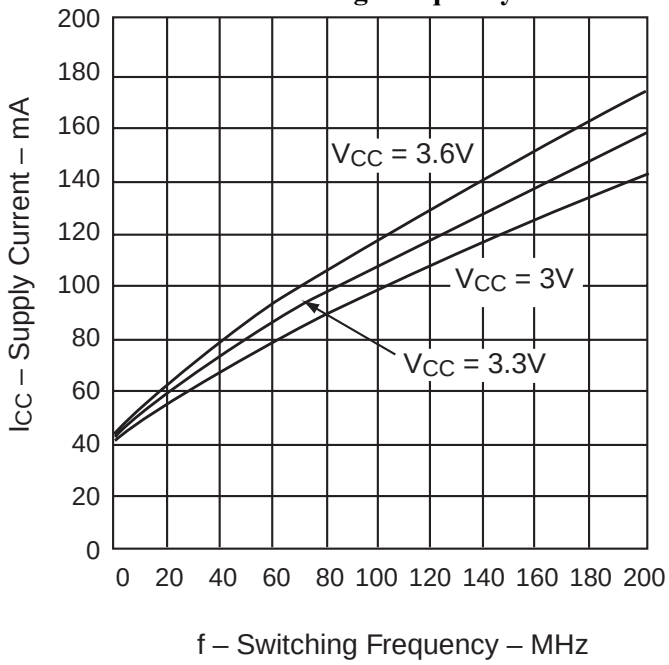


Figure 6. High-Level Output Voltage vs. High-Level Output Current

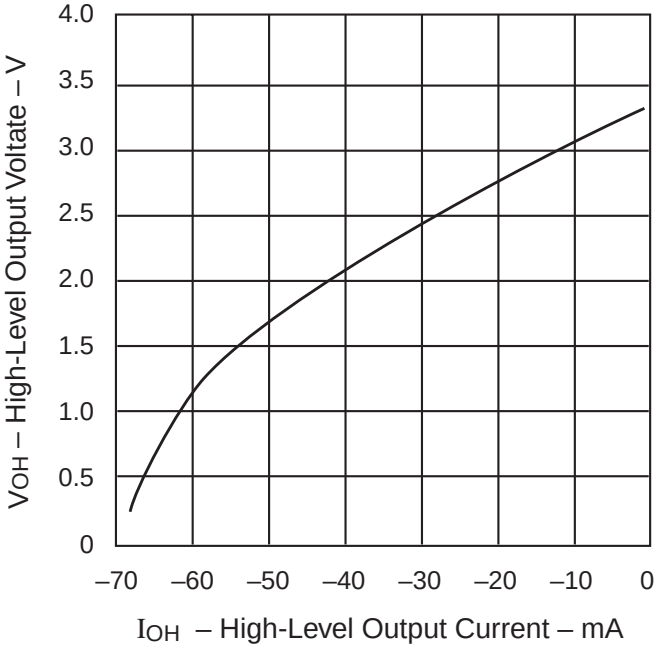
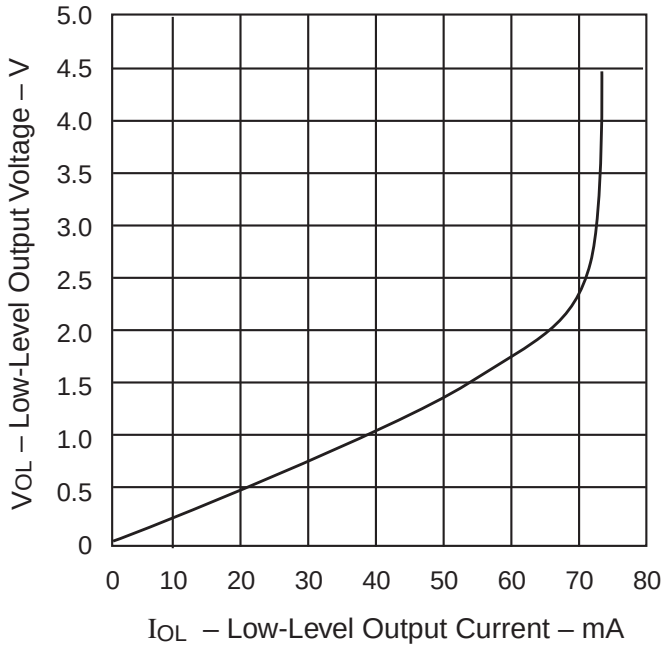


Figure 7. Low-Level Output Voltage vs. Low-Level Output Current



Typical Characteristics (for PI90LV388 only)

Figure 8. Low-to-High Propagation Delay Time vs. Free-Air Temperature

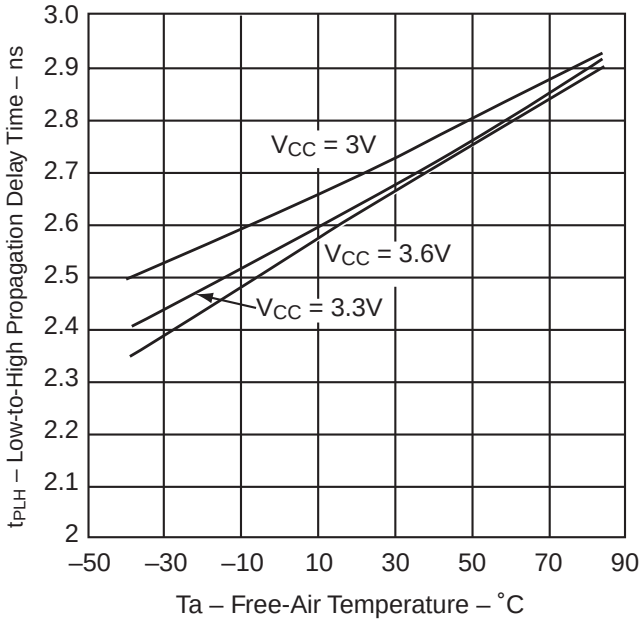
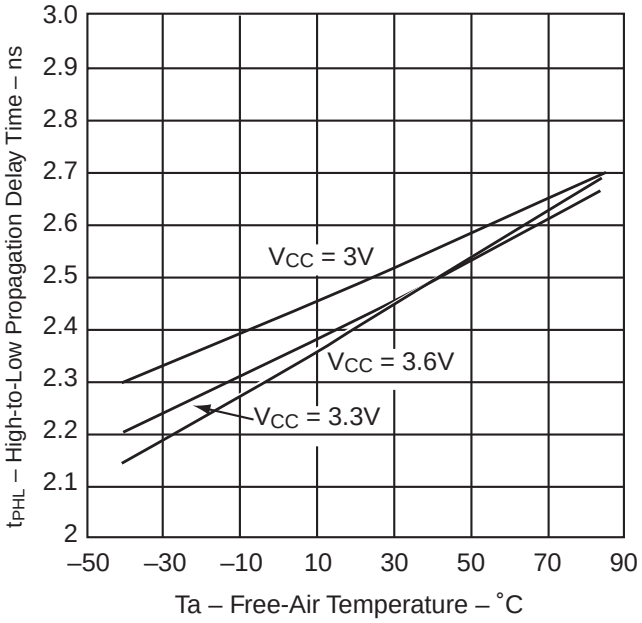
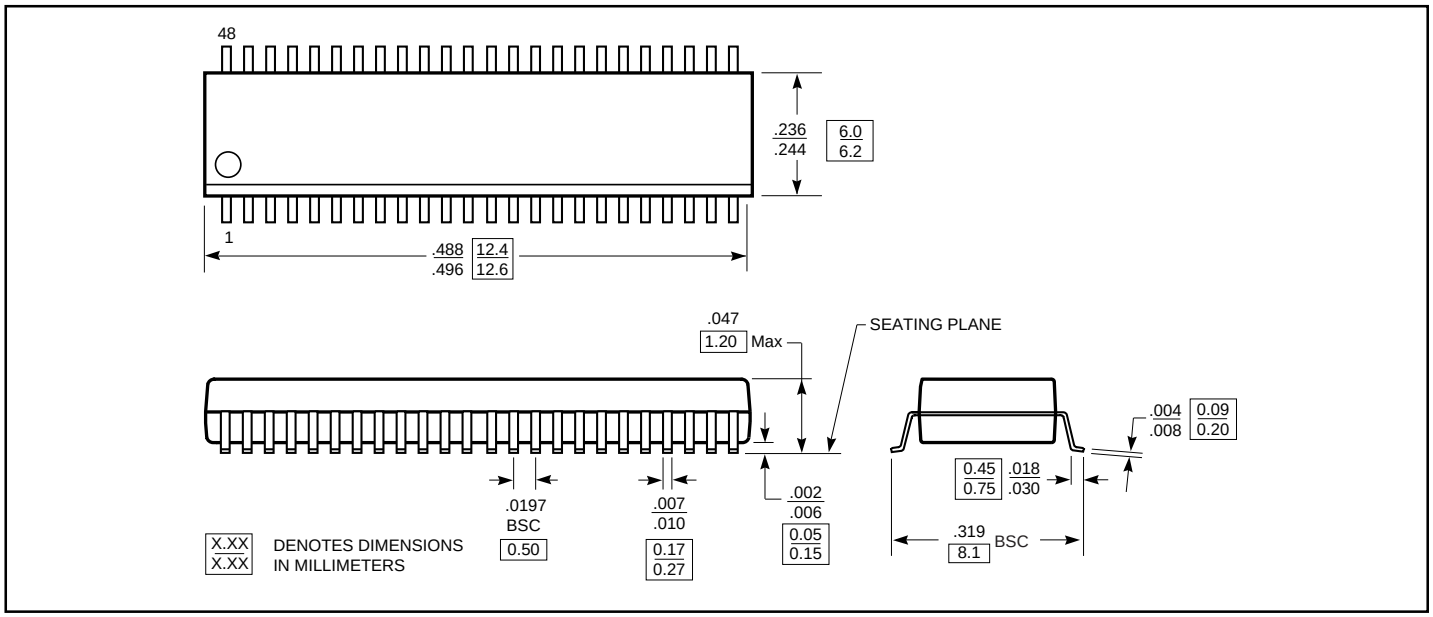


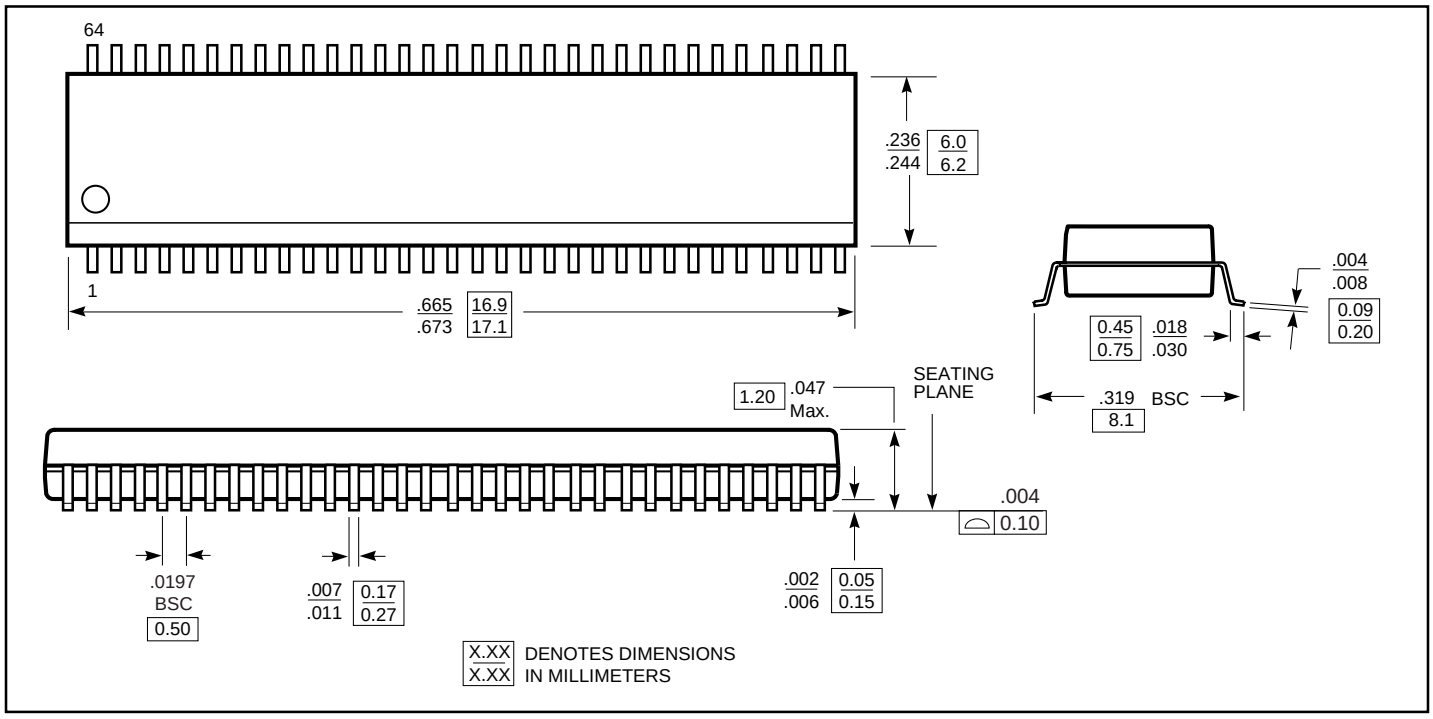
Figure 9. High-to-Low Propagation Delay Time vs. Free-Air Temperature



48-Pin TSSOP (A)



64-Pin TSSOP (A)



Ordering Information

Ordering Code	Package Name	Package Type	Temperature Range
PI90LV386, PI90LVT386	A64	64-pin TSSOP (A)	–40°C to 85°C
PI90LV388, PI90LVR88	A48	48-pin TSSOP (A)	