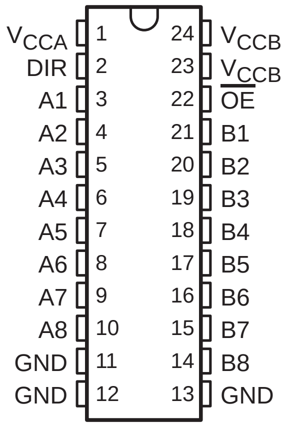
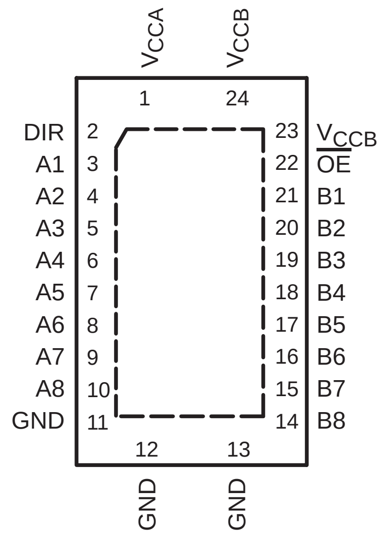
- **Control Inputs V_{IH}/V_{IL} Levels Are Referenced to V_{CCA} Voltage**
- **V_{CC} Isolation Feature − If Either V_{CC} Input Is at GND, All I/O Ports Are in the High-Impedance State**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.65-V to 5.5-V Power-Supply Range**

DGV OR PW PACKAGE
(TOP VIEW)



RGY PACKAGE
(TOP VIEW)



description/ordering information

This 8-bit noninverting bus transceiver uses two separate configurable power-supply rails. The SN74LVC8T245 is optimized to operate with V_{CCA}/V_{CCB} set at 1.65 V to 5.5 V. The A port is designed to track V_{CCA}. V_{CCA} accepts any supply voltage from 1.65 V to 5.5 V. The B port is designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.65 V to 5.5 V. This allows for universal low-voltage bidirectional translation between any of the 1.8-V, 2.5-V, 3.3-V, and 5.5-V voltage nodes.

The SN74LVC8T245 is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the outputs so the buses are effectively isolated.

The SN74LVC8T245 is designed so that the control pins (DIR and $\overline{OE}$) are supplied by V_{CCA}.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	QFN − RGY	Tape and reel	SN74LVC8T245RGYR	
	TSSOP − PW	Tube	SN74LVC8T245PW	
		Tape and reel	SN74LVC8T245PWR	
	TVSOP − DGV	Tape and reel	SN74LVC8T245DGVR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

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.

PRODUCT PREVIEW

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.

description/ordering information (continued)

The SN74LVC8T245 solution is compatible with a single-supply system and can be replaced later with a ’245 function with minimal PCB redesign.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

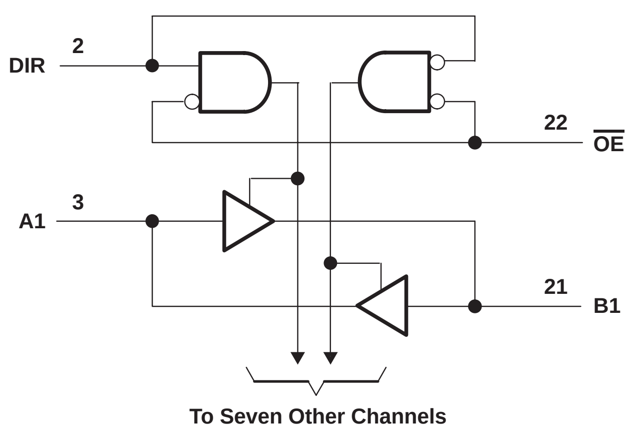
The V_{CC} isolation feature ensures that if either V_{CC} input is at GND, both ports are in the high-impedance state.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

FUNCTION TABLE
(each 8-bit section)

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CCA} and V_{CCB}	−0.5 V to 6.5 V
Input voltage range, V_I (see Note 1): I/O ports (A port)	−0.5 V to 6.5 V
I/O ports (B port)	−0.5 V to 6.5 V
Control inputs	−0.5 V to 6.5 V
Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1): (A port)	−0.5 V to 6.5 V
(B port)	−0.5 V to 6.5 V
Voltage range applied to any output in the high or low state, V_O (see Notes 1 and 2): (A port)	−0.5 V to V_{CCA} + 0.5 V
(B port)	−0.5 V to V_{CCB} + 0.5 V
Input clamp current, I_{IK} ($V_I < 0$)	−50 mA
Output clamp current, I_{OK} ($V_O < 0$)	−50 mA
Continuous output current, I_O	±50 mA
Continuous current through V_{CCA}, V_{CCB}, or GND	±100 mA
Package thermal impedance, θ_{JA} (see Note 3): DGV package	86°C/W
(see Note 3): PW package	88°C/W
(see Note 4): RGY package	TBD°C/W
Storage temperature range, T_{stg}	−65°C to 150°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. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
2. The output positive-voltage rating may be exceeded up to 6.5 V maximum if the output current rating is observed.
3. The package thermal impedance is calculated in accordance with JESD 51-7.
4. The package thermal impedance is calculated in accordance with JESD 51-5.

PRODUCT PREVIEW

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recommended operating conditions (see Notes 5 through 7)

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.65	5.5	V
V_{CCB}					1.65	5.5	
V_{IH}	High-level input voltage	Data inputs (see Note 8)	1.65 V to 1.95 V		$V_{CCI} \times 0.65$		V
			2.3 V to 2.7 V		1.7		
			3 V to 3.6 V		2		
			4.5 V to 5.5 V		$V_{CCI} \times 0.7$		
V_{IL}	Low-level input voltage	Data inputs (see Note 8)	1.65 V to 1.95 V			$V_{CCI} \times 0.35$	V
			2.3 V to 2.7 V			0.7	
			3 V to 3.6 V			0.8	
			4.5 V to 5.5 V			$V_{CCI} \times 0.3$	
V_{IH}	High-level input voltage	DIR (Referenced to V_{CCA}) (see Note 9)	1.65 V to 1.95 V		$V_{CCA} \times 0.65$		V
			2.3 V to 2.7 V		1.7		
			3 V to 3.6 V		2		
			4.5 V to 5.5 V		$V_{CCA} \times 0.7$		
V_{IL}	Low-level input voltage	DIR (Referenced to V_{CCA}) (see Note 9)	1.65 V to 1.95 V			$V_{CCA} \times 0.35$	V
			2.3 V to 2.7 V			0.7	
			3 V to 3.6 V			0.8	
			4.5 V to 5.5 V			$V_{CCA} \times 0.3$	
V_I	Input voltage				0	5.5	V
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-State			0	3.6	
I_{OH}	High-level output current			1.65 V to 1.95 V		−4	mA
				2.3 V to 2.7 V		−8	
				3 V to 3.6 V		−24	
				4.5 V to 5.5 V		−32	
I_{OL}	Low-level output current			1.65 V to 1.95 V		4	mA
				2.3 V to 2.7 V		8	
				3 V to 3.6 V		24	
				4.5 V to 5.5 V		32	
$\Delta t/\Delta v$	Input transition rise or fall rate	Data inputs	1.65 V to 1.95 V			20	ns/V
			2.3 V to 2.7 V			20	
			3 V to 3.6 V			10	
			4.5 V to 5.5 V			5	
T_A	Operating free-air temperature				−40	85	°C

NOTES:
5. V_{CCI} is the V_{CC} associated with the data input port.
6. V_{CCO} is the V_{CC} associated with the output port.
7. All unused data inputs of the device must be held at V_{CCI} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
8. For V_{CCI} values not specified in the data sheet, $V_{IH(min)} = V_{CCI}$ x 0.7 V, $V_{IL(max)} = V_{CCI}$ x 0.3 V.
9. For V_{CCI} values not specified in the data sheet, $V_{IH(min)} = V_{CCA}$ x 0.7 V, $V_{IL(max)} = V_{CCA}$ x 0.3 V.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Notes 10 and 11)

PARAMETER		TEST CONDITIONS		V_{CCA}	V_{CCB}	T_A = 25°C MIN	T_A = 25°C TYP	T_A = 25°C MAX	−40°C to 85°C MIN	−40°C to 85°C MAX	UNIT
V_{OH}		I_{OH} = −100 µA	$V_I = V_{IH}$	1.65 V to 4.5 V	1.65 V to 4.5 V				V_{CCO} − 0.1 V		V
		I_{OH} = −4 mA	$V_I = V_{IH}$	1.65V	1.65 V				1.2		
		I_{OH} = −8 mA	$V_I = V_{IH}$	2.3 V	2.3 V				1.9		
		I_{OH} = −24 mA	$V_I = V_{IH}$	3 V	3 V				2.4		
		I_{OH} = −32 mA	$V_I = V_{IH}$	4.5 V	4.5 V				3.8		
V_{OL}		I_{OL} = 100 µA	$V_I = V_{IL}$	1.65 V to 4.5 V	1.65 V to 4.5 V					0.1	V
		I_{OL} = 4 mA	$V_I = V_{IL}$	1.65 V	1.65 V					0.45	
		I_{OL} = 8 mA	$V_I = V_{IL}$	2.3 V	2.3 V					0.3	
		I_{OL} = 24 mA	$V_I = V_{IL}$	3 V	3 V					0.55	
		I_{OL} = 32 mA	$V_I = V_{IL}$	4.5 V	4.5 V					0.55	
I_I	Control inputs	$V_I = V_{CCA}$ or GND		1.65 V to 5.5 V	1.65 V to 5.5 V			±1		±2	µA
I_{off}	A or B port	V_I or V_O = 0 to 5.5 V		0 V	0 to 5.5 V			±1		±2	µA
				0 to 5.5 V	0 V			±1		±2	
I_{OZ}	A or B ports	$V_O = V_{CCO}$ or GND	$\overline{OE} = V_{IH}$	1.65 V to 5.5 V	1.65 V to 5.5 V			±1		±2	µA
I_{CCA}		$V_I = V_{CCI}$ or GND	I_O = 0	1.65 V to 5.5 V	1.65 V to 5.5 V					15	µA
				5 V	0 V					15	
				0 V	5 V					−2	
I_{CCB}		$V_I = V_{CCI}$ or GND	I_O = 0	1.65 V to 5.5 V	1.65 V to 5.5 V					15	µA
				5 V	0 V					−2	
				0 V	5 V					15	
I_{CCA} + I_{CCB}		$V_I = V_{CCI}$ or GND	I_O = 0	1.65 V to 5.5 V	1.65 V to 5.5 V					25	µA
ΔI_{CCA}	A port	One A port at V_{CCA} − 0.6 V, DIR at V_{CCA}, B port = OPEN		3 V to 5.5 V	3 V to 5.5 V					50	µA
	Control inputs	DIR at V_{CCA} − 0.6 V, B port = OPEN, A port at V_{CCA} or GND								50	
ΔI_{CCB}	B port	One B port at V_{CCB} − 0.6 V, DIR at GND, A port = OPEN		3 V to 5.5 V	3 V to 5.5 V					50	µA
C_i	Control inputs	$V_I = V_{CCA}$ or GND		3.3 V	3.3 V						pF
C_{io}	A or B ports	$V_O = V_{CCA/B}$ or GND		3.3 V	3.3 V						pF

NOTES: 10. V_{CCO} is the V_{CC} associated with the output port.
11. V_{CCI} is the V_{CC} associated with the input port.

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switching characteristics over recommended operating free-air temperature range, V_{CCA} = 1.8 V ± 0.15 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		V_{CCB} = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											

switching characteristics over recommended operating free-air temperature range, V_{CCA} = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		V_{CCB} = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											

switching characteristics over recommended operating free-air temperature range, V_{CCA} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		V_{CCB} = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											

switching characteristics over recommended operating free-air temperature range, V_{CCA} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		V_{CCB} = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											
t_{PZH}†	$\overline{OE}$	A									ns
t_{PZL}†											
t_{PZH}†	$\overline{OE}$	B									ns
t_{PZL}†											

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operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CCA} = V_{CCB} = 1.8 V	V_{CCA} = V_{CCB} = 2.5 V	V_{CCA} = V_{CCB} = 3.3 V	V_{CCA} = V_{CCB} = 5 V	UNIT
			TYP	TYP	TYP	TYP	
C_{pdA}†	A port input, B port output	C_L = 0, f = 10 MHz, t_r = t_f =1 ns					pF
	B port input, A port output						
C_{pdB}†	A port input, B port output						
	B port input, A port output						

† Power-dissipation capacitance per transceiver

power-up considerations

A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies. To guard against such power-up problems, take the following precautions:

1. Connect ground before any supply voltage is applied.
2. Power up V_{CCA}.
3. V_{CCB} can be ramped up along with or after V_{CCA}.

typical total static power consumption (I_{CCA} + I_{CCB})

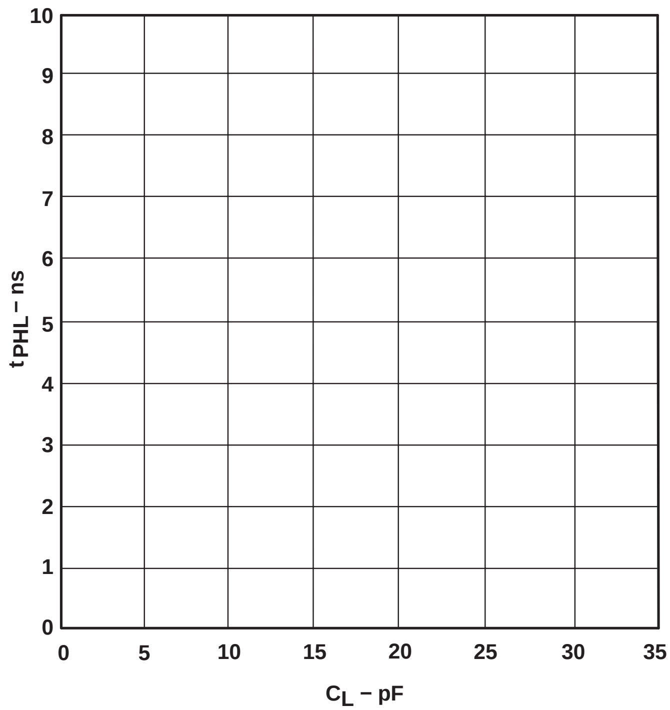
Table 1

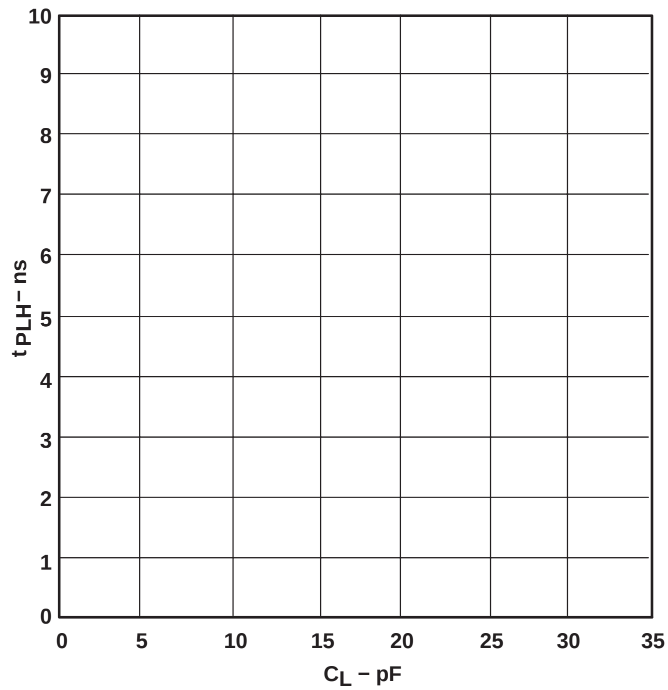
V_{CCB}	V_{CCA}					UNIT
	0 V	1.8 V	2.5 V	3.3 V	5 V	
0 V						μA
1.8 V						
2.5 V						
3.3 V						
5 V						

PRODUCT PREVIEW

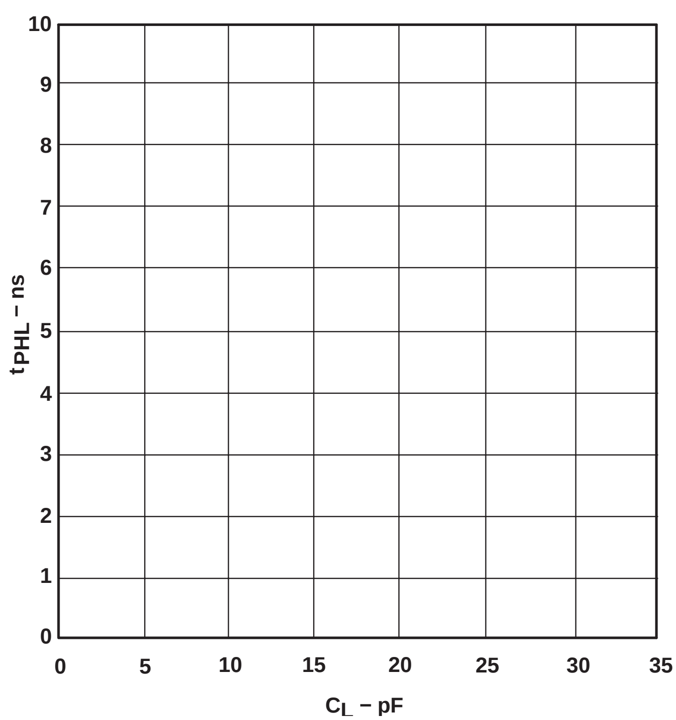
TYPICAL CHARACTERISTICS

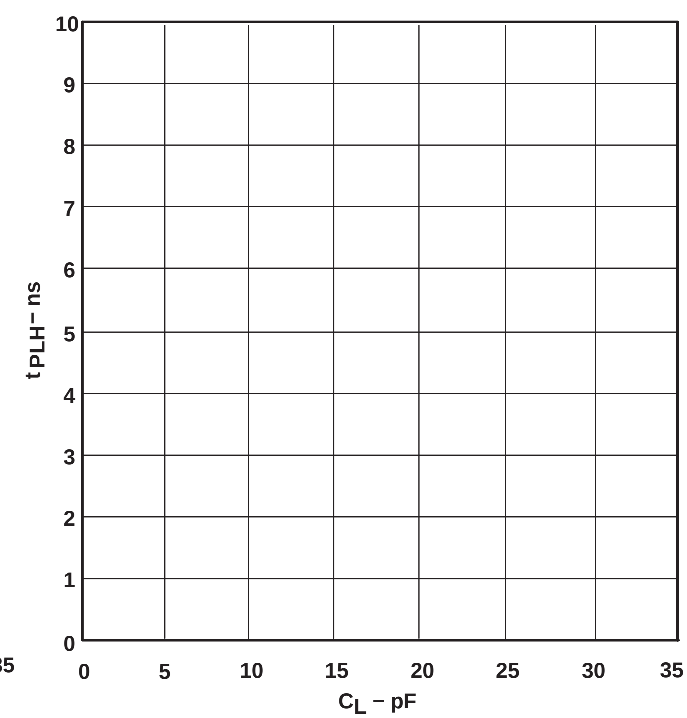
TYPICAL PROPAGATION DELAY (A TO B) vs LOAD CAPACITANCE
$T_A = 25°C, V_{CCA} = 1.8\ V$





TYPICAL PROPAGATION DELAY (B TO A) vs LOAD CAPACITANCE
$T_A = 25°C, V_{CCA} = 1.8\ V$





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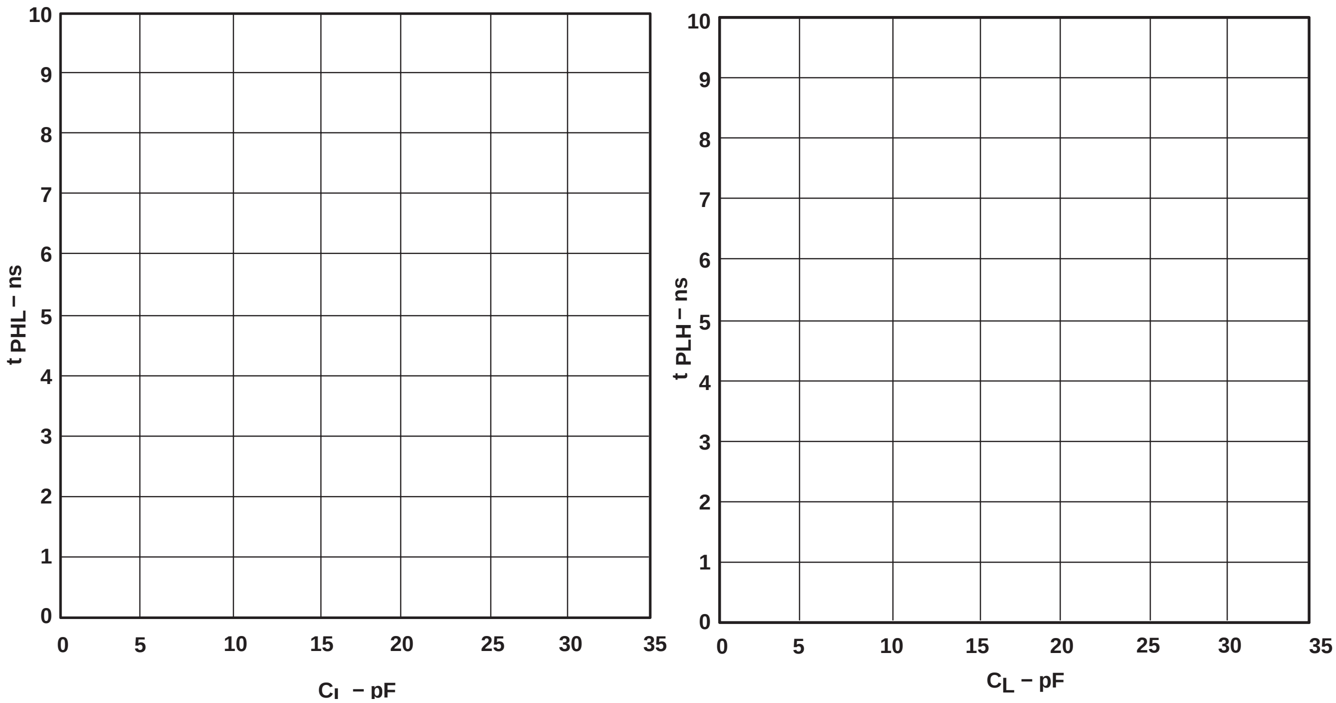
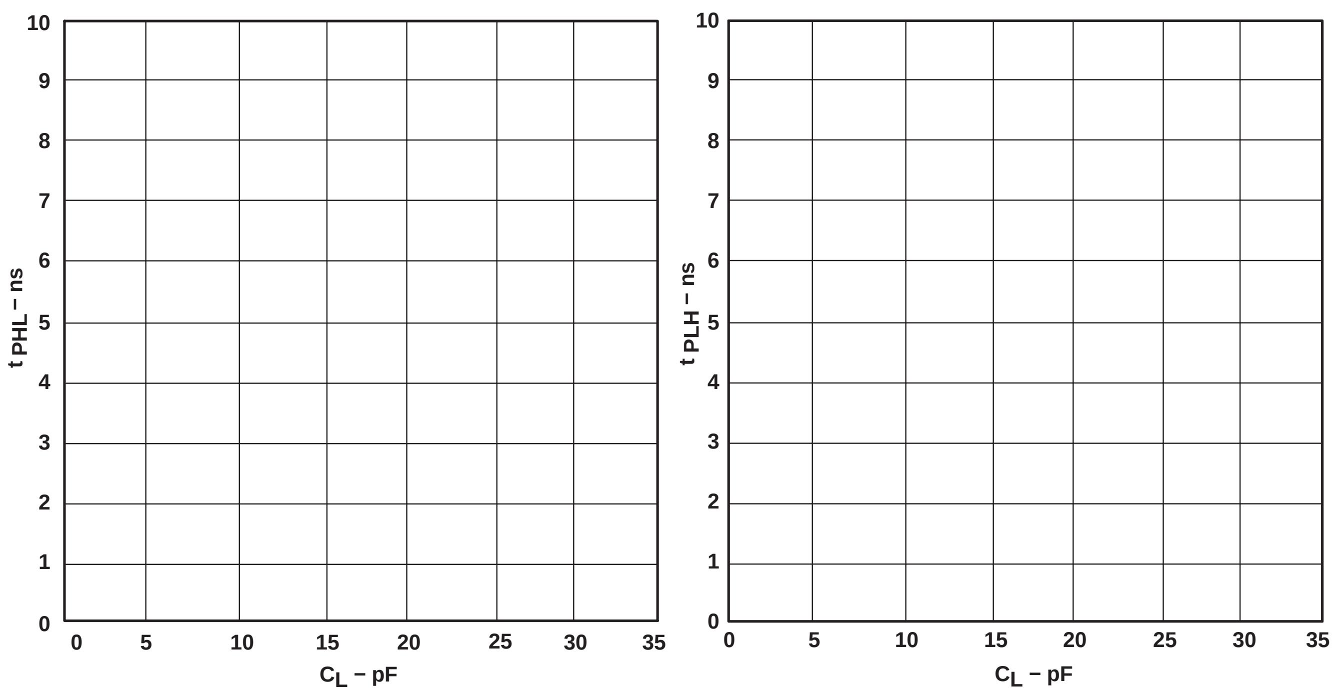
PRODUCT PREVIEW

TYPICAL CHARACTERISTICS

TYPICAL PROPAGATION DELAY (A TO B) vs LOAD CAPACITANCE
$T_A = 25°C, V_{CCA} = 2.5\ V$

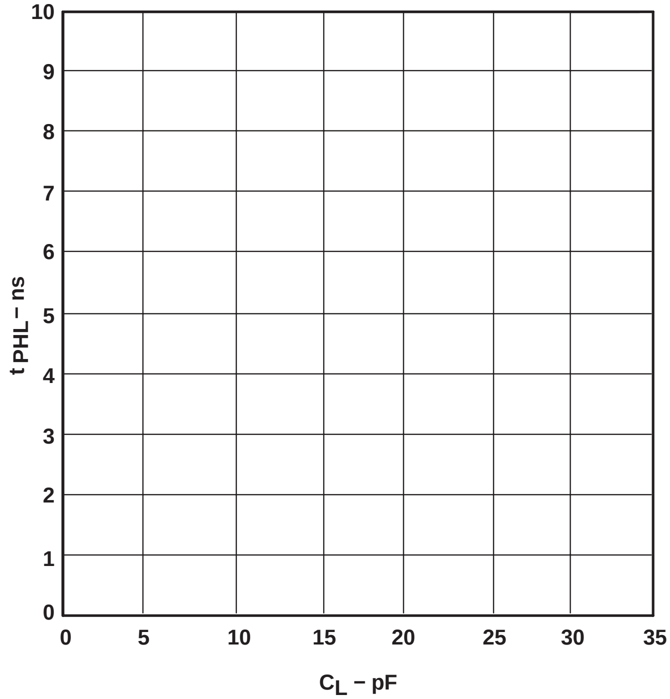


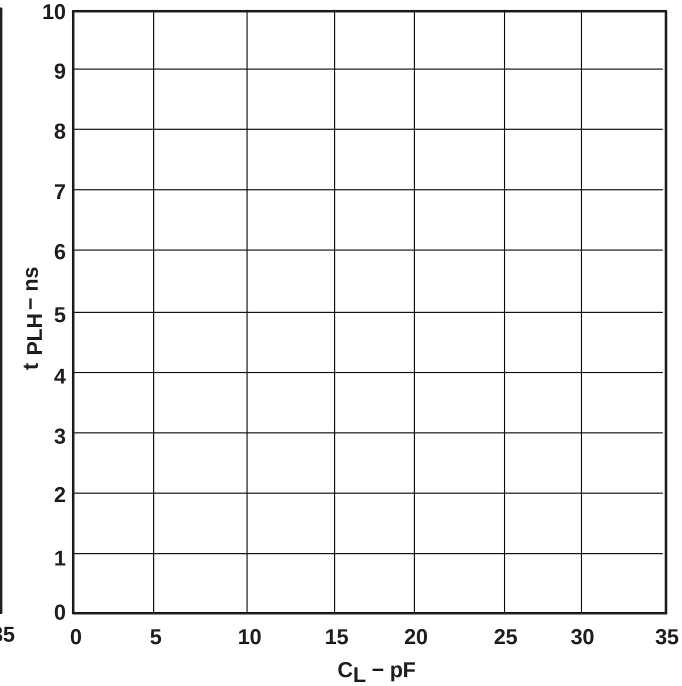
TYPICAL PROPAGATION DELAY (B TO A) vs LOAD CAPACITANCE
$T_A = 25°C, V_{CCA} = 2.5\ V$



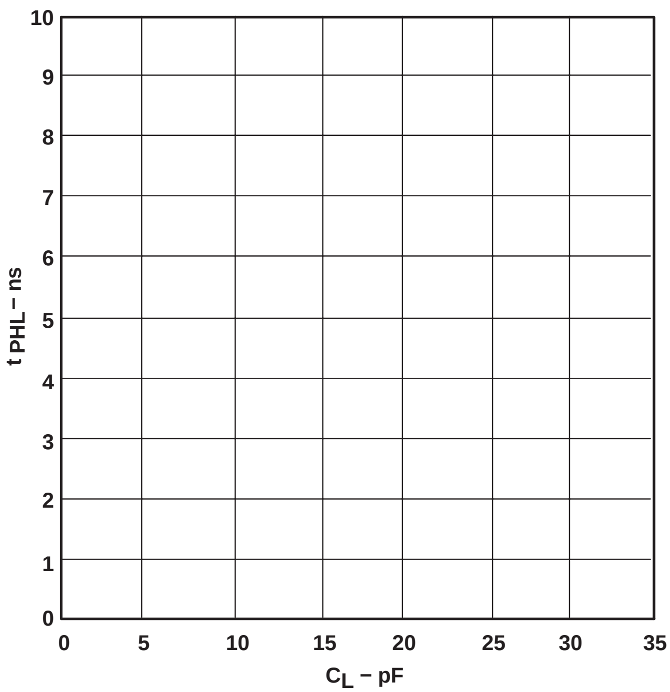
TYPICAL CHARACTERISTICS

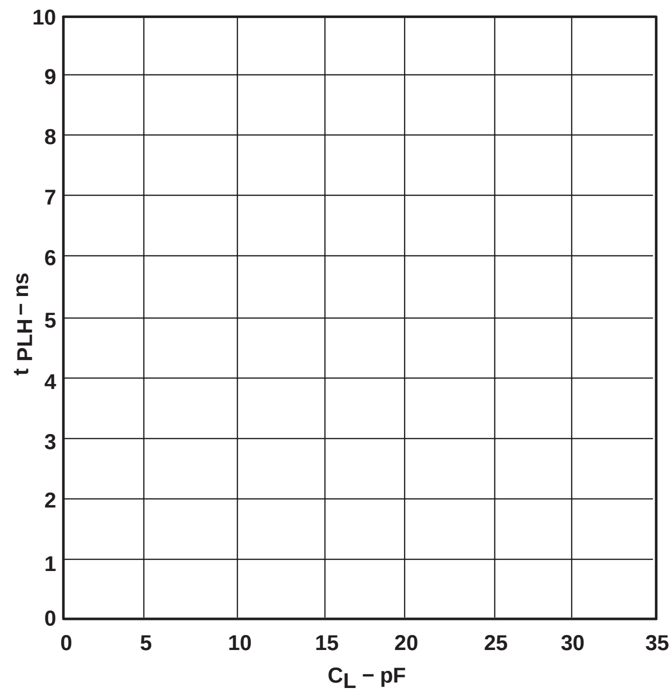
TYPICAL PROPAGATION DELAY (A TO B) vs LOAD CAPACITANCE
$T_A = 25°C, V_{CCA} = 3.3 V$





TYPICAL PROPAGATION DELAY (B TO A) vs LOAD CAPACITANCE
$T_A = 25°C, V_{CCA} = 3.3 V$





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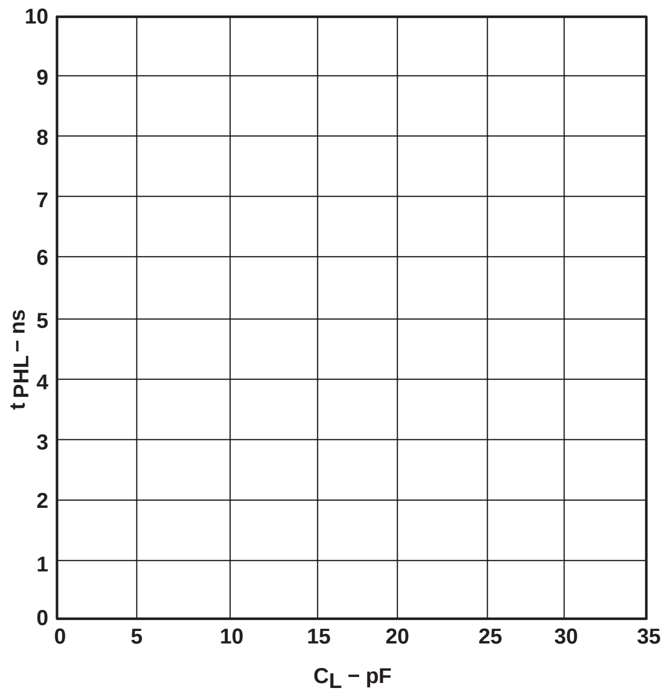
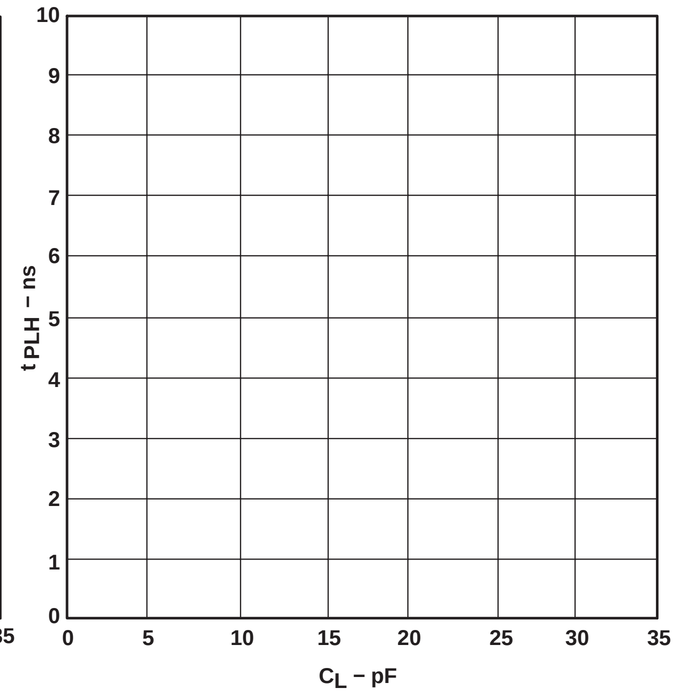
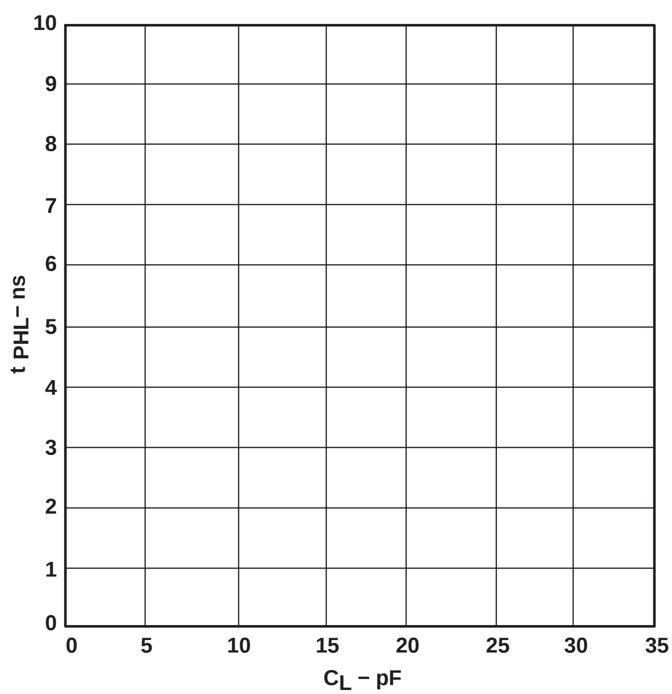
TYPICAL CHARACTERISTICS

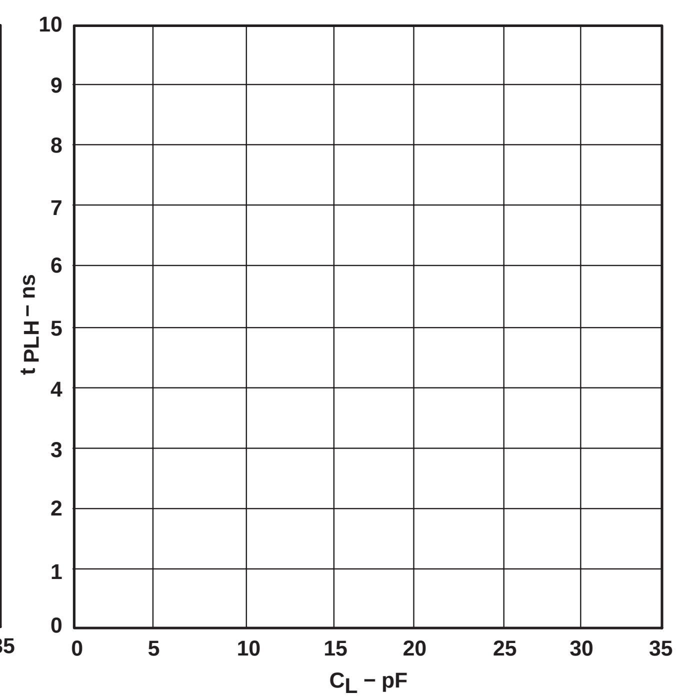
TYPICAL PROPAGATION DELAY (A to B) vs LOAD CAPACITANCE
T_A = 25°C, V_{CCA} = 5 V



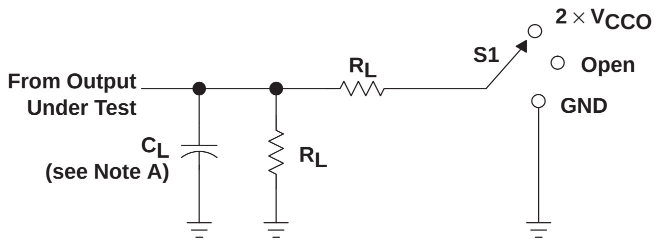


TYPICAL PROPAGATION DELAY (B TO A) vs LOAD CAPACITANCE
T_A = 25°C, V_{CCA} = 5 V





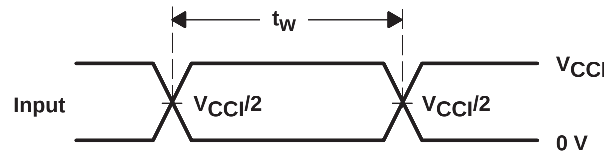
PARAMETER MEASUREMENT INFORMATION



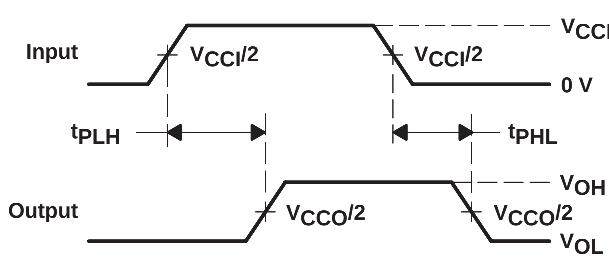
LOAD CIRCUIT

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	GND

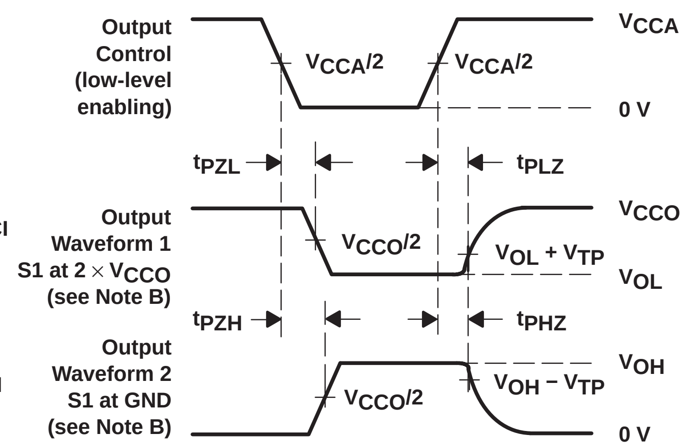
V_{CCO}	C_L	R_L	V_{TP}
1.8 V ± 0.15 V	15 pF	2 kΩ	0.15 V
2.5 V ± 0.2 V	15 pF	2 kΩ	0.15 V
3.3 V ± 0.3 V	15 pF	2 kΩ	0.3 V
5 V ± 0.5 V	15 pF	2 kΩ	0.3 V



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES:
- A. C_L includes probe and jig capacitance.
- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, dv/dt ≥ 1 V/ns, dv/dt ≥1 V/ns.
- D. The outputs are measured one at a time, with one transition per measurement.
- E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
- F. t_{PZL} and t_{PZH} are the same as t_{en}.
- G. t_{PLH} and t_{PHL} are the same as t_{pd}.
- H. V_{CCI} is the V_{CC} associated with the input port.
- I. V_{CCO} is the V_{CC} associated with the output port.
- J. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74LVC8T245DGVR	PREVIEW	TVSOP	DGV	24	2000	TBD	Call TI	Call TI

(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) 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.
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.

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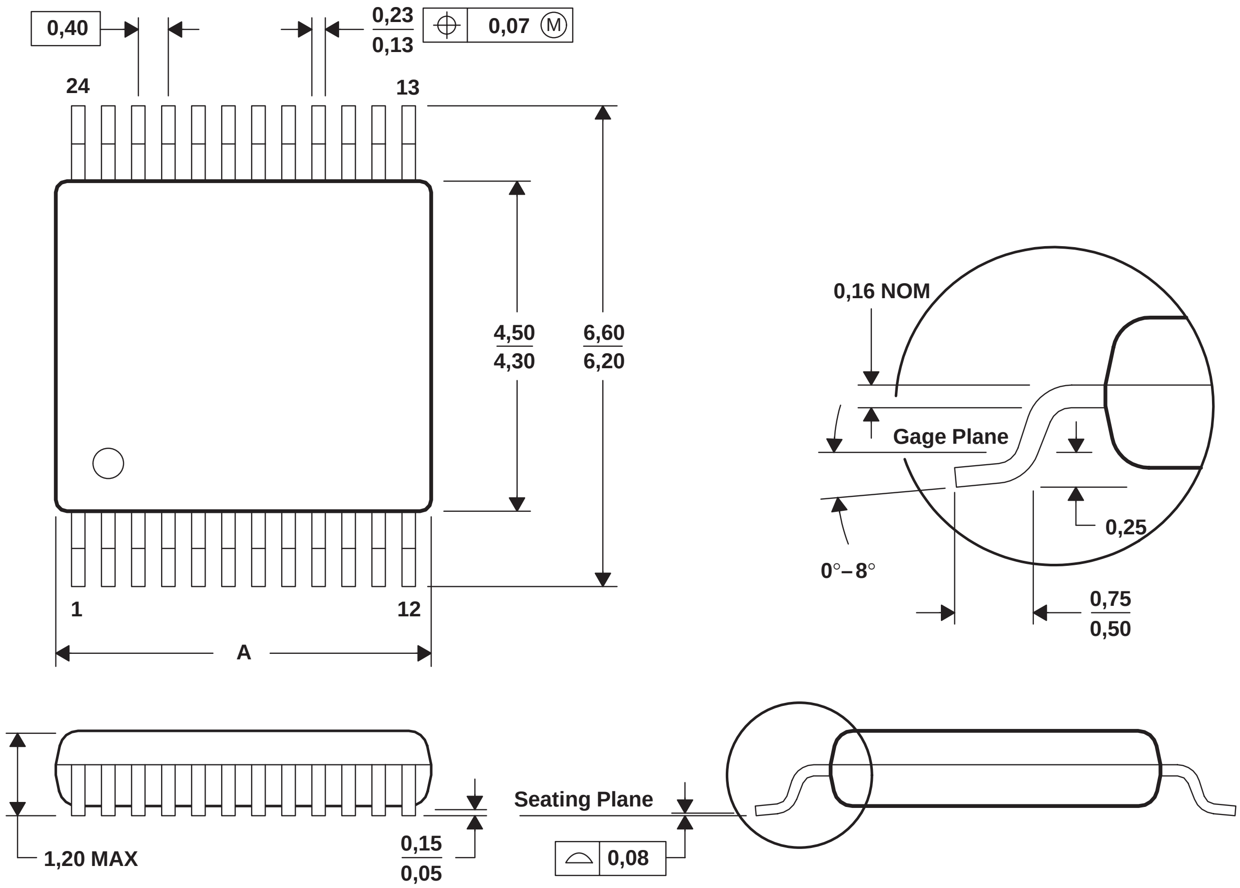
DGV (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

24 PINS SHOWN



DIM \ PINS **	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
D. Falls within JEDEC: 24/48 Pins – MO-153
14/16/20/56 Pins – MO-194

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