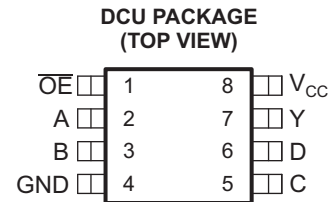


# ULTRA-CONFIGURABLE MULTIPLE-FUNCTION GATE WITH 3-STATE OUTPUT

Check for Samples: [SN74LVC1G99-Q1](#)

## FEATURES

- Qualified for Automotive Applications
- Supports 5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Low Power Consumption, 15- $\mu$ A Max  $I_{CC}$
- $\pm 24$ -mA Output Drive at 3.3 V
- Offers Nine Different Logic Functions in a Single Package
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Input Hysteresis Allows for Slow Input Transition Time and Better Noise Immunity at Input



## DESCRIPTION/ORDERING INFORMATION

The SN74LVC1G99-Q1 is operational from 1.65 V to 5.5 V.

The SN74LVC1G99-Q1 features configurable multiple functions with a 3-state output. The output is disabled when the output-enable ( $\overline{OE}$ ) input is high. When  $\overline{OE}$  is low, the output state is determined by 16 patterns of 4-bit input. The user can choose logic functions, such as MUX, AND, OR, NAND, NOR, XOR, XNOR, inverter, and buffer. All inputs can be connected to  $V_{CC}$  or GND.

This device functions as an independent inverter, but because of Schmitt action, it has different input threshold levels for positive-going ( $V_{T+}$ ) and negative-going ( $V_{T-}$ ) signals.

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.

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.

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup> (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>
-40°C to 125°C	VSSOP – DCU	Reel of 3000	SN74LVC1G99QDCURQ1	CAZ_

(1) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).

(3) DCU: The actual top-side marking has one additional character that designates the assembly/test site.

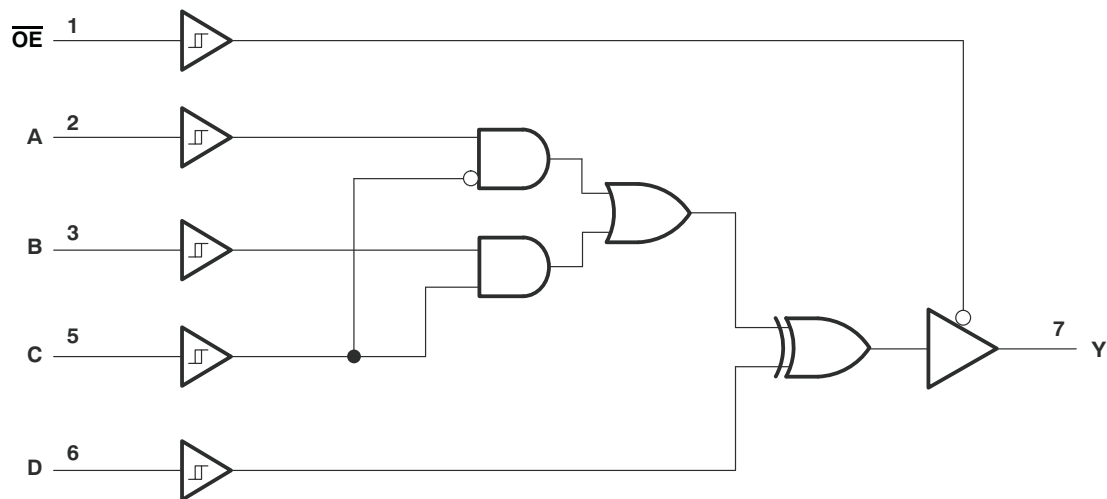


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

**FUNCTION TABLE**

INPUTS					OUTPUT Y
$\overline{\text{OE}}$	D	C	B	A	
L	L	L	L	L	L
L	L	L	L	H	H
L	L	L	H	L	L
L	L	L	H	H	H
L	L	H	L	L	L
L	L	H	L	H	L
L	L	H	H	L	H
L	L	H	H	H	H
L	H	L	L	L	H
L	H	L	L	H	L
L	H	L	H	L	H
L	H	L	H	H	L
L	H	H	L	L	H
L	H	H	L	H	H
L	H	H	H	L	L
L	H	H	H	H	L
H	H or L	H or L	H or L	H or L	Z

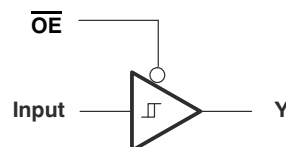
### LOGIC DIAGRAM (POSITIVE LOGIC)



### FUNCTION SELECTION TABLE

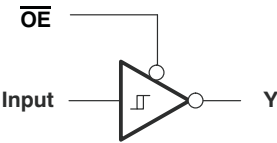
PRIMARY FUNCTION	COMPLEMENTARY FUNCTION	PAGE
3-state buffer		3
3-state inverter		3
3-state 2-in-1 data selector MUX		4
3-state 2-in-1 data selector MUX, inverted out		4
3-state 2-input AND	3-state 2-input NOR, both inputs inverted	5
3-state 2-input AND, one input inverted	3-state 2-input NOR, one input inverted	5
3-state 2-input AND, both inputs inverted	3-state 2-input NOR	5
3-state 2-input NAND	3-state 2-input OR, both inputs inverted	6
3-state 2-input NAND, one input inverted	3-state 2-input OR, one input inverted	6
3-state 2-input NAND, both inputs inverted	3-state 2-input OR	6
3-state 2-input XOR		7
3-state 2-input XNOR	3-state 2-input XOR, one input inverted	7

### 3-STATE BUFFER FUNCTIONS AVAILABLE



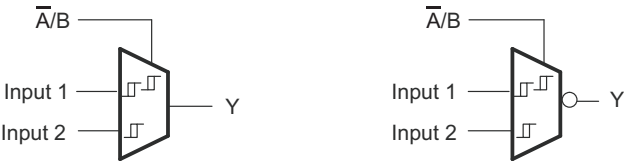
FUNCTION	$\overline{OE}$	A	B	C	D
3-state buffer	L	Input	H or L	L	L
		H or L	Input	H	L
		L	H	Input	L
		H	L	Input	H
		H	H or L	L	Input
		H or L	L	H	Input
		L	L	H or L	Input

3-STATE INVERTER FUNCTIONS AVAILABLE



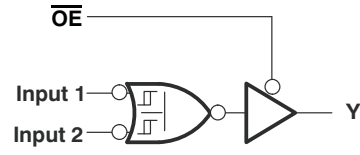
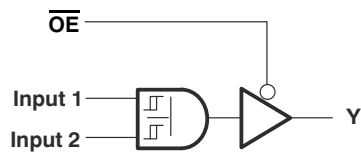
FUNCTION	$\overline{OE}$	A	B	C	D
3-state buffer	L	Input	H or L	L	H
		X	Input	H	H
		L	H	Input	H
		H	L	Input	L
		H	H or L	L	Input
		H or L	H	H	Input
		H	H	H or L	Input

3-STATE MUX FUNCTIONS AVAILABLE

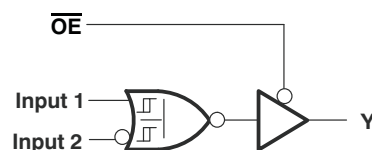
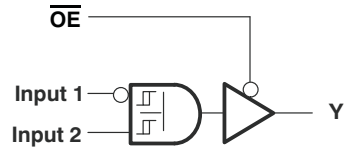


FUNCTION	$\overline{OE}$	A	B	C	D
3-state 2-to-1, data selector MUX	L	Input 1	Input 2	$\overline{\text{Input 1}}$ or Input 2	L
3-state 2-to-1, data selector MUX		Input 2	Input 1	$\overline{\text{Input 2}}$ or Input 1	L
3-state 2-to-1, data selector MUX, inverted out		Input 1	Input 2	$\overline{\text{Input 1}}$ or Input 2	H
3-state 2-to-1, data selector MUX, inverted out		Input 2	Input 1	$\overline{\text{Input 2}}$ or Input 1	H

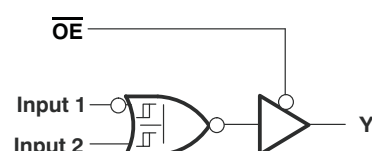
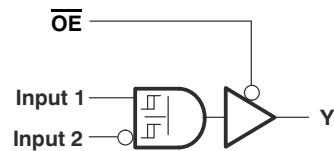
### 3-STATE AND/NOR/OR FUNCTIONS AVAILABLE



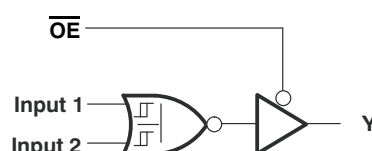
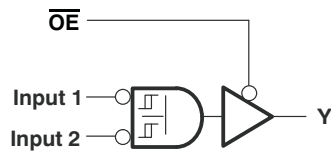
NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state AND	3-state NOR	L	L	Input 1	Input 2	L
2	3-state AND	3-state NOR		L	Input 2	Input 1	L



NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state AND	3-state NOR	L	Input 2	L	Input 1	L
2	3-state AND	3-state NOR		H	Input 1	Input 2	H

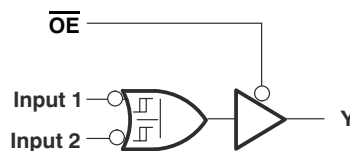
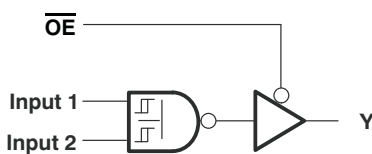


NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state AND	3-state NOR	L	Input 1	L	Input 2	L
2	3-state AND	3-state NOR		H	Input 2	Input 1	H

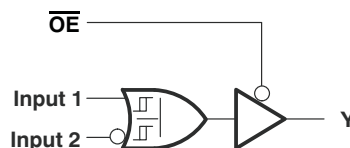
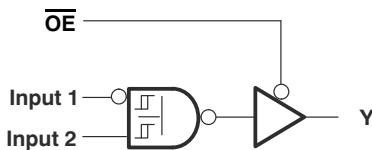


NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state AND, both inverted inputs	3-state NOR	L	Input 1	H	Input 2	H
2	3-state AND, both inverted inputs	3-state NOR		Input 2	H	Input 1	H

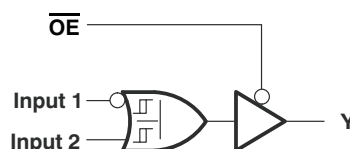
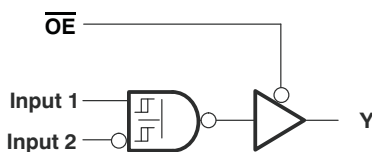
### 3-STATE NAND/OR FUNCTIONS AVAILABLE



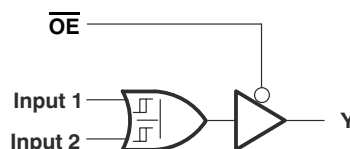
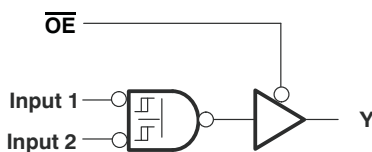
NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state NAND	3-state OR	L	L	Input 1	Input 2	H
2	3-state NAND	3-state OR		L	Input 2	Input 1	H



NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state NAND	3-state OR	L	Input 2	L	Input 1	H
2	3-state NAND	3-state OR		H	Input 1	Input 2	L

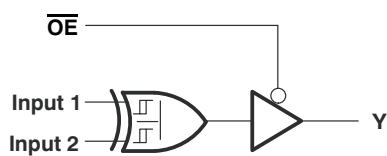


NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state NAND	3-state OR	L	Input 1	L	Input 2	H
2	3-state NAND	3-state OR		H	Input 2	Input 1	L

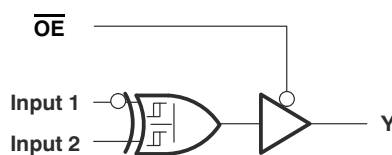


NO. OF INPUTS	AND/NAND FUNCTION	OR/NOR FUNCTION	$\overline{OE}$	A	B	C	D
2	3-state NAND	3-state OR	L	Input 1	H	Input 2	L
2	3-state NAND	3-state OR		Input 2	H	Input 1	L

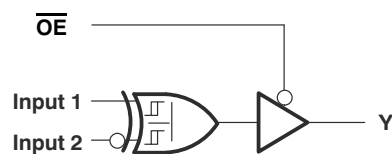
### 3-STATE XOR/XNOR FUNCTIONS AVAILABLE



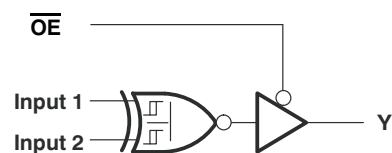
FUNCTION	$\overline{OE}$	A	B	C	D
3-state XOR	L	Input 1	H or L	L	Input 2
		Input 2	H or L	L	Input 1
		H or L	Input 1	H	Input 2
		H or L	Input 2	H	Input 1
		L	H	Input 1	Input 2
		L	H	Input 2	Input 1



FUNCTION	$\overline{OE}$	A	B	C	D
3-state XOR	L	H	L	Input 1	Input 2



FUNCTION	$\overline{OE}$	A	B	C	D
3-state XOR	L	H	L	Input 1	Input 2



FUNCTION	$\overline{OE}$	A	B	C	D
3-state XNOR	L	H	L	Input 1	Input 2
3-state XNOR		H	L	Input 2	Input 1

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage range	−0.5	6.5	V
$V_I$	Input voltage range <sup>(2)</sup>	−0.5	6.5	V
$V_O$	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	−0.5	6.5	V
$V_O$	Voltage range applied to any output in the high or low state <sup>(2) (3)</sup>	−0.5	$V_{CC} + 0.5$	V
$I_{IK}$	Input clamp current	$V_I < 0$		−50 mA
$I_{OK}$	Output clamp current	$V_O < 0$		−50 mA
$I_O$	Continuous output current		±50	mA
	Continuous current through $V_{CC}$ or GND		±100	mA
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	DCU package		227 °C/W
$T_{stg}$	Storage temperature range	−65	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.
- (2) The input and output negative voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of  $V_{CC}$  is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

**RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>**

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	Operating	1.65	5.5
		Data retention only	1.5	
$V_I$	Input voltage	0	5.5	V
$V_O$	Output voltage	0	$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 1.65\text{ V}$	−4	mA
		$V_{CC} = 2.3\text{ V}$	−8	
		$V_{CC} = 3\text{ V}$	−16	
			−24	
		$V_{CC} = 4.5\text{ V}$	−32	
$I_{OL}$	Low-level output current	$V_{CC} = 1.65\text{ V}$	4	mA
		$V_{CC} = 2.3\text{ V}$	8	
		$V_{CC} = 3\text{ V}$	16	
			24	
		$V_{CC} = 4.5\text{ V}$	32	
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 1.8\text{ V} \pm 0.15\text{ V}, 2.5\text{ V} \pm 0.2\text{ V}$	20	ns/V
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	10	
		$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$	5	

- (1) All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number [SCBA004](#).



## ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>T+</sub> Positive-going input threshold voltage		1.65 V	0.79		1.26	V
		2.3 V	1.11		1.66	
		3 V	1.5		1.97	
		4.5 V	2.16		2.84	
		5.5 V	2.61		3.43	
V <sub>T-</sub> Negative- going input threshold voltage		1.65 V	0.39		0.72	V
		2.3 V	0.58		0.97	
		3 V	0.84		1.24	
		4.5 V	1.41		1.89	
		5.5 V	1.87		2.39	
$\Delta V_T$ Hysteresis (V <sub>T+</sub> – V <sub>T-</sub> )		1.65 V	0.37		0.72	V
		2.3 V	0.48		0.87	
		3 V	0.56		0.97	
		4.5 V	0.71		1.14	
		5.5 V	0.71		1.21	
V <sub>OH</sub>	I <sub>OH</sub> = –100 $\mu$ A	1.65 V to 5.5 V	V <sub>CC</sub> – 0.1			V
	I <sub>OH</sub> = –4 mA	1.65 V	1.2			
	I <sub>OH</sub> = –8 mA	2.3 V	1.9			
	I <sub>OH</sub> = –16 mA	3 V	2.4			
	I <sub>OH</sub> = –24 mA		2.3			
	I <sub>OH</sub> = –32 mA	4.5 V	3.8			
V <sub>OL</sub>	I <sub>OL</sub> = 100 $\mu$ A	1.65 V to 5.5 V			0.1	V
	I <sub>OL</sub> = 4 mA	1.65 V			0.45	
	I <sub>OL</sub> = 8 mA	2.3 V			0.35	
	I <sub>OL</sub> = 16 mA	3 V			0.45	
	I <sub>OL</sub> = 24 mA				0.55	
	I <sub>OL</sub> = 32 mA	4.5 V			0.60	
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	0 V to 5.5 V			±5	$\mu$ A
I <sub>off</sub>	V <sub>I</sub> or V <sub>O</sub> = 5.5 V	0 V			±10	$\mu$ A
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	1.65 V to 5.5 V			±10	$\mu$ A
I <sub>CC</sub>	V <sub>I</sub> = 5.5 V or GND, I <sub>O</sub> = 0	1.65 V to 5.5 V			15	$\mu$ A
$\Delta I_{CC}$	One input at V <sub>CC</sub> – 0.6 V, Other inputs at V <sub>CC</sub> or GND	3 V to 5.5 V			500	$\mu$ A
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V			3.5	pF
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V			6	pF

(1) T<sub>A</sub> = 25°C

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range,  $C_L = 30$  pF or 50 pF (unless otherwise noted) (see [Figure 1](#))

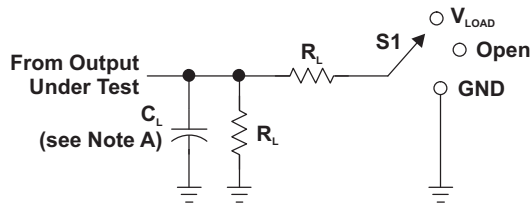
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		$V_{CC} = 5\text{ V}$ $\pm 0.5\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	Y	4.6	32.8	2.6	13.7	2.4	10.4	1.8	6.9	ns
	B		4.6	30.9	2.6	13.3	2.3	10.2	1.8	6.8	
	C		4.4	31.8	2.5	14.3	2.5	10.6	1.8	7.2	
	D		4.3	27.7	2.5	12.7	2.4	9.6	1.6	6.5	
$t_{en}$	$\overline{OE}$	Y	4.2	27.2	2.4	13.3	2	9	1.7	6.0	ns
$t_{dis}$	$\overline{OE}$	Y	3.7	17	2	7.3	2.1	7.4	1	5.6	ns

## OPERATING CHARACTERISTICS

$T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	$V_{CC} = 5\text{ V}$	UNIT
		TYP	TYP	TYP	TYP	
$C_{pd}$ Power dissipation capacitance	$f = 10\text{ MHz}$	19	20	22	27	pF

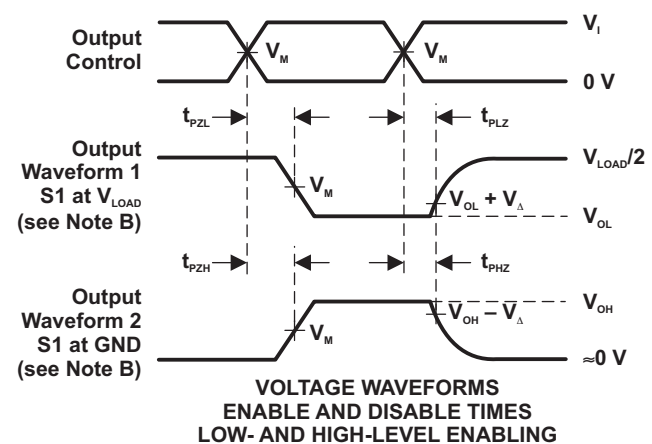
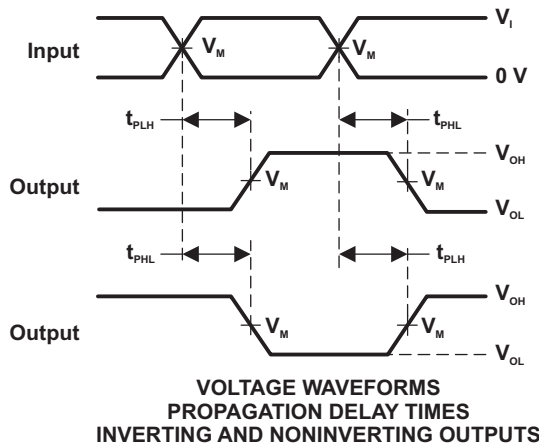
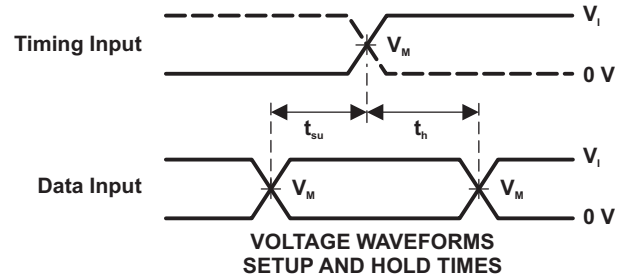
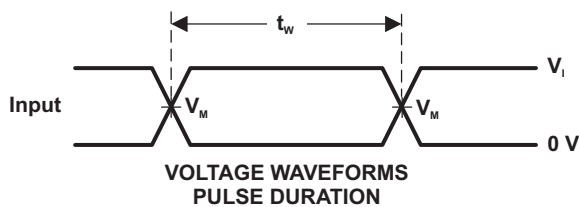
## PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$V_{LOAD}$
$t_{PHZ}/t_{PZH}$	GND

$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8\text{ V} \pm 0.15\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
$3.3\text{ V} \pm 0.3\text{ V}$	3 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
$5\text{ V} \pm 0.5\text{ V}$	$V_{CC}$	$\leq 2.5\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 $\Omega$	0.3 V



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_o = 50\text{ }\Omega$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
SN74LVC1G99QDCURQ1	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**OTHER QUALIFIED VERSIONS OF SN74LVC1G99-Q1 :**

- Catalog: [SN74LVC1G99](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

**TAPE AND REEL INFORMATION**


\*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
SN74LVC1G99QDCURQ1	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC1G99QDCURQ1	US8	DCU	8	3000	202.0	201.0	28.0

DCU (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)

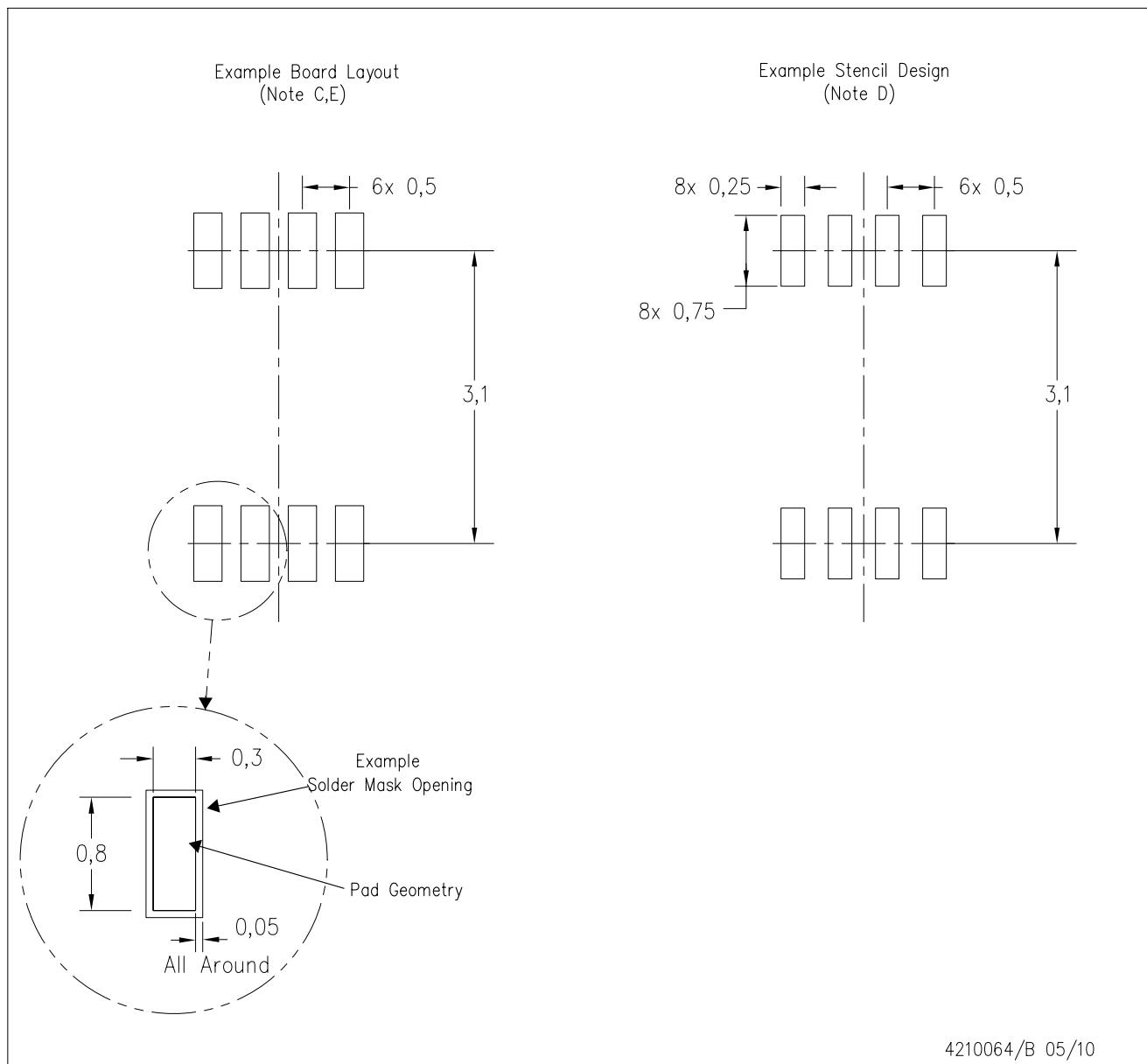


## NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- Falls within JEDEC MO-187 variation CA.

DCU (S-PDSO-G8)

PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)



- 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.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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