

## 3.3 V ECL 1:2 Fanout Buffer

### FEATURES

- 1:2 ECL Fanout Buffer
- Operating Range
  - PECL  $V_{CC} = 3.0\text{ V to }3.8\text{ V}$  With  $V_{EE} = 0\text{ V}$
  - NECL:  $V_{CC} = 0\text{ V}$  with  $V_{EE} = -3.0$  to  $-3.8\text{ V}$
- 5 ps Skew Between Outputs
- Support for Clock Frequencies > 2.0 GHz
- 265 ps Typical Propagation Delay
- Deterministic Output Value for Open Input Conditions or When Inputs =  $V_{EE}$
- Built-in Temperature Compensation
- Drop in Compatible to MC10LVEL11, MC100LVEL11
- Built-In Input Pull Down Resistors

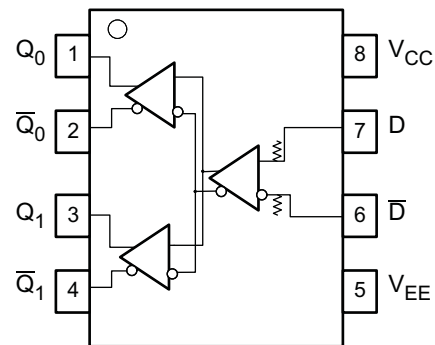
### APPLICATIONS

- Data and Clock Transmission Over Backplane
- Signaling Level Conversion

### DESCRIPTION

The SN65LVEL11 is a fully differential 1:2 ECL fanout buffer. The device includes circuitry to maintain a known logic level when inputs are in open condition. The SN65LVEL11 is functionally equivalent to SN65EL11 with improved performance. The SN65LVEL11 is housed in an industry standard SOIC-8 package and is also available in the TSSOP-8 package option.

### PINOUT ASSIGNMENT



**Table 1. Pin Description**

PIN	FUNCTION
D, $\bar{D}$	PECL/ECL data inputs
$Q_0, \bar{Q}_0, Q_1, \bar{Q}_1$	PECL/ECL outputs
$V_{CC}$	Positive supply
$V_{EE}$	Negative supply

### ORDERING INFORMATION<sup>(1)</sup>

PART NUMBER	PART MARKING	PACKAGE	LEAD FINISH
SN65LVEL11D	SN65LVEL11	SOIC	NiPdAu
SN65LVEL11DGK	SN65LVEL11	SOIC-TSSOP	NiPdAu

(1) Leaded device options not initially available. Contact TI sales representative for further details.



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

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

PARAMETER	CONDITION	VALUE	UNIT
Absolute PECL mode supply voltage, $V_{CC}$	$V_{EE} = 0\text{ V}$	6	V
Absolute NECL mode power supply, $V_{EE}$	$V_{CC} = 0\text{ V}$	-6	V
PECL mode input voltage	$V_{EE} = 0\text{ V}; V_I \leq V_{CC}$	6	V
NECL mode input voltage	$V_{CC} = 0\text{ V}; V_I \geq V_{EE}$	-6	V
Output current	Continuous	50	mA
	Surge	100	
Operating temperature range		-40 to 85	°C
Storage temperature range		-65 to 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.

## POWER DISSIPATION RATINGS

PACKAGE	CIRCUIT BOARD MODEL	POWER RATING $T_A < 25^\circ\text{C}$ (mW)	THERMAL RESISTANCE, JUNCTION TO AMBIENT NO AIRFLOW	DERATING FACTOR $T_A > 25^\circ\text{C}$ (mW/°C)	POWER RATING $T_A = 85^\circ\text{C}$ (mW)
SOIC	Low-K	719	139	7	288
	High-K	840	119	8	336
SOIC-TSSOP	Low-K	469	213	5	188
	High-K	527	189	5	211

## THERMAL CHARACTERISTICS

PARAMETER		PACKAGE	VALUE	UNIT
$\theta_{JB}$	Junction-to Board Thermal Resistance	SOIC	79	°C/W
		SOIC-TSSOP	120	
$\theta_{JC}$	Junction-to Case Thermal Resistance	SOIC	98	°C/W
		SOIC-TSSOP	74	

## KEY ATTRIBUTES

CHARACTERISTICS	VALUE
Internal input pull down resistor	75 k $\Omega$
Moisture sensitivity level	Level 1
Flammability rating (Oxygen Index: 28 to 34)	UL 94 V-0 at 0.125 in
ESD-HBM	4 kV
ESD-machine model	200 V
ESD-charge device model	2 kV
Meets or exceeds JEDEC Spec EIA/JESD78 latchup test	

**LVPECL DC CHARACTERISTICS<sup>(1)</sup> ( $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = 0.0\text{ V}$ )<sup>(2)</sup>**

CHARACTERISTICS		–40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$	Power Supply Current		20	25		20	25		21	25	mA
$V_{OH}$	Output HIGH Voltage <sup>(3)</sup>	2215		2420	2215	2286	2420	2215		2420	mV
$V_{OL}$	Output LOW Voltage <sup>(3)</sup>	1470		1680	1470	1584	1680	1470		1680	mV
$V_{IH}$	Input High Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	1490		1825	1490		1825	1490		1825	mV
$V_{IHCMR}$	Input HIGH voltage common mode range (Differential) <sup>(4)</sup>										V
		$V_{pp} < 500\text{ mV}$	1.2	3.1	1.1		3.1	1.1		3.1	
		$V_{pp} > 500\text{ mV}$	1.4	3.1	1.3		3.1	1.3		3.1	
$I_{IH}$	Input HIGH Current			150			150			150	μA
$I_{IL}$	Input LOW current										μA
		D	0.5		0.5		0.5		0.5		
		$\bar{D}$	–600		–600		–600		–600		

- (1) Device will meet the specifications after thermal balance has been established when mounted in a socket or printed circuit board with maintained transverse airflow greater than 500 lfm. Electrical parameters are assured only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.
- (2) Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $\pm 0.3\text{ V}$
- (3) Outputs are terminated through a  $50\ \Omega$  resistor to  $V_{CC} - 2.0\text{ V}$ .
- (4)  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between  $V_{PP}$  min and 1 V.

**LVPNECL DC CHARACTERISTICS<sup>(1)</sup> ( $V_{EE} = -3.3\text{ V}$ ;  $V_{CC} = 0.0\text{ V}$ ;) <sup>(2)</sup>**

CHARACTERISTICS		–40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$I_{EE}$	Power supply current		20	25		20	25		21	25	mA
$V_{OH}$	Output HIGH voltage <sup>(3)</sup>	–1085		–880	–1085	–1013	–880	–1085		–880	mV
$V_{OL}$	Output LOW voltage <sup>(3)</sup>	–1830		–1620	–1830	–1722	–1620	–1830		–1620	mV
$V_{IH}$	Input high voltage (Single-Ended)	–1165		–880	–1165		–880	–1165		–880	mV
$V_{IL}$	Input LOW voltage (Single-Ended)	–1810		–1475	–1810		–1475	–1810		–1475	mV
$V_{IHCMR}$	Input HIGH voltage common mode range (Differential) <sup>(4)</sup>										V
		$V_{pp} < 500\text{ mV}$	–2.1	–0.2	–2.2		–0.2	–2.2		–0.2	
		$V_{pp} > 500\text{ mV}$	–1.9	–0.2	–2.0		–0.2	–2.0		–0.2	
$I_{IH}$	Input HIGH current			150			150			150	μA
$I_{IL}$	Input LOW current										μA
		D	0.5		0.5		0.5		0.5		
		$\bar{D}$	–600		–600		–600		–600		

- (1) Device will meet the specifications after thermal balance has been established when mounted in a socket or printed circuit board with maintained transverse airflow greater than 500 lfm. Electrical parameters are assured only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.
- (2) Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $\pm 0.3\text{ V}$ .
- (3) Outputs are terminated through a  $50\ \Omega$  resistor to  $V_{CC} - 2.0\text{ V}$ .
- (4)  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between  $V_{PP}$  min and 1 V.

**AC CHARACTERISTICS** <sup>(1)</sup>( $V_{CC} = 3.3\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  or  $V_{CC} = 0.0\text{ V}$ ;  $V_{EE} = -3.3\text{ V}$ )<sup>(2)</sup>

CHARACTERISTIC		-40°C			25°C			85°C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$f_{MAX}$	Max switching frequency <sup>(3)</sup> See Figure 6	2.9			2.7			2.4			GHz
$t_{PLH}/t_{PHL}$	Propagation delay to output	235		350	235		350	235		350	ps
$t_{SKEW}$	Within device skew <sup>(4)</sup>	10 18			10 18			10 18			ps
	Device to device skew <sup>(5)</sup>	10 25			10 25			10 25			ps
	Duty cycle skew <sup>(6)</sup>	5 15			5 15			5 15			ps
$t_{JITTER}$	Random clock jitter (RMS)	0.2			0.2			0.2			ps
$V_{PP}$	Input swing <sup>(7)</sup>	200		1000	200		1000	200		1000	mV
$t_r/t_f$	Output rise/fall times Q (20%–80%)	150		300	150		300	150		300	ps

- (1) Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm. Electrical parameters are assured only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.
- (2)  $V_{EE}$  can vary  $\pm 0.3\text{ V}$
- (3) Maximum switching frequency measured at output amplitude of 300 mVpp.
- (4) Within-device skew is defined as identical transitions on similar paths through a device.
- (5) Device-Device Skew is defined as identical transitions at identical Vcc levels.
- (6) Duty cycle skew is the difference between a  $t_{PLH}$  and  $t_{PHL}$  propagation delay through a device.
- (7)  $V_{PP(min)}$  is the minimum input swing for which AC parameters are assured.

**Typical Termination for Output Driver**

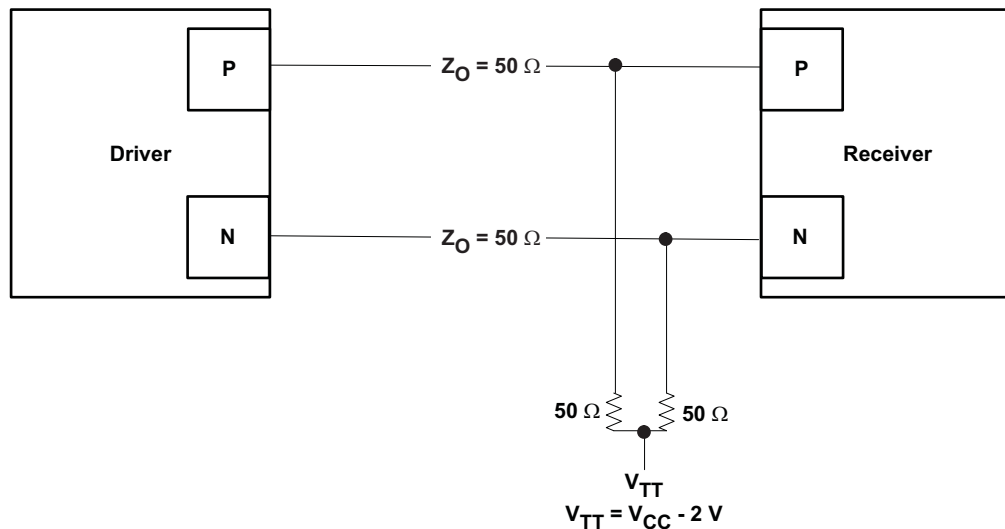


Figure 1. Termination for Output Driver

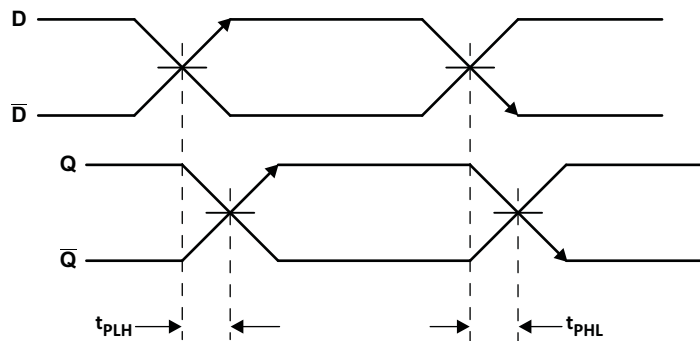


Figure 2. Propagation Delay

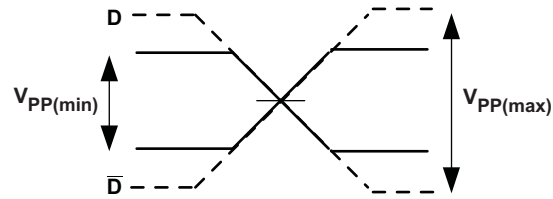


Figure 3. Input Voltage Swing

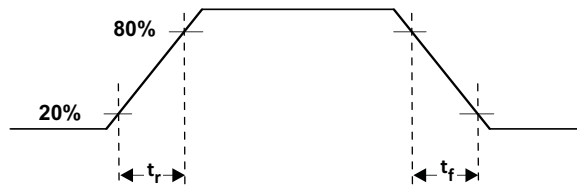


Figure 4. Output Rise and Fall Times

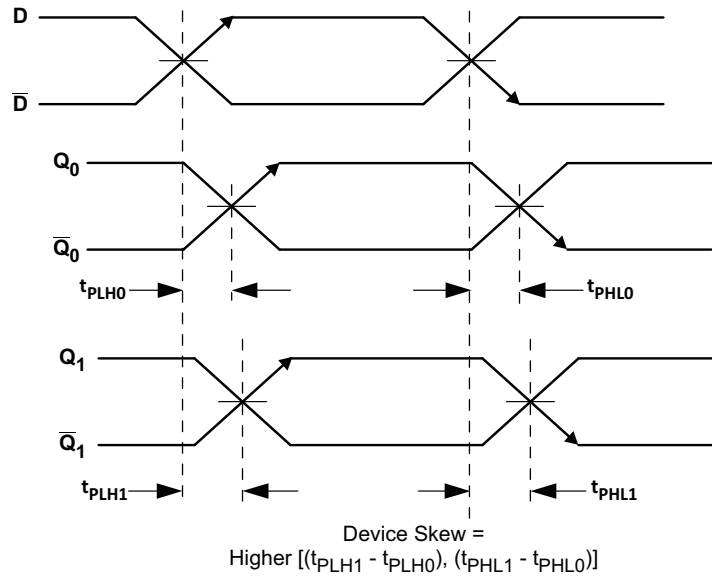


Figure 5. Device Skew

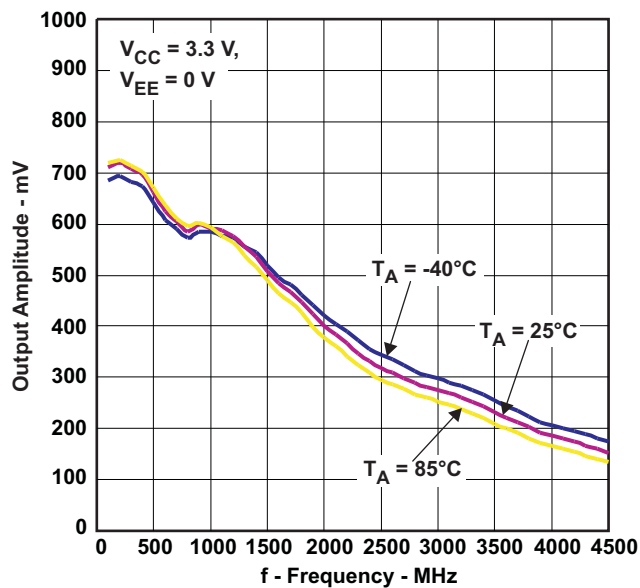


Figure 6. Output Amplitude vs Frequency

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65LVEL11D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVEL11	<a href="#">Samples</a>
SN65LVEL11DGK	ACTIVE	VSSOP	DGK	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	SINI	<a href="#">Samples</a>
SN65LVEL11DGKR	ACTIVE	VSSOP	DGK	8	2500	RoHS & Green	Call TI   NIPDAU	Level-1-260C-UNLIM	-40 to 85	SINI	<a href="#">Samples</a>
SN65LVEL11DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	LVEL11	<a href="#">Samples</a>

(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.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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
SN65LEVEL11DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LVEL11DR	SOIC	D	8	2500	356.0	356.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN65LVEL11D	D	SOIC	8	75	506.6	8	3940	4.32
SN65LVEL11DGK	DGK	VSSOP	8	80	330.2	6.6	3005	1.88



D0008A

# PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed  $.006$  [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
 EXPOSED METAL SHOWN  
 SCALE:8X



SOLDER MASK DETAILS

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NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.





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



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