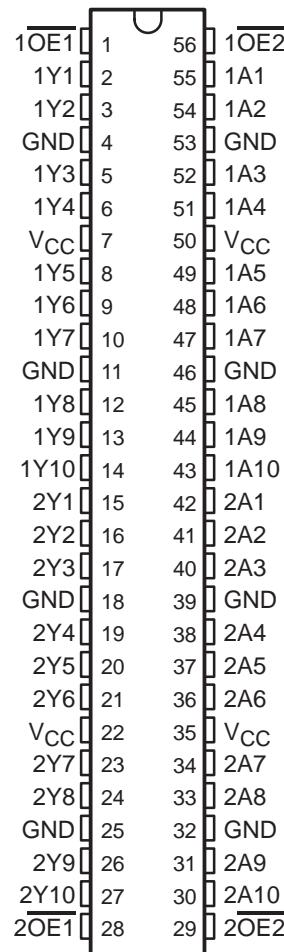


- State-of-the-Art Advanced BiCMOS Technology (ABT) **Widebus™** Design for 2.5-V and 3.3-V Operation and Low Static Power Dissipation
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 2.3-V to 3.6-V  $V_{CC}$ )
- Typical  $V_{OLP}$  (Output Ground Bounce) <0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Power Off Disables Outputs, Permitting Live Insertion
- High-Impedance State During Power Up and Power Down Prevents Driver Conflict
- Uses Bus Hold on Data Inputs in Place of External Pullup/Pulldown Resistors to Prevent the Bus From Floating
- Output Ports Have Equivalent 30- $\Omega$  Series Resistors, So No External Resistors Are Required
- Auto3-State Eliminates Bus Current Loading When Output Exceeds  $V_{CC} + 0.5$  V
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model; and Exceeds 1000 V Using Charged-Device Model, Robotic Method
- Flow-Through Architecture Facilitates Printed Circuit Board Layout
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- Package Options Include Plastic Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), Thin Very Small-Outline (DGV) Packages, and 380-mil Fine-Pitch Ceramic Flat (WD) Package

SN54ALVTH162827 . . . WD PACKAGE  
 SN74ALVTH162827 . . . DGG, DGV, OR DL PACKAGE  
 (TOP VIEW)



NOTE: For order entry:

The DGG package is abbreviated to G, and  
 the DGV package is abbreviated to V.

## description

The 'ALVTH162827 devices are 20-bit buffers/line drivers designed for 2.5-V or 3.3-V  $V_{CC}$  operation, but with the capability to provide a TTL interface to a 5-V system environment.



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.

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**SN54ALVTH162827, SN74ALVTH162827  
2.5-V/3.3-V 20-BIT BUFFERS/DRIVERS  
WITH 3-STATE OUTPUTS**

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**description (continued)**

The devices are composed of two 10-bit sections with separate output-enable signals. For either 10-bit buffer section, the two output-enable ( $\overline{OE1}$  and  $\overline{OE2}$ , or  $\overline{OE1}$  and  $\overline{OE2}$ ) inputs must be low for the corresponding Y outputs to be active. If either output-enable input is high, the outputs of that 10-bit buffer section are in the high-impedance state.

When  $V_{CC}$  is between 0 and 1.2 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.2 V,  $\overline{OE}$  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.

All outputs are designed to sink up to 12 mA, and include equivalent 30- $\Omega$  resistors to reduce overshoot and undershoot.

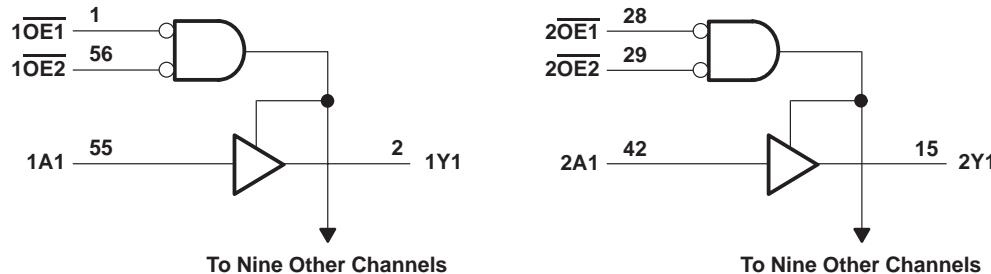
Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

The SN54ALVTH162827 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALVTH162827 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**FUNCTION TABLE  
(each 10-bit section)**

INPUTS			OUTPUT
$\overline{OE1}$	$\overline{OE2}$	A	Y
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

**logic diagram (positive logic)**



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

Supply voltage range, $V_{CC}$ .....	–0.5 V to 4.6 V		
Input voltage range, $V_I$ (see Note 1) .....	–0.5 V to 7 V		
Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1) .....	–0.5 V to 7 V		
Voltage range applied to any output in the high state, $V_O$ (see Note 1) .....	–0.5 V to 7 V		
Output current in the low state, $I_O$ : SN54ALVTH162827 SN74ALVTH162827 .....	96 mA		
Output current in the high state, $I_O$ : SN54ALVTH162827 SN74ALVTH162827 .....	128 mA		
Output current in the high state, $I_O$ : SN54ALVTH162827 .....	–48 mA		
Output current in the high state, $I_O$ : SN74ALVTH162827 .....	–64 mA		
Input clamp current, $I_{I_K}$ ( $V_I < 0$ ) .....	–50 mA		
Output clamp current, $I_{O_K}$ ( $V_O < 0$ ) .....	–50 mA		
Package thermal impedance, $\theta_{JA}$ (see Note 2): DGG package DGV package .....	81°C/W		
DL package .....	86°C/W		
Storage temperature range, $T_{stg}$ .....	74°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 clamp-current ratings are observed.  
 2. The package thermal impedance is calculated in accordance with JESD 51.

**recommended operating conditions,  $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (see Note 3)**

		SN54ALVTH162827			SN74ALVTH162827			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{CC}$	Supply voltage	2.3		2.7	2.3		2.7	V
$V_{IH}$	High-level input voltage		1.7			1.7		V
$V_{IL}$	Low-level input voltage			0.7			0.7	V
$V_I$	Input voltage	0	$V_{CC}$	5.5	0	$V_{CC}$	5.5	V
$I_{OH}$	High-level output current			–6			–8	mA
$I_{OL}$	Low-level output current			8			12	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10			10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate			200			200	$\mu\text{s}/\text{V}$
$T_A$	Operating free-air temperature	–55		125	–40		85	°C

NOTE 3: All unused control 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.

**SN54ALVTH162827, SN74ALVTH162827  
2.5-V/3.3-V 20-BIT BUFFERS/DRIVERS  
WITH 3-STATE OUTPUTS**

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**recommended operating conditions,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (see Note 3)**

		SN54ALVTH162827			SN74ALVTH162827			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{CC}$	Supply voltage	3	3.6		3	3.6	3.6	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage		0.8			0.8	0.8	V
$V_I$	Input voltage	0	$V_{CC}$	5.5	0	$V_{CC}$	5.5	V
$I_{OH}$	High-level output current			-8			-12	mA
$I_{OL}$	Low-level output current			8			12	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10		10	10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200			200			$\mu\text{s}/\text{V}$
$T_A$	Operating free-air temperature	-55		125	-40		85	$^{\circ}\text{C}$

NOTE 3: All unused control 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.

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electrical characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	SN54ALVTH162827			SN74ALVTH162827			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{IK}$	$V_{CC} = 2.3 \text{ V}$ , $I_I = -18 \text{ mA}$			-1.2			-1.2	V
$V_{OH}$	$V_{CC} = 2.3 \text{ V}$ to $2.7 \text{ V}$ , $I_{OH} = -100 \mu\text{A}$	$V_{CC} - 0.2$			$V_{CC} - 0.2$			V
	$V_{CC} = 2.3 \text{ V}$ , $I_{OH} = -6 \text{ mA}$	1.7			1.7			
$V_{OL}$	$V_{CC} = 2.3 \text{ V}$ to $2.7 \text{ V}$ , $I_{OL} = 100 \mu\text{A}$			0.2			0.2	V
	$V_{CC} = 2.3 \text{ V}$ , $I_{OL} = 8 \text{ mA}$			0.7				
	$V_{CC} = 2.3 \text{ V}$ , $I_{OL} = 12 \text{ mA}$						0.7	
$I_I$	Control inputs	$V_{CC} = 2.7 \text{ V}$ , $V_I = V_{CC}$ or GND		±1			±1	μA
		$V_{CC} = 0$ or $2.7 \text{ V}$ , $V_I = 5.5 \text{ V}$		10			10	
	Data inputs	$V_I = 5.5 \text{ V}$		10			10	
		$V_I = V_{CC}$		1			1	
		$V_I = 0$		-5			-5	
$I_{off}$	$V_{CC} = 0$ , $V_I$ or $V_O = 0$ to $4.5 \text{ V}$						±100	μA
$I_{BHL}^{\ddagger}$	$V_{CC} = 2.3 \text{ V}$ , $V_I = 0.7 \text{ V}$	415			115			μA
$I_{BHH}^{\$}$	$V_{CC} = 2.3 \text{ V}$ , $V_I = 1.7 \text{ V}$		-10		-10			μA
$I_{BHLO}^{\parallel}$	$V_{CC} = 2.7 \text{ V}$ , $V_I = 0$ to $V_{CC}$	300			300			μA
$I_{BHHO}^{\#}$	$V_{CC} = 2.7 \text{ V}$ , $V_I = 0$ to $V_{CC}$	-300			-300			μA
$I_{EX}^{\parallel}$	$V_{CC} = 2.3 \text{ V}$ , $V_O = 5.5 \text{ V}$		125		125			μA
$I_{OZ(PU/PD)}^{\star}$	$V_{CC} \leq 1.2 \text{ V}$ , $V_O = 0.5 \text{ V}$ to $V_{CC}$ , $V_I = \text{GND}$ or $V_{CC}$ , $\overline{OE}$ = don't care		±100		±100			μA
$I_{OZH}$	$V_{CC} = 2.7 \text{ V}$	$V_O = 2.3 \text{ V}$ , $V_I = 0.7 \text{ V}$ or $1.7 \text{ V}$		5			5	μA
$I_{OZL}$	$V_{CC} = 2.7 \text{ V}$	$V_O = 0.5 \text{ V}$ , $V_I = 0.7 \text{ V}$ or $1.7 \text{ V}$		-5			-5	μA
$I_{CC}$	$V_{CC} = 2.7 \text{ V}$ , $I_O = 0$ , $V_I = V_{CC}$ or GND	Outputs high	0.04	0.1	0.04	0.1		mA
		Outputs low	2.3	5	2.3	5		
		Outputs disabled	0.04	0.1	0.04	0.1		
$C_I$	$V_{CC} = 2.5 \text{ V}$ , $V_I = 2.5 \text{ V}$ or 0		3.5		3.5			pF
$C_O$	$V_{CC} = 2.5 \text{ V}$ , $V_O = 2.5 \text{ V}$ or 0		6		6			pF

† All typical values are at  $V_{CC} = 2.5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ The bus-hold circuit can sink at least the minimum low sustaining current at  $V_{IL}$  max.  $I_{BHL}$  should be measured after lowering  $V_{IN}$  to GND and then raising it to  $V_{IL}$  max.

§ The bus-hold circuit can source at least the minimum high sustaining current at  $V_{IH}$  min.  $I_{BHH}$  should be measured after raising  $V_{IN}$  to  $V_{CC}$  and then lowering it to  $V_{IH}$  min.

¶ An external driver must source at least  $I_{BHLO}$  to switch this node from low to high.

# An external driver must sink at least  $I_{BHHO}$  to switch this node from high to low.

|| Current into an output in the high state when  $V_O > V_{CC}$

★ High-impedance state during power up or power down

**SN54ALVTH162827, SN74ALVTH162827  
2.5-V/3.3-V 20-BIT BUFFERS/DRIVERS  
WITH 3-STATE OUTPUTS**

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**electrical characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	SN54ALVTH162827			SN74ALVTH162827			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{IK}$	$V_{CC} = 3 \text{ V}$ , $I_I = -18 \text{ mA}$			-1.2			-1.2	V
$V_{OH}$	$V_{CC} = 3 \text{ V}$ to $3.6 \text{ V}$ , $I_{OH} = -100 \mu\text{A}$	$V_{CC} - 0.2$			$V_{CC} - 0.2$			V
	$V_{CC} = 3 \text{ V}$	$I_{OH} = -8 \text{ mA}$	2				2	
$V_{OL}$	$V_{CC} = 3 \text{ V}$ to $3.6 \text{ V}$ , $I_{OL} = 100 \mu\text{A}$			0.2			0.2	V
	$V_{CC} = 3 \text{ V}$	$I_{OL} = 8 \text{ mA}$		0.8				
		$I_{OL} = 12 \text{ mA}$					0.8	
$I_I$	Control inputs	$V_{CC} = 3.6 \text{ V}$ , $V_I = V_{CC}$ or GND		$\pm 1$			$\pm 1$	$\mu\text{A}$
		$V_{CC} = 0$ or $3.6 \text{ V}$ , $V_I = 5.5 \text{ V}$		10			10	
	Data inputs	$V_I = 5.5 \text{ V}$		10			10	
		$V_I = V_{CC}$		1			1	
		$V_I = 0$		-5			-5	
$I_{off}$	$V_{CC} = 0$ , $V_I$ or $V_O = 0$ to $4.5 \text{ V}$						$\pm 100$	$\mu\text{A}$
$I_{BHL}^{\ddagger}$	$V_{CC} = 3 \text{ V}$ , $V_I = 0.8 \text{ V}$	75		75				$\mu\text{A}$
$I_{BHH}^{\$}$	$V_{CC} = 3 \text{ V}$ , $V_I = 2 \text{ V}$	-75		-75				$\mu\text{A}$
$I_{BHLO}^{\ \}$	$V_{CC} = 3.6 \text{ V}$ , $V_I = 0$ to $V_{CC}$	500		500				$\mu\text{A}$
$I_{BHHO}^{\#}$	$V_{CC} = 3.6 \text{ V}$ , $V_I = 0$ to $V_{CC}$	-500		-500				$\mu\text{A}$
$I_{EX}^{\ \ }$	$V_{CC} = 3 \text{ V}$ , $V_O = 5.5 \text{ V}$			125			125	$\mu\text{A}$
$I_{OZ(PU/PD)}^{\star}$	$V_{CC} \leq 1.2 \text{ V}$ , $V_O = 0.5 \text{ V}$ to $V_{CC}$ , $V_I = \text{GND}$ or $V_{CC}$ , $\overline{OE}$ = don't care			$\pm 100$			$\pm 100$	$\mu\text{A}$
$I_{OZH}$	$V_{CC} = 3.6 \text{ V}$	$V_O = 3 \text{ V}$ , $V_I = 0.8 \text{ V}$ or $2 \text{ V}$		5			5	$\mu\text{A}$
$I_{OZL}$	$V_{CC} = 3.6 \text{ V}$	$V_O = 0.5 \text{ V}$ , $V_I = 0.8 \text{ V}$ or $2 \text{ V}$		-5			-5	$\mu\text{A}$
$I_{CC}$	$V_{CC} = 3.6 \text{ V}$ , $I_O = 0$ , $V_I = V_{CC}$ or GND	Outputs high	0.07	0.1	0.07	0.1		mA
		Outputs low	3.2	5.5	3.2	5.5		
		Outputs disabled	0.07	0.1	0.07	0.1		
$\Delta I_{CC}^{\square}$	$V_{CC} = 3 \text{ V}$ to $3.6 \text{ V}$ , One input at $V_{CC} - 0.6 \text{ V}$ , Other inputs at $V_{CC}$ or GND			0.4			0.4	mA
$C_I$	$V_{CC} = 3.3 \text{ V}$ , $V_I = 3.3 \text{ V}$ or 0			3.5			3.5	pF
$C_O$	$V_{CC} = 3.3 \text{ V}$ , $V_O = 3.3 \text{ V}$ or 0			6			6	pF

† All typical values are at  $V_{CC} = 3.3 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ The bus-hold circuit can sink at least the minimum low sustaining current at  $V_{IL}$  max.  $I_{BHL}$  should be measured after lowering  $V_{IN}$  to GND and then raising it to  $V_{IL}$  max.

§ The bus-hold circuit can source at least the minimum high sustaining current at  $V_{IH}$  min.  $I_{BHH}$  should be measured after raising  $V_{IN}$  to  $V_{CC}$  and then lowering it to  $V_{IH}$  min.

|| An external driver must source at least  $I_{BHLO}$  to switch this node from low to high.

# An external driver must sink at least  $I_{BHHO}$  to switch this node from high to low.

|| Current into an output in the high state when  $V_O > V_{CC}$

★ High-impedance state during power up or power down

□ This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

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SN54ALVTH162827, SN74ALVTH162827  
 2.5-V/3.3-V 20-BIT BUFFERS/DRIVERS  
 WITH 3-STATE OUTPUTS

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switching characteristics over recommended operating free-air temperature range,  $C_L = 30 \text{ pF}$ ,  $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ALVTH162827		SN74ALVTH162827		UNIT
			MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	1.7	4.1	1.7	4.1	ns
$t_{PHL}$			1.6	4	1.6	4	
$t_{PZH}$	$\overline{OE}$	Y	2.1	4.8	2.1	4.8	ns
$t_{PZL}$			1.9	4.8	1.9	4.8	
$t_{PHZ}$	$\overline{OE}$	Y	2.4	6	2.4	6	ns
$t_{PLZ}$			1.7	5	1.7	5	

switching characteristics over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$ ,  $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ALVTH162827		SN74ALVTH162827		UNIT
			MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	1	3.9	1	3.9	ns
$t_{PHL}$			1.5	3.7	1.5	3.7	
$t_{PZH}$	$\overline{OE}$	Y	1	5.6	1	5.6	ns
$t_{PZL}$			1.7	4.1	1.7	4.1	
$t_{PHZ}$	$\overline{OE}$	Y	3.6	6.3	3.6	6.3	ns
$t_{PLZ}$			1.7	5.1	1.7	5.1	

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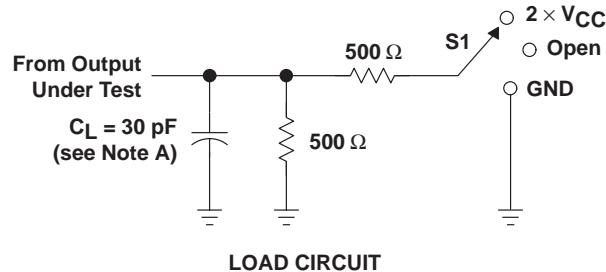


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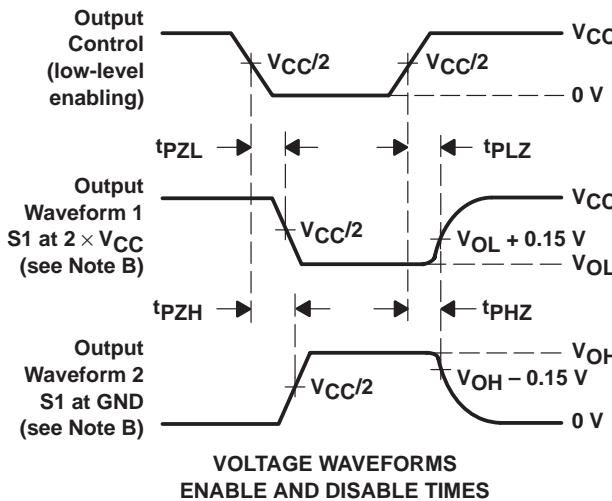
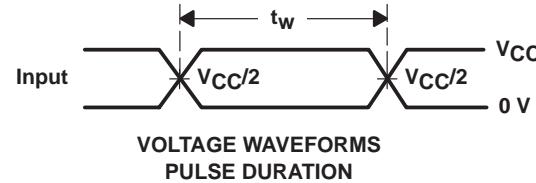
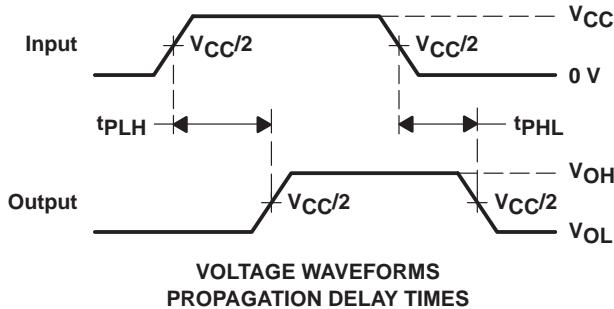
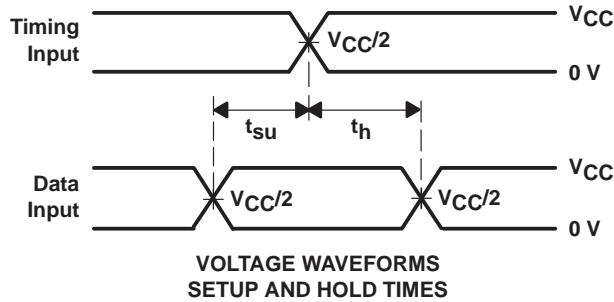
**SN54ALVTH162827, SN74ALVTH162827  
2.5-V/3.3-V 20-BIT BUFFERS/DRIVERS  
WITH 3-STATE OUTPUTS**

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**PARAMETER MEASUREMENT INFORMATION**  
 **$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$**



TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND



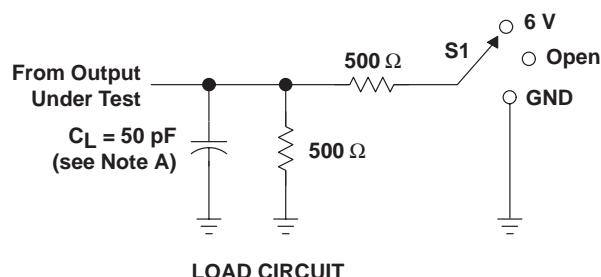
NOTES:

- $C_L$  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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2 \text{ ns}$ ,  $t_f \leq 2 \text{ ns}$ .
- The outputs are measured one at a time with one transition per measurement.

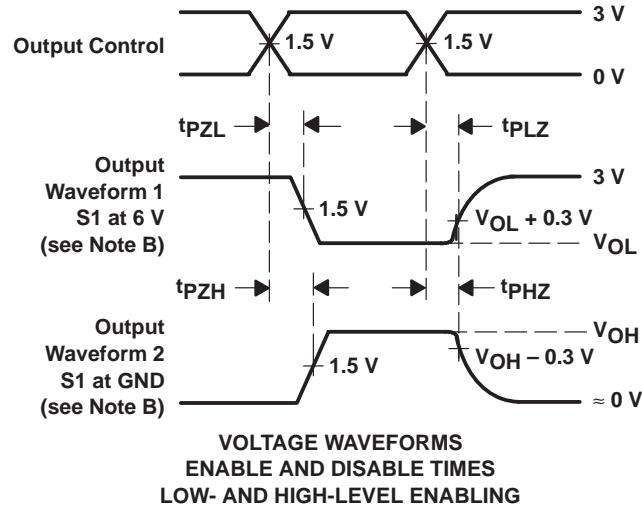
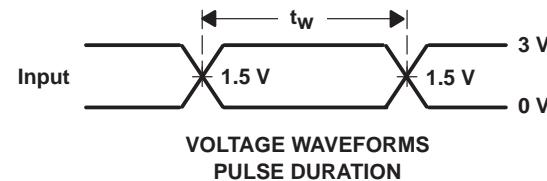
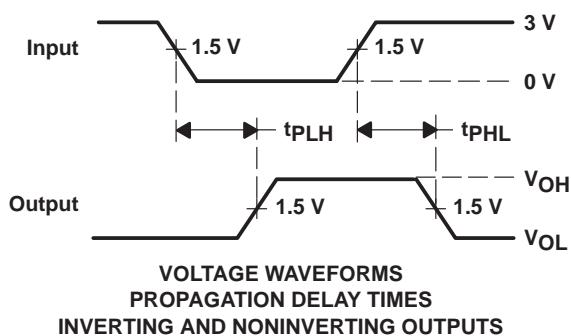
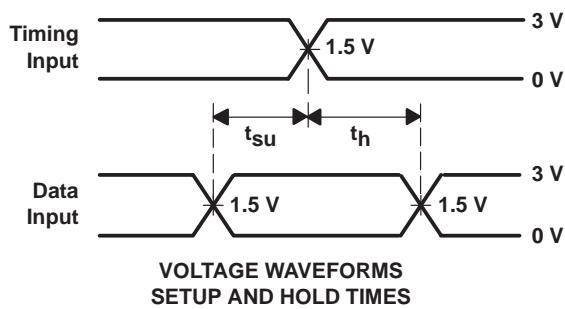
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$



TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND



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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
- The outputs are measured one at a time with one transition per measurement.

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 (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74ALVTH162827DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVTH162827	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74ALVTH162827GR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVTH162827	<span style="background-color: red; color: white; padding: 2px;">Samples</span>
SN74ALVTH162827VR	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VT2827	<span style="background-color: red; color: white; padding: 2px;">Samples</span>

(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), 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)

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

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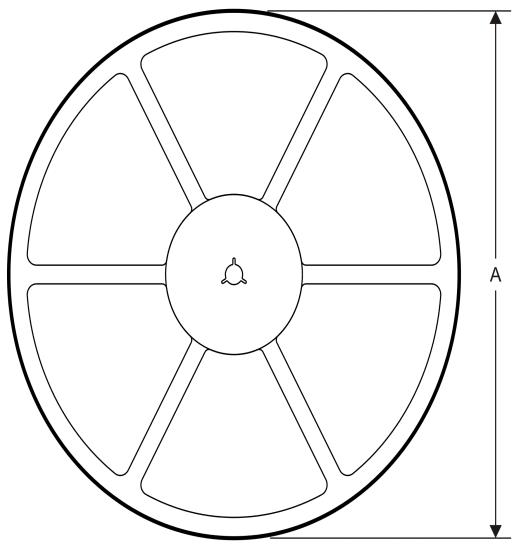
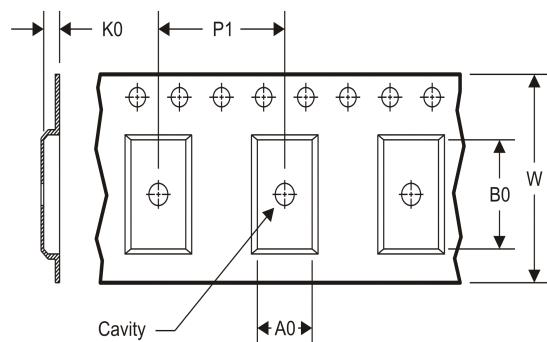
## PACKAGE OPTION ADDENDUM

10-Jun-2014

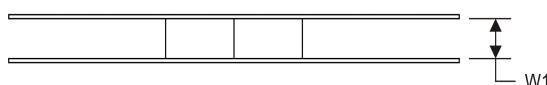
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**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers


**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
SN74ALVTH162827GR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ALVTH162827VR	TVSOP	DGV	56	2000	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1

**TAPE AND REEL BOX DIMENSIONS**

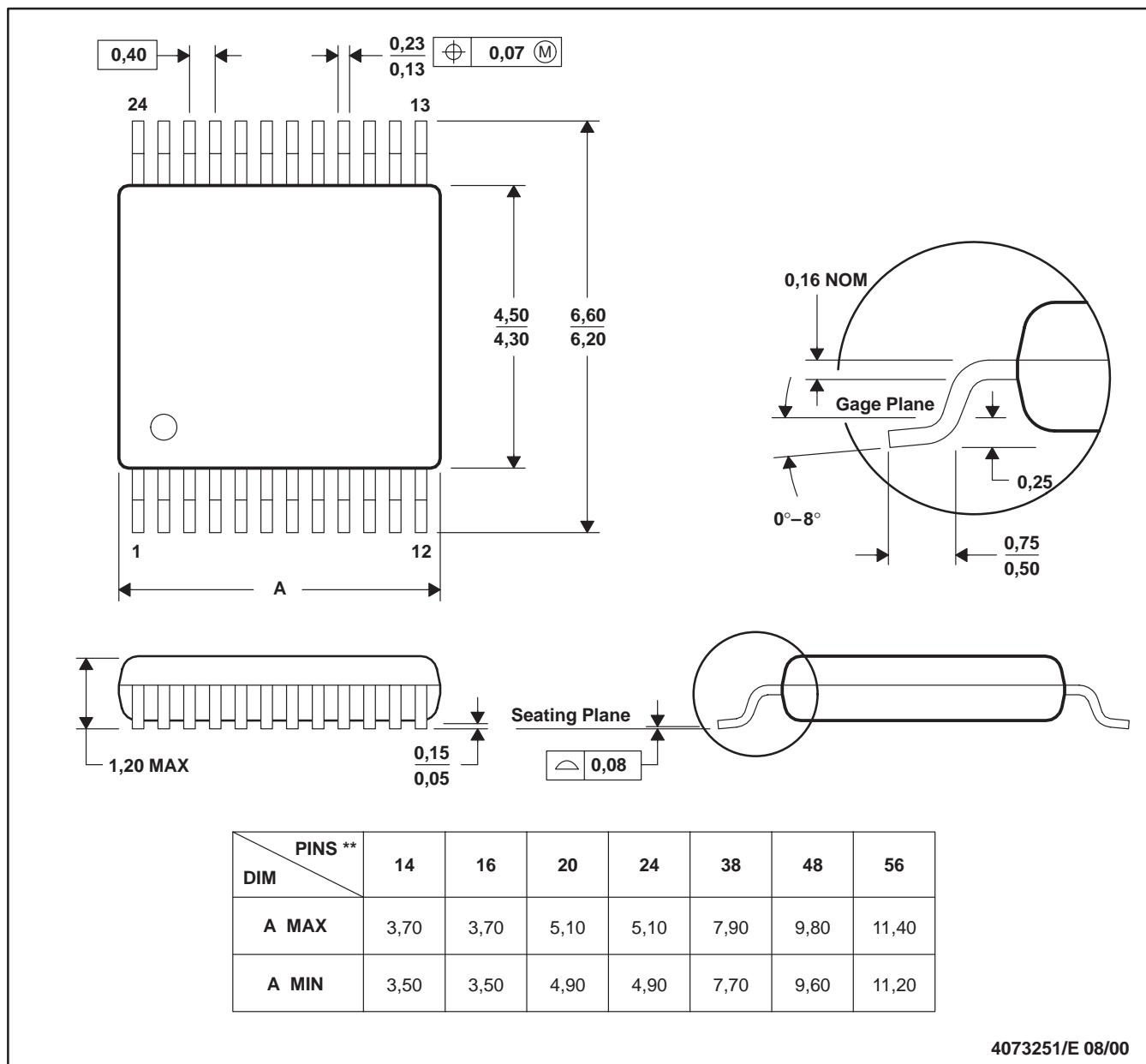

\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVTH162827GR	TSSOP	DGG	56	2000	367.0	367.0	45.0
SN74ALVTH162827VR	TVSOP	DGV	56	2000	367.0	367.0	45.0

## DGV (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

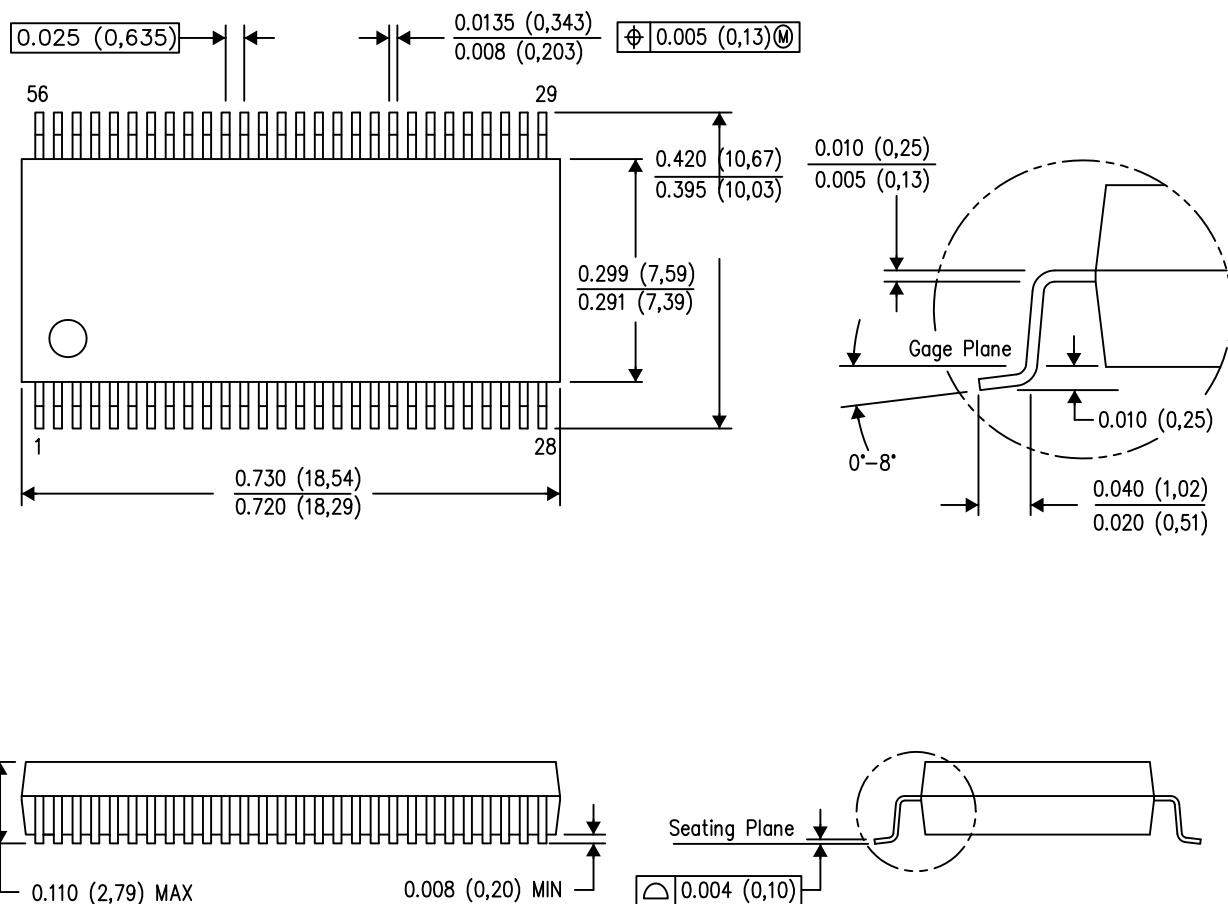
24 PINS SHOWN



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

DL (R-PDSO-G56)

## PLASTIC SMALL-OUTLINE PACKAGE



4040048-4/F 05/13

NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
- D. Falls within JEDEC M0-118

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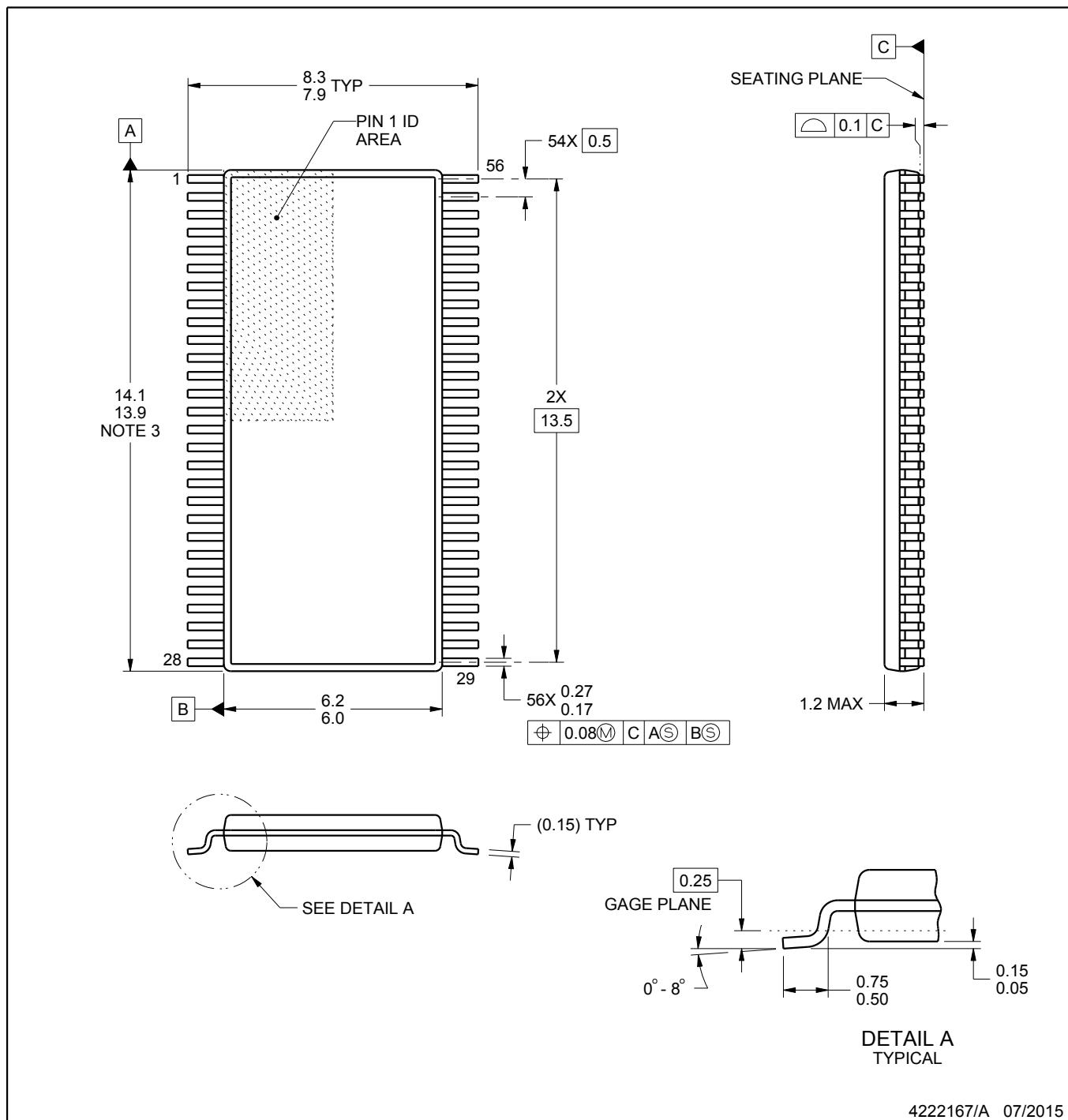
## PACKAGE OUTLINE

**DGG0056A**



## **TSSOP - 1.2 mm max height**

## SMALL OUTLINE PACKAGE



## NOTES:

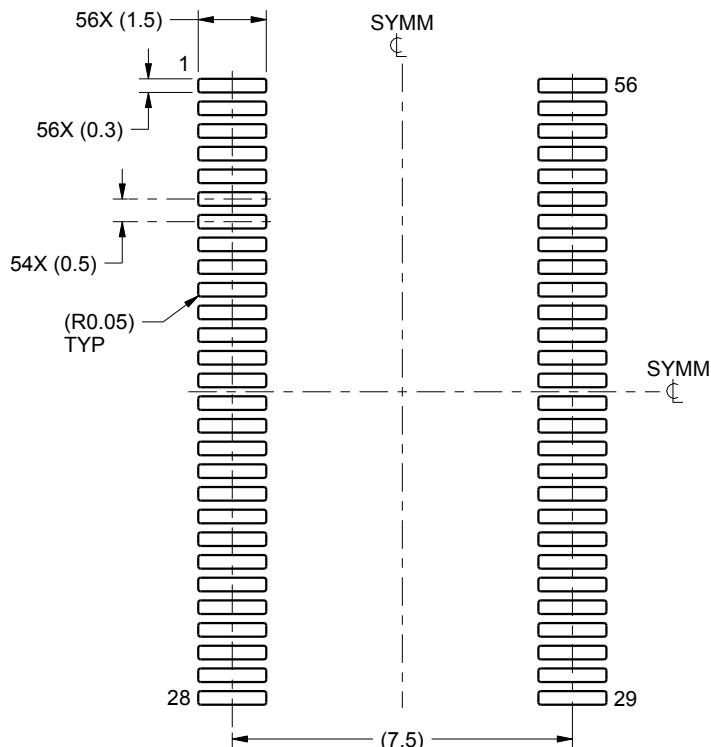
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

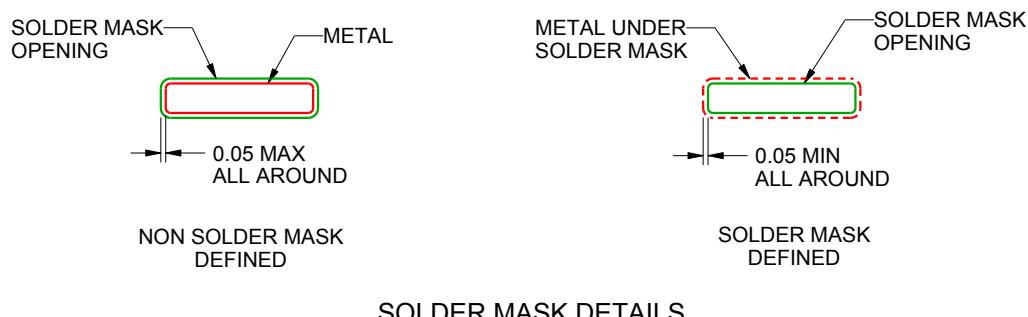
DGG0056A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4222167/A 07/2015

NOTES: (continued)

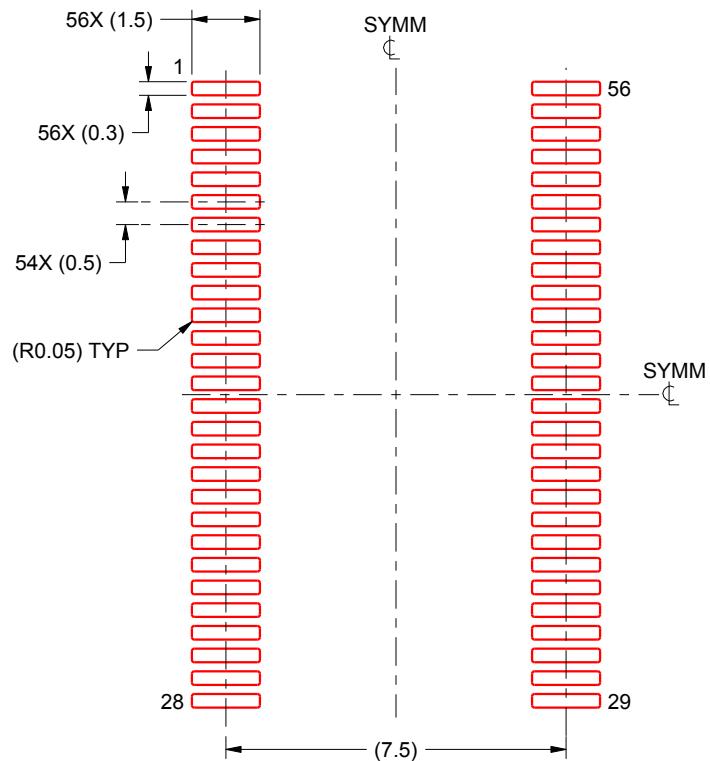
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DGG0056A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4222167/A 07/2015

NOTES: (continued)

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

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