

## FEATURES

- Member of the Texas Instruments Widebus™ Family
- Operates From 1.65 V to 3.6 V
- Max  $t_{pd}$  of 3.6 ns at 3.3 V
- $\pm 24$ -mA Output Drive at 3.3 V
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)

## DESCRIPTION/ORDERING INFORMATION

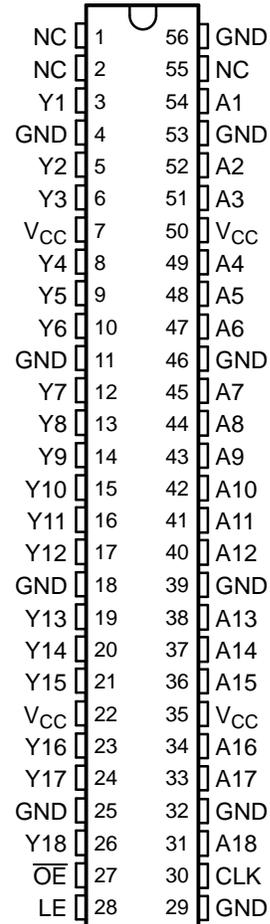
This 18-bit universal bus driver is designed for 1.65-V to 3.6-V  $V_{CC}$  operation.

Data flow from A to Y is controlled by the output-enable ( $\overline{OE}$ ) input. The device operates in the transparent mode when the latch-enable (LE) input is high. The A data is latched if the clock (CLK) input is held at a high or low logic level. If LE is low, the A data is stored in the latch/flip-flop on the low-to-high transition of CLK. When  $\overline{OE}$  is high, the outputs 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.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP - DL	Tube	SN74ALVCH16835DL	ALVCH16835
		Tape and reel	SN74ALVCH16835DLR	
	TSSOP - DGG	Tape and reel	SN74ALVCH16835DGGR	ALVCH16835
	TVSOP - DGV	Tape and reel	SN74ALVCH16835DGVR	VH835
	VFBGA - GQL	Tape and reel	SN74ALVCH16835KR	VH835
	VFBGA - ZQL (Pb-free)		74ALVCH16835ZQLR	

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



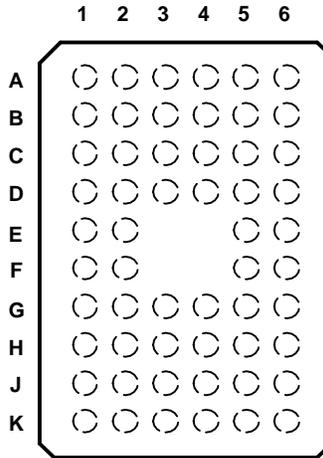
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Widebus is a trademark of Texas Instruments.

**SN74ALVCH16835**  
**18-BIT UNIVERSAL BUS DRIVER**  
**WITH 3-STATE OUTPUTS**

SCES053J—SEPTEMBER 1995—REVISED OCTOBER 2004

**GQL OR ZQL PACKAGE**  
**(TOP VIEW)**



**TERMINAL ASSIGNMENTS<sup>(1)</sup>**

	1	2	3	4	5	6
<b>A</b>	Y1	NC	NC	GND	NC	A1
<b>B</b>	Y3	Y2	GND	GND	A2	A3
<b>C</b>	Y5	Y4	V <sub>CC</sub>	V <sub>CC</sub>	A4	A5
<b>D</b>	Y7	Y6	GND	GND	A6	A7
<b>E</b>	Y9	Y8			A8	A9
<b>F</b>	Y10	Y11			A11	A10
<b>G</b>	Y12	Y13	GND	GND	A13	A12
<b>H</b>	Y14	Y15	V <sub>CC</sub>	V <sub>CC</sub>	A15	A14
<b>J</b>	Y16	Y17	GND	GND	A17	A16
<b>K</b>	Y18	$\overline{OE}$	LE	GND	CLK	A18

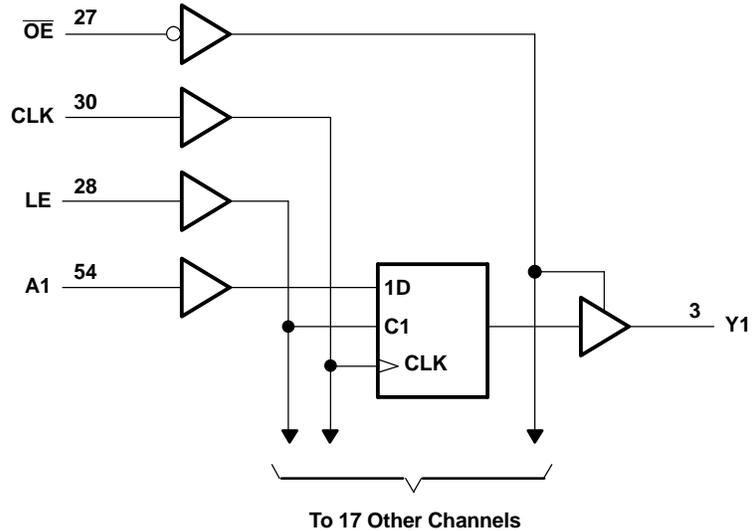
(1) NC - No internal connection

**FUNCTION TABLE**

INPUTS				OUTPUT Y
$\overline{OE}$	LE	CLK	A	
H	X	X	X	Z
L	H	X	L	L
L	H	X	H	H
L	L	↑	L	L
L	L	↑	H	H
L	L	H	X	Y <sub>0</sub> <sup>(1)</sup>
L	L	L	X	Y <sub>0</sub> <sup>(2)</sup>

- (1) Output level before the indicated steady-state input conditions were established, provided that CLK is high before LE goes low  
(2) Output level before the indicated steady-state input conditions were established

**LOGIC DIAGRAM (POSITIVE LOGIC)**



Pin numbers shown are for the DGG, DGV, and DL packages.

**SN74ALVCH16835**  
**18-BIT UNIVERSAL BUS DRIVER**  
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**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range	-0.5	4.6	V
V <sub>I</sub>	Input voltage range <sup>(2)</sup>	-0.5	4.6	V
V <sub>O</sub>	Output voltage range <sup>(2)(3)</sup>	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0	-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0	-50	mA
I <sub>O</sub>	Continuous output current		±50	mA
	Continuous current through each V <sub>CC</sub> or GND		±100	mA
θ <sub>JA</sub>	Package thermal impedance <sup>(4)</sup>	DGG package	64	°C/W
		DGV package	48	
		DL package	56	
		GQL/ZQL package	42	
T <sub>stg</sub>	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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 4.6 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	1.65	3.6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	
		V <sub>CC</sub> = 2.7 V to 3.6 V	2	
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7	
		V <sub>CC</sub> = 2.7 V to 3.6 V	0.8	
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 1.65 V	-4	mA
		V <sub>CC</sub> = 2.3 V	-12	
		V <sub>CC</sub> = 2.7 V	-12	
		V <sub>CC</sub> = 3 V	-24	
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 1.65 V	4	mA
		V <sub>CC</sub> = 2.3 V	12	
		V <sub>CC</sub> = 2.7 V	12	
		V <sub>CC</sub> = 3 V	24	
Δt/Δv	Input transition rise or fall rate		10	ns/V
T <sub>A</sub>	Operating free-air temperature	-40	85	°C

- (1) All unused control inputs of the device must be held at V<sub>CC</sub> 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>OH</sub>	I <sub>OH</sub> = -100 μA	1.65 V to 3.6 V	V <sub>CC</sub> - 0.2			V	
	I <sub>OH</sub> = -4 mA	1.65 V	1.2				
	I <sub>OH</sub> = -6 mA	2.3 V	2				
	I <sub>OH</sub> = -12 mA		2.3 V	1.7			
			2.7 V	2.2			
			3 V	2.4			
I <sub>OH</sub> = -24 mA	3 V	2					
V <sub>OL</sub>	I <sub>OL</sub> = 100 μA	1.65 V to 3.6 V	0.2			V	
	I <sub>OL</sub> = 4 mA	1.65 V	0.45				
	I <sub>OL</sub> = 6 mA	2.3 V	0.4				
	I <sub>OL</sub> = 12 mA		2.3 V	0.7			
			2.7 V	0.4			
	I <sub>OL</sub> = 24 mA	3 V	0.55				
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.6 V	±5			μA	
I <sub>I(hold)</sub>	V <sub>I</sub> = 0.58 V	1.65 V	25			μA	
	V <sub>I</sub> = 1.07 V	1.65 V	-25				
	V <sub>I</sub> = 0.7 V	2.3 V	45				
	V <sub>I</sub> = 1.7 V	2.3 V	-45				
	V <sub>I</sub> = 0.8 V	3 V	75				
	V <sub>I</sub> = 2 V	3 V	-75				
	V <sub>I</sub> = 0 to 3.6 V <sup>(2)</sup>	3.6 V	±500				
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	3.6 V	±10			μA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	3.6 V	40			μA	
ΔI <sub>CC</sub>	One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND	3 V to 3.6 V	750			μA	
C <sub>i</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V			pF	
	Data inputs		3.5				
C <sub>o</sub>	Outputs	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V			pF	
			6				
			7				

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

## TIMING REQUIREMENTS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

		V <sub>CC</sub> = 1.8 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 2.7 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		UNIT
		MIN	TYP	MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	(1)		150		150		150		MHz
t <sub>w</sub>	Pulse duration	LE high	(1)		3.3	3.3	3.3	3.3		ns
		CLK high or low	(1)		3.3	3.3	3.3	3.3		
t <sub>su</sub>	Setup time	Data before CLK↑	(1)		2.2	2.1	1.7		ns	
		Data before LE↓	CLK high	(1)		1.9	1.6	1.5		
			CLK low	(1)		1.3	1.1	1		
t <sub>h</sub>	Hold time	Data after CLK↑	(1)		0.6	0.6	0.7		ns	
		Data after LE↓	CLK high or low	(1)		1.4	1.7	1.4		

(1) This information was not available at the time of publication.

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**SWITCHING CHARACTERISTICS**

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$		$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	TYP	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{max}$			(1)		150		150		150		MHz
$t_{pd}$	A	Y	(1)		1	4.2	4.2		1	3.6	ns
	LE		(1)		1.3	5	4.9		1.3	4.2	
	CLK		(1)		1.4	5.5	5.2		1.4	4.5	
$t_{en}$	$\overline{OE}$	Y	(1)		1.4	5.5	5.6		1.1	4.6	ns
$t_{dis}$	$\overline{OE}$	Y	(1)		1	4.5	4.3		1.3	3.9	ns

(1) This information was not available at the time of publication.

**SWITCHING CHARACTERISTICS**

from 0°C to 65°C,  $C_L = 50\text{ pF}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3\text{ V} \pm 0.15\text{ V}$		UNIT
			MIN	MAX	
$t_{pd}$	CLK	Y	1.7	4.5	ns

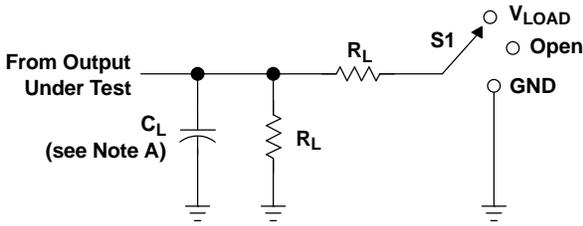
**OPERATING CHARACTERISTICS**

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

PARAMETER		TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
			TYP	TYP	TYP	
$C_{pd}$	Power dissipation	Outputs enabled	(1)	26	31	pF
	capacitance	Outputs disabled	(1)	12	14	

(1) This information was not available at the time of publication.

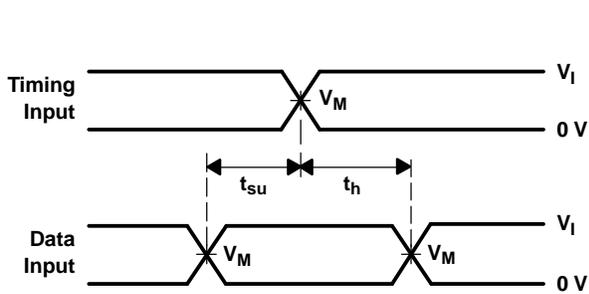
PARAMETER MEASUREMENT INFORMATION



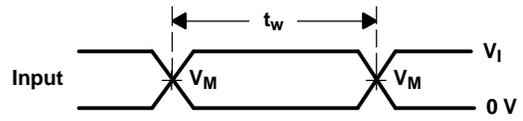
LOAD CIRCUIT

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

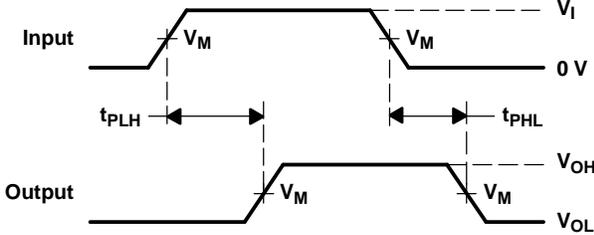
$V_{CC}$	INPUT		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
1.8 V	$V_{CC}$	$\leq 2$ ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5 V \pm 0.2 V$	$V_{CC}$	$\leq 2$ ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
2.7 V	2.7 V	$\leq 2.5$ ns	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
$3.3 V \pm 0.3 V$	2.7 V	$\leq 2.5$ ns	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V



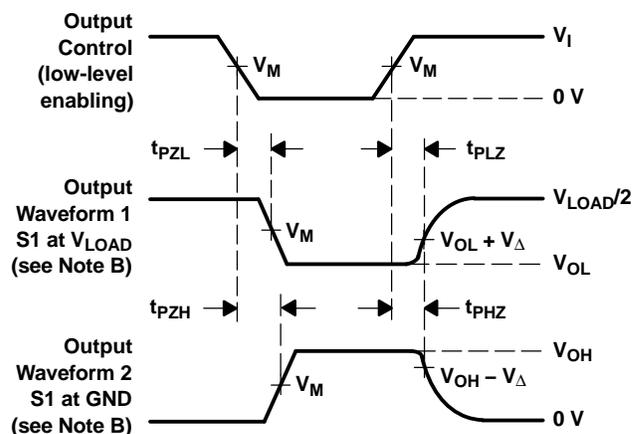
VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



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:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ .  
 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. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">SN74ALVCH16835DGGR</a>	Active	Production	TSSOP (DGG)   56	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVCH16835
SN74ALVCH16835DGGR.B	Active	Production	TSSOP (DGG)   56	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVCH16835
<a href="#">SN74ALVCH16835DGVR</a>	Active	Production	TVSOP (DGV)   56	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VH835
SN74ALVCH16835DGVR.B	Active	Production	TVSOP (DGV)   56	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VH835

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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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
SN74ALVCH16835DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.9	14.7	1.4	12.0	24.0	Q1
SN74ALVCH16835DGVR	TVSOP	DGV	56	2000	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1

**TAPE AND REEL BOX DIMENSIONS**

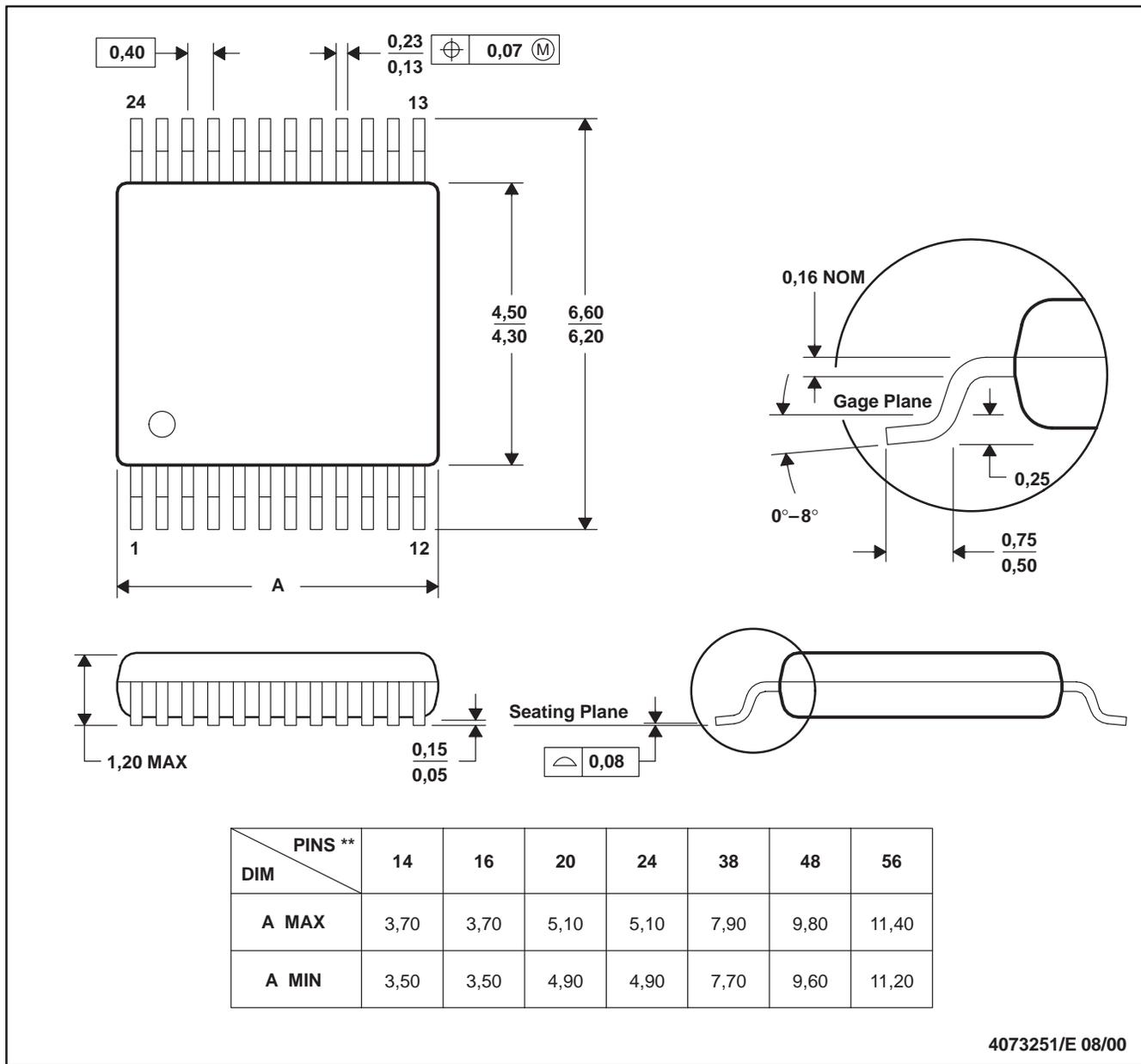

\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVCH16835DGGR	TSSOP	DGG	56	2000	356.0	356.0	45.0
SN74ALVCH16835DGVR	TVSOP	DGV	56	2000	356.0	356.0	45.0

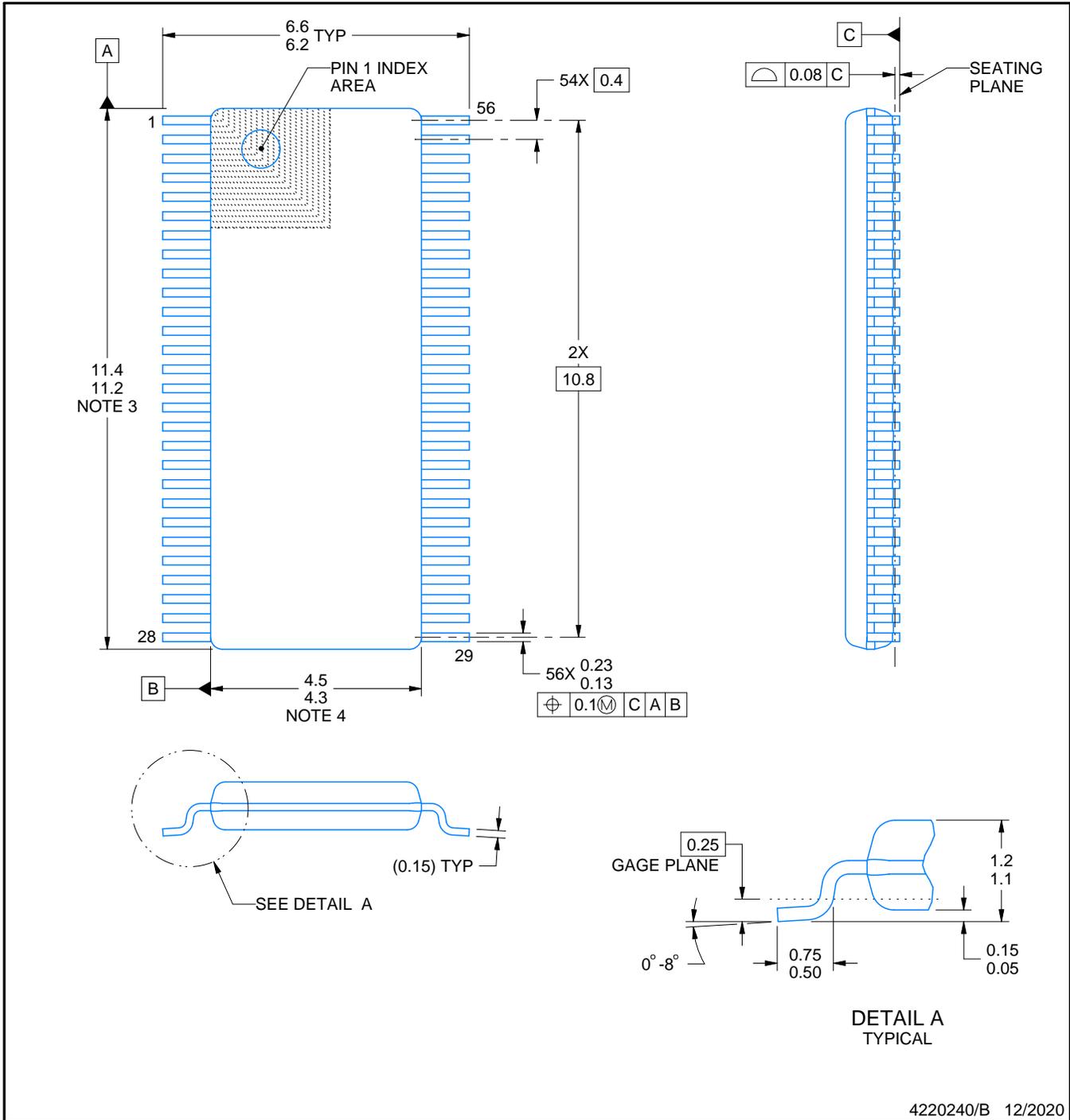
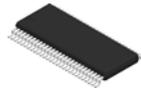
DGV (R-PDSO-G\*\*)

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



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NOTES:

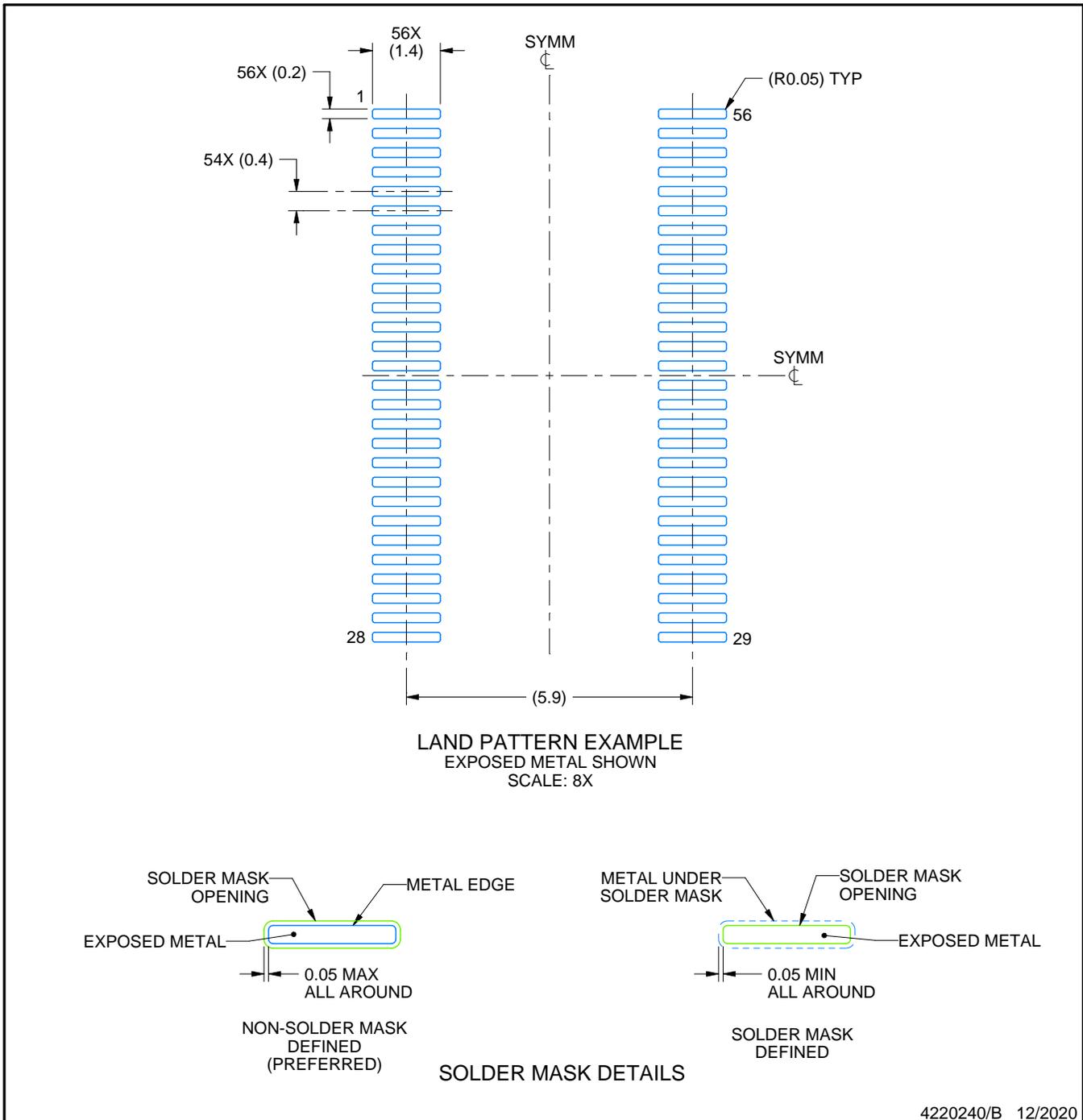
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-194.

# EXAMPLE BOARD LAYOUT

DGV0056A

TVSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

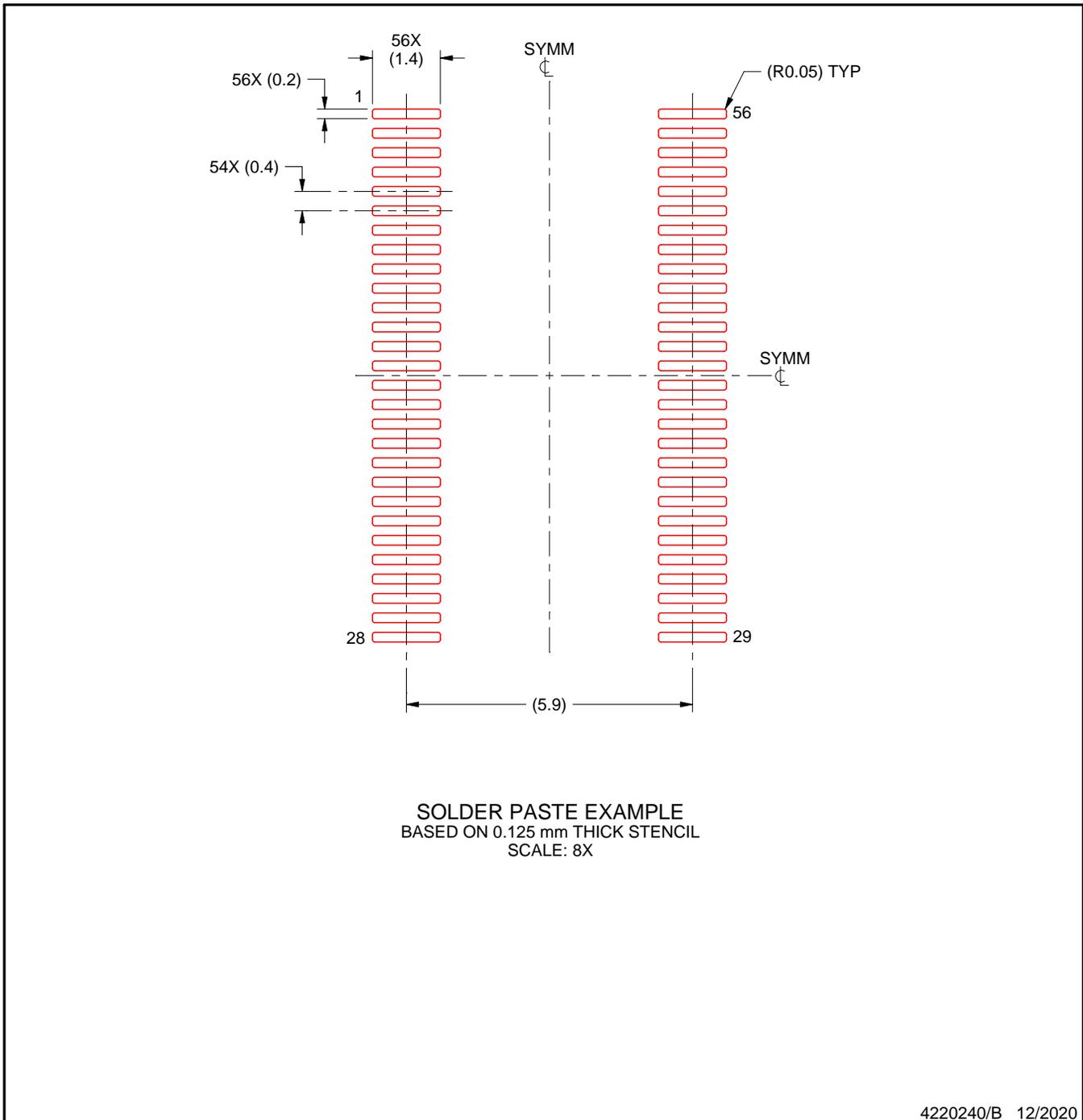
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DGV0056A

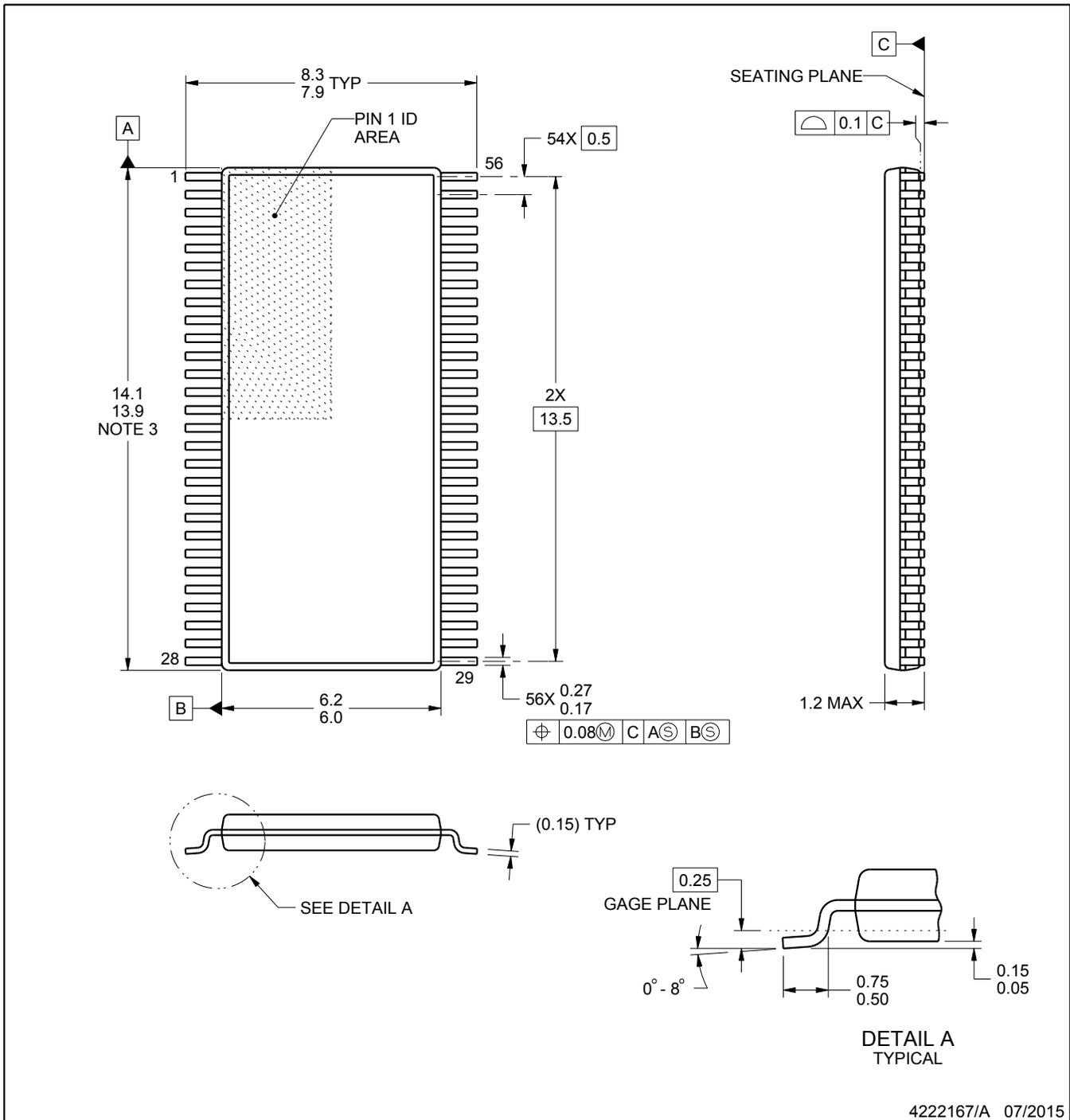
TVSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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.



4222167/A 07/2015

NOTES:

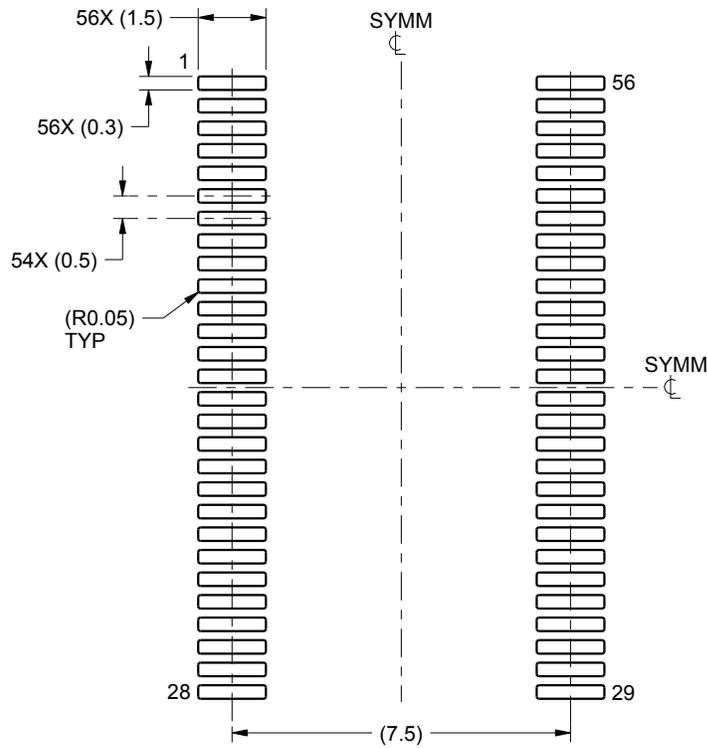
- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate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

# EXAMPLE BOARD LAYOUT

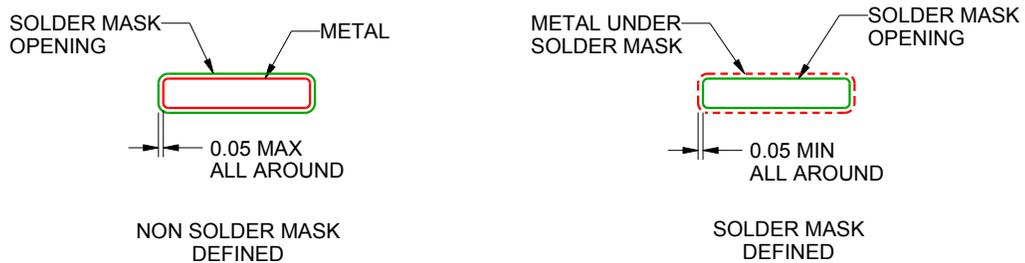
DGG0056A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

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NOTES: (continued)

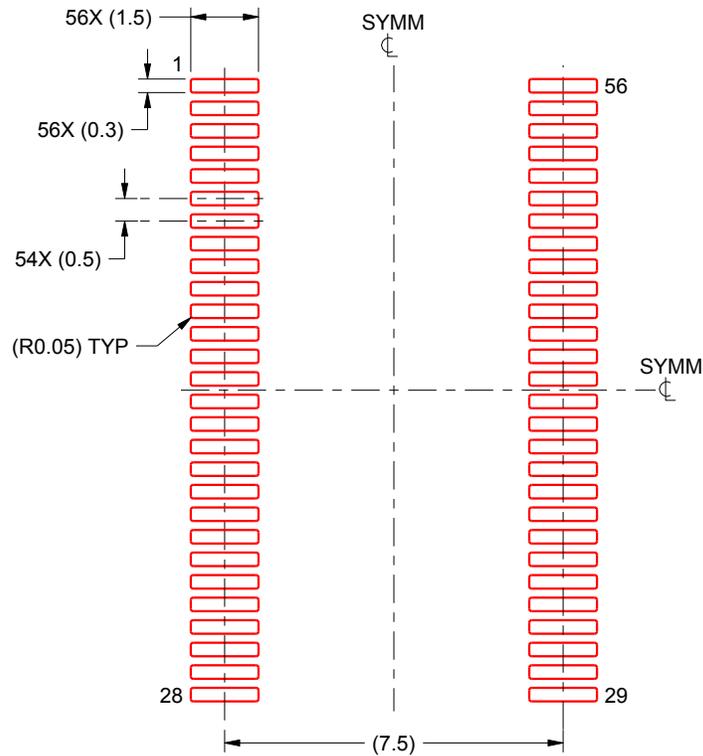
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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

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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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