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[Texas Instruments](#)

[SN74ALVCF162835GR](#)

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FEATURES

- Member of the Texas Instruments Widebus™ Family
- Ideal for Use in PC133 Register DIMM
- Typical Output Skew . . . <250 ps
- $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$. . . Normal Range
- $V_{CC} = 2.7\text{ V}$ to 3.6 V . . . Extended Range
- $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$
- Rail-to-Rail Output Swing for Increased Noise Margin
- Balanced Output Drivers . . . $\pm 18\text{ mA}$
- Low Switching Noise
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

DESCRIPTION/ORDERING INFORMATION

This 18-bit universal bus driver is designed for 2.3-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. When LE is low, 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.

The SN74ALVCF162835 has series damping resistors in the device output structure that reduce switching noise in 128-MB and 256-MB SDRAM modules. Designed with a drive capability of $\pm 18\text{ mA}$, this device is a midway drive between the SN74ALVC162835 ($\pm 12\text{ mA}$) and SN74ALVC16835 ($\pm 24\text{ mA}$).

DGG, DGV, OR DL PACKAGE (TOP VIEW)

NC	1	56	GND
NC	2	55	NC
Y1	3	54	A1
GND	4	53	GND
Y2	5	52	A2
Y3	6	51	A3
V_{CC}	7	50	V_{CC}
Y4	8	49	A4
Y5	9	48	A5
Y6	10	47	A6
GND	11	46	GND
Y7	12	45	A7
Y8	13	44	A8
Y9	14	43	A9
Y10	15	42	A10
Y11	16	41	A11
Y12	17	40	A12
GND	18	39	GND
Y13	19	38	A13
Y14	20	37	A14
Y15	21	36	A15
V_{CC}	22	35	V_{CC}
Y16	23	34	A16
Y17	24	33	A17
GND	25	32	GND
Y18	26	31	A18
\overline{OE}	27	30	CLK
LE	28	29	GND

NC – No internal connection

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP - DL	Tube	SN74ALVCF162835DL	ALVCF162835
		Tape and reel	SN74ALVCF162835DLR	
	TSSOP - DGG	Tape and reel	SN74ALVCF162835GR	ALVCF162835
	TVSOP - DGV	Tape and reel	SN74ALVCF162835VR	VF2835

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



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SN74ALVCF162835

3.3-V CMOS 18-BIT UNIVERSAL BUS DRIVER WITH 3-STATE OUTPUTS

SCES397A–JULY 2002–REVISED AUGUST 2004



DESCRIPTION/ORDERING INFORMATION (CONTINUED)

The SN74ALVCF162835 is a faster version of the SN74ALVC162835. It is suitable for PC133 applications and, particularly, SDRAM modules clocked at 133 MHz.

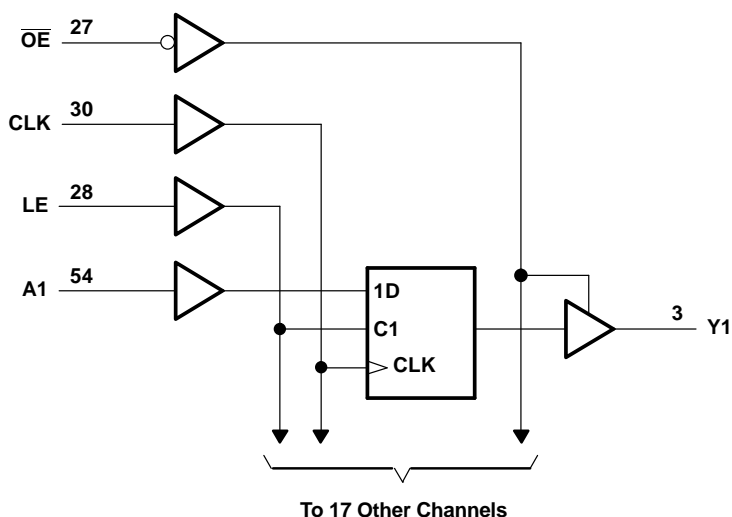
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

FUNCTION TABLE

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	L or H	X	$Y_0^{(1)}$

(1) Output level before the indicated steady-state input conditions were established

LOGIC DIAGRAM (POSITIVE LOGIC)



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	-0.5	4.6	V
V_I	Input voltage range ⁽²⁾	-0.5	4.6	V
V_O	Output voltage range ⁽²⁾⁽³⁾	-0.5	$V_{CC} + 0.5$	V
I_{IK}	Input clamp current	$V_I < 0$ or $V_I < V_{CC}$		-50 mA
I_{OK}	Output clamp current	$V_O < 0$		-50 mA
I_O	Continuous output current			± 50 mA
	Continuous current through each V_{CC} or GND			± 100 mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	DGG package		64
		DGV package		48
		DL package		56
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 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⁽¹⁾

		MIN	MAX	UNIT
V_{CC}	Supply voltage	2.3	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$		1.7
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$		2
V_{IL}	Low-level input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$		0.7
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$		0.8
V_I	Input voltage	0	V_{CC}	V
V_O	Output voltage	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2.3 \text{ V}$		-6
				-8
		$V_{CC} = 2.7 \text{ V}$		-6
				-12
		$V_{CC} = 3 \text{ V}$		-8
				-18
I_{OL}	Low-level output current	$V_{CC} = 2.3 \text{ V}$		6
				8
		$V_{CC} = 2.7 \text{ V}$		6
				12
		$V_{CC} = 3 \text{ V}$		8
				18
$\Delta t/\Delta v$	Input transition rise or fall rate			10 ns/V
T_A	Operating free-air temperature	-40	85	°C

- (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.

SN74ALVCF162835

3.3-V CMOS 18-BIT UNIVERSAL BUS DRIVER WITH 3-STATE OUTPUTS



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ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	V _{CC}	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{OH}		I _{OH} = -0.1 mA	2.3 V to 3.6 V	V _{CC} - 0.2			V
		I _{OH} = -6 mA	2.3 V	1.9			
		I _{OH} = -8 mA		1.7			
		I _{OH} = -6 mA	2.7 V	2.2			
		I _{OH} = -12 mA		2			
		I _{OH} = -8 mA	3 V	2.4			
		I _{OH} = -18 mA		2			
V _{OL}		I _{OL} = 0.1 mA	2.3 V to 3.6 V	0.2			V
		I _{OL} = 6 mA	2.3 V	0.4			
		I _{OL} = 8 mA		0.55			
		I _{OL} = 6 mA	2.7 V	0.4			
		I _{OL} = 12 mA		0.6			
		I _{OL} = 8 mA	3 V	0.55			
		I _{OL} = 18 mA		0.8			
V _{IK}	V _{CC} = 2.3 V, I _I = -18 mA		3.6 V	-1.2		V	
V _{hys}	V _{CC} = 3.6 V		3.6 V	100		mV	
I _I	V _I = V _{CC} or GND		3.6 V	±5		μA	
I _{OZ}	V _O = V _{CC} or GND		3.6 V	±10		μA	
I _{CC}	V _I = V _{CC} or GND, I _O = 0		3.6 V	0.1	40	μA	
ΔI _{CC}	One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND		3 V to 3.6 V	750		μA	
C _i	Inputs	V _I = 0 V	3.3 V	3.5		pF	
C _o	Outputs	V _O = 0 V	3.3 V	4.5		pF	

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

TIMING REQUIREMENTS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 and Figure 2)

				$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency			150		150		150		MHz
t _w	Pulse duration	LE high		3.3		3.3		3.3		ns
		CLK high or low		3.3		3.3		3.3		
t _{su}	Setup time	Data before CLK↑		1.8		1.5		1		ns
		Data before LE↓	CLK high	1.9		1.6		1.5		
			CLK low	1.3		1.1		1		
t _h	Hold time	Data after CLK↑		0.6		0.6		0.6		ns
		Data after LE↓	CLK high or low	1.4		1.7		1.4		

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1 and Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{max}			150		150		150		MHz
t_{pd}	A	Y	1	4		4.6	1	3.5	ns
	LE		1.3	5.5		5.4	1.3	4.6	
	CLK		1.4	5.9		5.6	1.4	3.5	
t_{en}	\overline{OE}	Y	1.4	5.9		6	1.1	5	ns
t_{dis}	\overline{OE}	Y	1	4.7		4.6	1.3	4.2	ns
$t_{sk(o)}$								500	ps

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	1.8	3.5	ns

OPERATING CHARACTERISTICS

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

PARAMETER			TEST CONDITIONS	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
				TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	$C_L = 0\text{ pF}, f = 10\text{ MHz}$	27	33	pF
		Outputs disabled		16	21	

SN74ALVCF162835

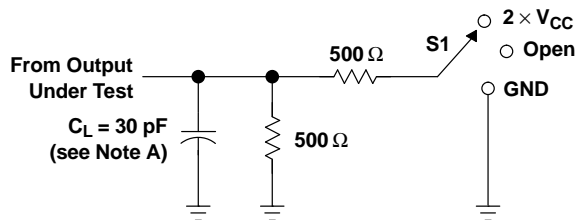
3.3-V CMOS 18-BIT UNIVERSAL BUS DRIVER WITH 3-STATE OUTPUTS

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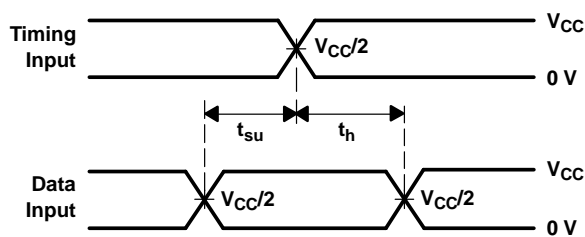
PARAMETER MEASUREMENT INFORMATION

$$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$$

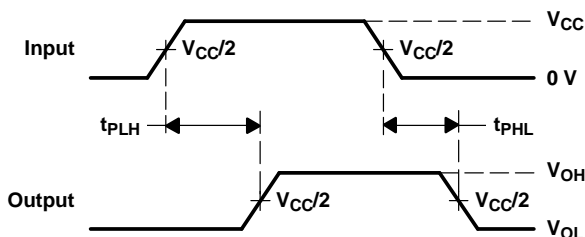


LOAD CIRCUIT

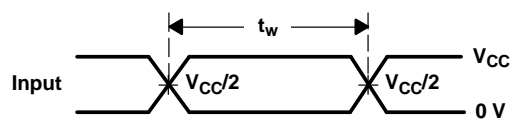
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 $\times V_{CC}$
t_{PHZ}/t_{PZH}	GND



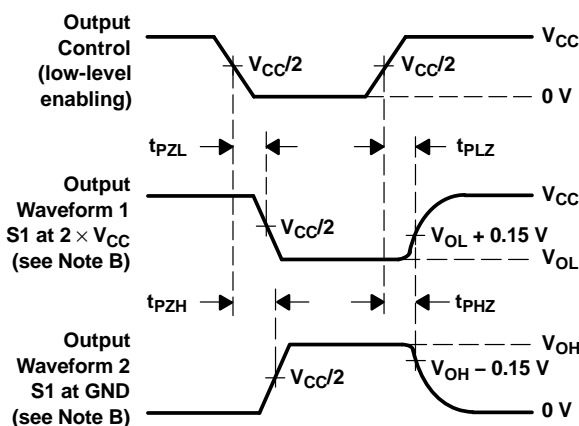
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



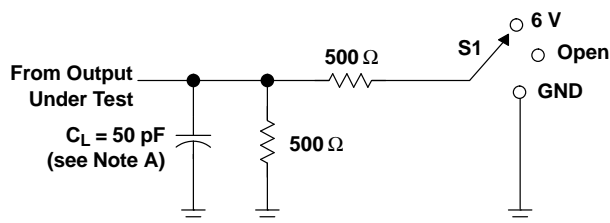
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- 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 $\leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2 \text{ ns}$, $t_f \leq 2 \text{ ns}$.
- 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} .

Figure 1. Load Circuit and Voltage Waveforms

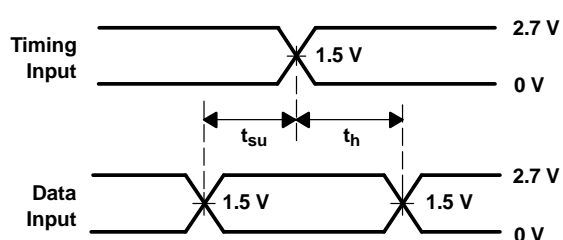
PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$

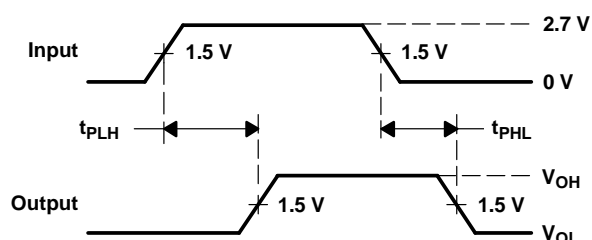


LOAD CIRCUIT

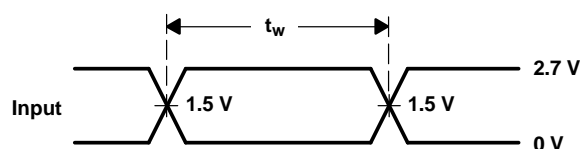
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



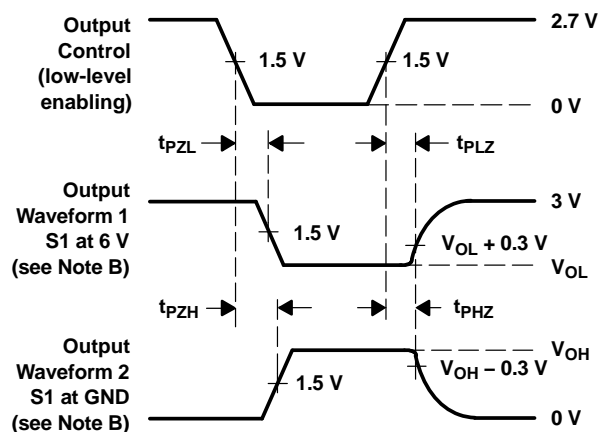
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- NOTES:
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 - 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.
 - 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} .

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
SN74ALVCF162835GR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVCF162835	Samples
SN74ALVCF162835VR	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VF2835	Samples

(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.

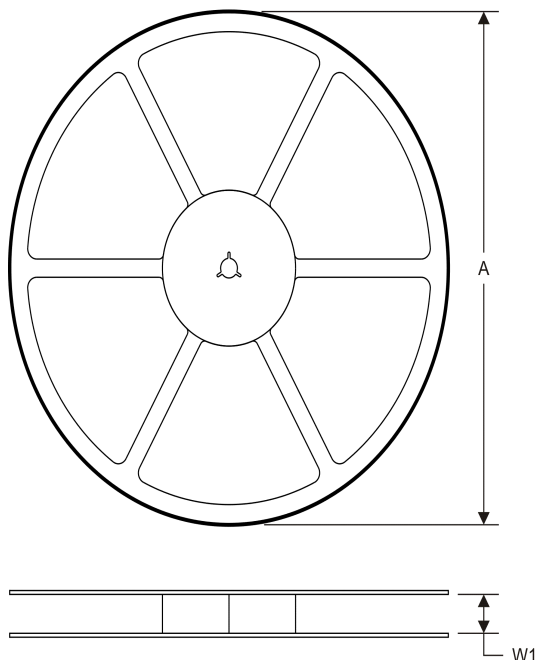
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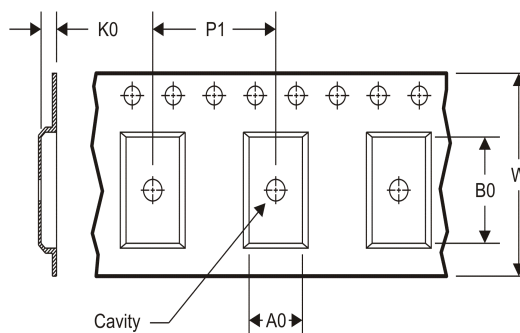
PACKAGE MATERIALS INFORMATION

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
SN74ALVCF162835GR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ALVCF162835VR	TVSOP	DGV	56	2000	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS



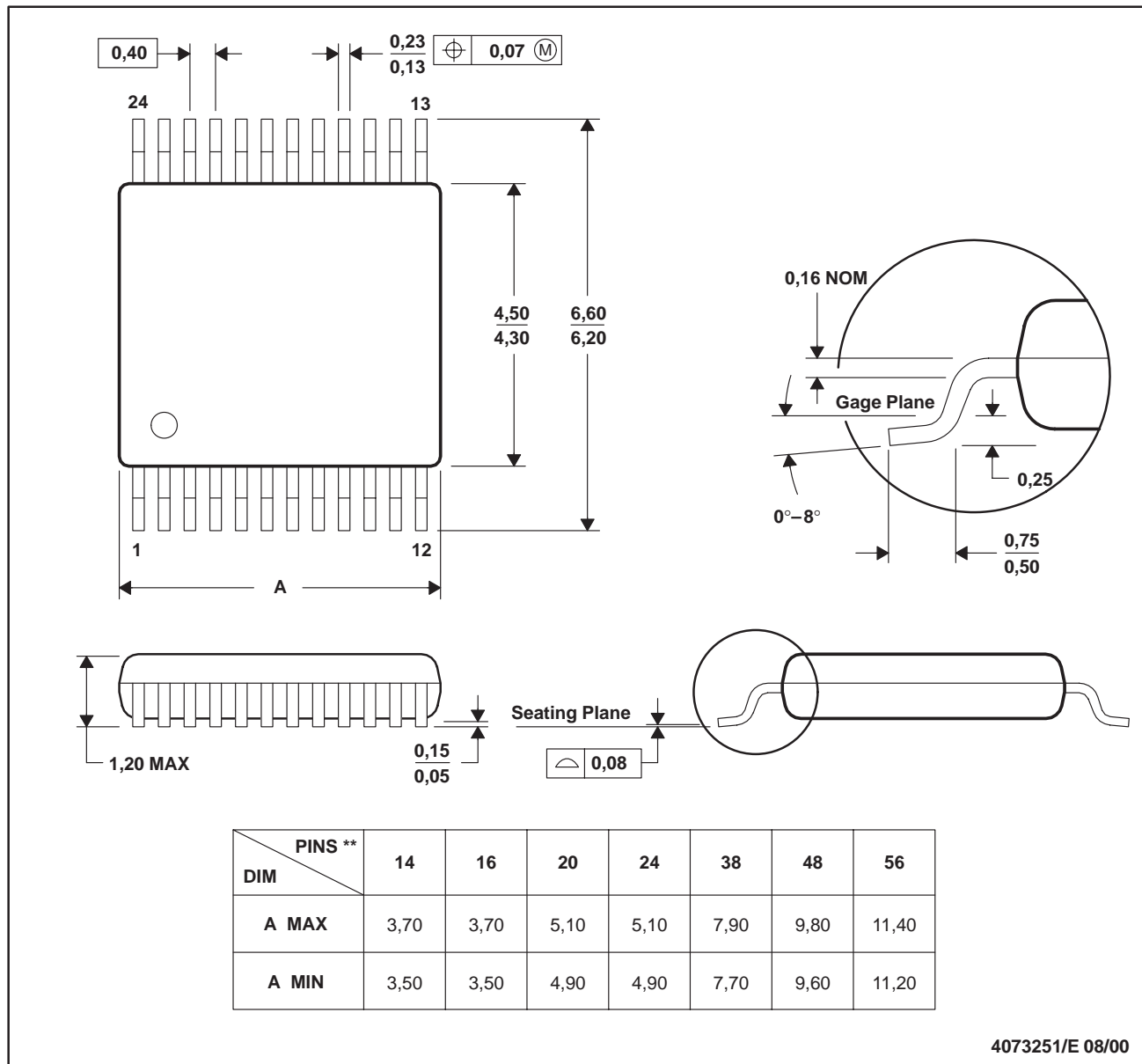
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVCF162835GR	TSSOP	DGG	56	2000	367.0	367.0	45.0
SN74ALVCF162835VR	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

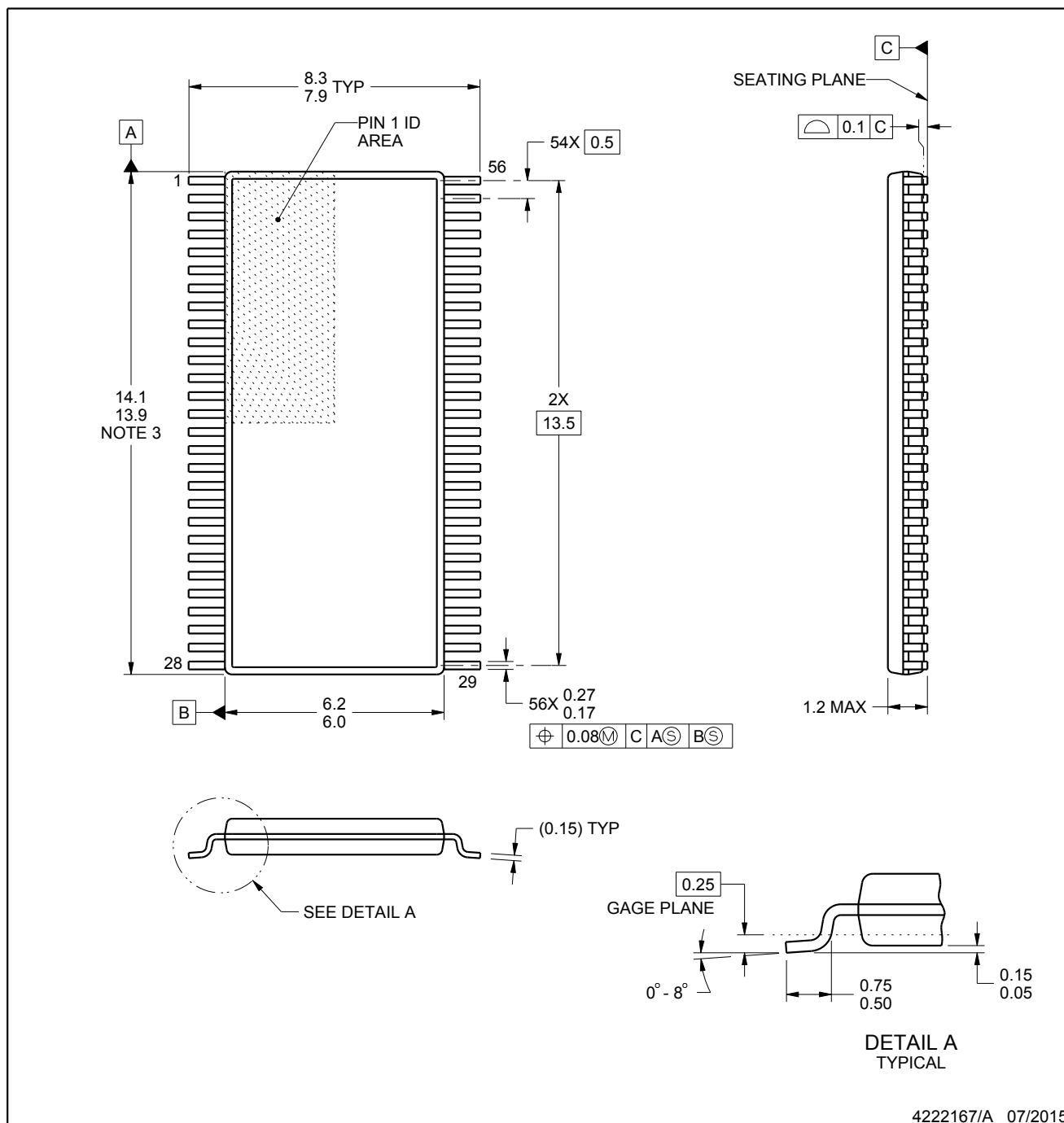


PACKAGE OUTLINE

DGG0056A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

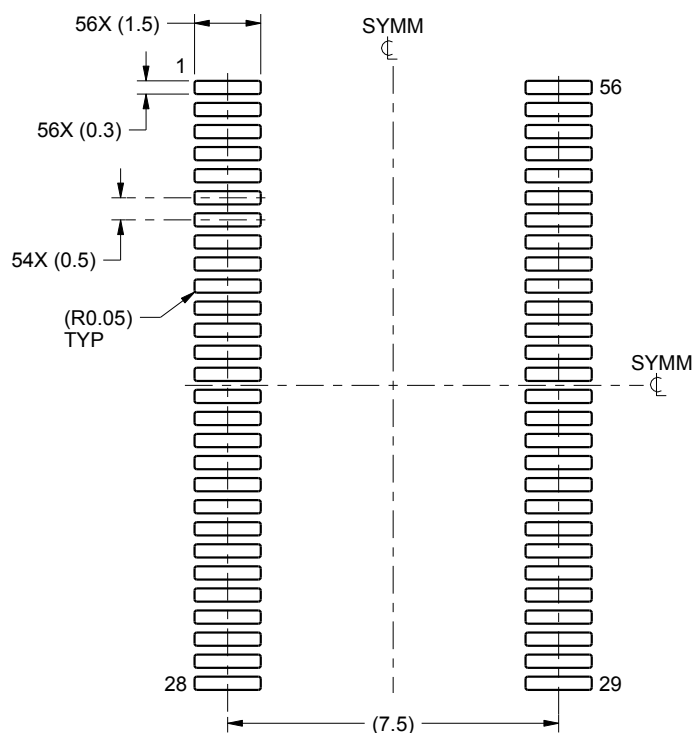
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

EXAMPLE BOARD LAYOUT

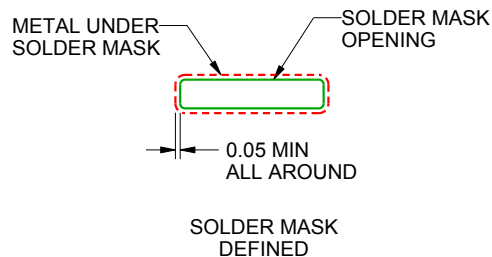
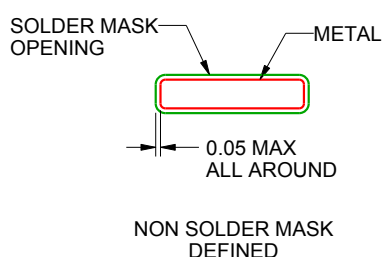
DGG0056A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4222167/A 07/2015

NOTES: (continued)

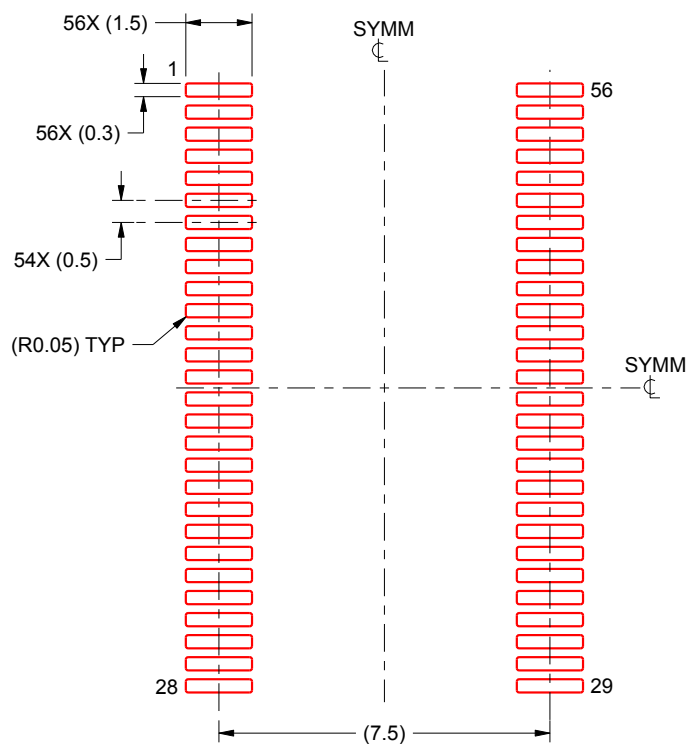
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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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