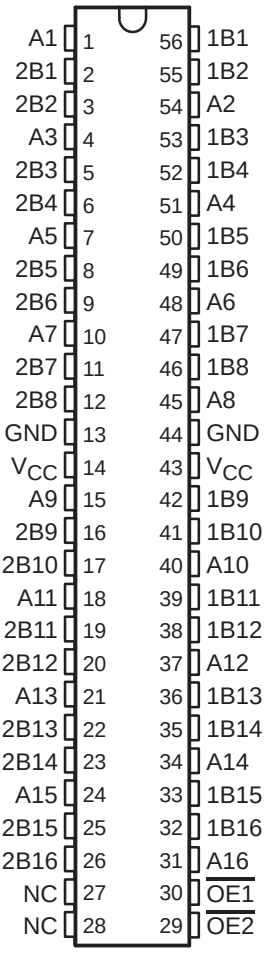
- **Member of Texas Instruments' Widebus™ Family**
- **5-Ω Switch Connection Between Two Ports**
- **TTL-Compatible Input Levels**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**

**DGG, DGV, OR DL PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## description

The SN74CBT16390 is a 16-bit to 32-bit switch used in applications in which two separate data paths must be multiplexed onto, or demultiplexed from, a single path. This device can be used for memory interleaving, in which two different banks of memory must be addressed simultaneously. This device also can be used to connect or isolate the PCI bus to one or two slots simultaneously.

Two output enables ($\overline{OE1}$ and $\overline{OE2}$) control the data flow. When $\overline{OE1}$ is low, A port is connected to 1B port. When $\overline{OE2}$ is low, A port is connected to 2B port. When both $\overline{OE1}$ and $\overline{OE2}$ are low, the A port is connected to both 1B and 2B ports. The control inputs can be driven with a 5-V CMOS, 5-V TTL, or an LVTTL driver.

**ORDERING INFORMATION**

| $T_A$ | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|
| –40°C to 85°C | SSOP – DL | Tube | SN74CBT16390DL | CBT16390 |
| | | Tape and reel | SN74CBT16390DLR | |
| | TSSOP – DGG | Tape and reel | SN74CBT16390DGGR | CBT16390 |
| | TVSOP – DGV | Tape and reel | SN74CBT16390DGVR | CY390 |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at 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.

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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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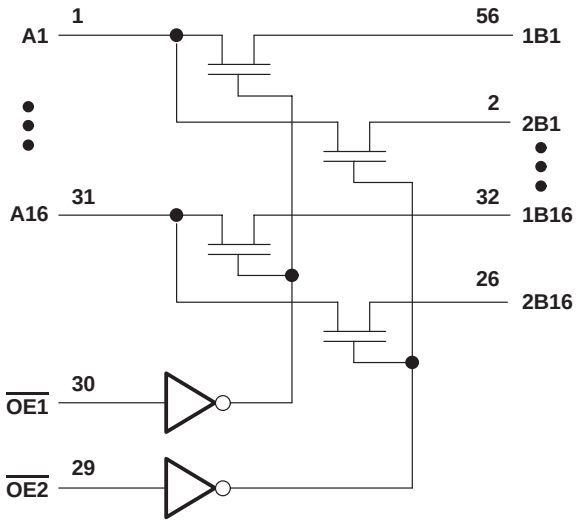
**FUNCTION TABLE**

| INPUTS | | FUNCTION |
|---|---|---|
| $\overline{OE1}$ | $\overline{OE2}$ | |
| L | L | A = 1B and A = 2B |
| L | H | A = 1B |
| H | L | A = 2B |
| H | H | Isolation |

## 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 7 V
Input voltage range, $V_I$ (see Note 1) . . . . . –0.5 V to $V_{CC}$ + 0.5 V
Continuous channel current . . . . . 128 mA
Input clamp current, $I_{IK}$ ($V_I$ < 0) . . . . . –50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DGG package . . . . . 64°C/W
DGV package . . . . . 48°C/W
DL package . . . . . 56°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 51-7.

## recommended operating conditions (see Note 3)

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | 4.5 | 5.5 | V |
| $V_{IH}$ | High-level control input voltage | 2 | | V |
| $V_{IL}$ | Low-level control input voltage | | 0.8 | V |
| $T_A$ | Operating free-air temperature | –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.

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

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IK}$ | | $V_{CC}$ = 4.5 V, | $I_I$ = –18 mA | | | | –1.2 | V |
| $I_I$ | | $V_{CC}$ = 0, | $V_I$ = 5.5 V | | | | 10 | μA |
| | | $V_{CC}$ = 5.5 V, | $V_I$ = 5.5 V or GND | | | | ±1 | |
| $I_{CC}$ | | $V_{CC}$ = 5.5 V, | $I_O$ = 0, | $V_I$ = $V_{CC}$ or GND | | | 3 | μA |
| $\Delta I_{CC}$‡ | Control inputs | $V_{CC}$ = 5.5 V, | One input at 3.4 V, | Other input at $V_{CC}$ or GND | | | 2.5 | mA |
| $C_i$ | Control inputs | $V_I$ = 3 V or 0 | | | | 5 | | pF |
| $C_{io(OFF)}$ | | $V_O$ = 3 V or 0 | | | | 5.5 | | pF |
| $r_{on}$§ | | $V_{CC}$ = 4.5 V | $V_I$ = 0 | $I_I$ = 64 mA | | 5 | 7 | Ω |
| | | | | $I_I$ = 30 mA | | 5 | 7 | |
| | | | $V_I$ = 2.4 V, | $I_I$ = 15 mA | | 7 | 12 | |

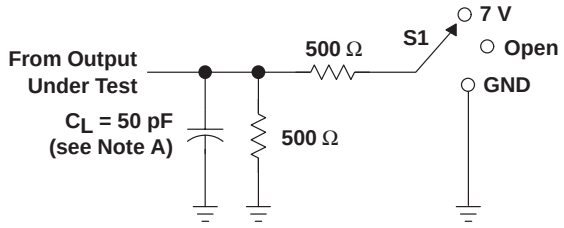
† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡ This is the increase in supply current for each input that is at the specified TTL voltage level rather than $V_{CC}$ or GND.
§ Measured by the voltage drop between A and B terminals at the indicated current through the switch. On-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $t_{pd}$¶ | A or B | B or A | | 0.25 | ns |
| $t_{en}$ | $\overline{OE}$ | A or B | 1.3 | 5.9 | ns |
| $t_{dis}$ | $\overline{OE}$ | A or B | 1 | 5.3 | ns |

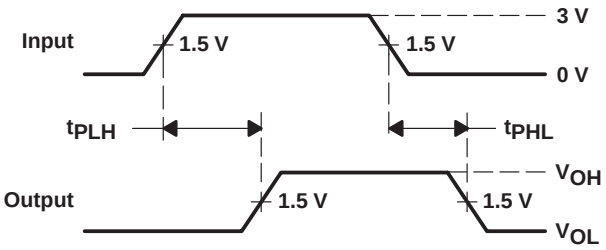
¶ The propagation delay is based on the RC time constant of the typical on-state resistance of the switch and a load capacitance of 50 pF, when driven by an ideal voltage source (zero output impedance).

## PARAMETER MEASUREMENT INFORMATION

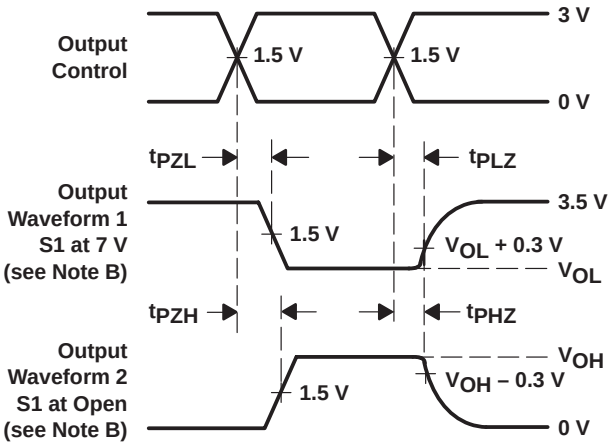



LOAD CIRCUIT

| TEST | S1 |
|---|---|
| $t_{pd}$ | Open |
| $t_{PLZ}/t_{PZL}$ | 7 V |
| $t_{PHZ}/t_{PZH}$ | Open |




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 ≤ 10 MHz, $Z_O$ = 50 Ω, $t_r$ ≤ 2.5 ns, $t_f$ ≤ 2.5 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**

## 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) |
|---|---|---|---|---|---|---|---|---|---|
| SN74CBT16390DGGR | Active | Production | TSSOP (DGG) \| 56 | 2000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CBT16390 |
| SN74CBT16390DGGR.B | Active | Production | TSSOP (DGG) \| 56 | 2000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CBT16390 |
| SN74CBT16390DGVR | Active | Production | TVSOP (DGV) \| 56 | 2000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CY390 |
| SN74CBT16390DGVR.B | Active | Production | TVSOP (DGV) \| 56 | 2000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CY390 |
| SN74CBT16390DL | Active | Production | SSOP (DL) \| 56 | 20 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CBT16390 |
| SN74CBT16390DL.B | Active | Production | SSOP (DL) \| 56 | 20 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CBT16390 |

(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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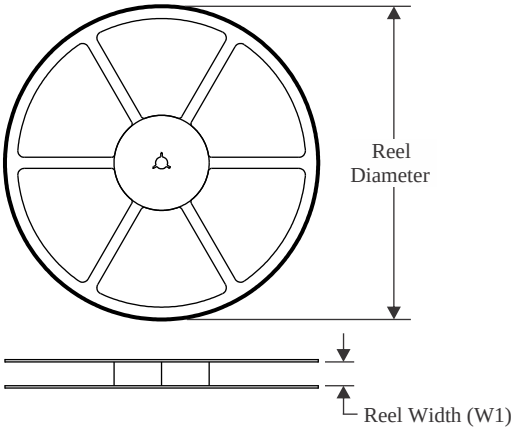
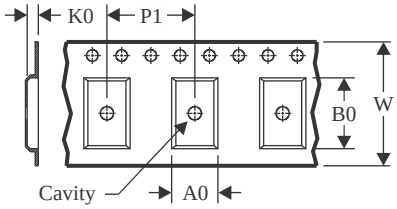
## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

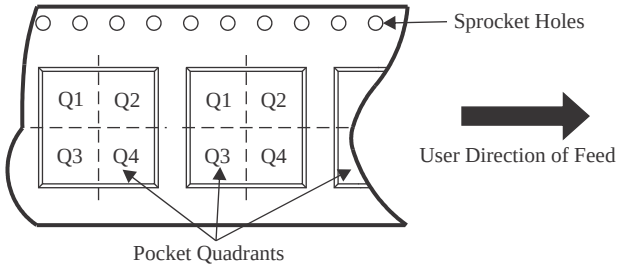



**TAPE DIMENSIONS**




| | |
|---|---|
| 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 |

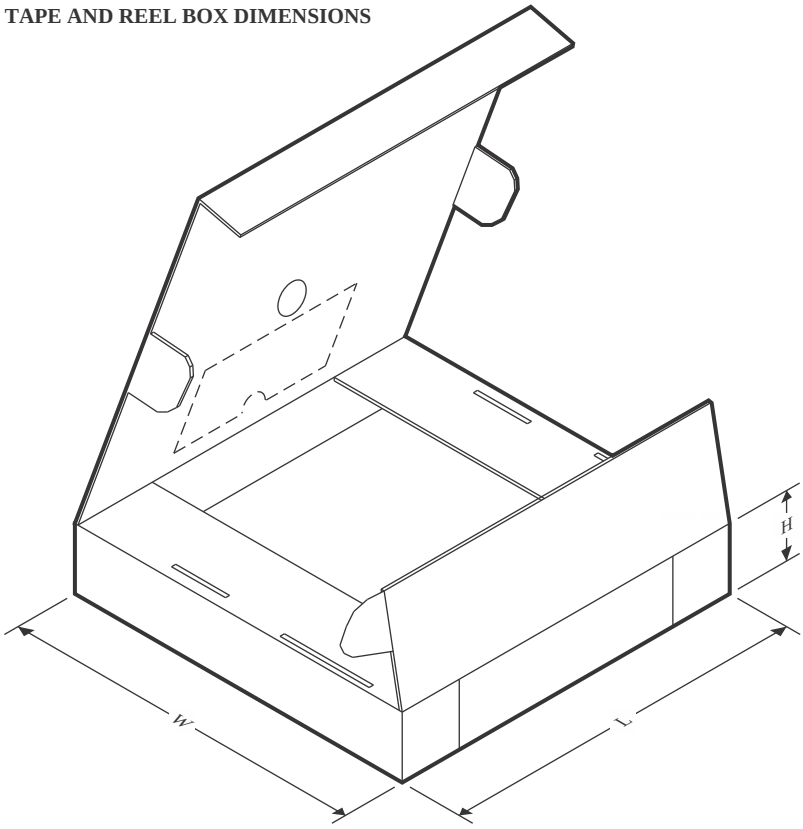
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN74CBT16390DGGR | TSSOP | DGG | 56 | 2000 | 330.0 | 24.4 | 8.9 | 14.7 | 1.4 | 12.0 | 24.0 | Q1 |
| SN74CBT16390DGVR | TVSOP | DGV | 56 | 2000 | 330.0 | 24.4 | 6.8 | 11.7 | 1.6 | 12.0 | 24.0 | Q1 |

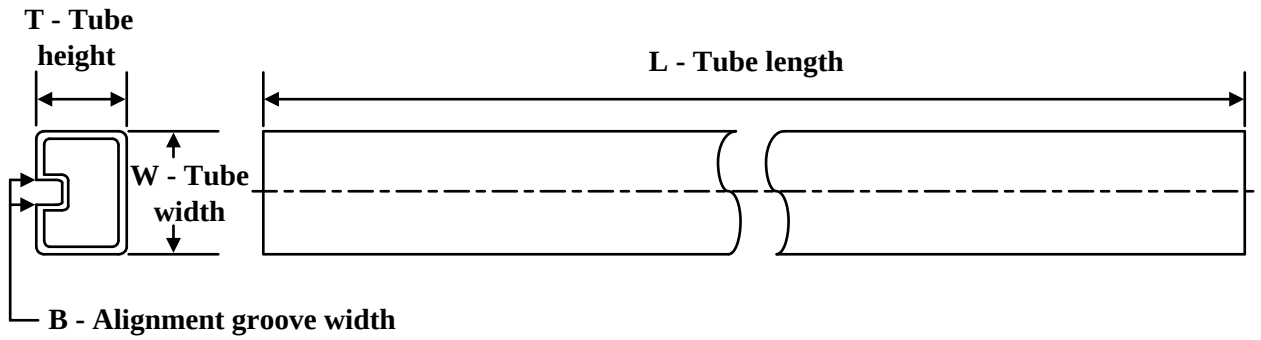
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN74CBT16390DGGR | TSSOP | DGG | 56 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74CBT16390DGVR | TVSOP | DGV | 56 | 2000 | 356.0 | 356.0 | 45.0 |

## TUBE

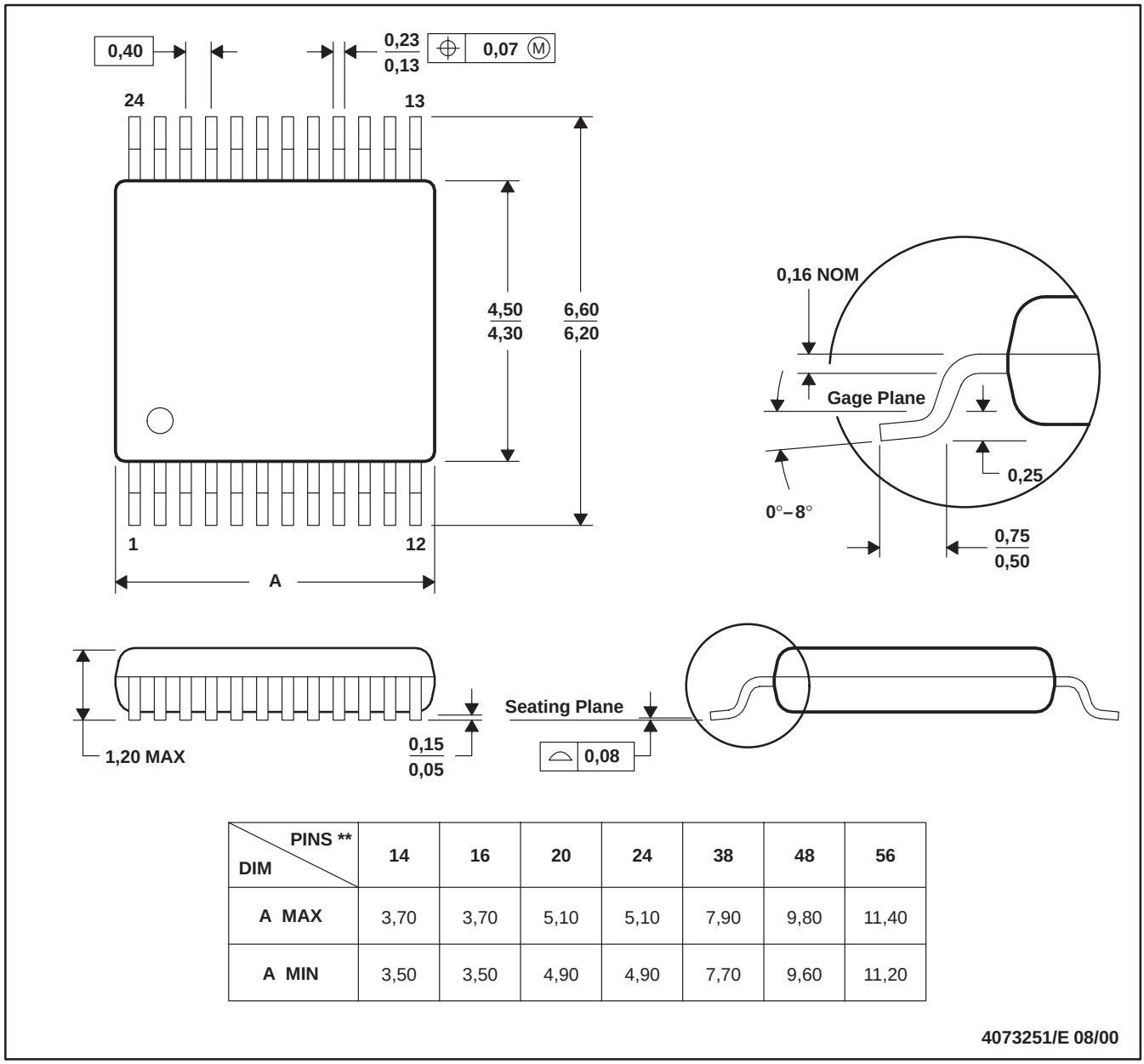



*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| SN74CBT16390DL | DL | SSOP | 56 | 20 | 473.7 | 14.24 | 5110 | 7.87 |
| SN74CBT16390DL.B | DL | SSOP | 56 | 20 | 473.7 | 14.24 | 5110 | 7.87 |

**DGV (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE**

**24 PINS SHOWN**




| DIM \ PINS ** | 14 | 16 | 20 | 24 | 38 | 48 | 56 |
|---|---|---|---|---|---|---|---|
| A MAX | 3,70 | 3,70 | 5,10 | 5,10 | 7,90 | 9,80 | 11,40 |
| A MIN | 3,50 | 3,50 | 4,90 | 4,90 | 7,70 | 9,60 | 11,20 |

**4073251/E 08/00**

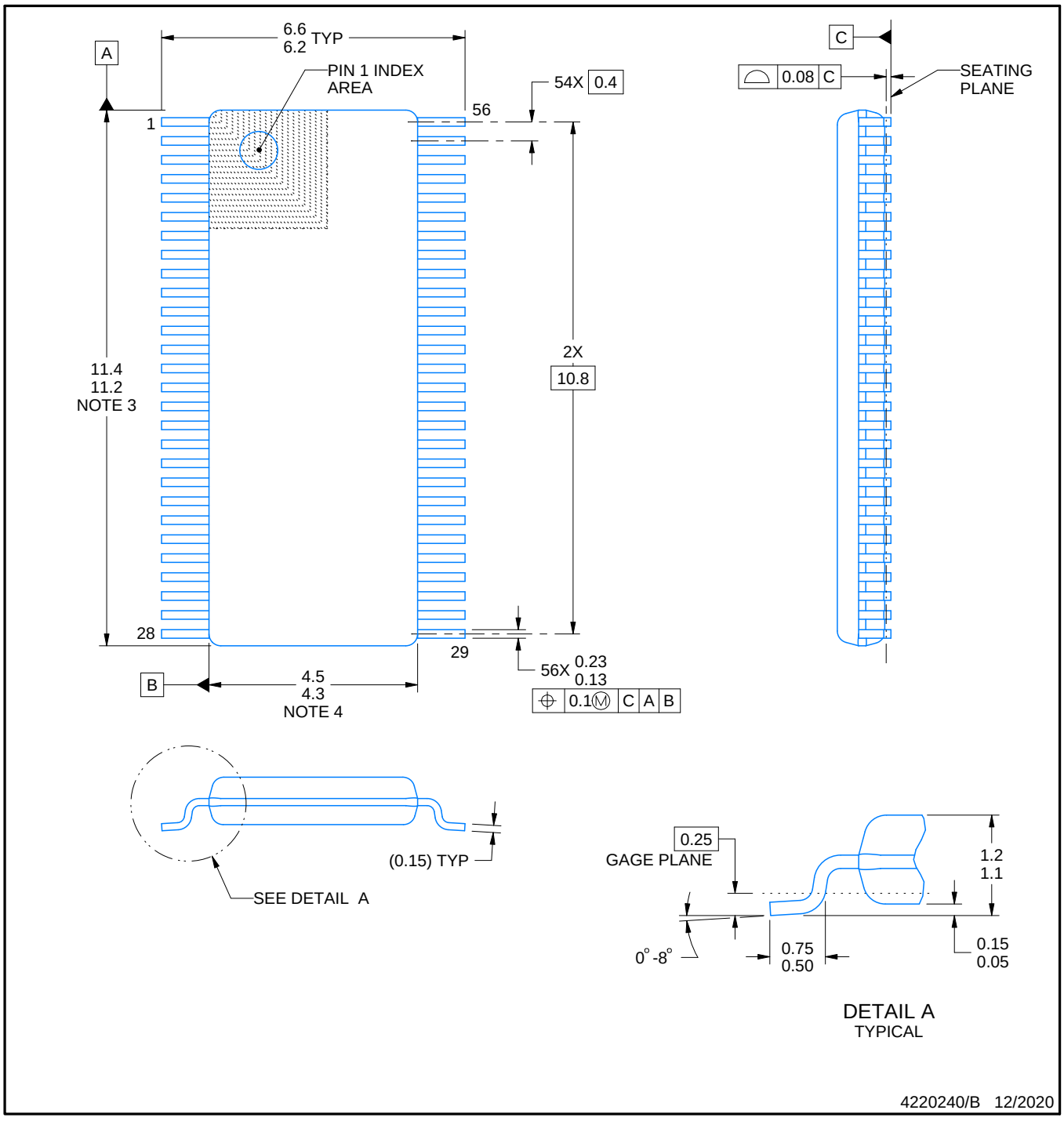
NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
D. Falls within JEDEC: 24/48 Pins – MO-153
14/16/20/56 Pins – MO-194

# PACKAGE OUTLINE

## DGV0056A

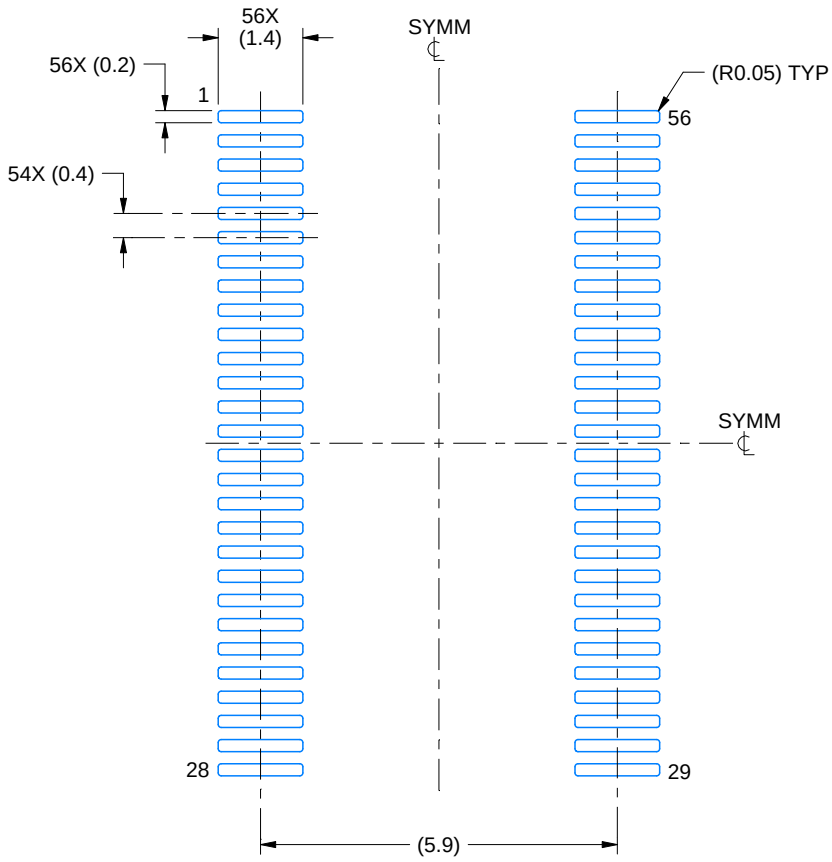
## TVSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

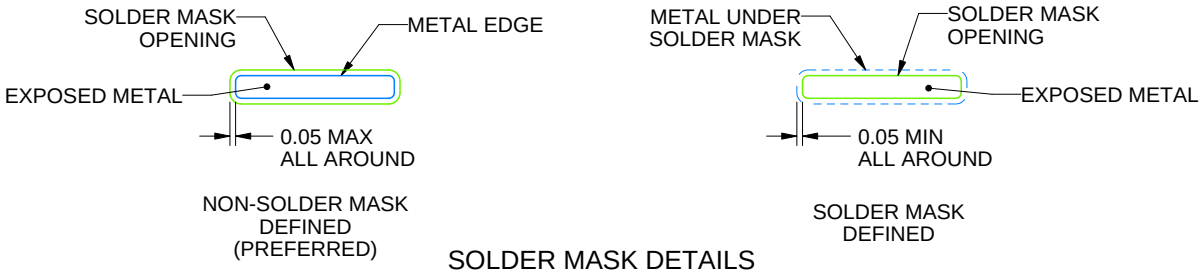



NOTES:

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. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-194.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X

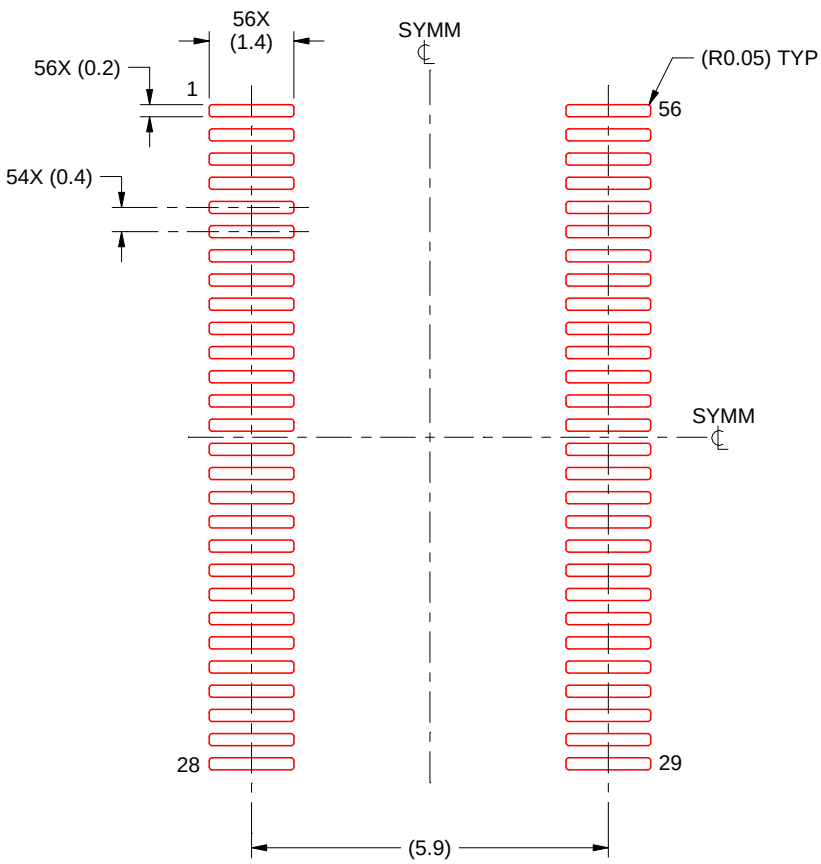



SOLDER MASK DETAILS

4220240/B 12/2020

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.



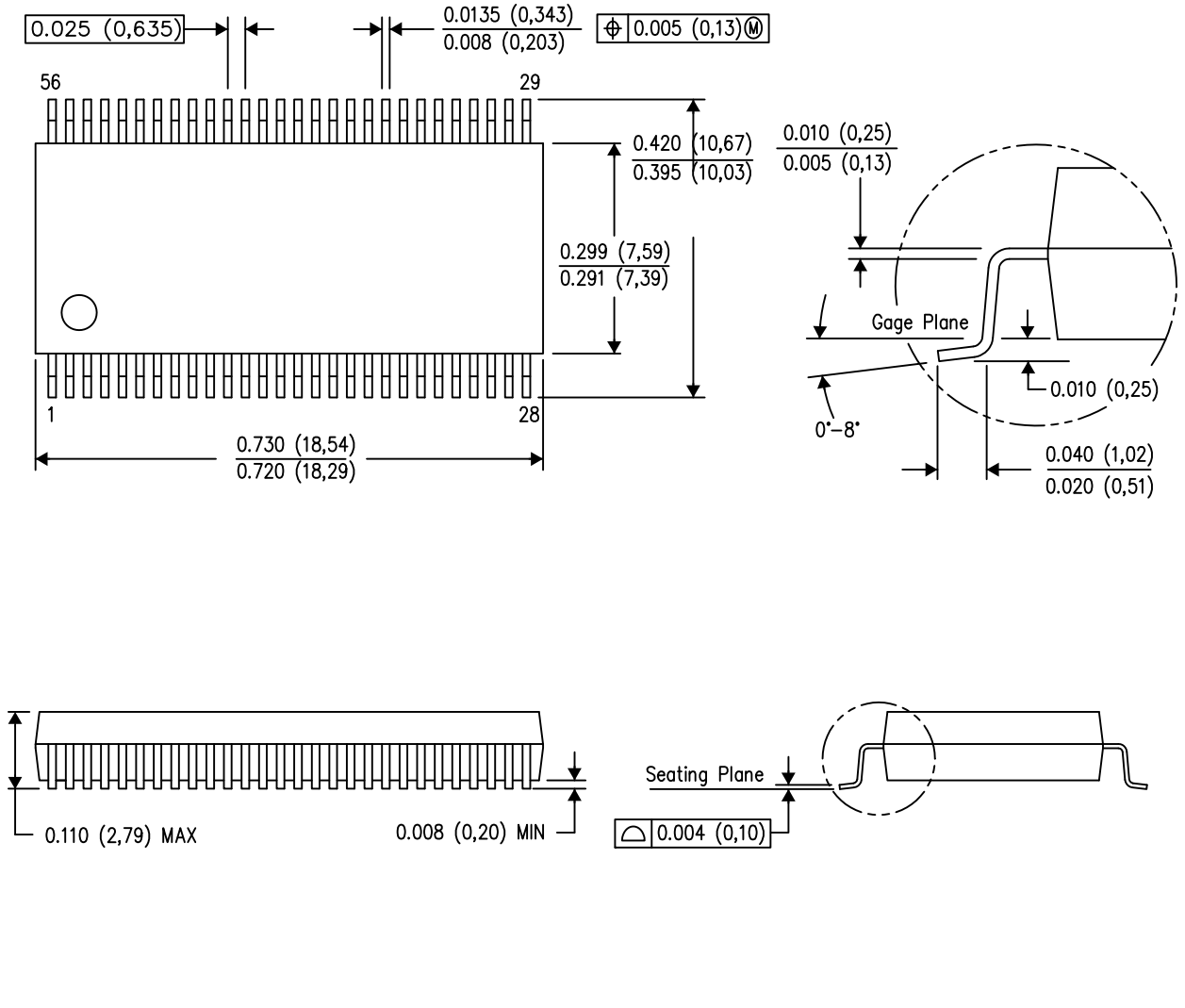

SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 8X

4220240/B 12/2020

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.

DL (R–PDSO–G56) PLASTIC SMALL–OUTLINE PACKAGE




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 MO–118

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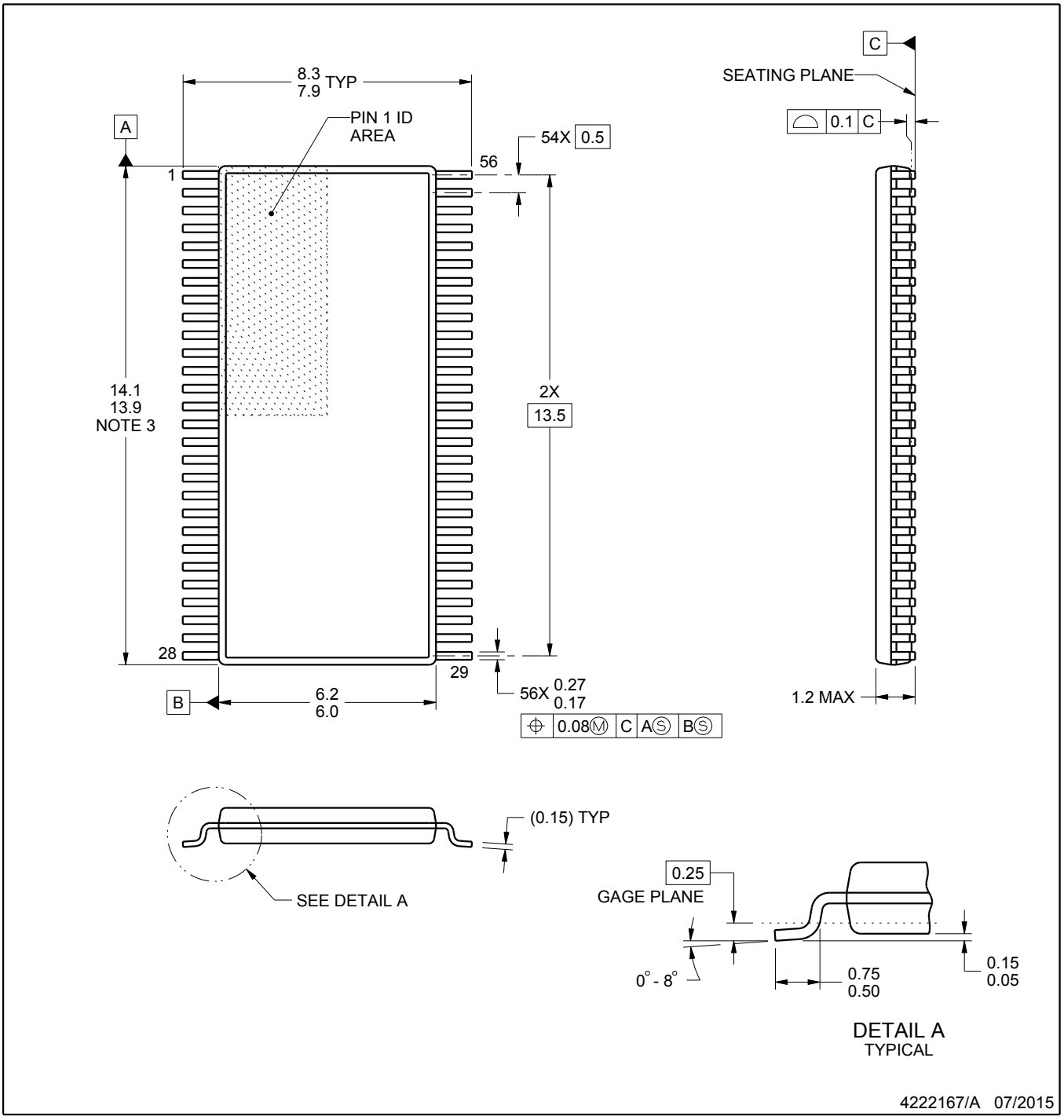
# PACKAGE OUTLINE

## DGG0056A

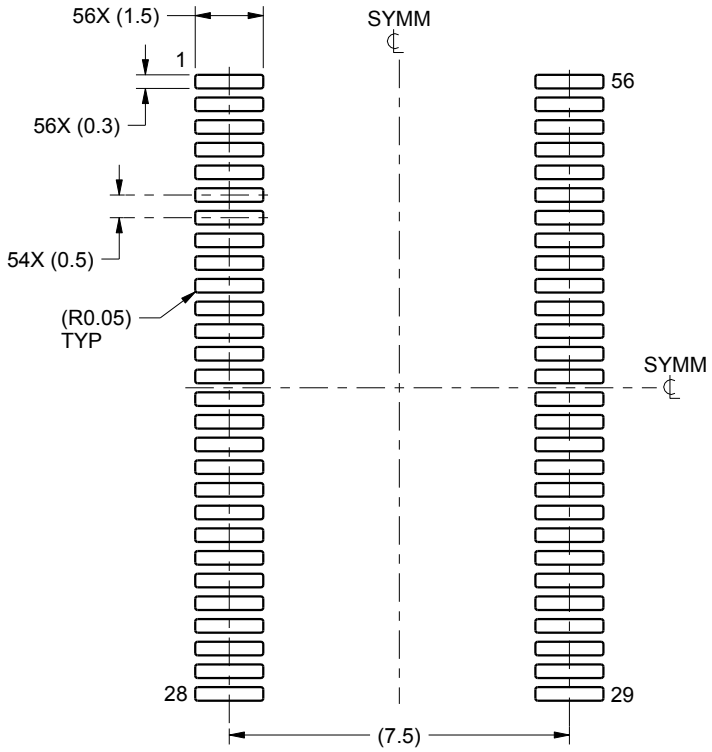
## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

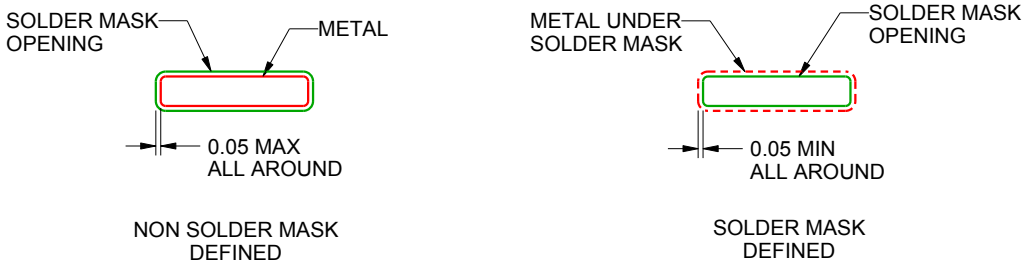



NOTES:

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.




LAND PATTERN EXAMPLE
SCALE:6X

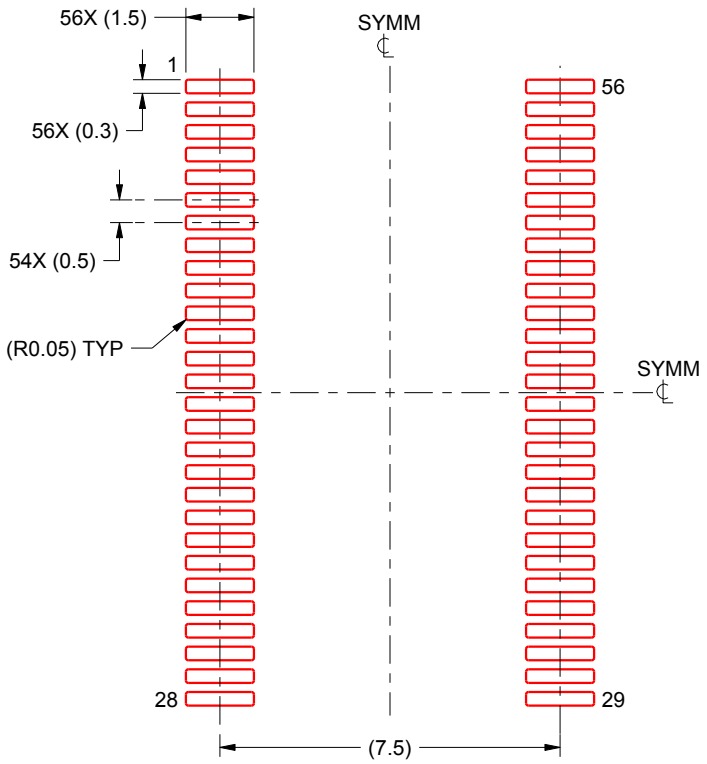



SOLDER MASK DETAILS

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.




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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