

PARALLEL-LOAD 8-BIT SHIFT REGISTERS

Check for Samples: [SN54LV165A](#), [SN74LV165A](#)

FEATURES

- 2-V to 5.5-V V_{CC} Operation
- Max t_{pd} of 10.5 ns at 5 V
- Support Mixed-Mode Voltage Operation on All Ports
- I_{off} Supports Partial-Power-Down Mode Operation
- 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)
 - 1000-V Charged-Device Model (C101)

DESCRIPTION

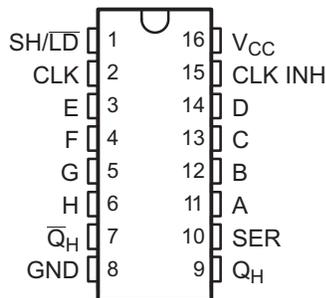
The 'LV165A devices are parallel-load, 8-bit shift registers designed for 2-V to 5.5-V V_{CC} operation.

When the devices are clocked, data is shifted toward the serial output Q_H . Parallel-in access to each stage is provided by eight individual direct data inputs that are enabled by a low level at the shift/load ($\overline{SH/LD}$) input. The 'LV165A devices feature a clock-inhibit function and a complemented serial output, \overline{Q}_H .

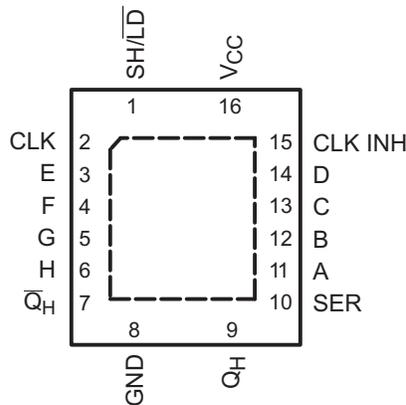
Clocking is accomplished by a low-to-high transition of the clock (CLK) input while $\overline{SH/LD}$ is held high and clock inhibit (CLK INH) is held low. The functions of CLK and CLK INH are interchangeable. Since a low CLK and a low-to-high transition of CLK INH accomplishes clocking, CLK INH should be changed to the high level only while CLK is high. Parallel loading is inhibited when $\overline{SH/LD}$ is held high. The parallel inputs to the register are enabled while $\overline{SH/LD}$ is held low, independently of the levels of CLK, CLK INH, or SER.

These devices are fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

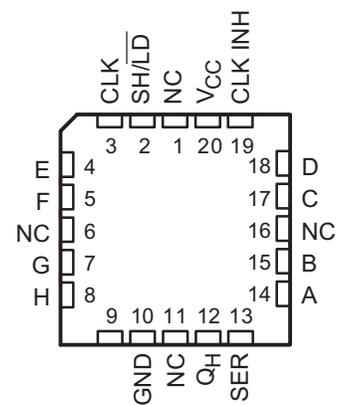
SN54LV165A ... JO R W PACKAGE
SN74LV165A ... D, DB, DGV, NS,
OR PW PACKAGE
(TOP VIEW)



SN74LV165A ... RGY PACKAGE
(TOP VIEW)



SN54LV165A ... FK PACKAGE
(TOP VIEW)



NC – No internal connection

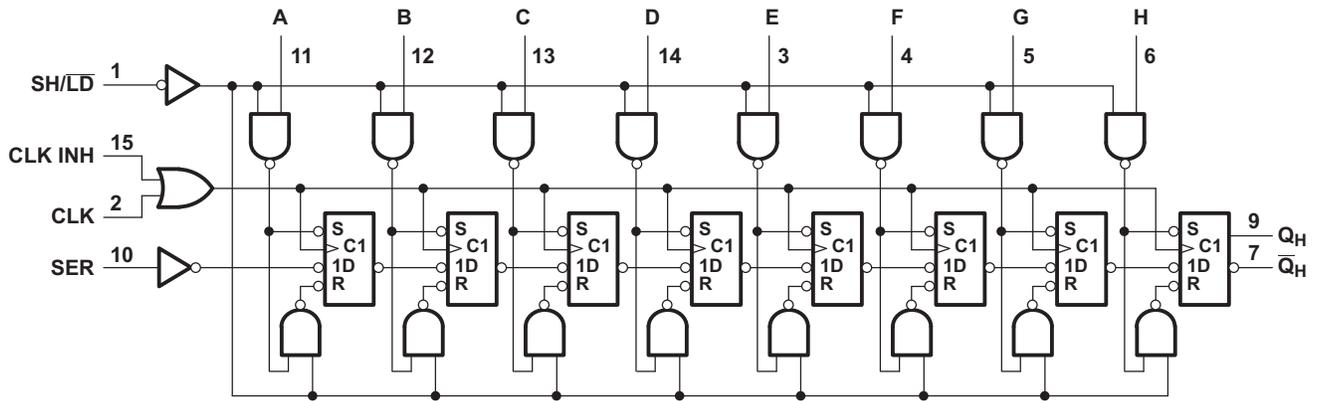


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

FUNCTION TABLE

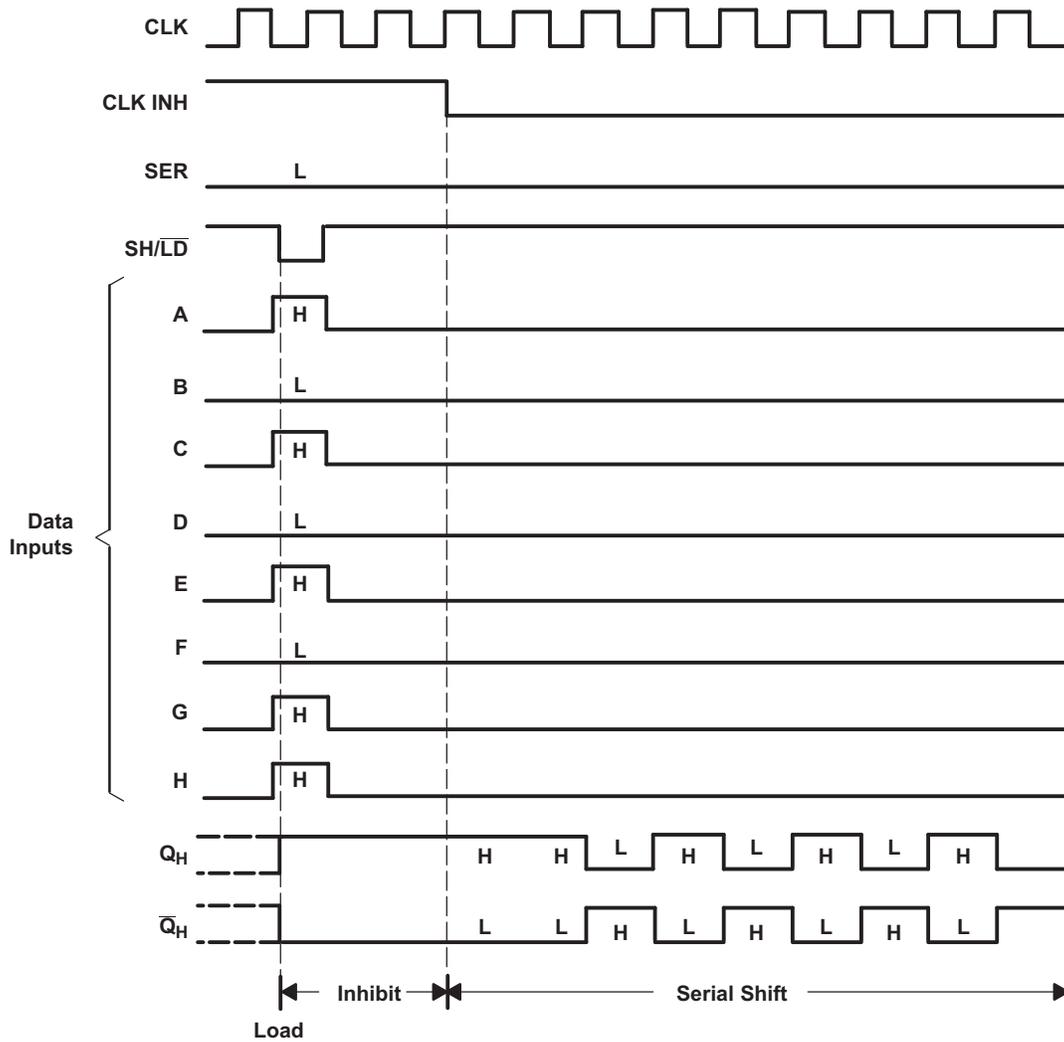
| INPUTS | | | OPERATION |
|--------|-----|---------|---------------|
| SH/LD | CLK | CLK INH | |
| L | X | X | Parallel load |
| H | H | X | Q_0 |
| H | X | H | Q_0 |
| H | L | ↑ | Shift |
| H | ↑ | L | Shift |

LOGIC DIAGRAM (POSITIVE LOGIC)



Pin numbers shown are for the D, DB, DGV, J, NS, PW, RGY, and W packages.

TYPICAL SHIFT, LOAD, AND INHIBIT SEQUENCES



ABSOLUTE MAXIMUM RATINGS

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

| | | VALUE | UNIT |
|--|----------------------------|------------------------|------|
| Supply voltage range, V_{CC} | | –0.5 to 7 | V |
| Input voltage range, V_I ⁽²⁾ | | –0.5 to 7 | V |
| Voltage range applied to any output in the high-impedance or power-off state, V_O ⁽²⁾ | | –0.5 to 7 | V |
| Output voltage range, V_O ⁽²⁾⁽³⁾ | | –0.5 to $V_{CC} + 0.5$ | V |
| Input clamp current, I_{IK} ($V_I < 0$) | | –20 | mA |
| Output clamp current, I_{OK} ($V_O < 0$) | | –50 | mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | | ±25 | mA |
| Continuous current through V_{CC} or GND | | ±50 | mA |
| Package thermal impedance, θ_{JA} | D package ⁽⁴⁾ | 73 | °C/W |
| | DB package ⁽⁴⁾ | 82 | |
| | DGV package ⁽⁴⁾ | 120 | |
| | NS package ⁽⁴⁾ | 67 | |
| | PW package ⁽⁴⁾ | 108 | |
| | RGY package ⁽⁵⁾ | 39 | |
| Storage temperature range, T_{stg} | | –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.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 5.5 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.
- (5) The package thermal impedance is calculated in accordance with JESD 51-5.

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

| | | SN54LV165A | | SN74LV165A | | UNIT |
|---------------------|------------------------------------|---|---------------------|---------------------|---------------------|--------------------|
| | | MIN | MAX | MIN | MAX | |
| V_{CC} | Supply voltage | 2 | 5.5 | 2 | | V |
| V_{IH} | High level input voltage | $V_{CC} = 2\text{ V}$ | 1.5 | 1.5 | | V |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | $V_{CC} \times 0.7$ | $V_{CC} \times 0.7$ | | |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | $V_{CC} \times 0.7$ | $V_{CC} \times 0.7$ | | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | $V_{CC} \times 0.7$ | $V_{CC} \times 0.7$ | | |
| V_{IL} | Low level input voltage | $V_{CC} = 2\text{ V}$ | | 0.5 | 0.5 | V |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | |
| V_I | Input voltage | 0 | 5.5 | 0 | 5.5 | V |
| V_O | Output voltage | 0 | V_{CC} | 0 | V_{CC} | V |
| I_{OH} | High level output current | $V_{CC} = 2\text{ V}$ | | -50 | -50 | μA |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | -2 | -2 | mA |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | -6 | -6 | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | -12 | -12 | |
| I_{OL} | Low level output current | $V_{CC} = 2\text{ V}$ | | 50 | 50 | μA |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | 2 | 2 | mA |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | 6 | 6 | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | 12 | 12 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | 200 | 200 | ns/V |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | 100 | 100 | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | 20 | 20 | |
| T_A | Operating free-air temperature | -55 | 125 | -40 | 125 | $^{\circ}\text{C}$ |

(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.

ELECTRICAL CHARACTERISTICS

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

| PARAMETER | TEST CONDITIONS | V_{CC} | -55 $^{\circ}\text{C}$ TO 125 $^{\circ}\text{C}$ | | | -40 $^{\circ}\text{C}$ TO 85 $^{\circ}\text{C}$ | | | -40 $^{\circ}\text{C}$ TO 125 $^{\circ}\text{C}$ | | | UNIT |
|-----------|----------------------------------|--------------|--|---------|----------------|---|----------------|------|--|---------------|-----|------|
| | | | SN54LV165A/ SN74LV165A-EP | | | SN74LV165A | | | SN74LV165A | | | |
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OH} | $I_{OH} = -50\ \mu\text{A}$ | 2 V to 5.5 V | $V_{CC} - 0.1$ | | $V_{CC} - 0.1$ | | $V_{CC} - 0.1$ | | | | V | |
| | $I_{OH} = -2\ \text{mA}$ | 2.3 V | 2 | | 2 | | 2 | | | | | |
| | $I_{OH} = -6\ \text{mA}$ | 3 V | 2.48 | | 2.48 | | 2.48 | | | | | |
| | $I_{OH} = -12\ \text{mA}$ | 4.5 V | 3.8 | | 3.8 | | 3.8 | | | | | |
| V_{OL} | $I_{OL} = 50\ \mu\text{A}$ | 2 V to 5.5 V | | 0.1 | | 0.1 | | | 0.1 | V | | |
| | $I_{OL} = 2\ \text{mA}$ | 2.3 V | | 0.4 | | 0.4 | | 0.4 | | | | |
| | $I_{OL} = 6\ \text{mA}$ | 3 V | | 0.44 | | 0.44 | | 0.44 | | | | |
| | $I_{OL} = 12\ \text{mA}$ | 4.5 V | | 0.55 | | 0.55 | | 0.55 | | | | |
| I_I | $V_I = 5.5\ \text{V}$ or GND | 0 to 5.5 V | | ± 1 | | ± 1 | | | ± 1 | μA | | |
| I_{CC} | $V_I = V_{CC}$ or GND, $I_O = 0$ | 5.5 V | | 20 | | 20 | | | 20 | μA | | |
| I_{off} | V_I or $V_O = 0$ to 5.5 V | 0 | | 5 | | 5 | | | 5 | μA | | |
| C_i | $V_I = V_{CC}$ or GND | 3.3 V | | 1.7 | | 1.7 | | | 1.7 | pF | | |

TIMING REQUIREMENTS

over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | TEST CONDITION | $T_A = 25^\circ\text{C}$ | | -55°C TO 125°C | | -40°C TO 85°C | | -40°C TO 125°C | | UNIT |
|----------------------|---|--------------------------|-----|------------------------------|-----|---------------|-----|----------------|-----|------|
| | | | | SN54LV165A/ SN74LV165A-EP | | SN74LV165A | | SN74LV165A | | |
| | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w Pulse duration | CLK high or low | 8.5 | | 9 | | 9 | | 9 | | ns |
| | SH/ $\overline{\text{LD}}$ low | 11 | | 13 | | 13 | | 13 | | |
| t_{su} Setup time | SH/ $\overline{\text{LD}}$ high before CLK \uparrow | 7 | | 8.5 | | 8.5 | | 8.5 | | ns |
| | SER before CLK \uparrow | 8.5 | | 9.5 | | 9.5 | | 9.5 | | |
| | CLK INH before CLK \uparrow | 7 | | 7 | | 7 | | 7 | | |
| | Data before SH/ $\overline{\text{LD}}$ \uparrow | 11.5 | | 12 | | 12 | | 12 | | |
| t_h Hold time | SER data after CLK \uparrow | -1 | | 0 | | 0 | | 0 | | ns |
| | Parallel data after SH/ $\overline{\text{LD}}$ \uparrow | 0 | | 0.5 | | 0.5 | | 0.5 | | |
| | SH/ $\overline{\text{LD}}$ high after CLK \uparrow | 0 | | 0 | | 0 | | 0 | | |

TIMING REQUIREMENTS

over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | TEST CONDITION | $T_A = 25^\circ\text{C}$ | | -55°C TO 125°C | | -40°C TO 85°C | | -40°C TO 125°C | | UNIT |
|----------------------|---|--------------------------|-----|------------------------------|-----|---------------|-----|----------------|-----|------|
| | | | | SN54LV165A/ SN74LV165A-EP | | SN74LV165A | | SN74LV165A | | |
| | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w Pulse duration | CLK high or low | 6 | | 7 | | 7 | | 7 | | ns |
| | SH/ $\overline{\text{LD}}$ low | 7.5 | | 9 | | 9 | | 9 | | |
| t_{su} Setup time | SH/ $\overline{\text{LD}}$ high before CLK \uparrow | 5 | | 6 | | 6 | | 6 | | ns |
| | SER before CLK \uparrow | 5 | | 6 | | 6 | | 6 | | |
| | CLK INH before CLK \uparrow | 5 | | 5 | | 5 | | 5 | | |
| | Data before SH/ $\overline{\text{LD}}$ \uparrow | 7.5 | | 8.5 | | 8.5 | | 8.5 | | |
| t_h Hold time | SER data after CLK \uparrow | 0 | | 0 | | 0 | | 0 | | ns |
| | Parallel data after SH/ $\overline{\text{LD}}$ \uparrow | 0.5 | | 0.5 | | 0.5 | | 0.5 | | |
| | SH/ $\overline{\text{LD}}$ high after CLK \uparrow | 0 | | 0 | | 0 | | 0 | | |

TIMING REQUIREMENTS

over recommended operating free-air temperature range, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | TEST CONDITION | $T_A = 25^\circ\text{C}$ | | -55°C TO 125°C | | -40°C TO 85°C | | -40°C TO 125°C | | UNIT |
|----------------------|---|--------------------------|-----|----------------|-----|---------------|-----|----------------|-----|------|
| | | | | SN54LV165A | | SN74LV165A | | SN74LV165A | | |
| | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w Pulse duration | CLK high or low | 4 | | 4 | | 4 | | 4 | | ns |
| | SH/ $\overline{\text{LD}}$ low | 5 | | 5 | | 6 | | 6 | | |
| t_{su} Setup time | SH/ $\overline{\text{LD}}$ high before CLK \uparrow | 4 | | 4 | | 4 | | 4 | | ns |
| | SER before CLK \uparrow | 4 | | 4 | | 4 | | 4 | | |
| | CLK INH before CLK \uparrow | 3.5 | | 3.5 | | 3.5 | | 3.5 | | |
| | Data before SH/ $\overline{\text{LD}}$ \uparrow | 5 | | 5 | | 5 | | 5 | | |
| t_h Hold time | SER data after CLK \uparrow | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| | Parallel data after SH/ $\overline{\text{LD}}$ \uparrow | 1 | | 1 | | 1 | | 1 | | |
| | SH/ $\overline{\text{LD}}$ high after CLK \uparrow | 0.5 | | 0.5 | | 0.5 | | 0.5 | | |

SWITCHING CHARACTERISTICS

 over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAP | $T_A = 25^\circ\text{C}$ | | | -55°C TO 125°C | | -40°C TO 85°C | | -40°C TO 125°C | | UNIT |
|-----------|-------------------------------|---------------------------|----------------------|--------------------------|---------------------|---------------------|------------------------------|---------------------|---------------|------|---------------------------|------|------|
| | | | | | | | SN54LV165A/ SN74LV165A-EP | | SN74LV165A | | SN74LV165A Recommended | | |
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| f_{max} | | | $C_L = 15\text{ pF}$ | 50 ⁽¹⁾ | 80 ⁽¹⁾ | | 45 ⁽¹⁾ | | 45 | | 45 | MHz | |
| | | | $C_L = 50\text{ pF}$ | 40 | 65 | | 35 | | 35 | | 35 | | |
| t_{pd} | CLK | Q_H or \overline{Q}_H | $C_L = 15\text{ pF}$ | | 12.2 ⁽¹⁾ | 19.8 ⁽¹⁾ | 1 ⁽¹⁾ | 22 ⁽¹⁾ | 1 | 22 | 1 | 22 | ns |
| | $\overline{SH}/\overline{LD}$ | | | | 13.1 ⁽¹⁾ | 21.5 ⁽¹⁾ | 1 ⁽¹⁾ | 23.5 ⁽¹⁾ | 1 | 23.5 | 1 | 23.5 | |
| | H | | | | 12.9 ⁽¹⁾ | 21.7 ⁽¹⁾ | 1 ⁽¹⁾ | 24 ⁽¹⁾ | 1 | 24 | 1 | 24 | |
| t_{pd} | CLK | Q_H or \overline{Q}_H | $C_L = 50\text{ pF}$ | | 15.3 | 23.3 | 1 | 26 | 1 | 26 | 1 | 26 | ns |
| | $\overline{SH}/\overline{LD}$ | | | | 16.1 | 25.1 | 1 | 28 | 1 | 28 | 1 | 28 | |
| | H | | | | 15.9 | 25.3 | 1 | 28 | 1 | 28 | 1 | 28 | |

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

SWITCHING CHARACTERISTICS

 over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAP | $T_A = 25^\circ\text{C}$ | | | -55°C TO 125°C | | -40°C TO 85°C | | -40°C TO 125°C | | UNIT |
|-----------|-------------------------------|---------------------------|----------------------|--------------------------|--------------------|---------------------|------------------------------|---------------------|---------------|------|---------------------------|------|------|
| | | | | | | | SN54LV165A/ SN74LV165A-EP | | SN74LV165A | | SN74LV165A Recommended | | |
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| f_{max} | | | $C_L = 15\text{ pF}$ | 65 ⁽¹⁾ | 115 ⁽¹⁾ | | 55 ⁽¹⁾ | | 55 | | 55 | MHz | |
| | | | $C_L = 50\text{ pF}$ | 60 | 90 | | 50 | | 50 | | 50 | | |
| t_{pd} | CLK | Q_H or \overline{Q}_H | $C_L = 15\text{ pF}$ | | 8.6 ⁽¹⁾ | 15.4 ⁽¹⁾ | 1 ⁽¹⁾ | 18 ⁽¹⁾ | 1 | 18 | 1 | 18 | ns |
| | $\overline{SH}/\overline{LD}$ | | | | 9.1 ⁽¹⁾ | 15.8 ⁽¹⁾ | 1 ⁽¹⁾ | 18.5 ⁽¹⁾ | 1 | 18.5 | 1 | 18.5 | |
| | H | | | | 8.9 ⁽¹⁾ | 14.1 ⁽¹⁾ | 1 ⁽¹⁾ | 16.5 ⁽¹⁾ | 1 | 16.5 | 1 | 16.5 | |
| t_{pd} | CLK | Q_H or \overline{Q}_H | $C_L = 50\text{ pF}$ | | 10.9 | 14.9 | 1 | 16.9 | 1 | 16.9 | 1 | 16.9 | ns |
| | $\overline{SH}/\overline{LD}$ | | | | 11.3 | 19.3 | 1 | 22 | 1 | 22 | 1 | 22 | |
| | H | | | | 11.1 | 17.6 | 1 | 20 | 1 | 20 | 1 | 20 | |

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAP | $T_A = 25^\circ\text{C}$ | | | -55°C TO 125°C | | -40°C TO 85°C | | -40°C TO 125°C | | UNIT |
|-----------|-------------------------------|---------------------------|----------------------|--------------------------|--------------------|--------------------|-------------------|---------------------|---------------|------|------------------------|------|------|
| | | | | | | | SN54LV165A | | SN74LV165A | | SN74LV165A Recommended | | |
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| f_{max} | | | $C_L = 15\text{ pF}$ | 110 ⁽¹⁾ | 165 ⁽¹⁾ | | 90 ⁽¹⁾ | | 90 | | 90 | MHz | |
| | | | $C_L = 50\text{ pF}$ | 95 | 125 | | 85 | | 85 | | 85 | | |
| t_{pd} | CLK | Q_H or \overline{Q}_H | $C_L = 15\text{ pF}$ | | 6 ⁽¹⁾ | 9.9 ⁽¹⁾ | 1 ⁽¹⁾ | 11.5 ⁽¹⁾ | 1 | 11.5 | 1 | 11.5 | ns |
| | $\overline{SH}/\overline{LD}$ | | | | 6 ⁽¹⁾ | 9.9 ⁽¹⁾ | 1 ⁽¹⁾ | 11.5 ⁽¹⁾ | 1 | 11.5 | 1 | 11.5 | |
| | H | | | | 6 ⁽¹⁾ | 9 ⁽¹⁾ | 1 ⁽¹⁾ | 10.5 ⁽¹⁾ | 1 | 10.5 | 1 | 10.5 | |
| t_{pd} | CLK | Q_H or \overline{Q}_H | $C_L = 50\text{ pF}$ | | 7.7 | 11.9 | 1 | 13.5 | 1 | 13.5 | 1 | 13.5 | ns |
| | $\overline{SH}/\overline{LD}$ | | | | 7.7 | 11.9 | 1 | 13.5 | 1 | 13.5 | 1 | 13.5 | |
| | H | | | | 7.6 | 11 | 1 | 12.5 | 1 | 12.5 | 1 | 12.5 | |

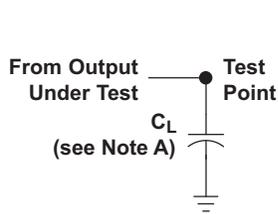
(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

OPERATING CHARACTERISTICS

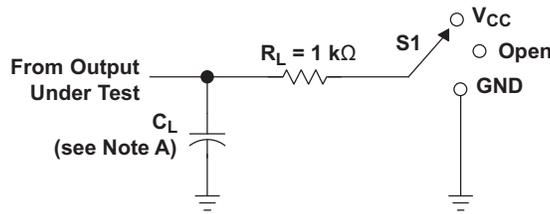
$T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | V_{CC} | TYP | UNIT |
|-----------|-------------------------------|--|----------|------|------|
| C_{pd} | Power dissipation capacitance | $C_L = 50\text{ pF}$ $f = 10\text{ MHz}$ | 3.3 V | 36.1 | pF |
| | | | 5 V | 37.5 | |

PARAMETER MEASUREMENT INFORMATION

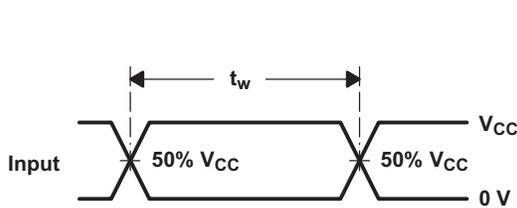


LOAD CIRCUIT FOR TOTEM-POLE OUTPUTS

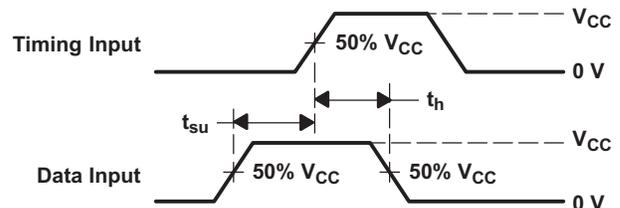


LOAD CIRCUIT FOR 3-STATE AND OPEN-DRAIN OUTPUTS

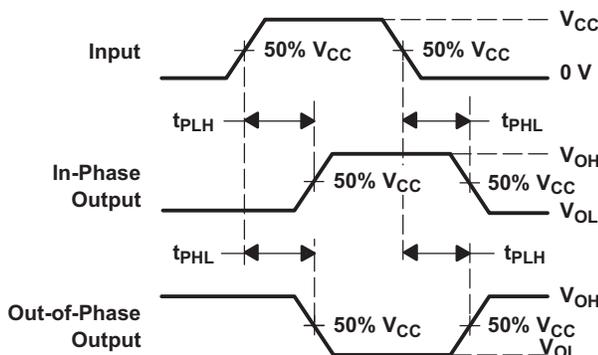
| TEST | S1 |
|-------------------|----------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | V_{CC} |
| t_{PHZ}/t_{PZH} | GND |
| Open Drain | V_{CC} |



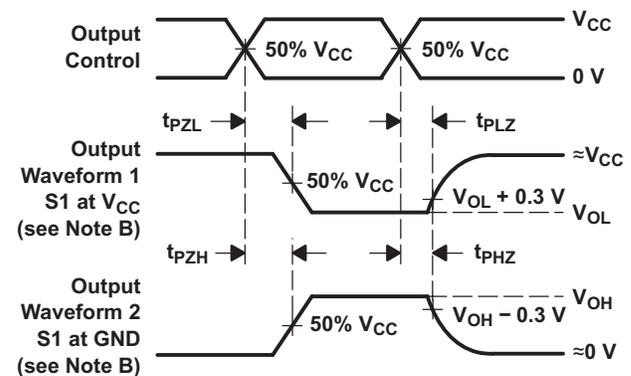
VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES LOW- AND HIGH-LEVEL ENABLING

- 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: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 3\text{ ns}$, $t_f \leq 3\text{ ns}$.
- D. The outputs are measured one at a time, with one input 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_{PHL} and t_{PLH} are the same as t_{pd} .
- H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

REVISION HISTORY

| Changes from Revision M (December 2010) to Revision N | Page |
|---|-------------------|
| • Extended maximum temperature operating range from 85°C to 125°C. | 5 |

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 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LV165AD | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADBR | ACTIVE | SSOP | DB | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADBRE4 | ACTIVE | SSOP | DB | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADBRG4 | ACTIVE | SSOP | DB | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADGVR | ACTIVE | TVSOP | DGV | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADGVRE4 | ACTIVE | TVSOP | DGV | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADGVRG4 | ACTIVE | TVSOP | DGV | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADRE4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADRG3 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ADRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ANSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 74LV165A | Samples |
| SN74LV165ANSRE4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 74LV165A | Samples |
| SN74LV165ANSRG4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 74LV165A | Samples |
| SN74LV165APW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |

| 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 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LV165APWE4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWG4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWRE4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWRG3 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWT | ACTIVE | TSSOP | PW | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWTE4 | ACTIVE | TSSOP | PW | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165APWTG4 | ACTIVE | TSSOP | PW | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV165A | Samples |
| SN74LV165ARGYR | ACTIVE | VQFN | RGY | 16 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | LV165A | Samples |
| SN74LV165ARGYRG4 | ACTIVE | VQFN | RGY | 16 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | LV165A | 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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OTHER QUALIFIED VERSIONS OF SN74LV165A :

- Enhanced Product: [SN74LV165A-EP](#)

NOTE: Qualified Version Definitions:

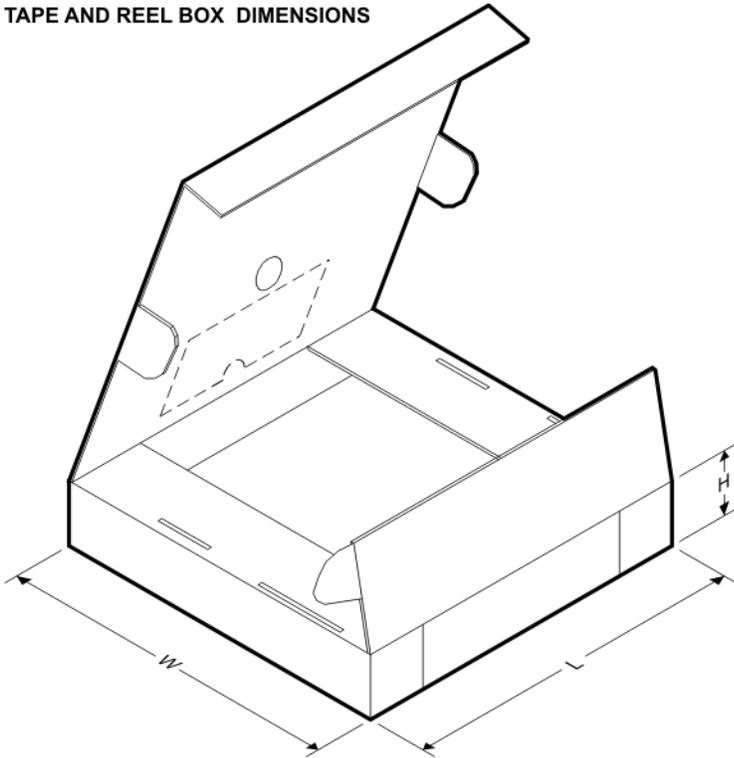
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV165ADBR | SSOP | DB | 16 | 2000 | 330.0 | 16.4 | 8.2 | 6.6 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74LV165ADGVR | TVSOP | DGV | 16 | 2000 | 330.0 | 12.4 | 6.8 | 4.0 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV165ADR | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LV165ADRG3 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LV165ADRG4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LV165ANSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74LV165APWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV165APWRG3 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV165APWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV165APWT | TSSOP | PW | 16 | 250 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV165ARGYR | VQFN | RGY | 16 | 3000 | 330.0 | 12.4 | 3.8 | 4.3 | 1.5 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


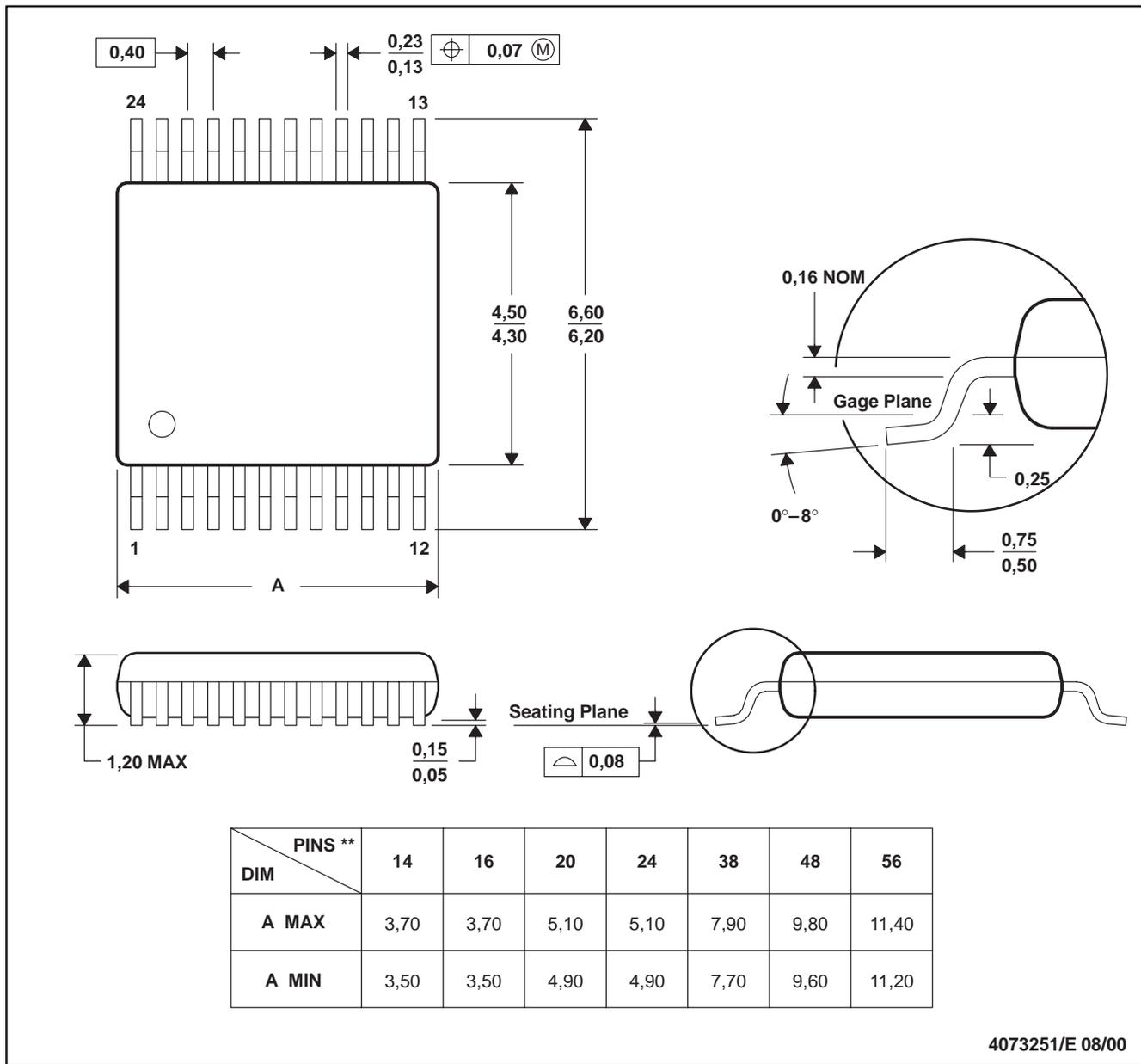
*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV165ADBR | SSOP | DB | 16 | 2000 | 367.0 | 367.0 | 38.0 |
| SN74LV165ADGVR | TVSOP | DGV | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| SN74LV165ADR | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| SN74LV165ADRG3 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| SN74LV165ADRG4 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| SN74LV165ANSR | SO | NS | 16 | 2000 | 367.0 | 367.0 | 38.0 |
| SN74LV165APWR | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74LV165APWRG3 | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74LV165APWRG4 | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| SN74LV165APWT | TSSOP | PW | 16 | 250 | 367.0 | 367.0 | 35.0 |
| SN74LV165ARGYR | VQFN | RGY | 16 | 3000 | 367.0 | 367.0 | 35.0 |

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

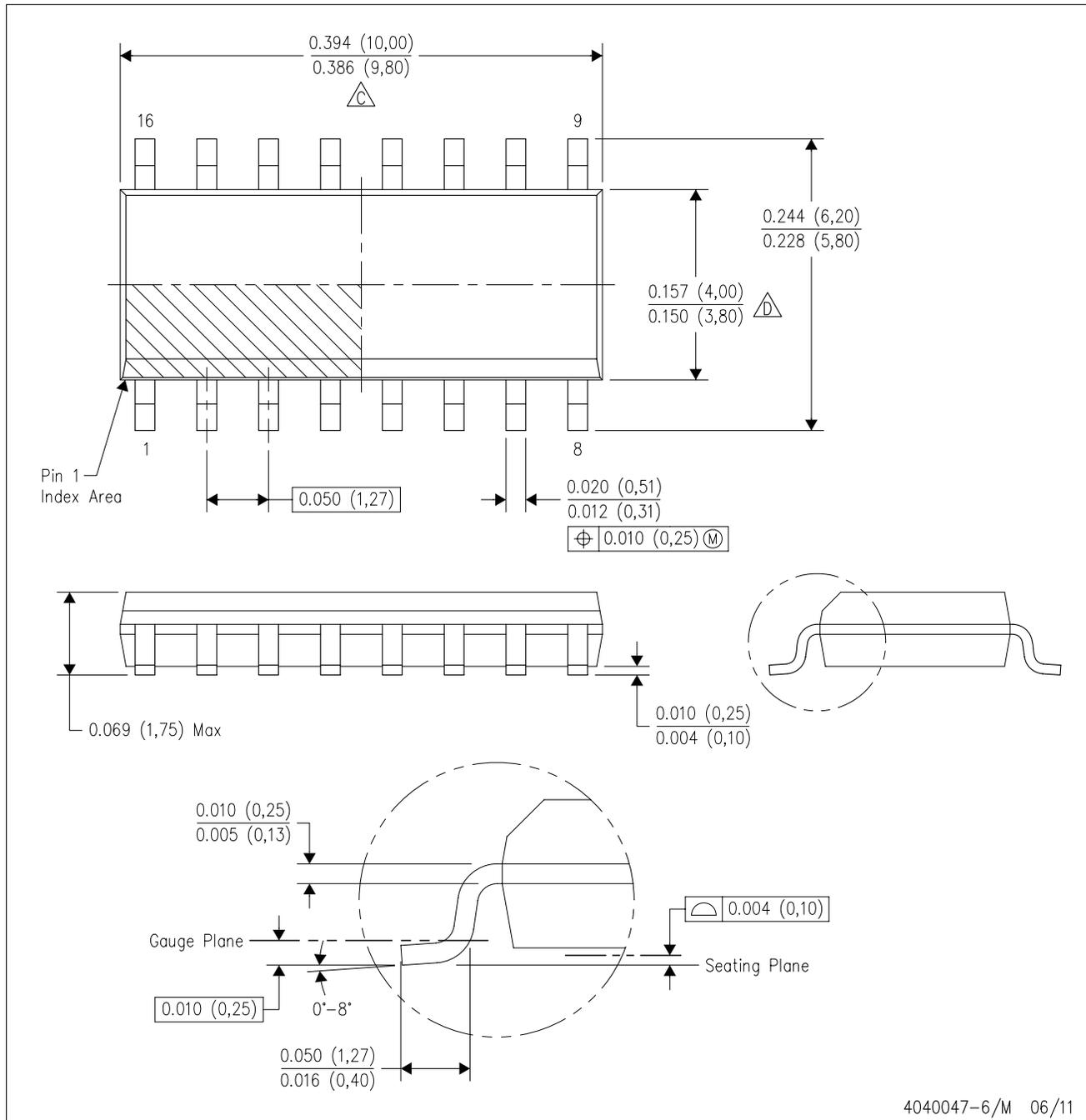
24 PINS SHOWN



- 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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

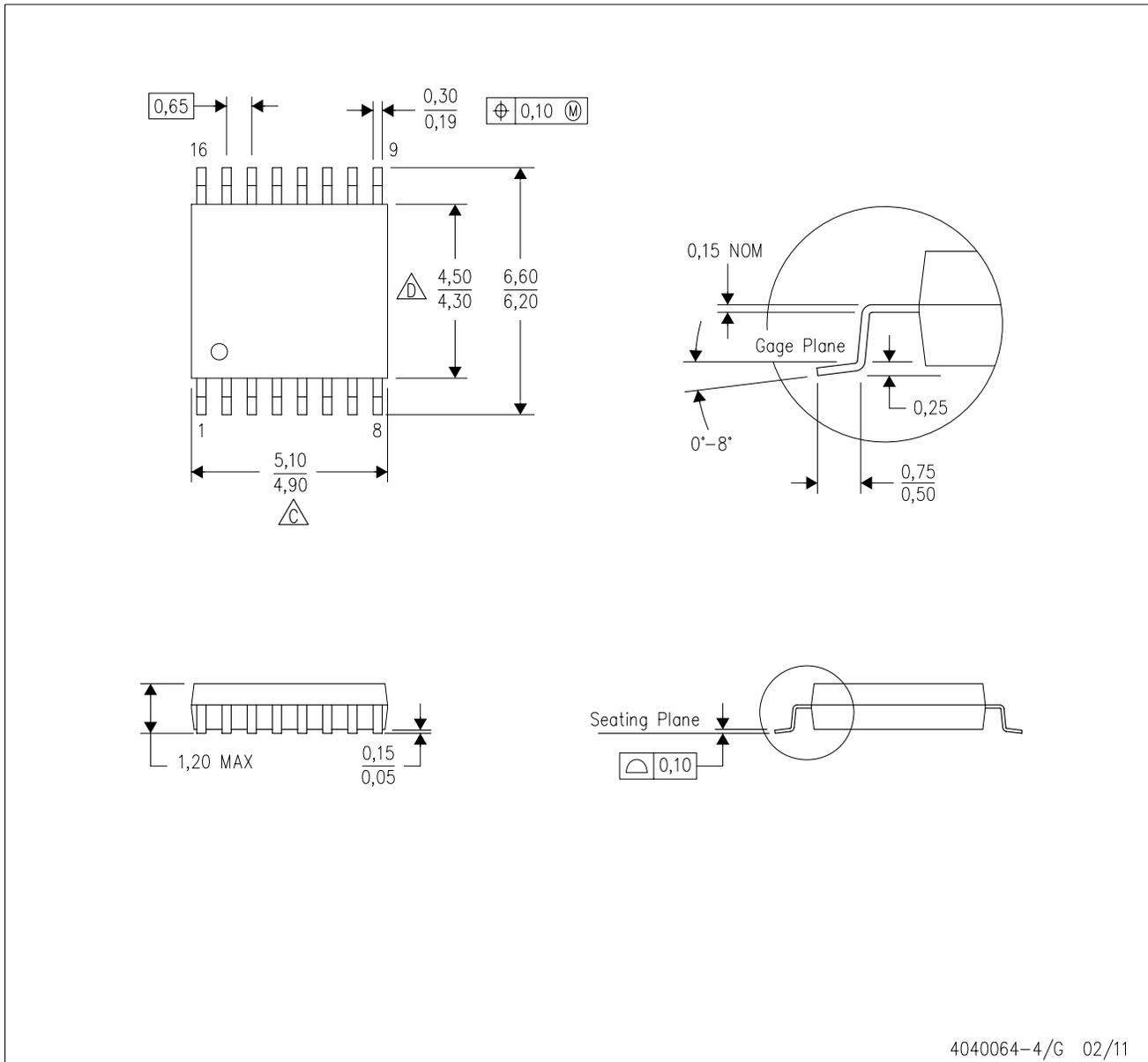


4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

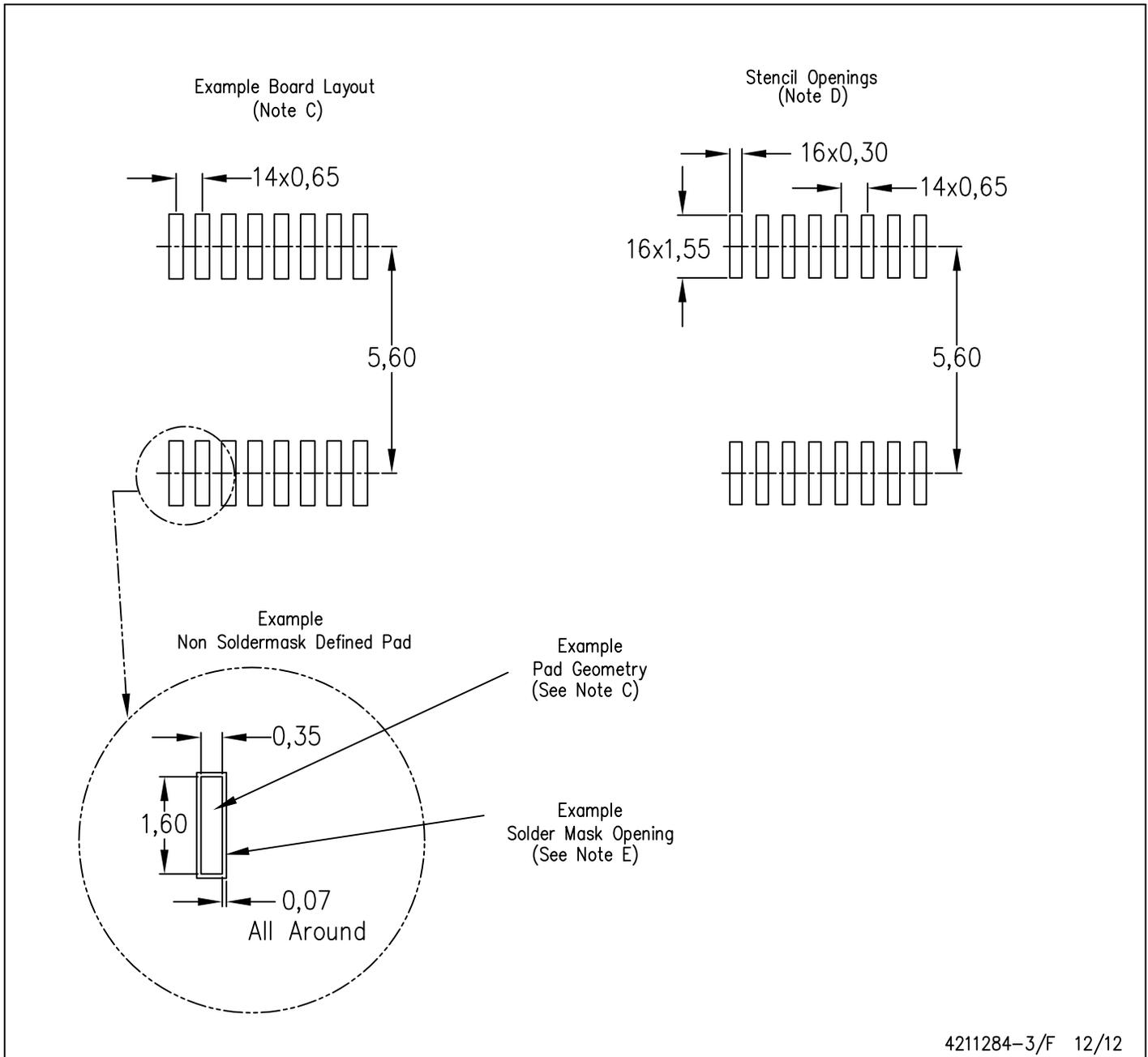


4040064-4/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 -  Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G16)

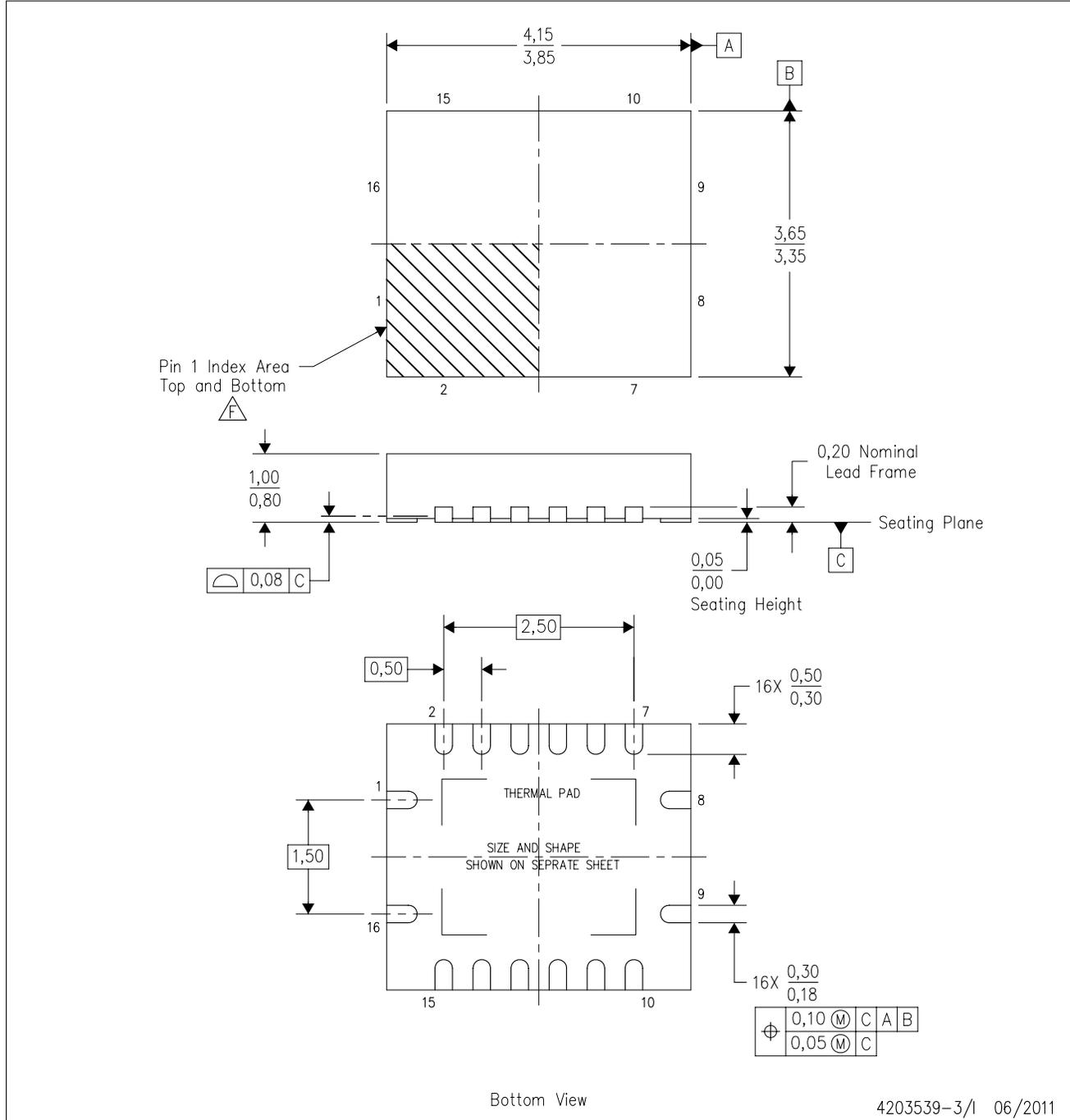
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - F. Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - G. Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N16)

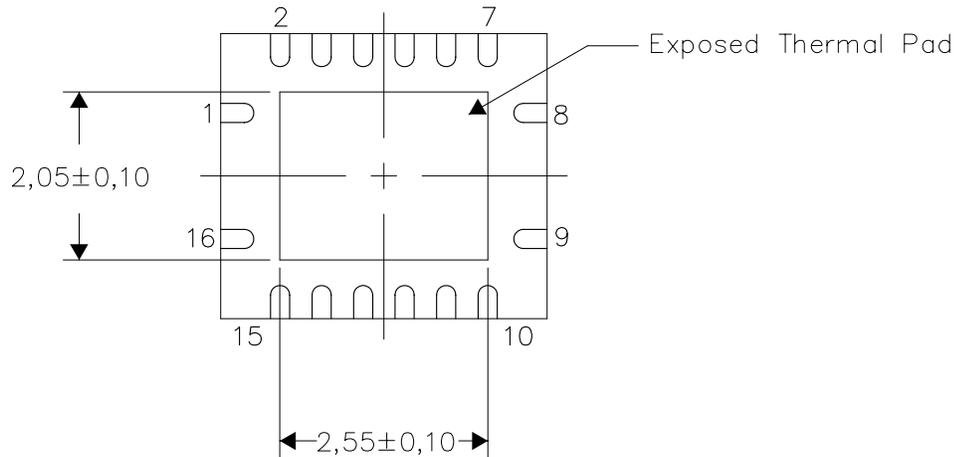
PLASTIC QUAD FLATPACK NO-LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

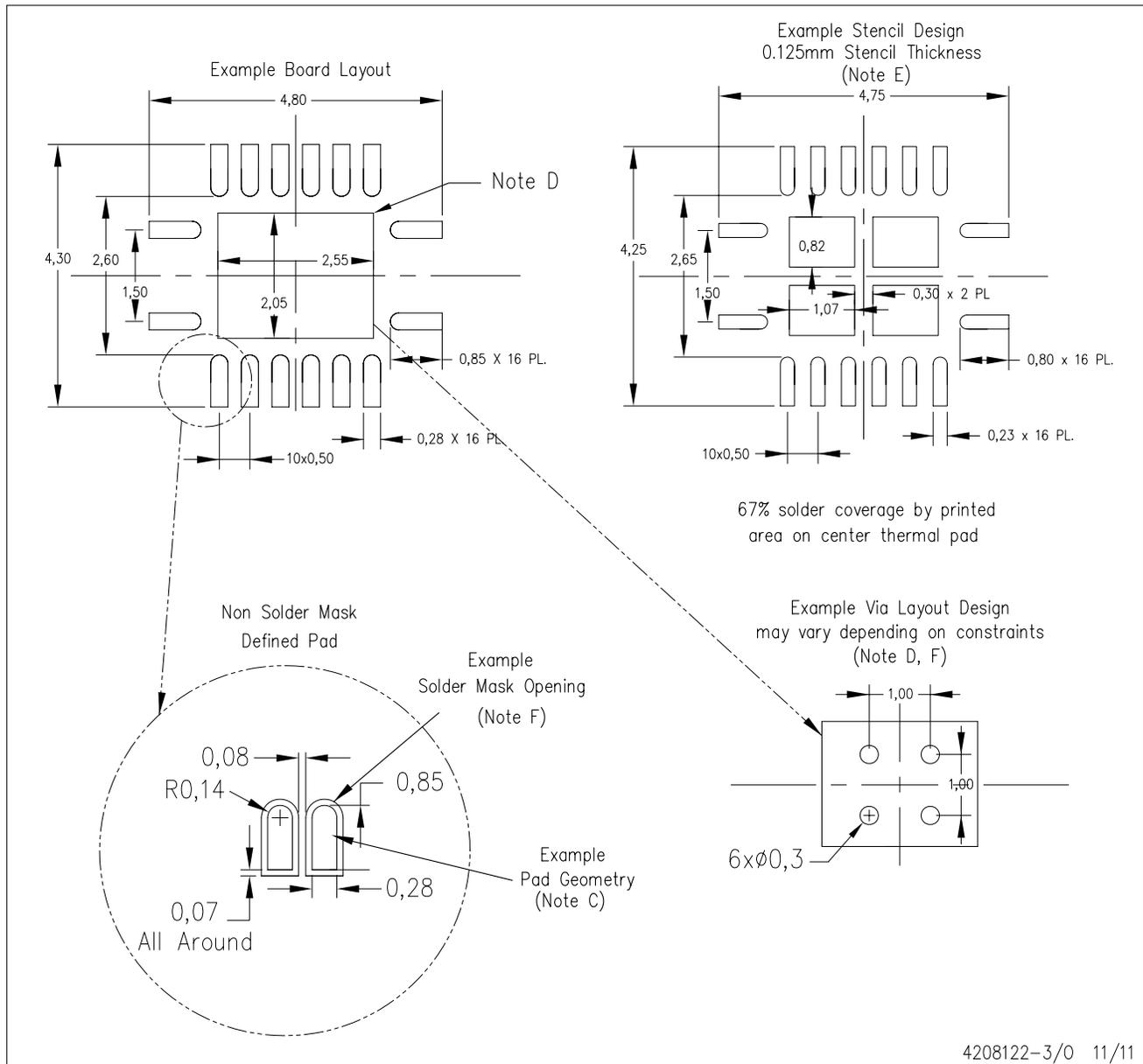
Exposed Thermal Pad Dimensions

4206353-3/0 11/11

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



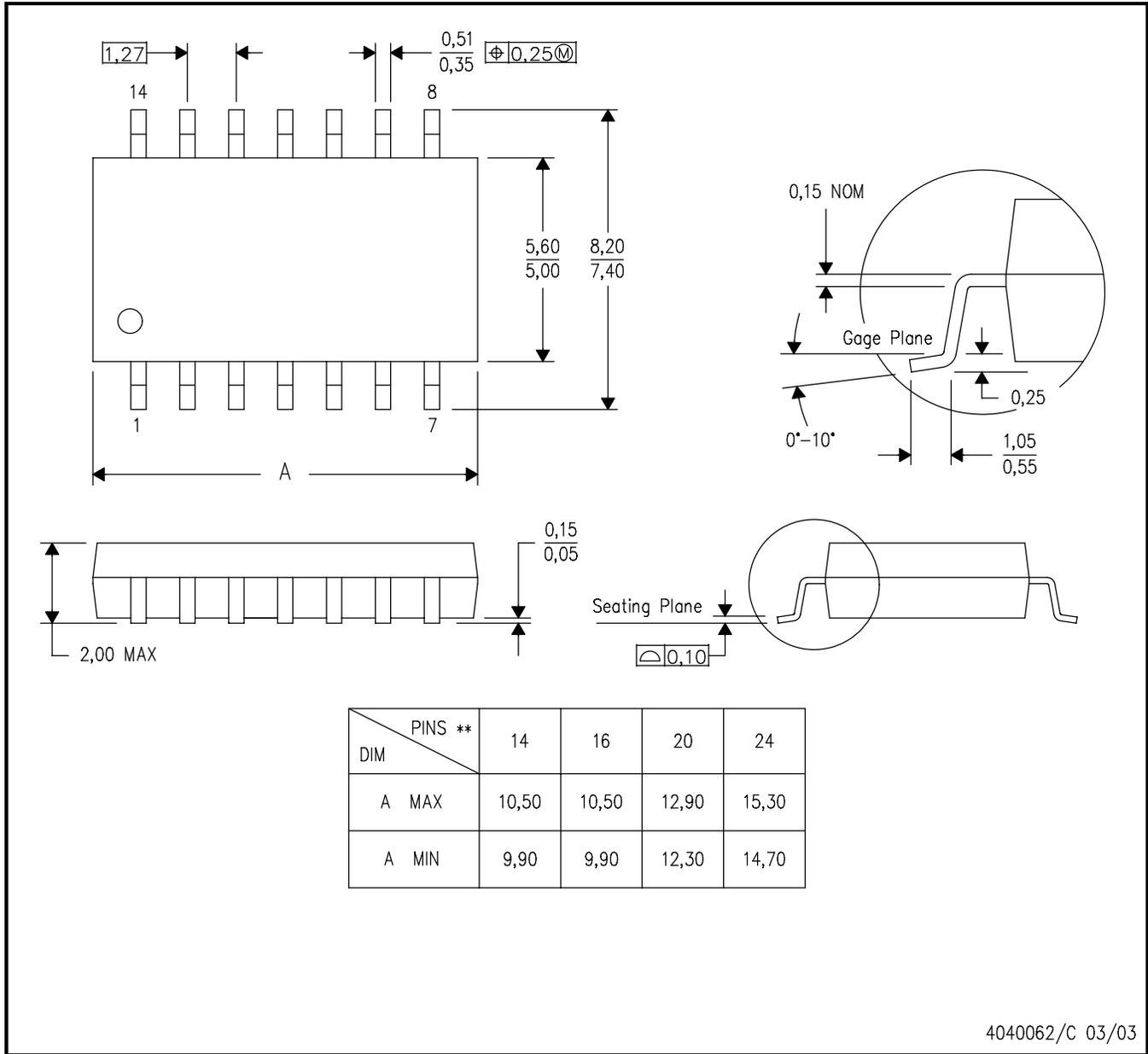
- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>.
 - E. 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 stencil design considerations.
 - F. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

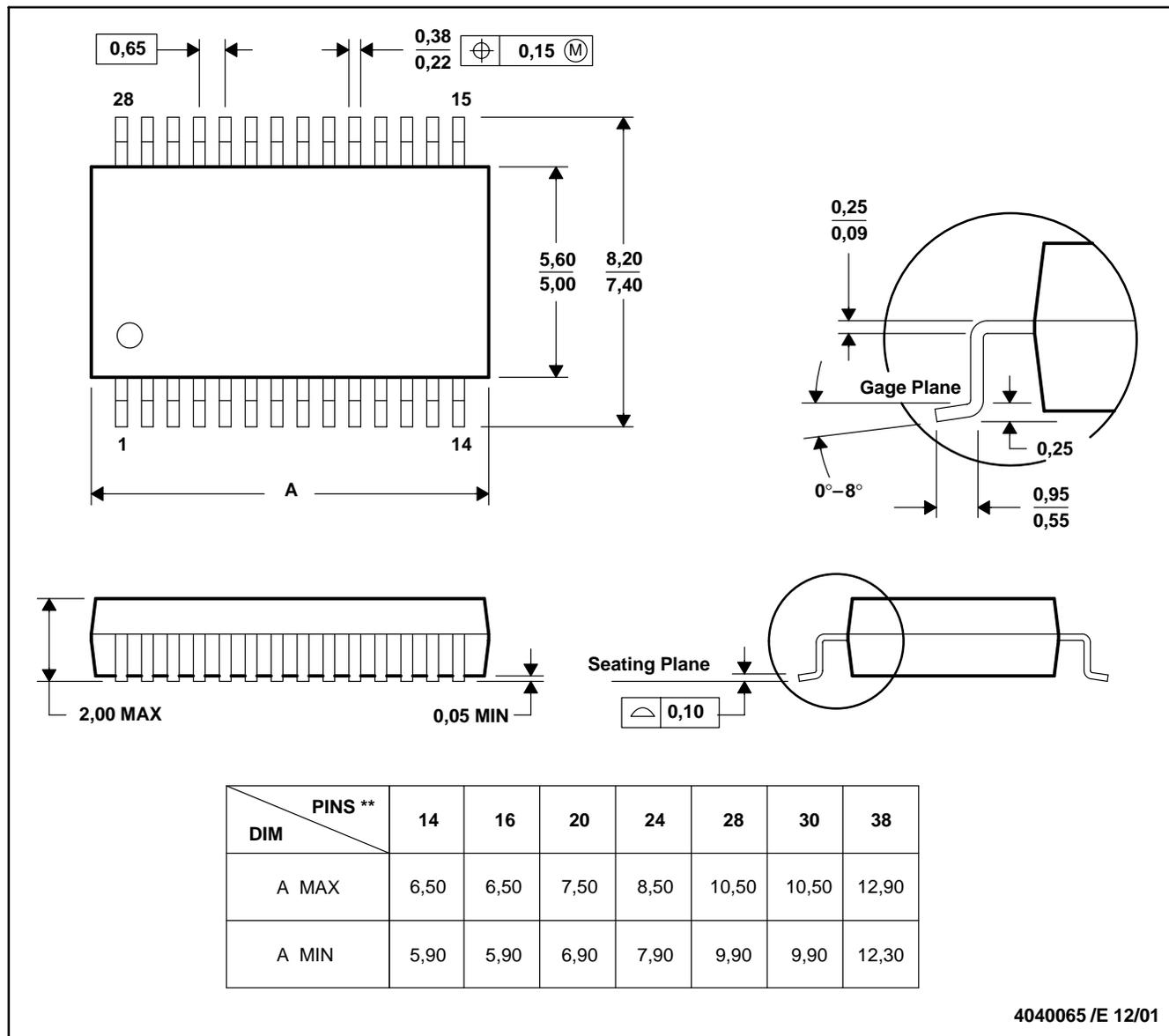


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 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.
 D. Falls within JEDEC MO-150

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| Security | www.ti.com/security |
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