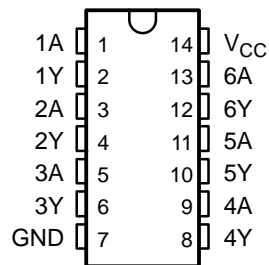


FEATURES

- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 3.8 ns
- Typical V_{OLP} (Output Ground Bounce)
<0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot)
>2 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Inputs Accept Voltages to 5.5 V
- 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)

D, DB, DGV, NS, OR PW PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

This hex inverter is designed for 1.65-V to 3.6-V V_{CC} operation.

The SN74LVCU04A contains six independent inverters with unbuffered outputs and performs the Boolean function $Y = \bar{A}$.

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of these devices as translators in a mixed 3.3-V/5-V system environment.

ORDERING INFORMATION

| T_A | PACKAGE ⁽¹⁾ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|------------------------|--------------|-----------------------|------------------|
| –40°C to 85°C | SOIC – D | Tube of 50 | SN74LVCU04AD | LVCU04A |
| | | Reel of 2500 | SN74LVCU04ADR | |
| | | Reel of 250 | SN74LVCU04ADT | |
| | SOP – NS | Reel of 2000 | SN74LVCU04ANSR | LVCU04A |
| | SSOP – DB | Reel of 2000 | SN74LVCU04ADBR | LCU04A |
| | TSSOP – PW | Tube of 90 | SN74LVCU04APW | LCU04A |
| | | Reel of 2000 | SN74LVCU04APWR | |
| | | Reel of 250 | SN74LVCU04APWT | |
| | TVSOP – DGV | Reel of 2000 | SN74LVCU04ADGVR | LCU04A |

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

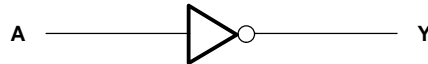
FUNCTION TABLE (EACH INVERTER)

| INPUT A | OUTPUT Y |
|------------|-------------|
| H | L |
| L | H |



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LOGIC DIAGRAM, EACH INVERTER (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 | 6.5 | V |
| V_I | Input voltage range ⁽²⁾ | -0.5 | 6.5 | V |
| V_O | Output voltage range ⁽²⁾⁽³⁾ | -0.5 | $V_{CC} + 0.5$ | V |
| I_{IK} | Input clamp current | | -50 | mA |
| | | $V_I < 0$ | | |
| I_{OK} | Output clamp current | | -50 | mA |
| | | $V_O < 0$ | | |
| I_O | Continuous output current | | ±50 | mA |
| | Continuous current through V_{CC} or GND | | ±100 | mA |
| θ_{JA} | Package thermal impedance ⁽⁴⁾ | D package | 86 | °C/W |
| | | DB package | 96 | |
| | | DGV package | 127 | |
| | | NS package | 76 | |
| | | PW package | 113 | |
| 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) The value of V_{CC} is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾

| | | MIN | MAX | UNIT | |
|-----------------|--------------------------------|----------------------------------|-----------------|------|----|
| V _{CC} | Supply voltage | Operating | 1.65 | 3.6 | V |
| | | Data retention only | 1.5 | | |
| V _{IH} | High-level input voltage | V _{CC} = 1.65 V | 1.32 | | V |
| | | V _{CC} = 2.3 V | 1.84 | | |
| | | V _{CC} = 2.7 V | 2.16 | | |
| | | V _{CC} = 3 V | 2.4 | | |
| | | V _{CC} = 3.6 V | 2.88 | | |
| V _{IL} | Low-level input voltage | V _{CC} = 1.65 V | | 0.4 | V |
| | | V _{CC} = 2.3 V | | 0.5 | |
| | | V _{CC} = 2.7 V to 3.6 V | | 0.65 | |
| V _I | Input voltage | 0 | 5.5 | V | |
| V _O | Output voltage | 0 | V _{CC} | V | |
| I _{OH} | High-level output current | V _{CC} = 1.65 V | | –4 | mA |
| | | V _{CC} = 2.3 V | | –8 | |
| | | V _{CC} = 2.7 V | | –12 | |
| | | V _{CC} = 3 V | | –24 | |
| I _{OL} | Low-level output current | V _{CC} = 1.65 V | | 4 | mA |
| | | V _{CC} = 2.3 V | | 8 | |
| | | V _{CC} = 2.7 V | | 12 | |
| | | V _{CC} = 3 V | | 24 | |
| 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.

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} = –100 μA, V _{IL} = 0 V | 1.65 V to 3.6 V | V _{CC} – 0.2 | | | V |
| | I _{OH} = –4 mA, V _{IL} = 0 V | 1.65 V | 1.2 | | | |
| | I _{OH} = –8 mA, V _{IL} = 0 V | 2.3 V | 1.7 | | | |
| | I _{OH} = –12 mA, V _{IL} = 0 V | 2.7 V | 2.2 | | | |
| | I _{OH} = –24 mA, V _{IL} = 0 V | 3 V | 2.4 | | | |
| V _{OL} | I _{OL} = 100 μA, V _{IH} = V _{CC} | 1.65 V to 3.6 V | | | 0.2 | V |
| | I _{OL} = 4 mA, V _{IH} = V _{CC} | 1.65 V | | | 0.45 | |
| | I _{OL} = 8 mA, V _{IH} = V _{CC} | 2.3 V | | | 0.7 | |
| | I _{OL} = 12 mA, V _{IH} = V _{CC} | 2.7 V | | | 0.4 | |
| | I _{OL} = 24 mA, V _{IH} = V _{CC} | 3 V | | | 0.55 | |
| I _I | V _I = 5.5 V or GND | 3.6 V | | | ±5 | μA |
| I _{CC} | V _I = V _{CC} or GND, I _O = 0 | 3.6 V | | | 10 | μA |
| ΔI _{CC} | One input at V _{CC} – 0.6 V, Other inputs at V _{CC} or GND | 2.7 V to 3.6 V | | | 500 | μA |
| C _i | V _I = V _{CC} or GND | 3.3 V | | 5 | | pF |

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

SN74LVCU04A HEX INVERTER

SCAS282M—JANUARY 1993—REVISED FEBRUARY 2005

Switching Characteristics

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

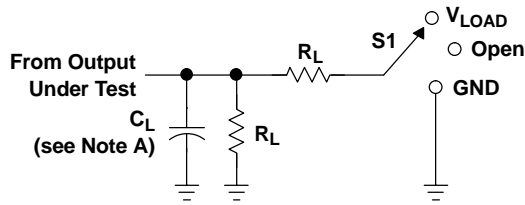
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$ | | $V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$ | | $V_{CC} = 2.7\text{ V}$ | | $V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$ | | UNIT |
|-------------|-----------------|----------------|--|-----|---|-----|-------------------------|-----|---|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | Y | 1 | 7.3 | 1 | 6.7 | 1 | 4.7 | 1 | 3.8 | ns |
| $t_{sk(o)}$ | | | | | | | | | 1 | | 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 capacitance per inverter | $f = 10\text{ MHz}$ | 3 | 4 | 5 | pF |

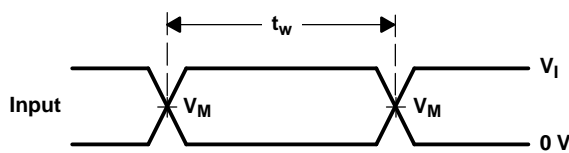
PARAMETER MEASUREMENT INFORMATION



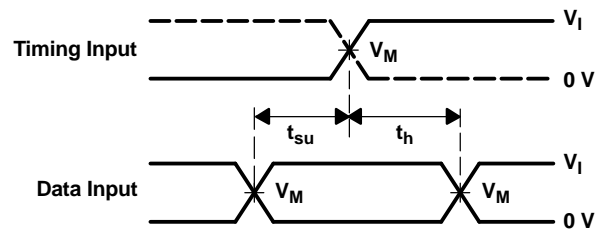
LOAD CIRCUIT

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

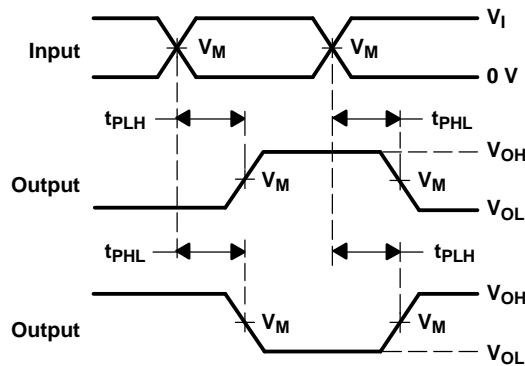
| V_{CC} | INPUTS | | V_M | V_{LOAD} | C_L | R_L | V_{Δ} |
|----------------------------------|----------|----------------------|------------|-------------------|-------|--------------|--------------|
| | V_I | t_r/t_f | | | | | |
| $1.8\text{ V} \pm 0.15\text{ V}$ | V_{CC} | $\leq 2\text{ ns}$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 1 k Ω | 0.15 V |
| $2.5\text{ V} \pm 0.2\text{ V}$ | V_{CC} | $\leq 2\text{ ns}$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 500 Ω | 0.15 V |
| 2.7 V | 2.7 V | $\leq 2.5\text{ ns}$ | 1.5 V | 6 V | 50 pF | 500 Ω | 0.3 V |
| $3.3\text{ V} \pm 0.3\text{ V}$ | 2.7 V | $\leq 2.5\text{ ns}$ | 1.5 V | 6 V | 50 pF | 500 Ω | 0.3 V |



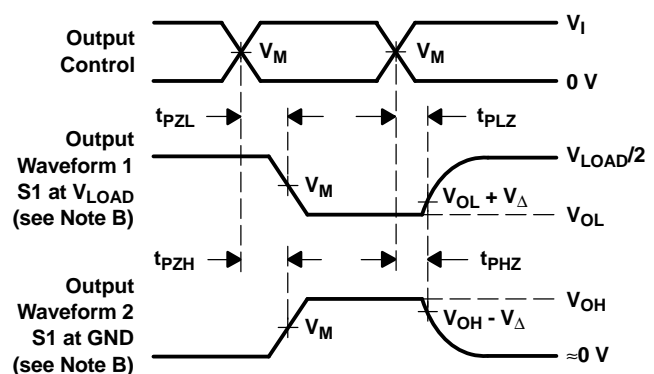
VOLTAGE WAVEFORMS
PULSE DURATION



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

- 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: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$.
 - 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 Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LVCU04AD | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LVCU04A | Samples |
| SN74LVCU04ADBR | ACTIVE | SSOP | DB | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LCU04A | Samples |
| SN74LVCU04ADGVR | ACTIVE | TVSOP | DGV | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LCU04A | Samples |
| SN74LVCU04ADR | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LVCU04A | Samples |
| SN74LVCU04ADT | ACTIVE | SOIC | D | 14 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LVCU04A | Samples |
| SN74LVCU04APW | ACTIVE | TSSOP | PW | 14 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LCU04A | Samples |
| SN74LVCU04APWR | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LCU04A | Samples |
| SN74LVCU04APWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LCU04A | Samples |
| SN74LVCU04APWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LCU04A | 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.

OBSELETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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 finish/Ball material - Orderable Devices 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.

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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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LVCU04ADBR | SSOP | DB | 14 | 2000 | 330.0 | 16.4 | 8.35 | 6.6 | 2.4 | 12.0 | 16.0 | Q1 |
| SN74LVCU04ADGVR | TVSOP | DGV | 14 | 2000 | 330.0 | 12.4 | 6.8 | 4.0 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LVCU04ADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LVCU04ADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LVCU04ADT | SOIC | D | 14 | 250 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LVCU04APWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 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) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVCU04ADBR | SSOP | DB | 14 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74LVCU04ADGVR | TVSOP | DGV | 14 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74LVCU04ADR | SOIC | D | 14 | 2500 | 853.0 | 449.0 | 35.0 |
| SN74LVCU04ADR | SOIC | D | 14 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74LVCU04ADT | SOIC | D | 14 | 250 | 210.0 | 185.0 | 35.0 |
| SN74LVCU04APWR | TSSOP | PW | 14 | 2000 | 853.0 | 449.0 | 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-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - 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 0.006 (0,15) each side.
 -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

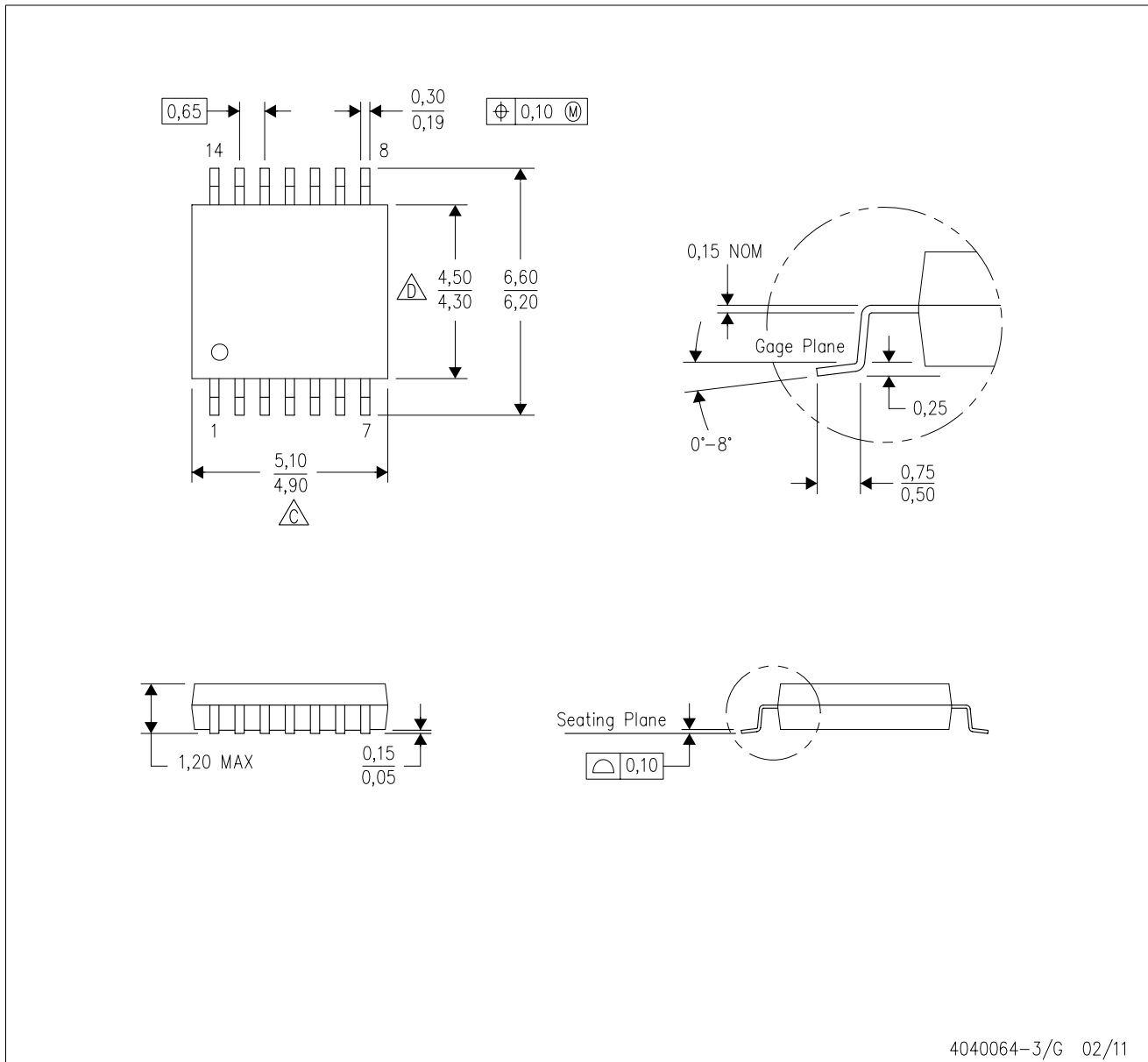
PLASTIC SMALL OUTLINE



- 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. 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.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- 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-G14)

PLASTIC SMALL OUTLINE



4211284-2/G 08/15

- 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.

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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