

# SN54HC7002, SN74HC7002 QUADRUPLE POSITIVE-NOR GATES WITH SCHMITT-TRIGGER INPUTS

SCLS033F – MARCH 1984 – REVISED NOVEMBER 2004

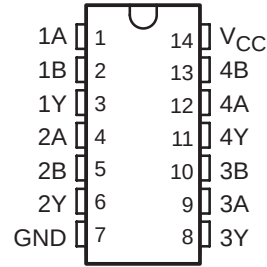
- Wide Operating Voltage Range of 2 V to 6 V
- Typical  $t_{pd} = 14$  ns
- Low Power Consumption, 20- $\mu$ A Max  $I_{CC}$
- Low Input Current of 1  $\mu$ A Max
- Operation From Very Slow Input Transitions
- Temperature-Compensated Threshold Levels
- High Noise Immunity

## description/ordering information

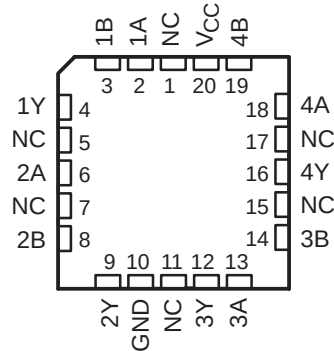
In these devices, each circuit functions as a quadruple NOR gate. They perform the Boolean function  $Y = \overline{A} \cdot \overline{B}$  or  $Y = A + B$  in positive logic. However, because of the Schmitt action, the inputs have different input threshold levels for positive- and negative-going signals.

These circuits are temperature compensated and can be triggered from the slowest of input ramps and still give clean jitter-free output signals.

SN54HC7002 . . . J OR W PACKAGE  
SN74HC7002 . . . D, N, NS, OR PW PACKAGE  
(TOP VIEW)



SN54HC7002 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE <sup>†</sup> |               | ORDERABLE<br>PART NUMBER | TOP-SIDE<br>MARKING |
|----------------|----------------------|---------------|--------------------------|---------------------|
| –40°C to 85°C  | PDIP – N             | Tube of 25    | SN74HC7002N              | SN74HC7002N         |
|                | SOIC – D             | Tube of 50    | SN74HC7002D              | HC7002              |
|                |                      | Reel of 2500  | SN74HC7002DR             |                     |
|                |                      | Reel of 250   | SN74HC7002DT             |                     |
|                | SOP – NS             | Reel of 2000  | SN74HC7002NSR            | HC7002              |
|                | TSSOP – PW           | Tube of 90    | SN74HC7002PW             | HC7002              |
|                |                      | Reel of 2000  | SN74HC7002PWR            |                     |
| Reel of 250    |                      | SN74HC7002PWT |                          |                     |
| –55°C to 125°C | CDIP – J             | Tube of 25    | SNJ54HC7002J             | SNJ54HC7002J        |
|                | CFP – W              | Tube of 150   | SNJ54HC7002W             | SNJ54HC7002W        |
|                | LCCC - FK            | Tube of 55    | SNJ54HC7002FK            | SNJ54HC7002FK       |

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



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**TEXAS  
INSTRUMENTS**

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SN54HC7002, SN74HC7002

QUADRUPLE POSITIVE-NOR GATES

WITH SCHMITT-TRIGGER INPUTS

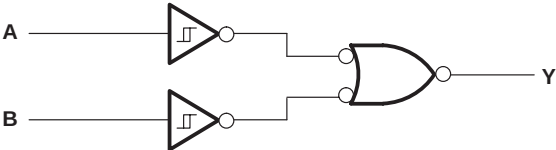
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FUNCTION TABLE

(each gate)

| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| H      | X | L      |
| X      | H | L      |
| L      | L | H      |

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                                             |                |
|-----------------------------------------------------------------------------|----------------|
| Supply voltage range, $V_{CC}$                                              | –0.5 V to 7 V  |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)  | ±20 mA         |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) | ±20 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, $\theta_{JA}$ (see Note 2):                      |                |
| D package                                                                   | 86°C/W         |
| N package                                                                   | 80°C/W         |
| NS package                                                                  | 76°C/W         |
| PW package                                                                  | 113°C/W        |
| Storage temperature range, $T_{stg}$                                        | –65°C to 150°C |

<sup>†</sup> 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:
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
  - The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

|          |                                | SN54HC7002 |     |          | SN74HC7002 |     |          | UNIT |
|----------|--------------------------------|------------|-----|----------|------------|-----|----------|------|
|          |                                | MIN        | NOM | MAX      | MIN        | NOM | MAX      |      |
| $V_{CC}$ | Supply voltage                 | 2          | 5   | 6        | 2          | 5   | 6        | V    |
| $V_I$    | Input voltage                  | 0          |     | $V_{CC}$ | 0          |     | $V_{CC}$ | V    |
| $V_O$    | Output voltage                 | 0          |     | $V_{CC}$ | 0          |     | $V_{CC}$ | V    |
| $T_A$    | Operating free-air temperature | –55        |     | 125      | –40        |     | 85       | °C   |

NOTE 3: 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 <sub>CC</sub> | T <sub>A</sub> = 25°C |       |      | SN54HC7002 |       | SN74HC7002 |       | UNIT |
|-----------------------------------|-----------------------------------------------------------|---------------------------|-----------------|-----------------------|-------|------|------------|-------|------------|-------|------|
|                                   |                                                           |                           |                 | MIN                   | TYP   | MAX  | MIN        | MAX   | MIN        | MAX   |      |
| V <sub>T+</sub>                   |                                                           |                           | 2 V             | 0.7                   | 1.2   | 1.5  | 0.7        | 1.5   | 0.7        | 1.5   | V    |
|                                   |                                                           |                           | 4.5 V           | 1.55                  | 2.5   | 3.15 | 1.55       | 3.15  | 1.55       | 3.15  |      |
|                                   |                                                           |                           | 6 V             | 2.1                   | 3.3   | 4.2  | 2.1        | 4.2   | 2.1        | 4.2   |      |
| V <sub>T–</sub>                   |                                                           |                           | 2 V             | 0.3                   | 0.6   | 1    | 0.3        | 1     | 0.3        | 1     | V    |
|                                   |                                                           |                           | 4.5 V           | 0.9                   | 1.6   | 2.45 | 0.9        | 2.45  | 0.9        | 2.45  |      |
|                                   |                                                           |                           | 6 V             | 1.2                   | 2     | 3.2  | 1.2        | 3.2   | 1.2        | 3.2   |      |
| V <sub>T+</sub> – V <sub>T–</sub> |                                                           |                           | 2 V             | 0.2                   | 0.6   | 1.2  | 0.2        | 1.2   | 0.2        | 1.2   | V    |
|                                   |                                                           |                           | 4.5 V           | 0.4                   | 0.9   | 2.1  | 0.4        | 2.1   | 0.4        | 2.1   |      |
|                                   |                                                           |                           | 6 V             | 0.5                   | 1.3   | 2.5  | 0.5        | 2.5   | 0.5        | 2.5   |      |
| V <sub>OH</sub>                   | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OH</sub> = –20 µA  | 2 V             | 1.9                   | 1.998 |      | 1.9        |       | 1.9        |       | V    |
|                                   |                                                           |                           | 4.5 V           | 4.4                   | 4.499 |      | 4.4        |       | 4.4        |       |      |
|                                   |                                                           |                           | 6 V             | 5.9                   | 5.999 |      | 5.9        |       | 5.9        |       |      |
|                                   |                                                           | I <sub>OH</sub> = –4 mA   | 4.5 V           | 3.98                  | 4.3   |      | 3.7        |       | 3.84       |       |      |
|                                   |                                                           | I <sub>OH</sub> = –5.2 mA | 6 V             | 5.48                  | 5.8   |      | 5.2        |       | 5.34       |       |      |
| V <sub>OL</sub>                   | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OL</sub> = 20 µA   | 2 V             |                       | 0.002 | 0.1  |            | 0.1   |            | 0.1   | V    |
|                                   |                                                           |                           | 4.5 V           |                       | 0.001 | 0.1  |            | 0.1   |            | 0.1   |      |
|                                   |                                                           |                           | 6 V             |                       | 0.001 | 0.1  |            | 0.1   |            | 0.1   |      |
|                                   |                                                           | I <sub>OL</sub> = 4 mA    | 4.5 V           |                       | 0.17  | 0.26 |            | 0.4   |            | 0.33  |      |
|                                   |                                                           | I <sub>OL</sub> = 5.2 mA  | 6 V             |                       | 0.15  | 0.26 |            | 0.4   |            | 0.33  |      |
| I <sub>I</sub>                    | V <sub>I</sub> = V <sub>CC</sub> or 0                     |                           | 6 V             |                       | ±0.1  | ±100 |            | ±1000 |            | ±1000 | nA   |
| I <sub>CC</sub>                   | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0 |                           | 6 V             |                       |       | 2    |            | 40    |            | 20    | µA   |
| C <sub>i</sub>                    |                                                           |                           | 2 V to 6 V      |                       | 3     | 10   |            | 10    |            | 10    | pF   |

switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC7002 |     | SN74HC7002 |     | UNIT |
|-----------------|--------------|-------------|-----------------|-----------------------|-----|-----|------------|-----|------------|-----|------|
|                 |              |             |                 | MIN                   | TYP | MAX | MIN        | MAX | MIN        | MAX |      |
| t <sub>pd</sub> | A or B       | Y           | 2 V             |                       | 60  | 130 |            | 195 |            | 163 | ns   |
|                 |              |             | 4.5 V           |                       | 18  | 26  |            | 39  |            | 33  |      |
|                 |              |             | 6 V             |                       | 14  | 22  |            | 33  |            | 28  |      |
| t <sub>t</sub>  |              | Any         | 2 V             |                       | 28  | 75  |            | 110 |            | 95  | ns   |
|                 |              |             | 4.5 V           |                       | 8   | 15  |            | 22  |            | 19  |      |
|                 |              |             | 6 V             |                       | 6   | 13  |            | 19  |            | 16  |      |

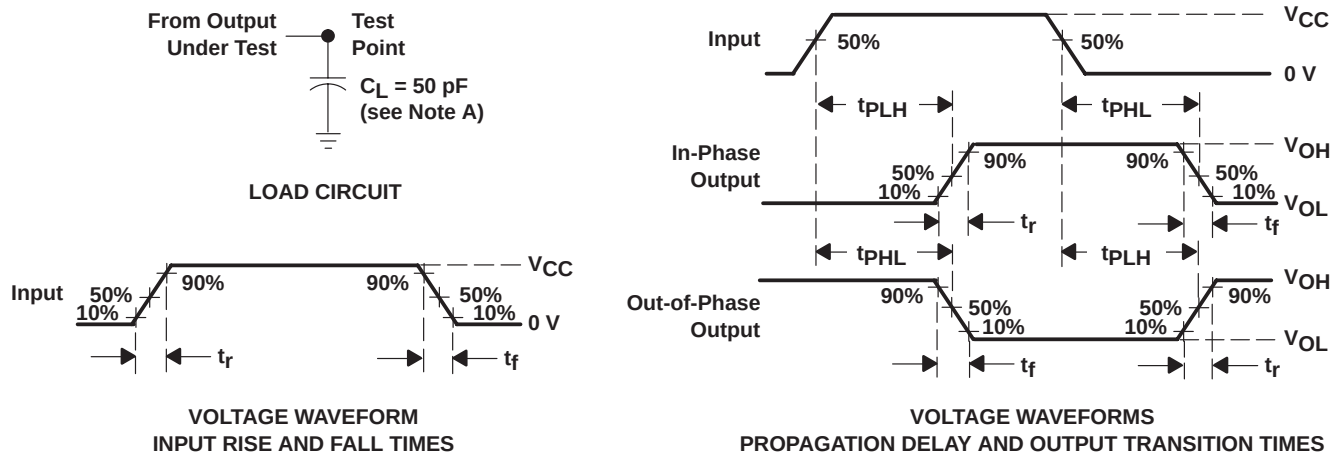
operating characteristics, T<sub>A</sub> = 25°C

| PARAMETER                                              | TEST CONDITIONS | TYP | UNIT |
|--------------------------------------------------------|-----------------|-----|------|
| C <sub>pd</sub> Power dissipation capacitance per gate | No load         | 20  | pF   |

# SN54HC7002, SN74HC7002 QUADRUPLE POSITIVE-NOR GATES WITH SCHMITT-TRIGGER INPUTS

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## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - C. The outputs are measured one at a time, with one input transition per measurement.
  - D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login)               |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-------------------------------------------|
| SN74HC7002D      | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | Contact TI Distributor<br>or Sales Office |
| SN74HC7002DE4    | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | Contact TI Distributor<br>or Sales Office |
| SN74HC7002DG4    | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | Contact TI Distributor<br>or Sales Office |
| SN74HC7002DR     | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002DRE4   | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002DRG4   | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002DT     | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002DTE4   | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002DTG4   | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002N      | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           | Contact TI Distributor<br>or Sales Office |
| SN74HC7002NE4    | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           | Contact TI Distributor<br>or Sales Office |
| SN74HC7002PW     | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002PWE4   | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002PWG4   | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002PWT    | ACTIVE                | TSSOP        | PW              | 14   | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002PWTE4  | ACTIVE                | TSSOP        | PW              | 14   | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |
| SN74HC7002PWTG4  | ACTIVE                | TSSOP        | PW              | 14   | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           | <a href="#">Purchase Samples</a>          |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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.

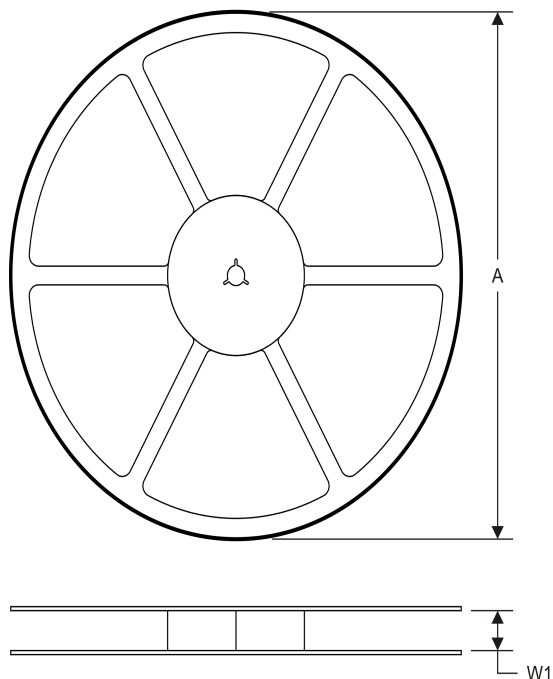
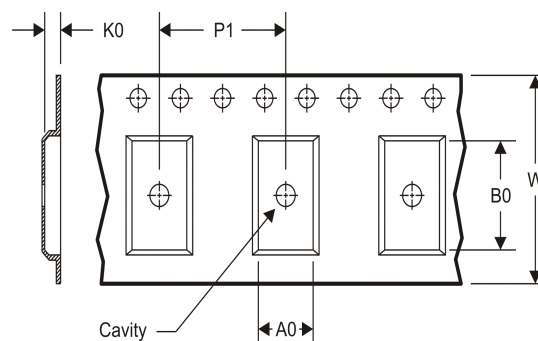
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


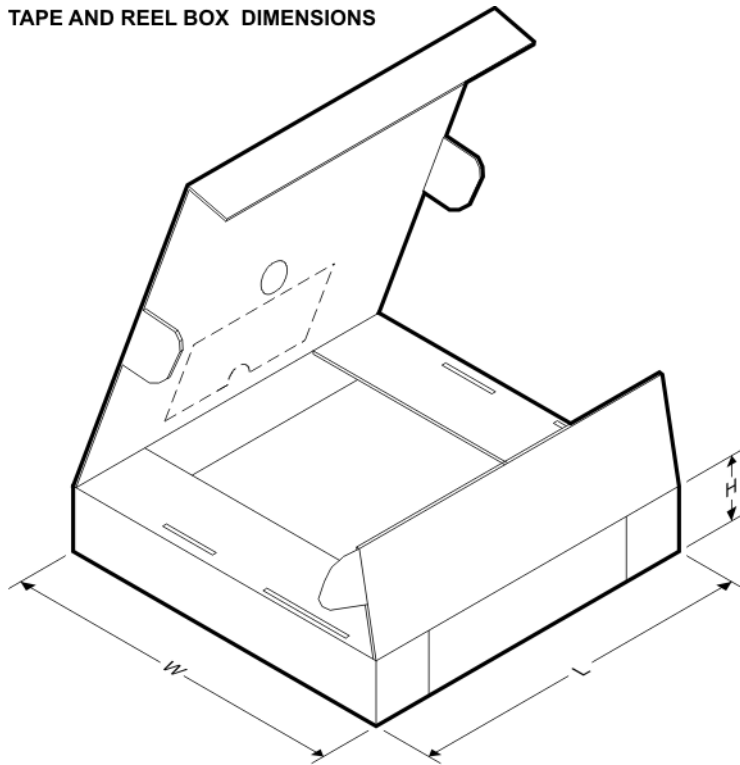
|    |                                                           |
|----|-----------------------------------------------------------|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

**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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC7002DR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC7002DT  | SOIC         | D               | 14   | 250  | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC7002PWT | TSSOP        | PW              | 14   | 250  | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

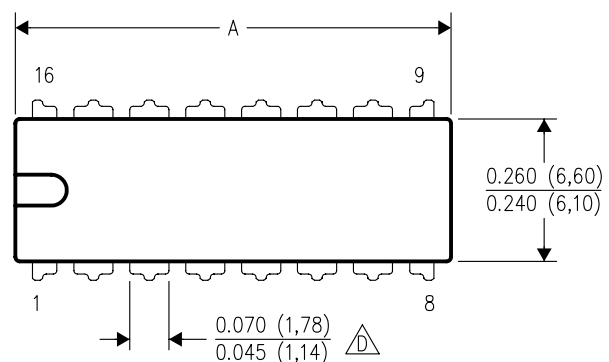
| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC7002DR  | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| SN74HC7002DT  | SOIC         | D               | 14   | 250  | 367.0       | 367.0      | 38.0        |
| SN74HC7002PWT | TSSOP        | PW              | 14   | 250  | 367.0       | 367.0      | 35.0        |



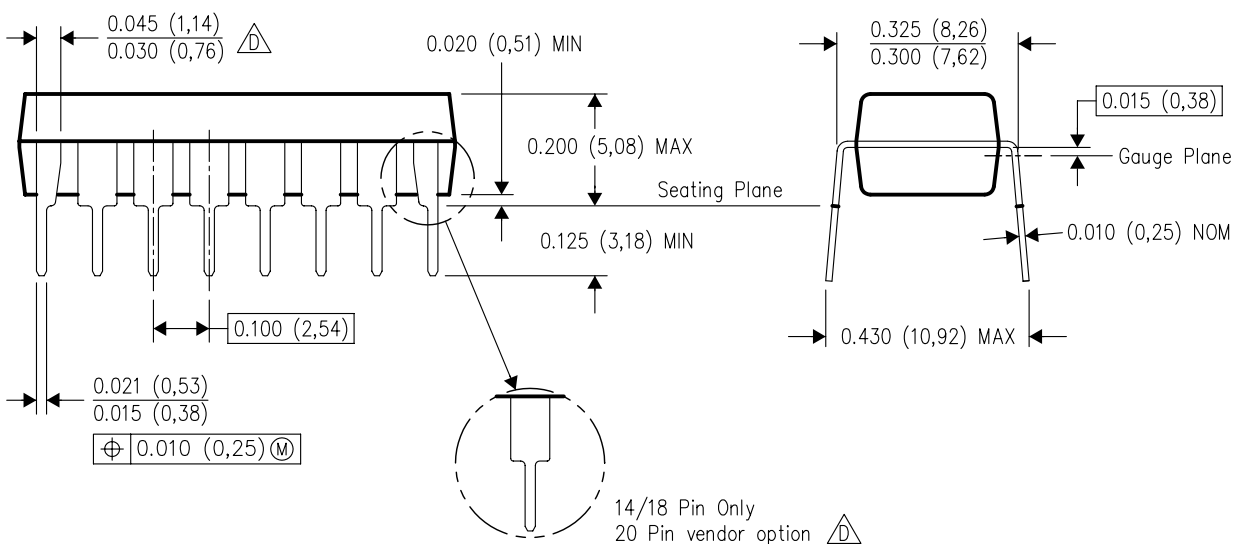
N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



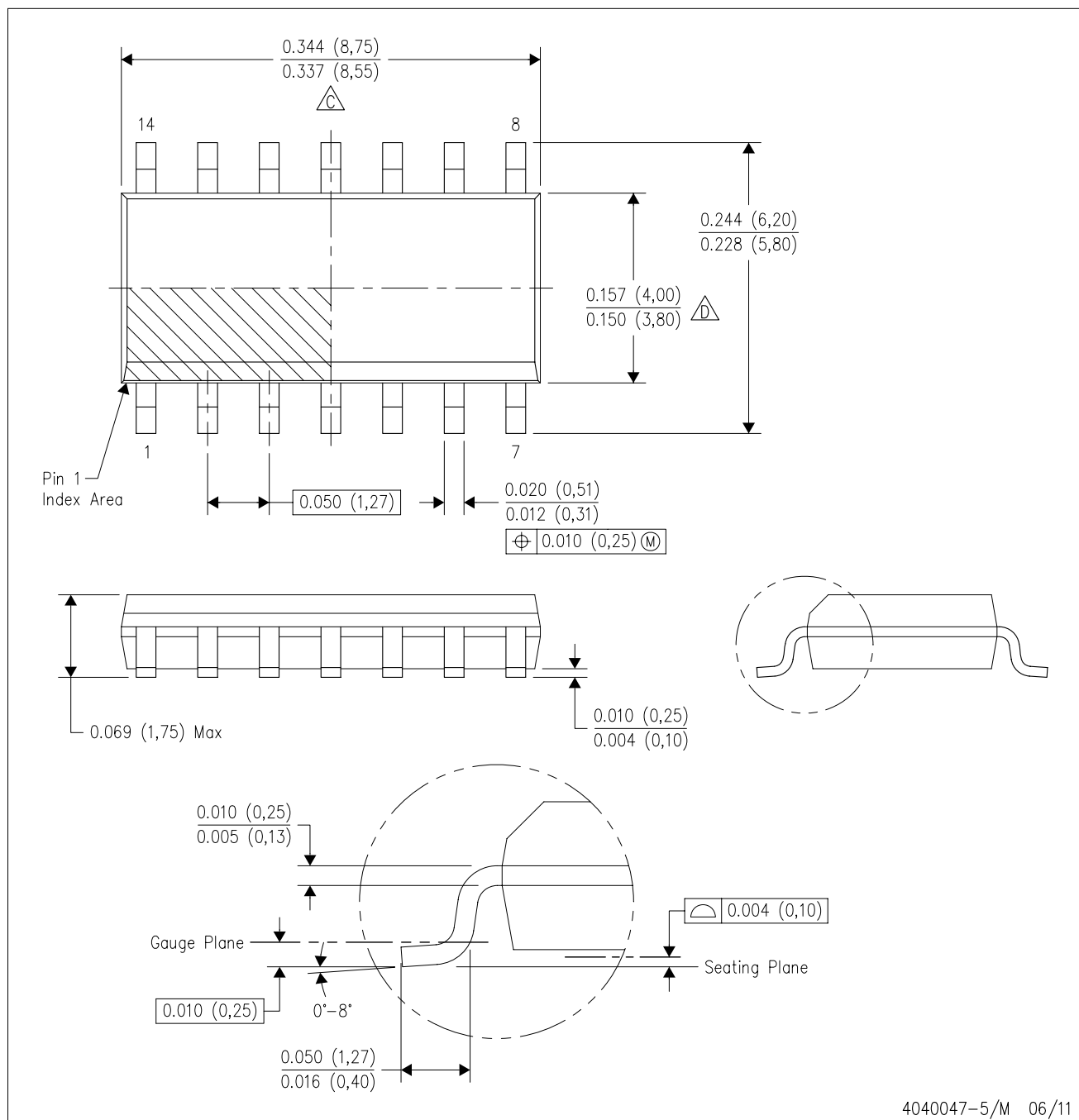
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NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE

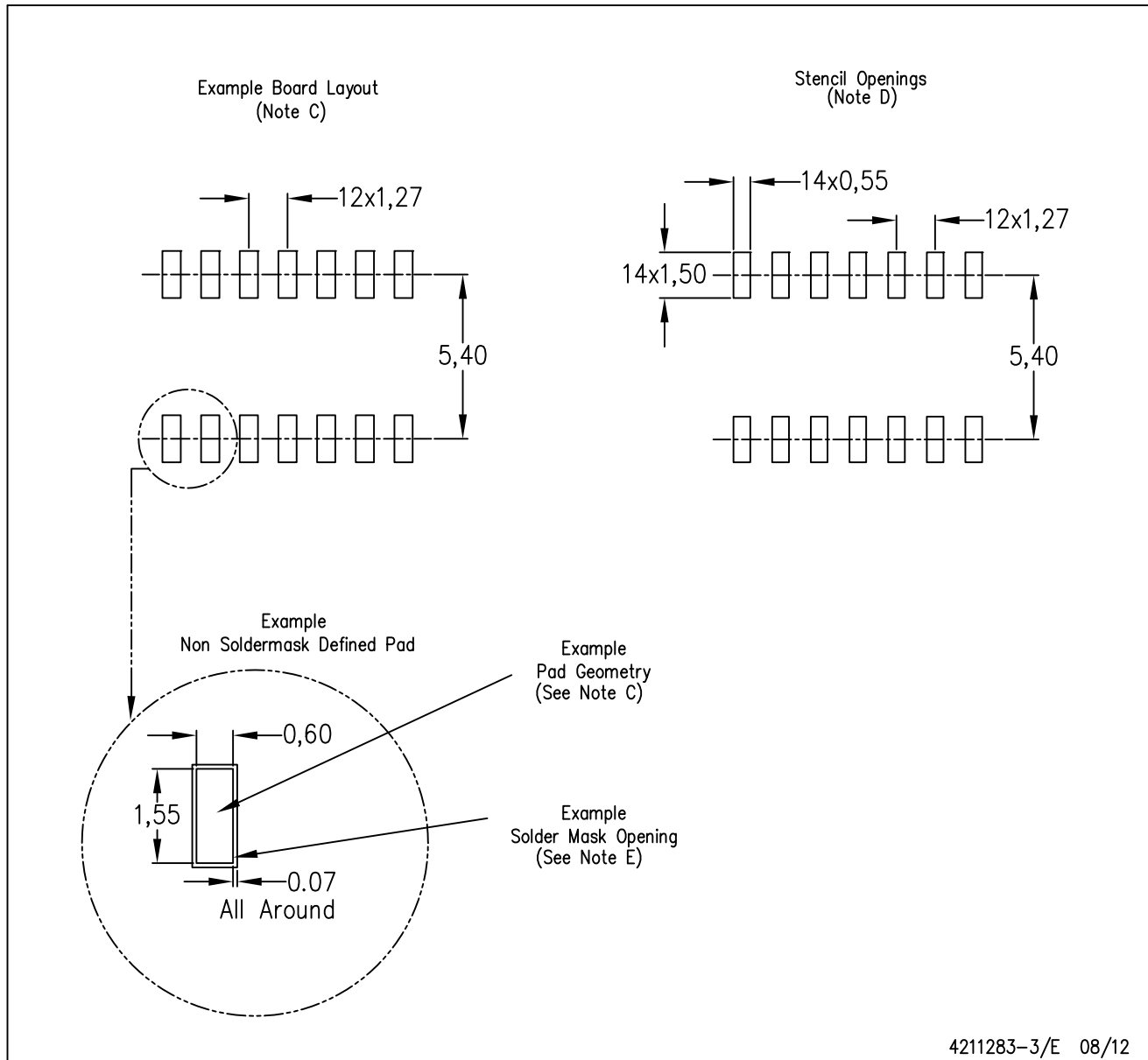


NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- 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 AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE

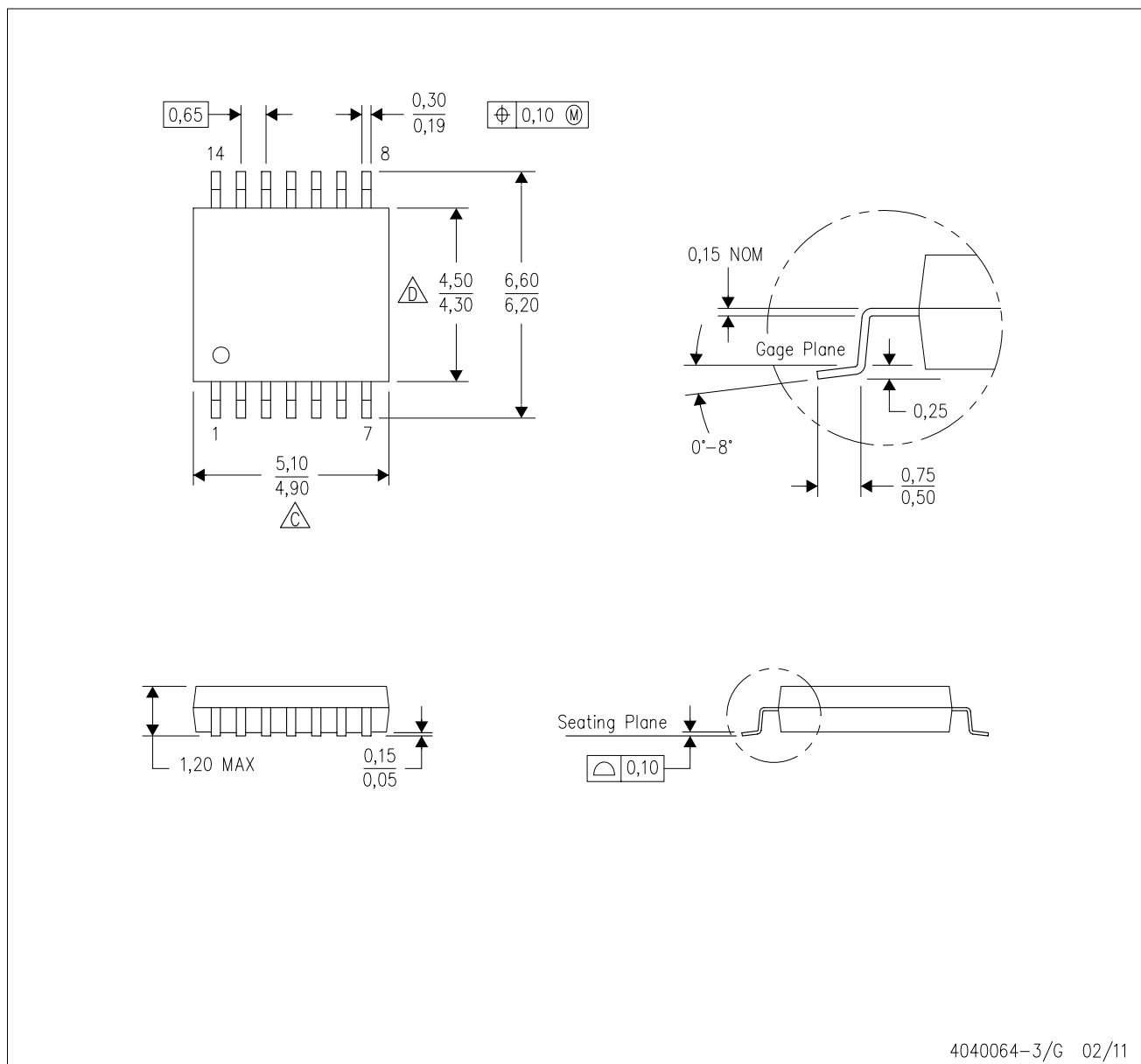


4211283-3/E 08/12

- 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)

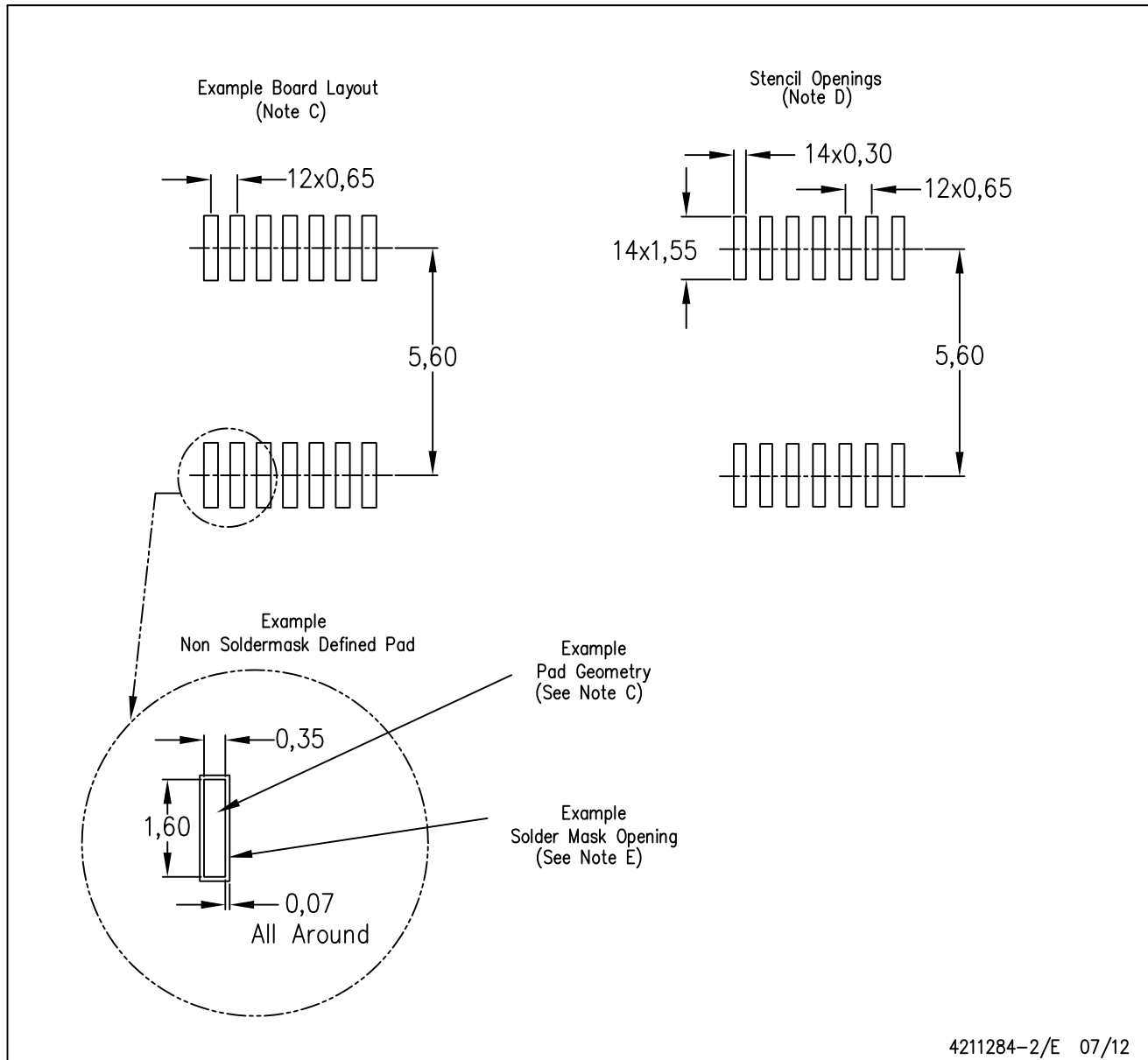
PLASTIC SMALL OUTLINE



- 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.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. 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



- 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.

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|                               |                                                                                          |
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