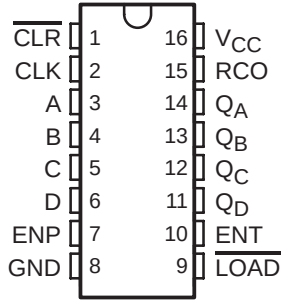


# SN54HC161, SN74HC161 4-BIT SYNCHRONOUS BINARY COUNTERS

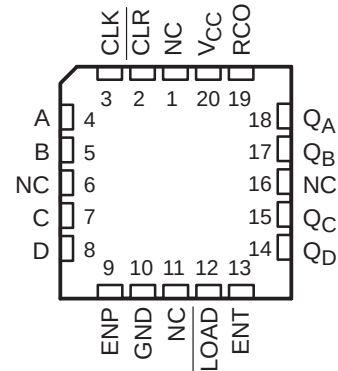
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- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 14$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Internal Look-Ahead for Fast Counting
- Carry Output for n-Bit Cascading
- Synchronous Counting
- Synchronously Programmable

SN54HC161 . . . J OR W PACKAGE  
SN74HC161 . . . D, N, NS, OR PW PACKAGE  
(TOP VIEW)



SN54HC161 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## description/ordering information

These synchronous, presettable counters feature an internal carry look-ahead for application in high-speed counting designs. The 'HC161 devices are 4-bit binary counters. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the count-enable (ENP, ENT) inputs and internal gating. This mode of operation eliminates the output counting spikes that are normally associated with synchronous (ripple-clock) counters. A buffered clock (CLK) input triggers the four flip-flops on the rising (positive-going) edge of the clock waveform.

## 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   | SN74HC161N               | SN74HC161N          |
|                | SOIC – D             | Tube of 40   | SN74HC161D               | HC161               |
|                |                      | Reel of 2500 | SN74HC161DR              |                     |
|                |                      | Reel of 250  | SN74HC161DT              |                     |
|                | SOP – NS             | Reel of 2000 | SN74HC161NSR             | HC161               |
|                | TSSOP – PW           | Tube of 90   | SN74HC161PW              | HC161               |
|                |                      | Reel of 2000 | SN74HC161PWR             |                     |
| Reel of 250    |                      | SN74HC161PWT |                          |                     |
| –55°C to 125°C | CDIP – J             | Tube of 25   | SNJ54HC161J              | SNJ54HC161J         |
|                | CFP – W              | Tube of 150  | SNJ54HC161W              | SNJ54HC161W         |
|                | LCCC – FK            | Tube of 55   | SNJ54HC161FK             | SNJ54HC161FK        |

<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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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.

**TEXAS  
INSTRUMENTS**

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# SN54HC161, SN74HC161

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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### description/ordering information (continued)

These counters are fully programmable; that is, they can be preset to any number between 0 and 9 or 15. As presetting is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with the setup data after the next clock pulse, regardless of the levels of the enable inputs.

The clear function for the 'HC161 devices is asynchronous. A low level at the clear ( $\overline{\text{CLR}}$ ) input sets all four of the flip-flop outputs low, regardless of the levels of the CLK, load ( $\overline{\text{LOAD}}$ ), or enable inputs.

The carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications without additional gating. Instrumental in accomplishing this function are ENP, ENT, and a ripple-carry output (RCO). Both ENP and ENT must be high to count, and ENT is fed forward to enable RCO. Enabling RCO produces a high-level pulse while the count is maximum (9 or 15 with  $Q_A$  high). This high-level overflow ripple-carry pulse can be used to enable successive cascaded stages. Transitions at ENP or ENT are allowed, regardless of the level of CLK.

These counters feature a fully independent clock circuit. Changes at control inputs (ENP, ENT, or  $\overline{\text{LOAD}}$ ) that modify the operating mode have no effect on the contents of the counter until clocking occurs. The function of the counter (whether enabled, disabled, loading, or counting) is dictated solely by the conditions meeting the stable setup and hold times.

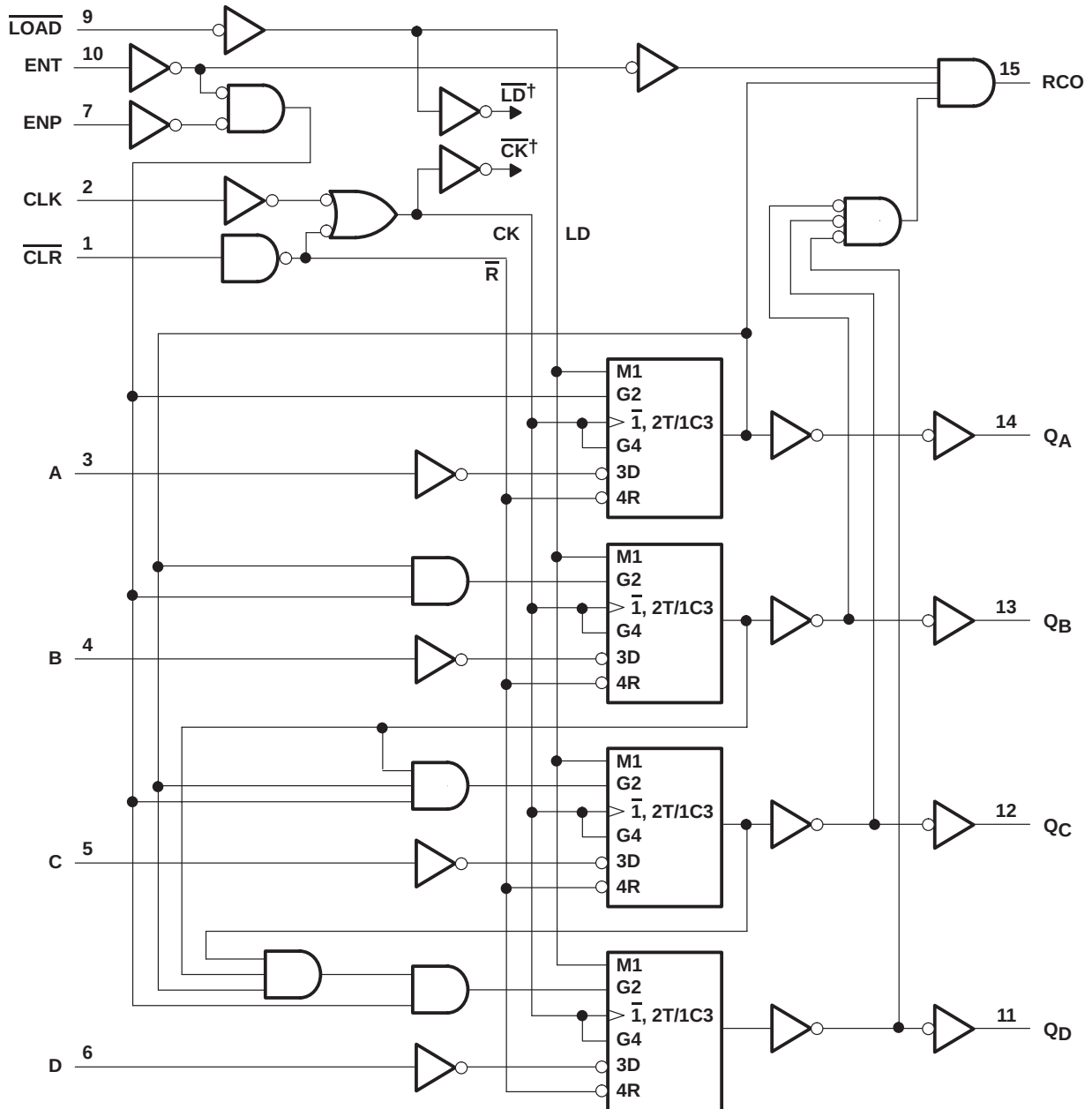


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# SN54HC161, SN74HC161 4-BIT SYNCHRONOUS BINARY COUNTERS

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## logic diagram (positive logic)



† For simplicity, routing of complementary signals  $\overline{LD}$  and  $\overline{CK}$  is not shown on this overall logic diagram. The uses of these signals are shown on the logic diagram of the D/T flip-flops.

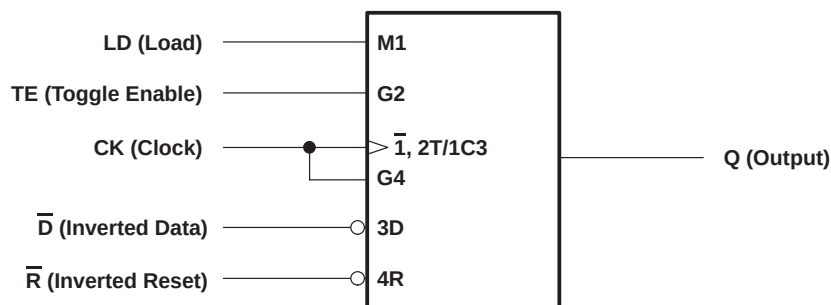
Pin numbers shown are for the D, J, N, NS, PW, and W packages.

# SN54HC161, SN74HC161

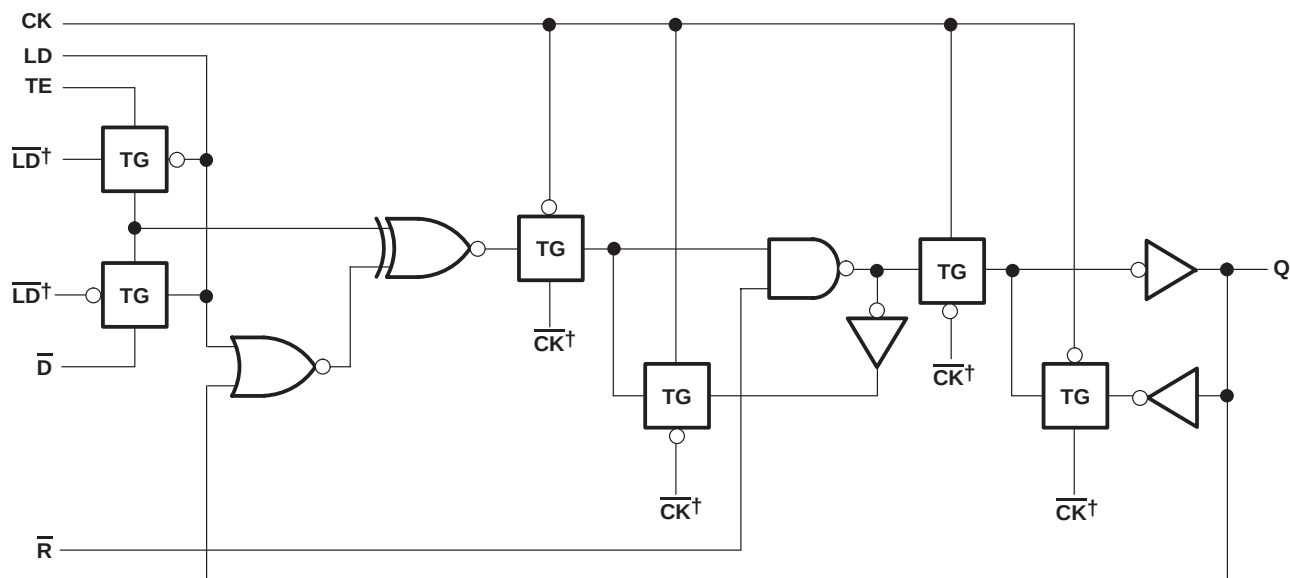
## 4-BIT SYNCHRONOUS BINARY COUNTERS

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### logic symbol, each D/T flip-flop



### logic diagram, each D/T flip-flop (positive logic)

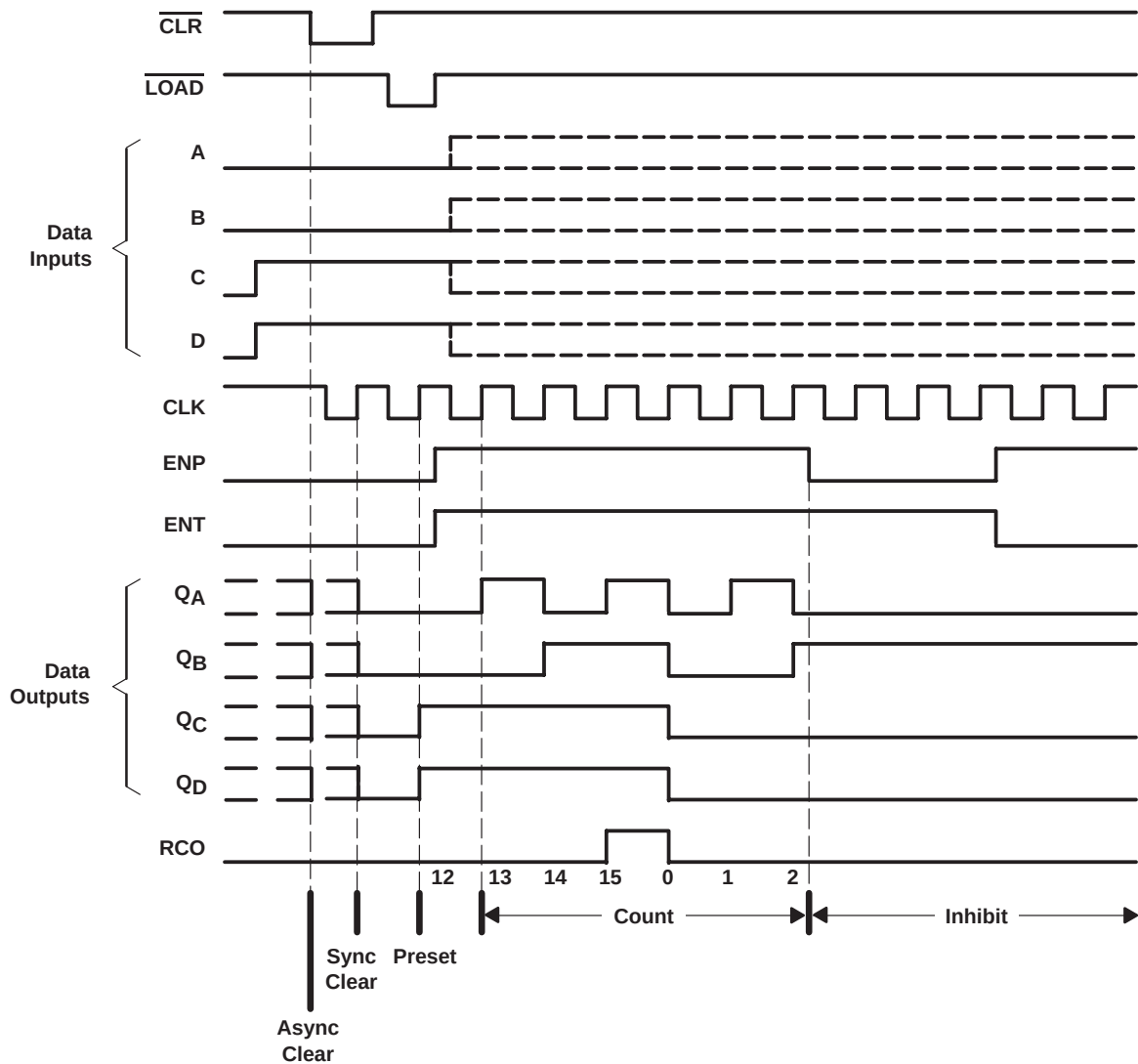


<sup>†</sup> The origins of  $\bar{LD}$  and  $\bar{CK}$  are shown in the logic diagram of the overall device.

## typical clear, preset, count, and inhibit sequence

The following sequence is illustrated below:

1. Clear outputs to zero (asynchronous)
2. Preset to binary 12
3. Count to 13, 14, 15, 0, 1, and 2
4. Inhibit



# SN54HC161, SN74HC161

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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### 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            | 73°C/W         |
| N package                                                                   | 67°C/W         |
| NS package                                                                  | 64°C/W         |
| PW package                                                                  | 108°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: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

### recommended operating conditions (see Note 3)

|                    |                                 |                         | SN54HC161 |                 |     | SN74HC161 |                 |     | UNIT |
|--------------------|---------------------------------|-------------------------|-----------|-----------------|-----|-----------|-----------------|-----|------|
|                    |                                 |                         | MIN       | NOM             | MAX | MIN       | NOM             | MAX |      |
| V <sub>CC</sub>    | Supply voltage                  |                         | 2         | 5               | 6   | 2         | 5               | 6   | V    |
| V <sub>IH</sub>    | High-level input voltage        | V <sub>CC</sub> = 2 V   | 1.5       |                 |     | 1.5       |                 |     | V    |
|                    |                                 | V <sub>CC</sub> = 4.5 V | 3.15      |                 |     | 3.15      |                 |     |      |
|                    |                                 | V <sub>CC</sub> = 6 V   | 4.2       |                 |     | 4.2       |                 |     |      |
| V <sub>IL</sub>    | Low-level input voltage         | V <sub>CC</sub> = 2 V   | 0.5       |                 |     | 0.5       |                 |     | V    |
|                    |                                 | V <sub>CC</sub> = 4.5 V | 1.35      |                 |     | 1.35      |                 |     |      |
|                    |                                 | V <sub>CC</sub> = 6 V   | 1.8       |                 |     | 1.8       |                 |     |      |
| V <sub>I</sub>     | Input voltage                   |                         | 0         | V <sub>CC</sub> |     | 0         | V <sub>CC</sub> |     | V    |
| V <sub>O</sub>     | Output voltage                  |                         | 0         | V <sub>CC</sub> |     | 0         | V <sub>CC</sub> |     | V    |
| Δt/Δv <sup>‡</sup> | Input transition rise/fall time | V <sub>CC</sub> = 2 V   | 1000      |                 |     | 1000      |                 |     | ns   |
|                    |                                 | V <sub>CC</sub> = 4.5 V | 500       |                 |     | 500       |                 |     |      |
|                    |                                 | V <sub>CC</sub> = 6 V   | 400       |                 |     | 400       |                 |     |      |
| T <sub>A</sub>     | 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.

<sup>‡</sup> If this device is used in the threshold region (from  $V_{IL\max} = 0.5$  V to  $V_{IH\min} = 1.5$  V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at  $t_t = 1000$  ns and  $V_{CC} = 2$  V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.



# SN54HC161, SN74HC161

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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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 |       |      | SN54HC161 |       | SN74HC161 |       | UNIT |
|-----------------|-----------------------------------------------------------|---------------------------|-----------------|-----------------------|-------|------|-----------|-------|-----------|-------|------|
|                 |                                                           |                           |                 | MIN                   | TYP   | MAX  | MIN       | MAX   | MIN       | MAX   |      |
| 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             |                       |       | 8    |           | 160   |           | 80    | µA   |
| C <sub>i</sub>  |                                                           |                           | 2 V to 6 V      |                       | 3     | 10   |           | 10    |           | 10    | pF   |

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

|                    |                                              |                 | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     | SN54HC161 |     | SN74HC161 |     | UNIT |
|--------------------|----------------------------------------------|-----------------|-----------------|-----------------------|-----|-----------|-----|-----------|-----|------|
|                    |                                              |                 |                 | MIN                   | MAX | MIN       | MAX | MIN       | MAX |      |
| f <sub>clock</sub> | Clock frequency                              |                 | 2 V             | 6                     |     | 4.2       |     | 5         |     | MHz  |
|                    |                                              |                 | 4.5 V           | 31                    |     | 21        |     | 25        |     |      |
|                    |                                              |                 | 6 V             | 36                    |     | 25        |     | 29        |     |      |
| t <sub>w</sub>     | Pulse duration                               | CLK high or low | 2 V             | 80                    |     | 120       |     | 100       |     | ns   |
|                    |                                              |                 | 4.5 V           | 16                    |     | 24        |     | 20        |     |      |
|                    |                                              |                 | 6 V             | 14                    |     | 20        |     | 17        |     |      |
|                    | CLR low                                      | 2 V             | 80              |                       | 120 |           | 100 |           |     |      |
|                    |                                              | 4.5 V           | 16              |                       | 24  |           | 20  |           |     |      |
|                    |                                              | 6 V             | 14              |                       | 20  |           | 17  |           |     |      |
| t <sub>su</sub>    | Setup time before CLK↑                       | A, B, C, or D   | 2 V             | 150                   |     | 225       |     | 190       |     | ns   |
|                    |                                              |                 | 4.5 V           | 30                    |     | 45        |     | 38        |     |      |
|                    |                                              |                 | 6 V             | 26                    |     | 38        |     | 32        |     |      |
|                    |                                              | LOAD low        | 2 V             | 135                   |     | 205       |     | 170       |     |      |
|                    |                                              |                 | 4.5 V           | 27                    |     | 41        |     | 34        |     |      |
|                    |                                              |                 | 6 V             | 23                    |     | 35        |     | 29        |     |      |
|                    |                                              | ENP, ENT        | 2 V             | 170                   |     | 255       |     | 215       |     |      |
|                    |                                              |                 | 4.5 V           | 34                    |     | 51        |     | 43        |     |      |
|                    |                                              |                 | 6 V             | 29                    |     | 43        |     | 37        |     |      |
|                    |                                              | CLR inactive    | 2 V             | 125                   |     | 190       |     | 155       |     |      |
|                    |                                              |                 | 4.5 V           | 25                    |     | 38        |     | 31        |     |      |
|                    |                                              |                 | 6 V             | 21                    |     | 32        |     | 26        |     |      |
| t <sub>h</sub>     | Hold time, all synchronous inputs after CLK↑ |                 | 2 V             | 0                     |     | 0         |     | 0         |     | ns   |
|                    |                                              |                 | 4.5 V           | 0                     |     | 0         |     | 0         |     |      |
|                    |                                              |                 | 6 V             | 0                     |     | 0         |     | 0         |     |      |



# SN54HC161, SN74HC161

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

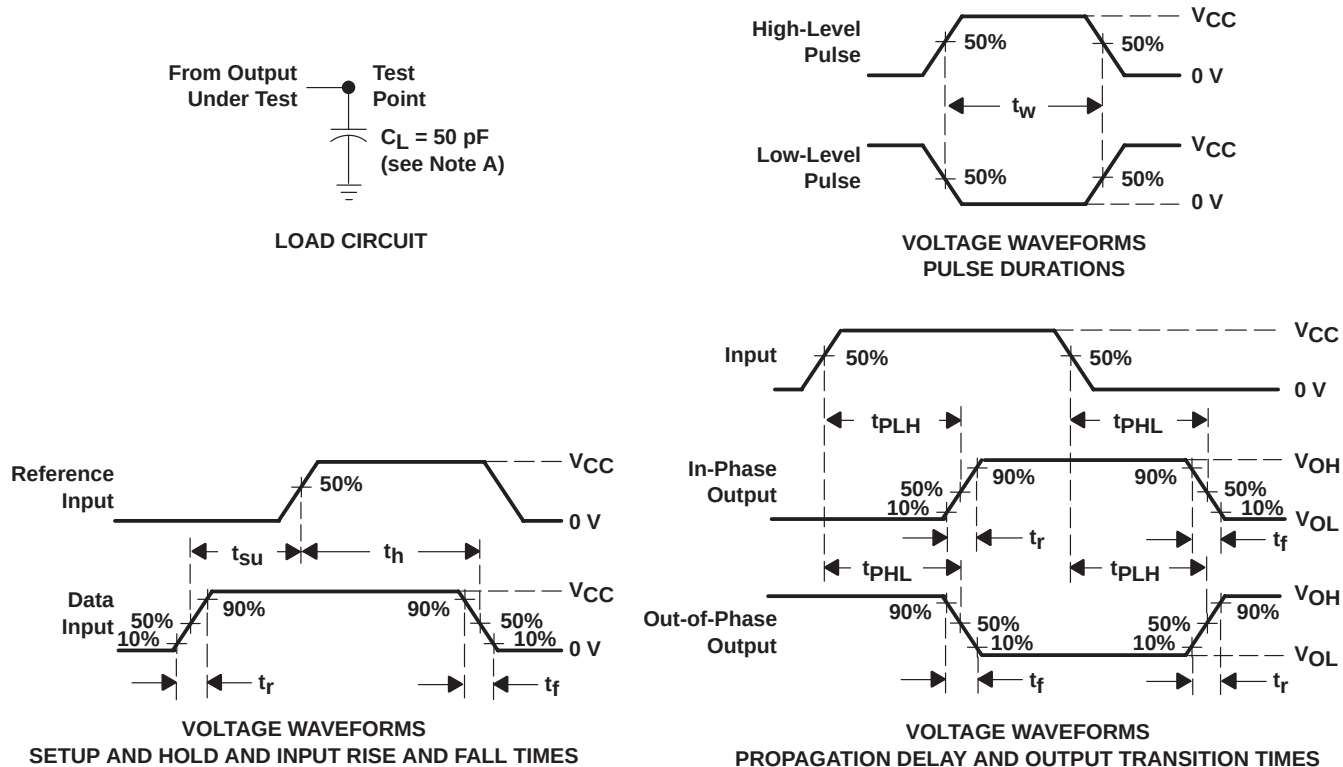
| PARAMETER  | FROM<br>(INPUT)         | TO<br>(OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC161 |     | SN74HC161 |     | UNIT |
|------------|-------------------------|----------------|----------|--------------------------|-----|-----|-----------|-----|-----------|-----|------|
|            |                         |                |          | MIN                      | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| $f_{\max}$ |                         |                | 2 V      | 6                        | 14  |     | 4.2       |     | 5         |     | MHz  |
|            |                         |                | 4.5 V    | 31                       | 40  |     | 21        |     | 25        |     |      |
|            |                         |                | 6 V      | 36                       | 44  |     | 25        |     | 29        |     |      |
| $t_{pd}$   | CLK                     | RCO            | 2 V      |                          | 83  | 215 |           | 325 |           | 270 | ns   |
|            |                         |                | 4.5 V    |                          | 24  | 43  |           | 65  |           | 54  |      |
|            |                         |                | 6 V      |                          | 20  | 37  |           | 55  |           | 46  |      |
|            |                         | Any Q          | 2 V      |                          | 80  | 205 |           | 310 |           | 255 |      |
|            |                         |                | 4.5 V    |                          | 25  | 41  |           | 62  |           | 51  |      |
|            |                         |                | 6 V      |                          | 21  | 35  |           | 53  |           | 43  |      |
|            | ENT                     | RCO            | 2 V      |                          | 62  | 195 |           | 295 |           | 245 |      |
|            |                         |                | 4.5 V    |                          | 17  | 39  |           | 59  |           | 49  |      |
|            |                         |                | 6 V      |                          | 14  | 33  |           | 50  |           | 42  |      |
| $t_{PHL}$  | $\overline{\text{CLR}}$ | Any Q          | 2 V      |                          | 105 | 210 |           | 315 |           | 265 | ns   |
|            |                         |                | 4.5 V    |                          | 21  | 42  |           | 63  |           | 53  |      |
|            |                         |                | 6 V      |                          | 18  | 36  |           | 54  |           | 45  |      |
|            |                         | RCO            | 2 V      |                          | 110 | 220 |           | 330 |           | 275 |      |
|            |                         |                | 4.5 V    |                          | 22  | 44  |           | 66  |           | 55  |      |
|            |                         |                | 6 V      |                          | 19  | 37  |           | 56  |           | 47  |      |
| $t_t$      |                         | Any            | 2 V      |                          | 38  | 75  |           | 110 |           | 95  | ns   |
|            |                         |                | 4.5 V    |                          | 8   | 15  |           | 22  |           | 19  |      |
|            |                         |                | 6 V      |                          | 6   | 13  |           | 19  |           | 16  |      |

operating characteristics,  $T_A = 25^\circ\text{C}$

| PARAMETER |                               | TEST CONDITIONS | TYP | UNIT |
|-----------|-------------------------------|-----------------|-----|------|
| $C_{pd}$  | Power dissipation capacitance | No load         | 60  | pF   |



## 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. For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

# SN54HC161, SN74HC161

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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### APPLICATION INFORMATION

#### n-bit synchronous counters

This application demonstrates how the look-ahead carry circuit can be used to implement a high-speed n-bit counter. The 'HC161 devices count in binary. Virtually any count mode (modulo-N,  $N_1$ -to- $N_2$ ,  $N_1$ -to-maximum) can be used with this fast look-ahead circuit.

The application circuit shown in Figure 2 is not valid for clock frequencies above 18 MHz (at 25°C and 4.5-V  $V_{CC}$ ). The reason for this is that there is a glitch that is produced on the second stage's RCO and every succeeding stage's RCO. This glitch is common to all HC vendors that Texas Instruments has evaluated, in addition to the bipolar equivalents (LS, ALS, AS).



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## APPLICATION INFORMATION

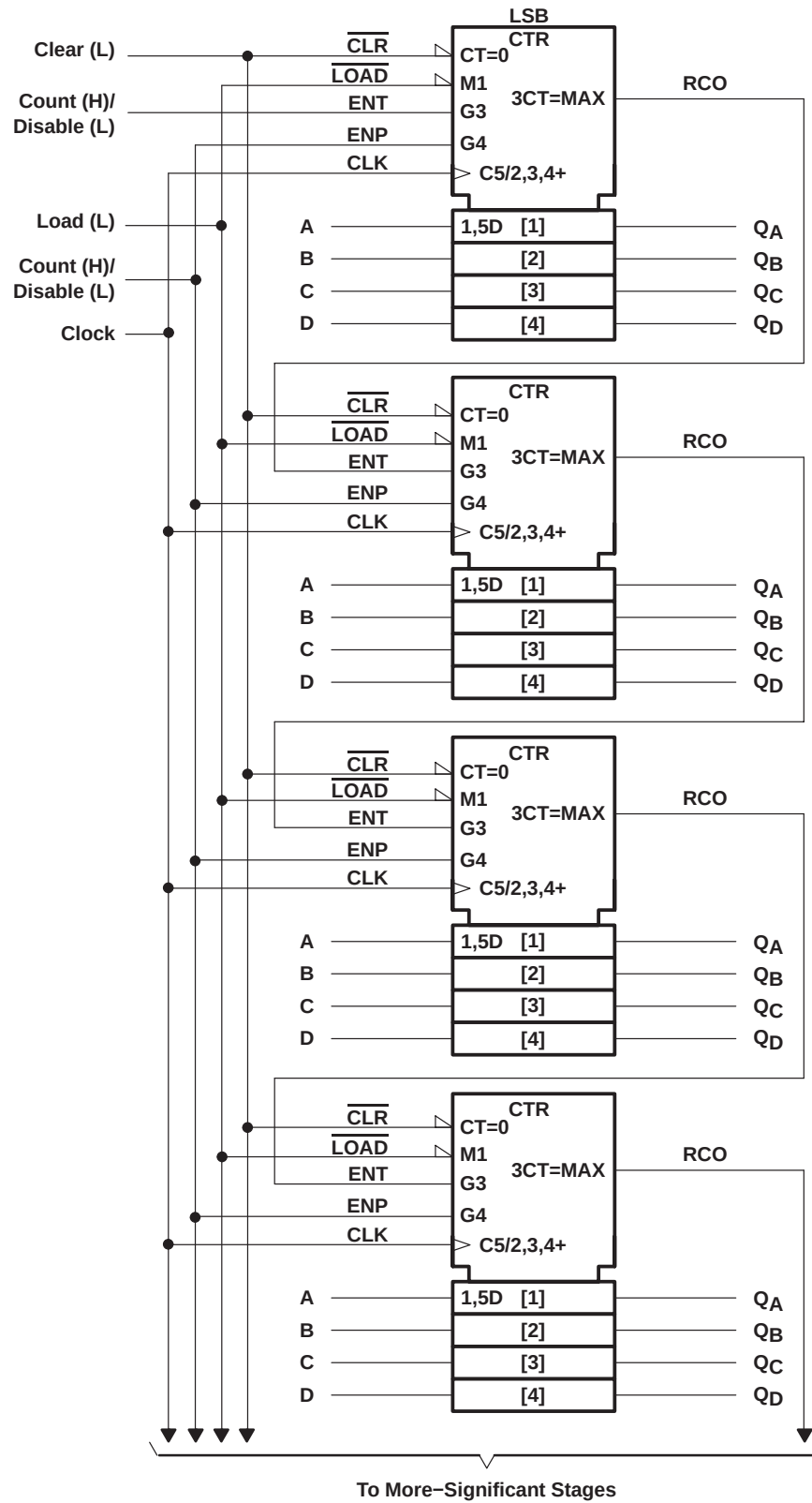


Figure 2



# SN54HC161, SN74HC161

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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### APPLICATION INFORMATION

The glitch on RCO is caused because the propagation delay of the rising edge of  $Q_A$  of the second stage is shorter than the propagation delay of the falling edge of ENT. RCO is the product of ENT,  $Q_A$ ,  $Q_B$ ,  $Q_C$ , and  $Q_D$  ( $ENT \times Q_A \times Q_B \times Q_C \times Q_D$ ). The resulting glitch is about 7–12 ns in duration. Figure 3 shows the condition in which the glitch occurs. For simplicity, only two stages are being considered, but the results can be applied to other stages.  $Q_B$ ,  $Q_C$ , and  $Q_D$  of the first and second stage are at logic one, and  $Q_A$  of both stages are at logic zero (1110 1110) after the first clock pulse. On the rising edge of the second clock pulse,  $Q_A$  and RCO of the first stage go high. On the rising edge of the third clock pulse,  $Q_A$  and RCO of the first stage return to a low level, and  $Q_A$  of the second stage goes to a high level. At this time, the glitch on RCO of the second stage appears because of the race condition inside the chip.

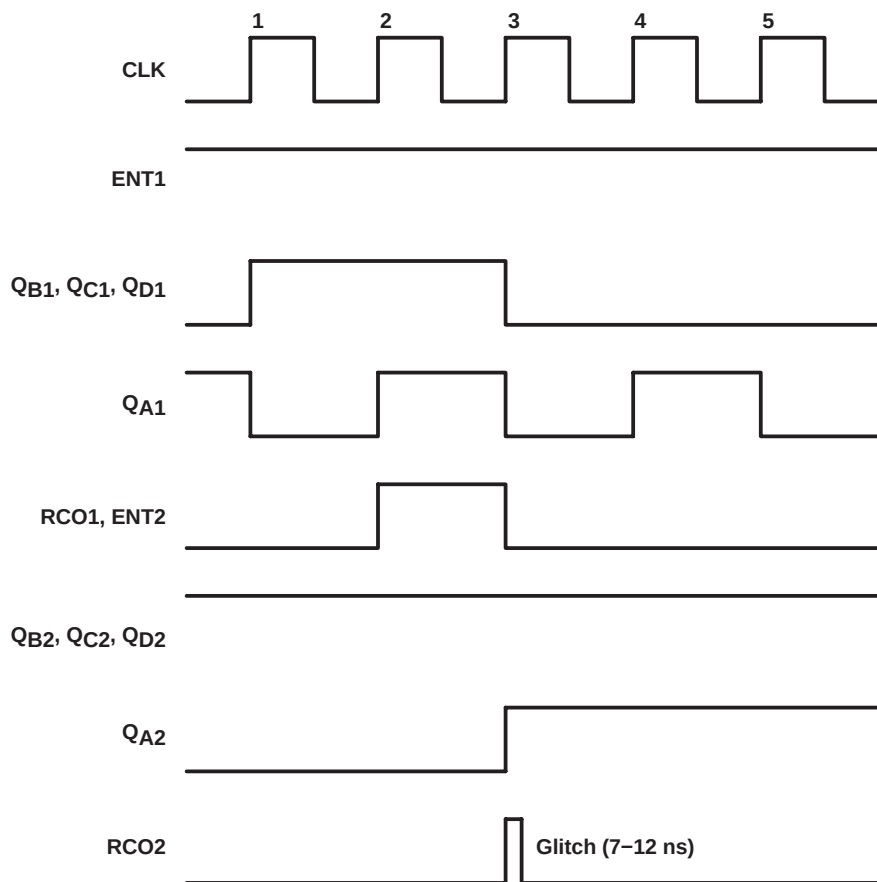


Figure 3

The glitch causes a problem in the next stage (stage three) if the glitch is still present when the next rising clock edge appears (clock pulse 4). To ensure that this does not happen, the clock frequency must be less than the inverse of the sum of the clock-to-RCO propagation delay and the glitch duration ( $t_g$ ). In other words,  $f_{\max} = 1/(t_{pd} \text{ CLK-to-RCO} + t_g)$ . For example, at 25°C at 4.5-V  $V_{CC}$ , the clock-to-RCO propagation delay is 43 ns and the maximum duration of the glitch is 12 ns. Therefore, the maximum clock frequency that the cascaded counters can use is 18 MHz. The following tables contain the  $f_{\text{clock}}$ ,  $t_w$ , and  $f_{\max}$  specifications for applications that use more than two 'HC161 devices cascaded together.

# SN54HC161, SN74HC161 4-BIT SYNCHRONOUS BINARY COUNTERS

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## APPLICATION INFORMATION

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

|                                       | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     | SN54HC161 |     | SN74HC161 |     | UNIT |
|---------------------------------------|----------|--------------------------|-----|-----------|-----|-----------|-----|------|
|                                       |          | MIN                      | MAX | MIN       | MAX | MIN       | MAX |      |
| $f_{\text{clock}}$ Clock frequency    | 2 V      |                          | 3.6 |           | 2.5 |           | 2.9 | MHz  |
|                                       | 4.5 V    |                          | 18  |           | 12  |           | 14  |      |
|                                       | 6 V      |                          | 21  |           | 14  |           | 17  |      |
| $t_W$ Pulse duration, CLK high or low | 2 V      | 140                      |     | 200       |     | 170       |     | ns   |
|                                       | 4.5 V    | 28                       |     | 40        |     | 36        |     |      |
|                                       | 6 V      | 24                       |     | 36        |     | 30        |     |      |

**switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Note 4)**

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     | SN54HC161 |     | SN74HC161 |     | UNIT |
|------------------|--------------|-------------|----------|--------------------------|-----|-----------|-----|-----------|-----|------|
|                  |              |             |          | MIN                      | MAX | MIN       | MAX | MIN       | MAX |      |
| $f_{\text{max}}$ |              |             | 2 V      | 3.6                      |     | 2.5       |     | 2.9       |     | MHz  |
|                  |              |             | 4.5 V    | 18                       |     | 12        |     | 14        |     |      |
|                  |              |             | 6 V      | 21                       |     | 14        |     | 17        |     |      |

NOTE 4: These limits apply only to applications that use more than two 'HC161 devices cascaded together.

If the 'HC161 devices are used as a single unit, or only two cascaded together, then the maximum clock frequency that the device can use is not limited because of the glitch. In these situations, the device can be operated at the maximum specifications.

A glitch can appear on RCO of a single 'HC161 device, depending on the relationship of ENT to CLK. Any application that uses RCO to drive any input except an ENT of another cascaded 'HC161 device must take this into consideration.



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)            | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|------------------------------------|-------------------------|
| 5962-8407501VEA  | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   |              | 5962-8407501VE<br>A<br>SNV54HC161J | <a href="#">Samples</a> |
| 5962-8407501VFA  | ACTIVE        | CFP          | W                  | 16   | 25             | TBD                        | A42                     | N / A for Pkg Type   |              | 5962-8407501VF<br>A<br>SNV54HC161W | <a href="#">Samples</a> |
| 84075012A        | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | 84075012A<br>SNJ54HC<br>161FK      | <a href="#">Samples</a> |
| 8407501EA        | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 8407501EA<br>SNJ54HC161J           | <a href="#">Samples</a> |
| 8407501FA        | ACTIVE        | CFP          | W                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 8407501FA<br>SNJ54HC161W           | <a href="#">Samples</a> |
| JM38510/66302BEA | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | JM38510/<br>66302BEA               | <a href="#">Samples</a> |
| JM38510/66302BFA | ACTIVE        | CFP          | W                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | JM38510/<br>66302BFA               | <a href="#">Samples</a> |
| M38510/66302BEA  | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | JM38510/<br>66302BEA               | <a href="#">Samples</a> |
| M38510/66302BFA  | ACTIVE        | CFP          | W                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | JM38510/<br>66302BFA               | <a href="#">Samples</a> |
| SN54HC161J       | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | SN54HC161J                         | <a href="#">Samples</a> |
| SN74HC161D       | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                              | <a href="#">Samples</a> |
| SN74HC161DE4     | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                              | <a href="#">Samples</a> |
| SN74HC161DG4     | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                              | <a href="#">Samples</a> |
| SN74HC161DR      | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                              | <a href="#">Samples</a> |
| SN74HC161DRE4    | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                              | <a href="#">Samples</a> |
| SN74HC161DRG4    | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                              | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)       | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------------|-------------------------|
| SN74HC161DT      | ACTIVE        | SOIC         | D                  | 16   | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                         | <a href="#">Samples</a> |
| SN74HC161N       | ACTIVE        | PDIP         | N                  | 16   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | -40 to 85    | SN74HC161N                    | <a href="#">Samples</a> |
| SN74HC161N3      | OBSOLETE      | PDIP         | N                  | 16   |                | TBD                        | Call TI                 | Call TI              | -40 to 85    |                               |                         |
| SN74HC161NE4     | ACTIVE        | PDIP         | N                  | 16   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | -40 to 85    | SN74HC161N                    | <a href="#">Samples</a> |
| SN74HC161NSR     | ACTIVE        | SO           | NS                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                         | <a href="#">Samples</a> |
| SN74HC161PW      | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                         | <a href="#">Samples</a> |
| SN74HC161PWG4    | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                         | <a href="#">Samples</a> |
| SN74HC161PWR     | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                         | <a href="#">Samples</a> |
| SN74HC161PWT     | ACTIVE        | TSSOP        | PW                 | 16   | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | HC161                         | <a href="#">Samples</a> |
| SNJ54HC161FK     | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | 84075012A<br>SNJ54HC<br>161FK | <a href="#">Samples</a> |
| SNJ54HC161J      | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 8407501EA<br>SNJ54HC161J      | <a href="#">Samples</a> |
| SNJ54HC161W      | ACTIVE        | CFP          | W                  | 16   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 8407501FA<br>SNJ54HC161W      | <a href="#">Samples</a> |

(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)

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

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> 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.

<sup>(6)</sup> 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 SN54HC161, SN54HC161-SP, SN74HC161 :**

● Catalog: [SN74HC161](#), [SN54HC161](#)

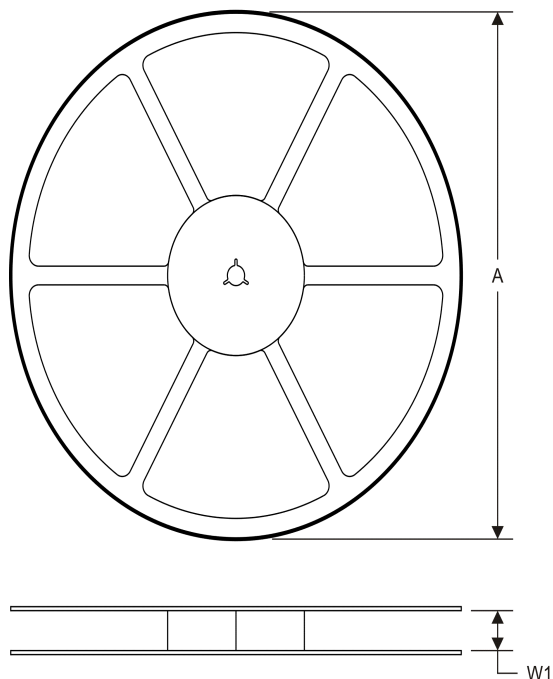
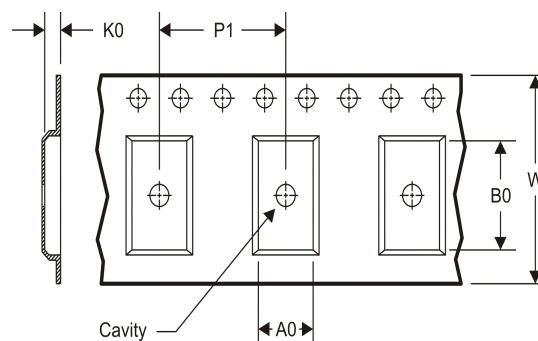
● Military: [SN54HC161](#)

● Space: [SN54HC161-SP](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application



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

**TAPE DIMENSIONS**


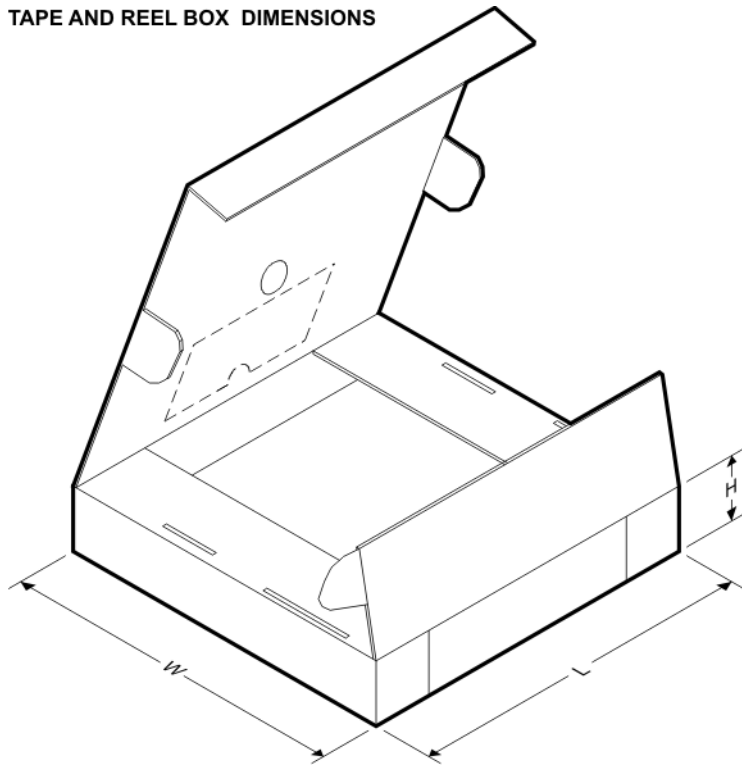
|    |                                                           |
|----|-----------------------------------------------------------|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC161DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC161NSR | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74HC161PWR | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC161PWT | TSSOP        | PW              | 16   | 250  | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



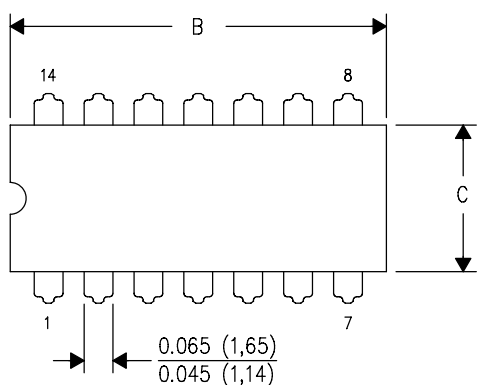
\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC161DR  | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| SN74HC161NSR | SO           | NS              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| SN74HC161PWR | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| SN74HC161PWT | TSSOP        | PW              | 16   | 250  | 367.0       | 367.0      | 35.0        |

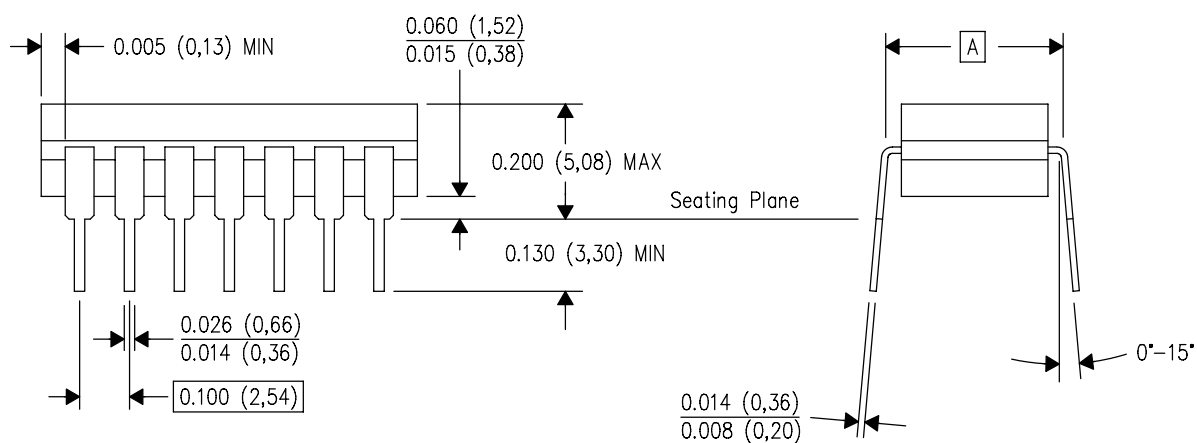
J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



| PINS **<br>DIM | 14                     | 16                     | 18                     | 20                     |
|----------------|------------------------|------------------------|------------------------|------------------------|
| A              | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX          | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN          | —                      | —                      | —                      | —                      |
| C MAX          | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN          | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |

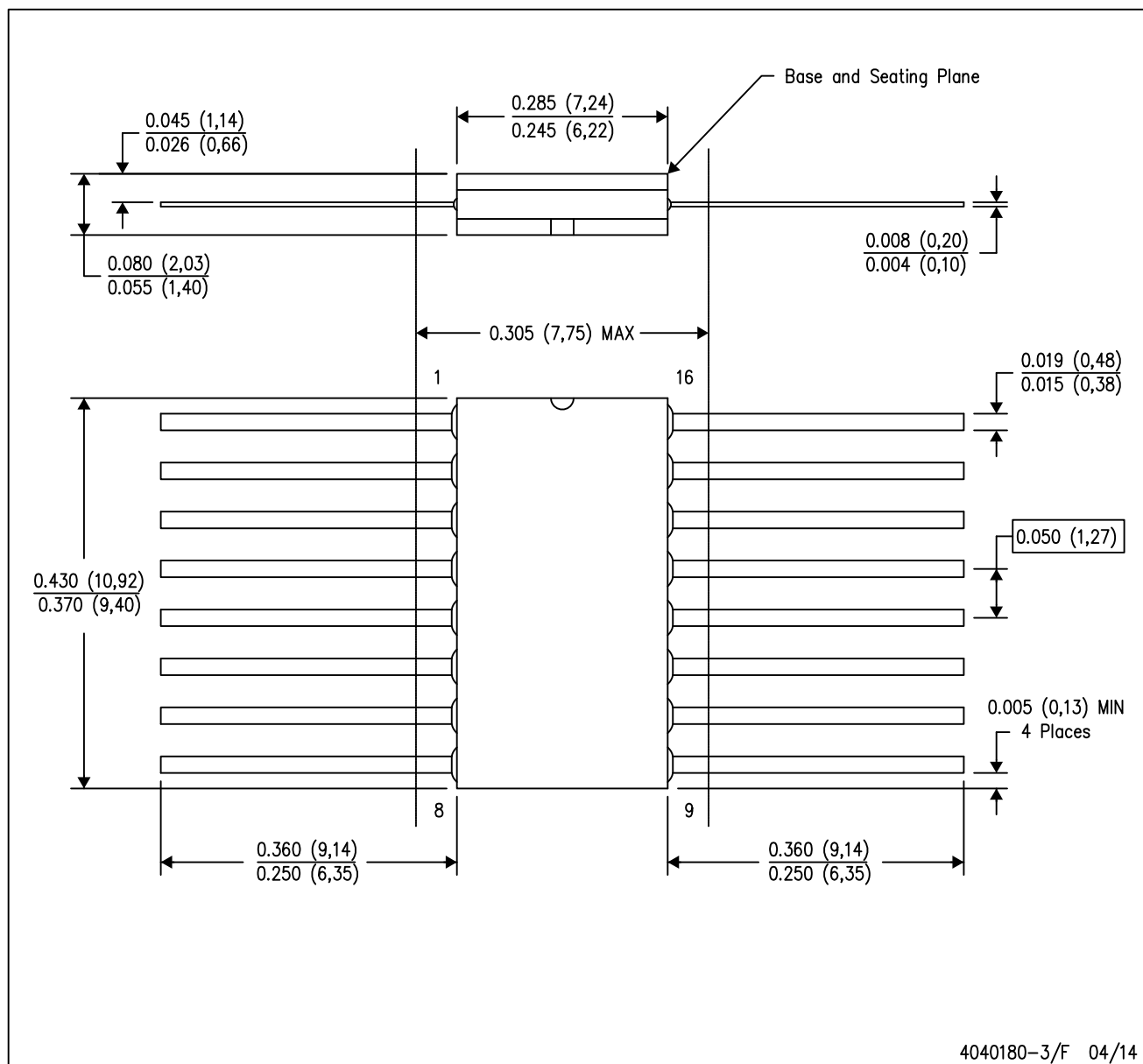


4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

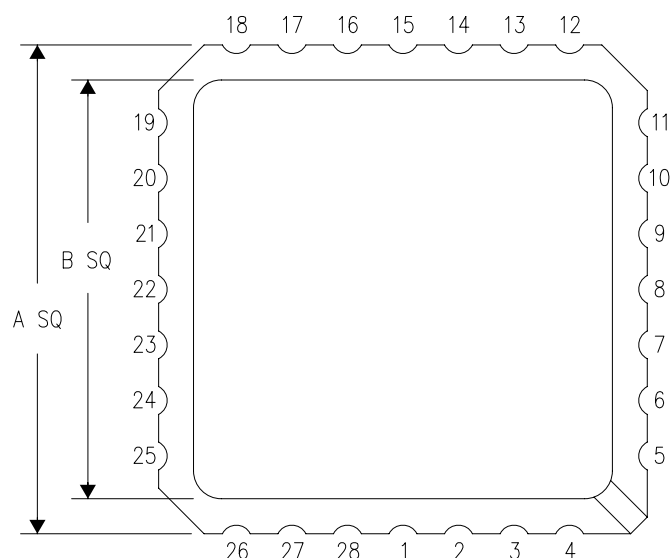
CERAMIC DUAL FLATPACK



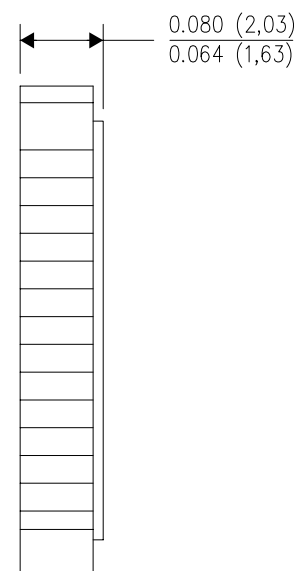
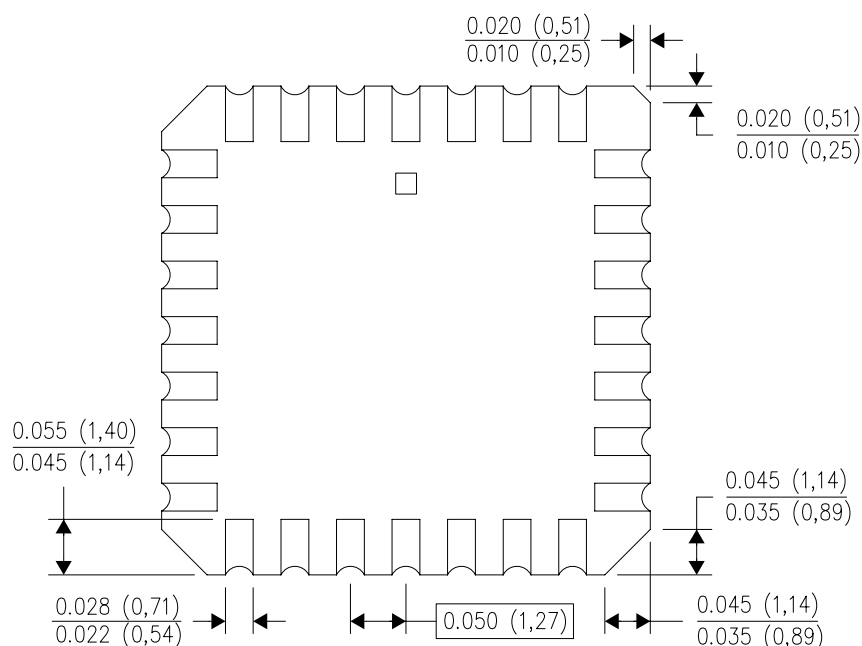
FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF<br>TERMINALS<br>** | A                |                  | B                |                  |
|---------------------------|------------------|------------------|------------------|------------------|
|                           | MIN              | MAX              | MIN              | MAX              |
| 20                        | 0.342<br>(8,69)  | 0.358<br>(9,09)  | 0.307<br>(7,80)  | 0.358<br>(9,09)  |
| 28                        | 0.442<br>(11,23) | 0.458<br>(11,63) | 0.406<br>(10,31) | 0.458<br>(11,63) |
| 44                        | 0.640<br>(16,26) | 0.660<br>(16,76) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 52                        | 0.740<br>(18,78) | 0.761<br>(19,32) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 68                        | 0.938<br>(23,83) | 0.962<br>(24,43) | 0.850<br>(21,6)  | 0.858<br>(21,8)  |
| 84                        | 1.141<br>(28,99) | 1.165<br>(29,59) | 1.047<br>(26,6)  | 1.063<br>(27,0)  |



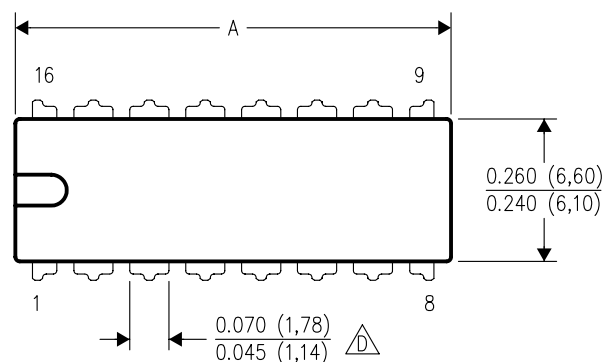
4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

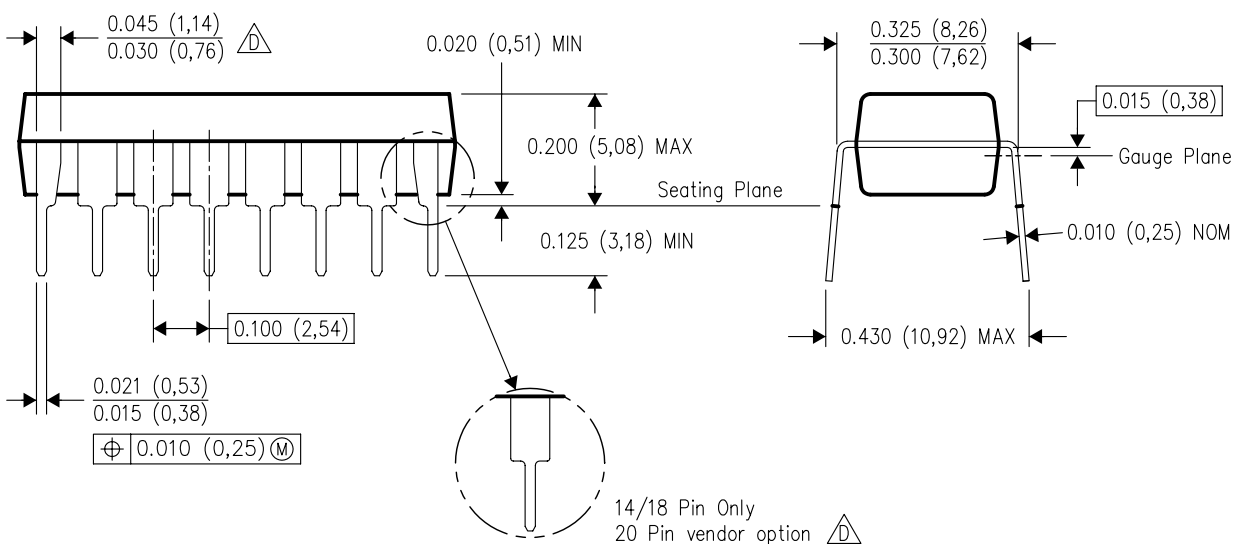
N (R-PDIP-T\*\*)

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               |



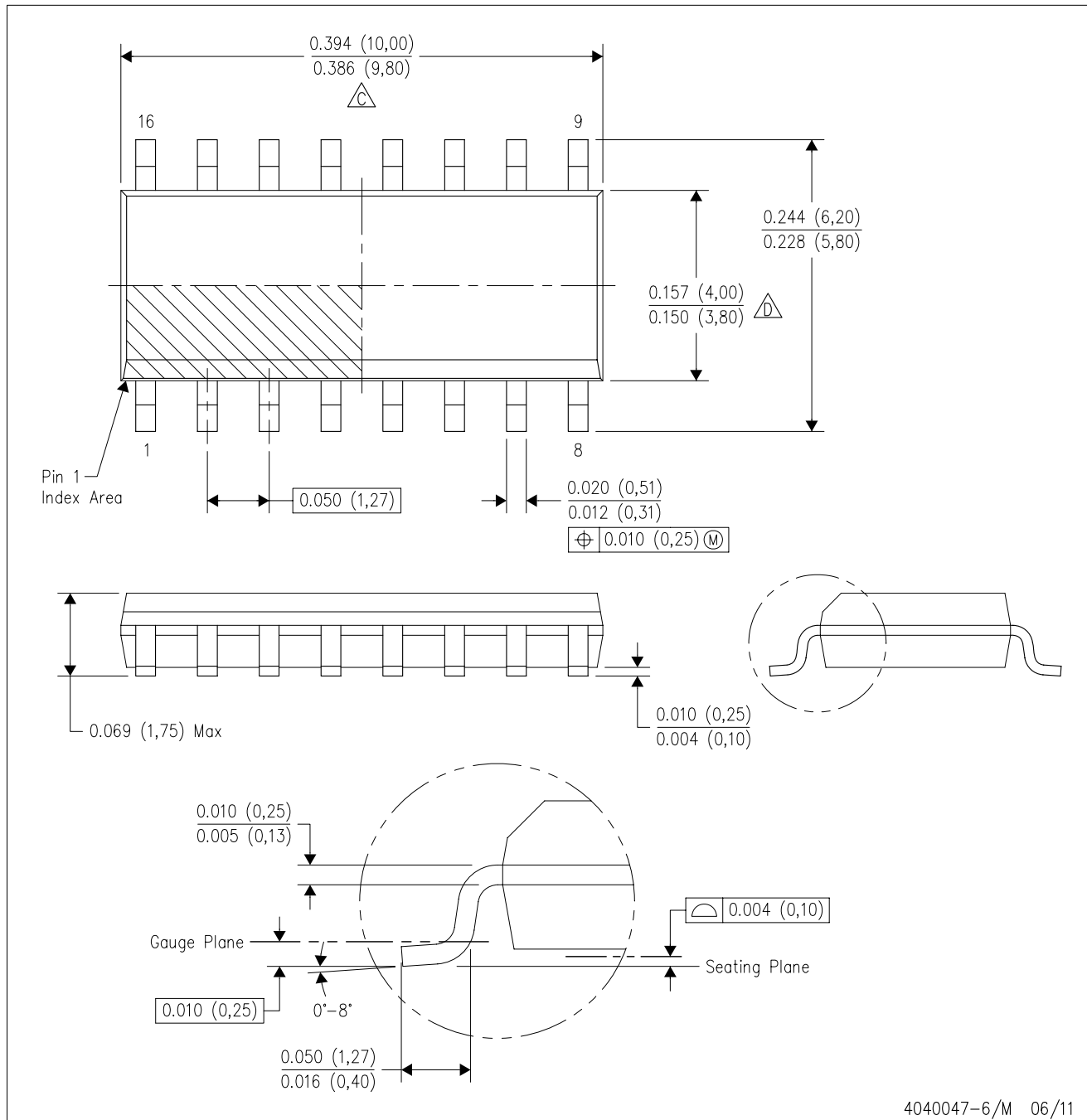
4040049/E 12/2002

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-G16)

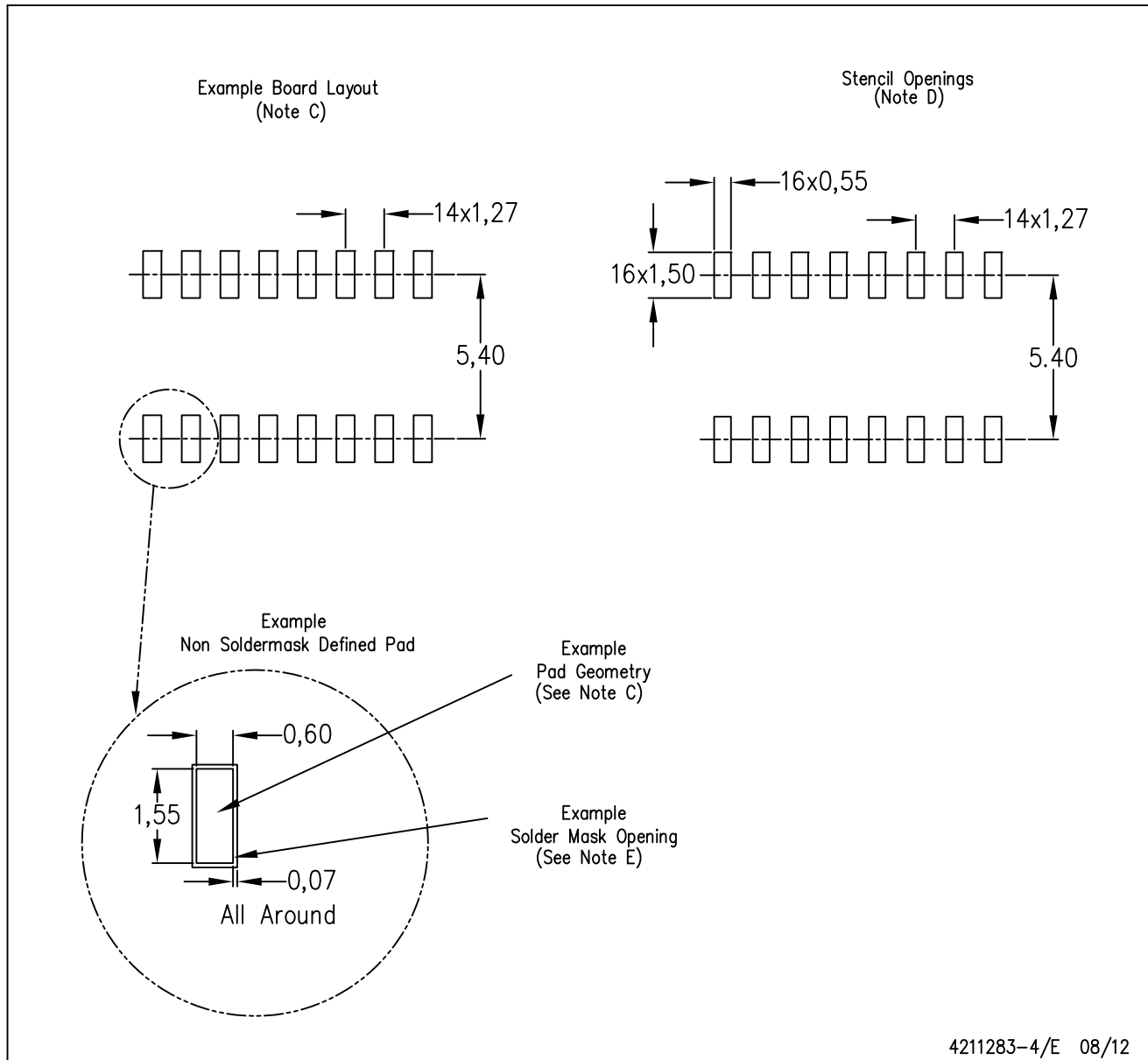
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  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.
  - $\triangle D$  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.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

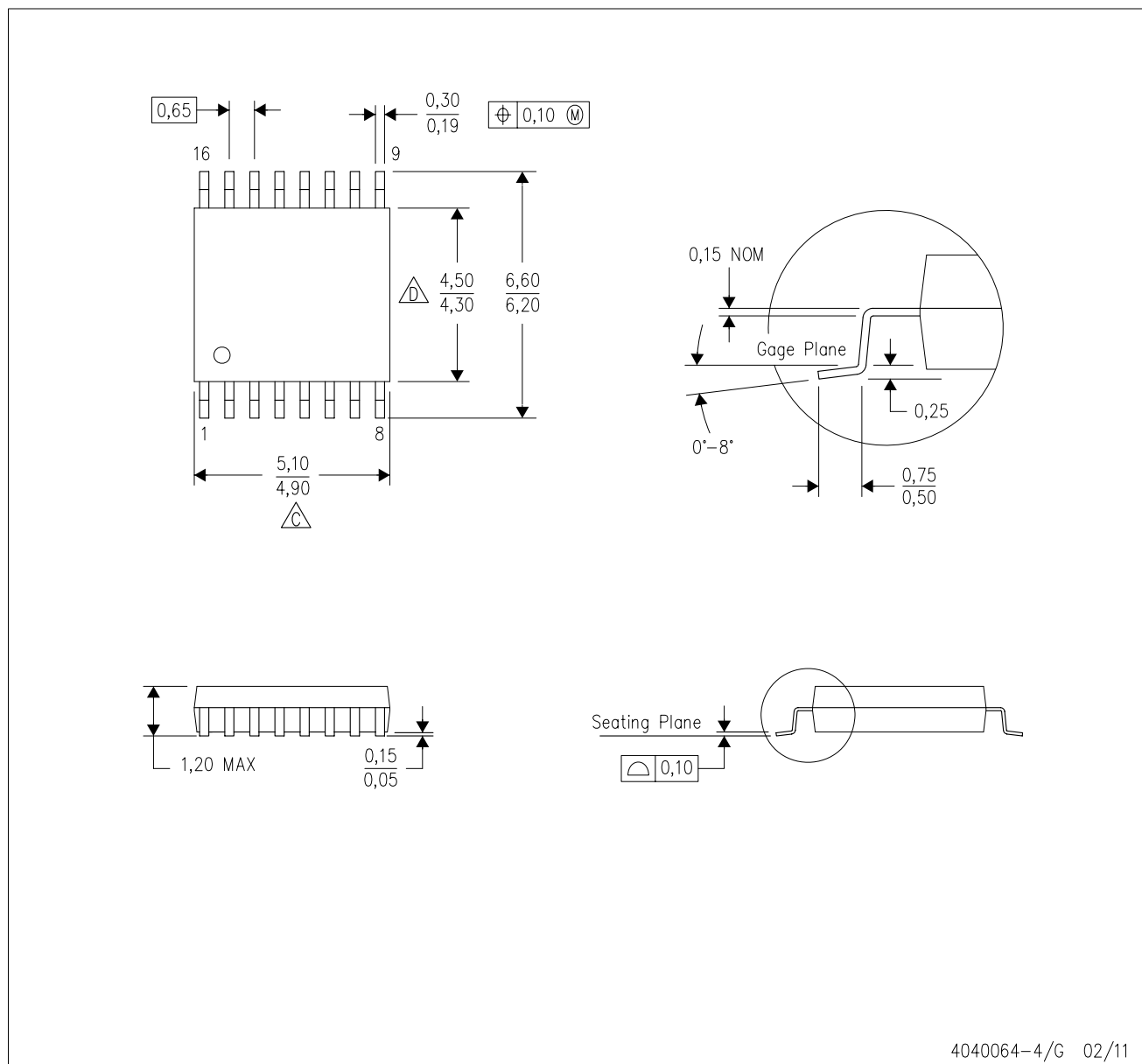


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers 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-G16)

PLASTIC SMALL OUTLINE

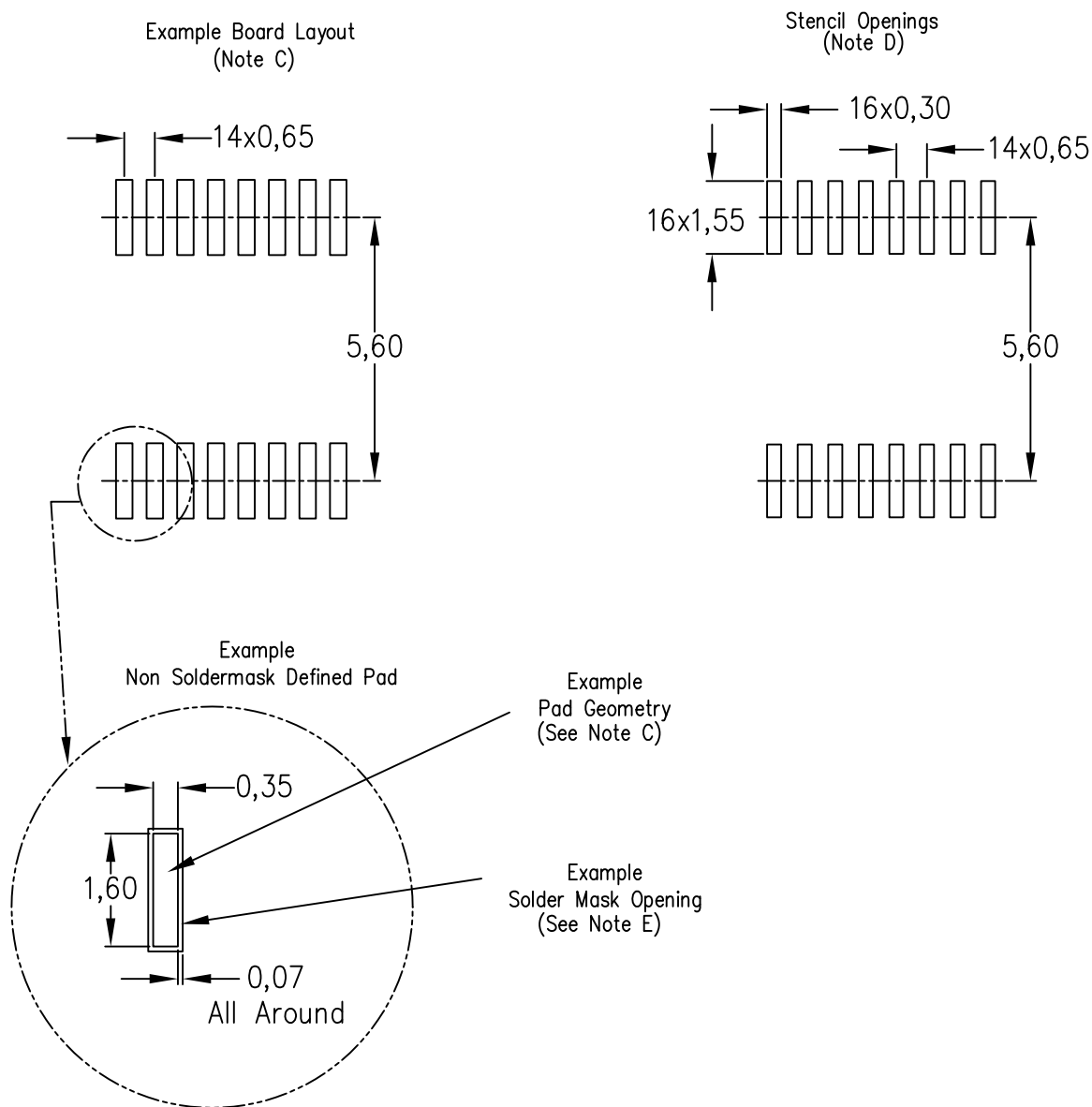


4040064-4/G 02/11

- 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.
  - 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-G16)

PLASTIC SMALL OUTLINE



4211284-3/F 12/12

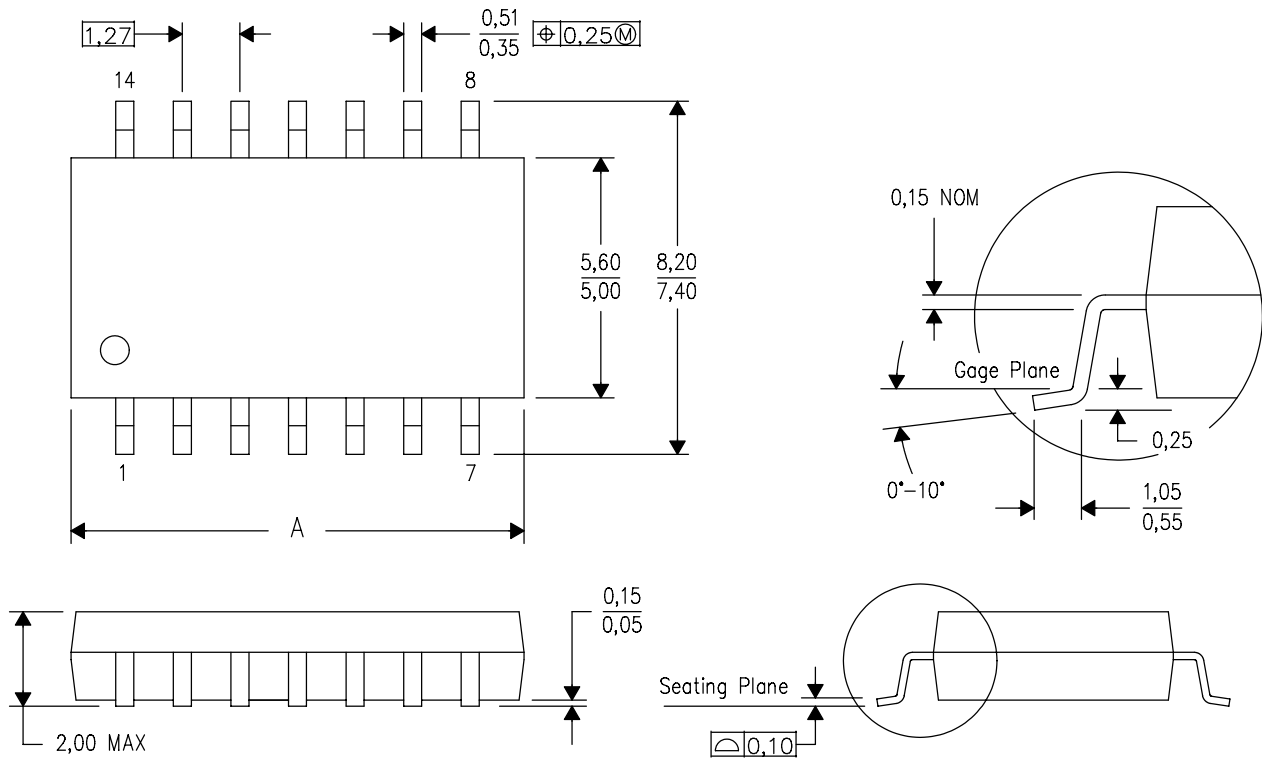
- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers 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.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



| DIM \ PINS ** | 14    | 16    | 20    | 24    |
|---------------|-------|-------|-------|-------|
| A MAX         | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN         | 9,90  | 9,90  | 12,30 | 14,70 |

4040062/C 03/03

- 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.

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