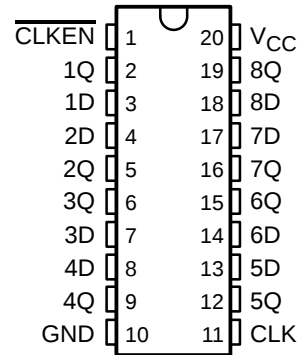


# SN54HC377, SN74HC377 OCTAL D-TYPE FLIP-FLOPS WITH CLOCK ENABLE

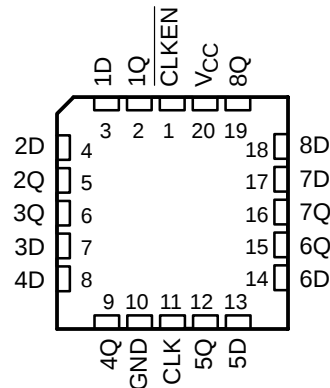
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- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 12$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Eight Flip-Flops With Single-Rail Outputs
- Clock Enable Latched to Avoid False Clocking
- Applications Include:
  - Buffer/Storage Registers
  - Shift Registers
  - Pattern Generators

SN54HC377 . . . J OR W PACKAGE  
SN74HC377 . . . DW, N, OR NS PACKAGE  
(TOP VIEW)



SN54HC377 . . . FK PACKAGE  
(TOP VIEW)



## description/ordering information

These devices are positive-edge-triggered octal D-type flip-flops with an enable input. The 'HC377 devices are similar to the 'HC273 devices, but feature a latched clock-enable (CLKEN) input instead of a common clear.

Information at the data (D) inputs meeting the setup time requirements is transferred to the Q outputs on the positive-going edge of the clock (CLK) pulse, if CLKEN is low. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When CLK is at either the high or low level, the D input has no effect at the output. These devices are designed to prevent false clocking by transitions at CLKEN.

## ORDERING INFORMATION

| $T_A$          | PACKAGE <sup>†</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------------------|---------------|-----------------------|------------------|
| –40°C to 85°C  | PDIP – N             | Tube          | SN74HC377N            | SN74HC377N       |
|                | SOIC – DW            | Tube          | SN74HC377DW           |                  |
|                |                      | Tape and reel | SN74HC377DWR          | HC377            |
|                | SOP – NS             | Tape and reel | SN74HC377NSR          |                  |
| –55°C to 125°C | CDIP – J             | Tube          | SNJ54HC377J           | SNJ54HC377J      |
|                | CFP – W              | Tube          | SNJ54HC377W           | SNJ54HC377W      |
|                | LCCC – FK            | Tube          | SNJ54HC377FK          | SNJ54HC377FK     |

<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).



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

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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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

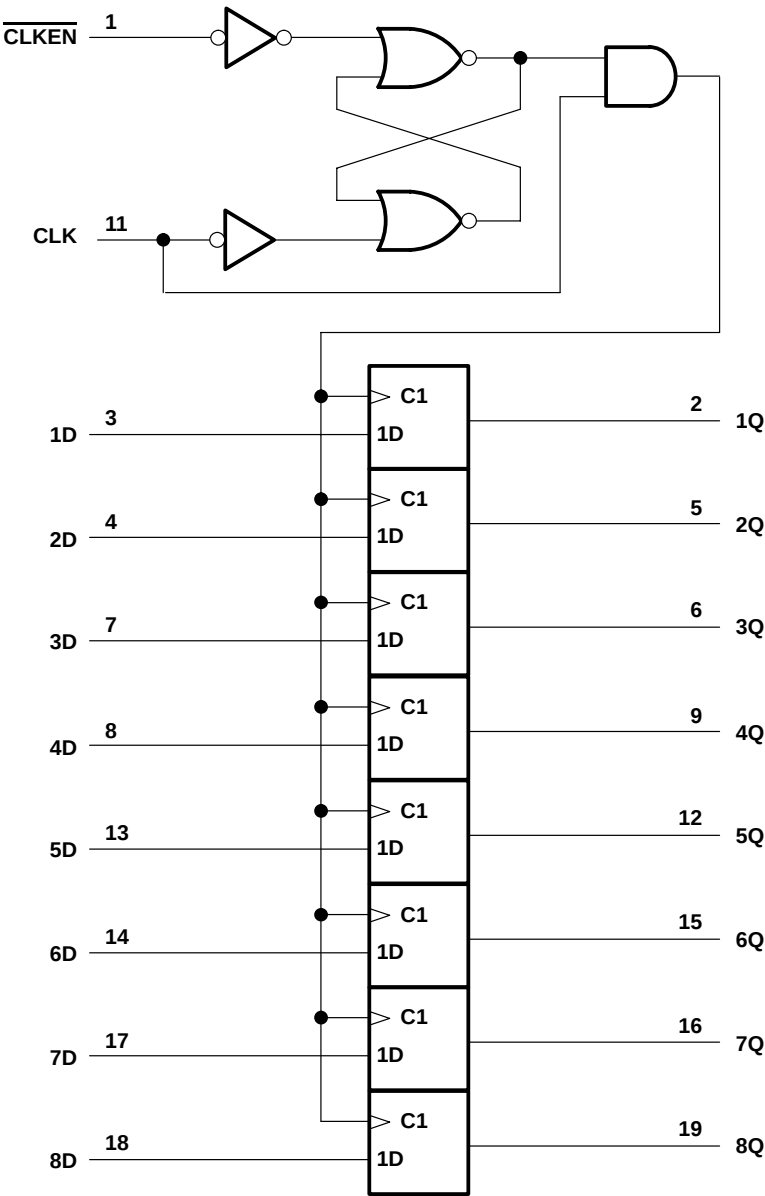
SN54HC377, SN74HC377  
OCTAL D-TYPE FLIP-FLOPS  
WITH CLOCK ENABLE

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FUNCTION TABLE  
(each flip-flop)

| INPUTS |     |   | OUTPUT<br>Q    |
|--------|-----|---|----------------|
| CLKEN  | CLK | D |                |
| H      | X   | X | Q <sub>0</sub> |
| L      | ↑   | H | H              |
| L      | ↑   | L | L              |
| X      | L   | X | Q <sub>0</sub> |

logic diagram (positive logic)



# SN54HC377, SN74HC377 OCTAL D-TYPE FLIP-FLOPS WITH CLOCK ENABLE

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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): DW package           | 58°C/W         |
| N package                                                                   | 69°C/W         |
| NS package                                                                  | 60°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)

|                 |                                 |                         | SN54HC377 |                 |     | SN74HC377 |                 |     | 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           | 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.

# SN54HC377, SN74HC377

## OCTAL D-TYPE FLIP-FLOPS

### WITH CLOCK ENABLE

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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 |       |      | SN54HC377 |       | SN74HC377 |       | 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 |     | SN54HC377 |     | SN74HC377 |     | UNIT |
|--------------------|---------------------------------------|-----------------|-----------------------|-----|-----------|-----|-----------|-----|------|
|                    |                                       |                 | MIN                   | MAX | MIN       | MAX | MIN       | MAX |      |
| f <sub>clock</sub> | Clock frequency                       | 2 V             |                       | 5   |           | 3   |           | 4   | MHz  |
|                    |                                       | 4.5 V           |                       | 25  |           | 16  |           | 20  |      |
|                    |                                       | 6 V             |                       | 29  |           | 19  |           | 23  |      |
| t <sub>w</sub>     | Pulse duration, CLK high or low       | 2 V             | 100                   |     | 150       |     | 125       |     | ns   |
|                    |                                       | 4.5 V           | 20                    |     | 30        |     | 25        |     |      |
|                    |                                       | 6 V             | 17                    |     | 25        |     | 21        |     |      |
| t <sub>su</sub>    | D                                     | 2 V             | 100                   |     | 150       |     | 125       |     | ns   |
|                    |                                       | 4.5 V           | 20                    |     | 30        |     | 25        |     |      |
|                    |                                       | 6 V             | 17                    |     | 25        |     | 21        |     |      |
|                    | <u>CLKEN</u> high or low              | 2 V             | 100                   |     | 150       |     | 125       |     |      |
|                    |                                       | 4.5 V           | 20                    |     | 30        |     | 25        |     |      |
|                    |                                       | 6 V             | 17                    |     | 25        |     | 21        |     |      |
| t <sub>h</sub>     | <u>CLKEN</u> inactive or active, data | 2 V             | 5                     |     | 5         |     | 5         |     | ns   |
|                    |                                       | 4.5 V           | 5                     |     | 5         |     | 5         |     |      |
|                    |                                       | 6 V             | 5                     |     | 5         |     | 5         |     |      |

# SN54HC377, SN74HC377 OCTAL D-TYPE FLIP-FLOPS WITH CLOCK ENABLE

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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) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC377 |     | SN74HC377 |     | UNIT |
|------------|-----------------|----------------|----------|--------------------------|-----|-----|-----------|-----|-----------|-----|------|
|            |                 |                |          | MIN                      | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| $f_{\max}$ |                 |                | 2 V      | 5                        | 11  |     | 3         |     | 4         |     | MHz  |
|            |                 |                | 4.5 V    | 25                       | 54  |     | 16        |     | 20        |     |      |
|            |                 |                | 6 V      | 29                       | 64  |     | 19        |     | 23        |     |      |
| $t_{pd}$   | CLK             | Any            | 2 V      |                          | 56  | 160 |           | 240 |           | 200 | ns   |
|            |                 |                | 4.5 V    |                          | 15  | 32  |           | 48  |           | 40  |      |
|            |                 |                | 6 V      |                          | 12  | 27  |           | 41  |           | 34  |      |
| $t_t$      |                 | Any            | 2 V      |                          | 38  | 75  |           | 110 |           | 95  | ns   |
|            |                 |                | 4.5 V    |                          | 8   | 15  |           | 22  |           | 19  |      |
|            |                 |                | 6 V      |                          | 6   | 13  |           | 19  |           | 16  |      |

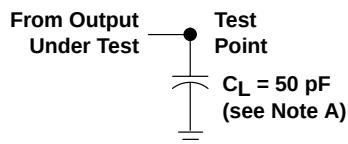
operating characteristics,  $T_A = 25^\circ\text{C}$

| PARAMETER |                                             | TEST CONDITIONS | TYP | UNIT |
|-----------|---------------------------------------------|-----------------|-----|------|
| $C_{pd}$  | Power dissipation capacitance per flip-flop | No load         | 30  | pF   |

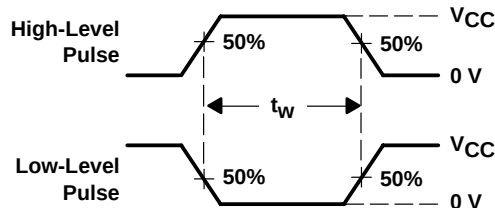
# SN54HC377, SN74HC377 OCTAL D-TYPE FLIP-FLOPS WITH CLOCK ENABLE

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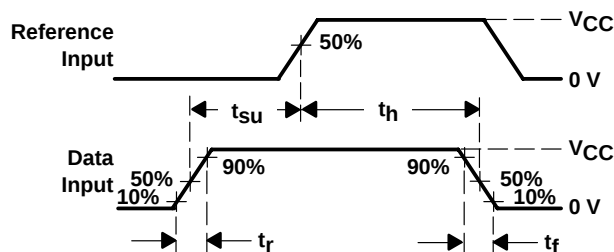
## PARAMETER MEASUREMENT INFORMATION



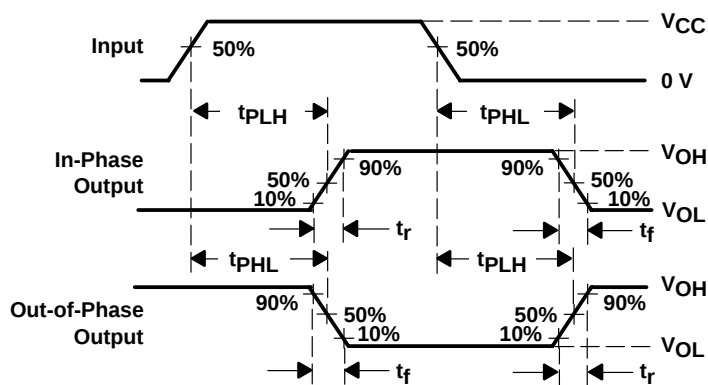
LOAD CIRCUIT



VOLTAGE WAVEFORMS  
PULSE DURATIONS



VOLTAGE WAVEFORMS  
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

- 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

## PACKAGING INFORMATION

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup>               |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--------------------------------------------|
| 5962-87807012A   | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC                             |
| 5962-8780701RA   | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC                             |
| SN54HC377J       | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC                             |
| SN74HC377DW      | ACTIVE                | SOIC         | DW              | 20   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-250C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74HC377DWR     | ACTIVE                | SOIC         | DW              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-250C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74HC377N       | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC                             |
| SN74HC377NSR     | ACTIVE                | SO           | NS              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| SNJ54HC377FK     | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC                             |
| SNJ54HC377J      | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC                             |

<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) 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.

**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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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.

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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- 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.
  - The terminals are gold plated.
  - Falls within JEDEC MS-004

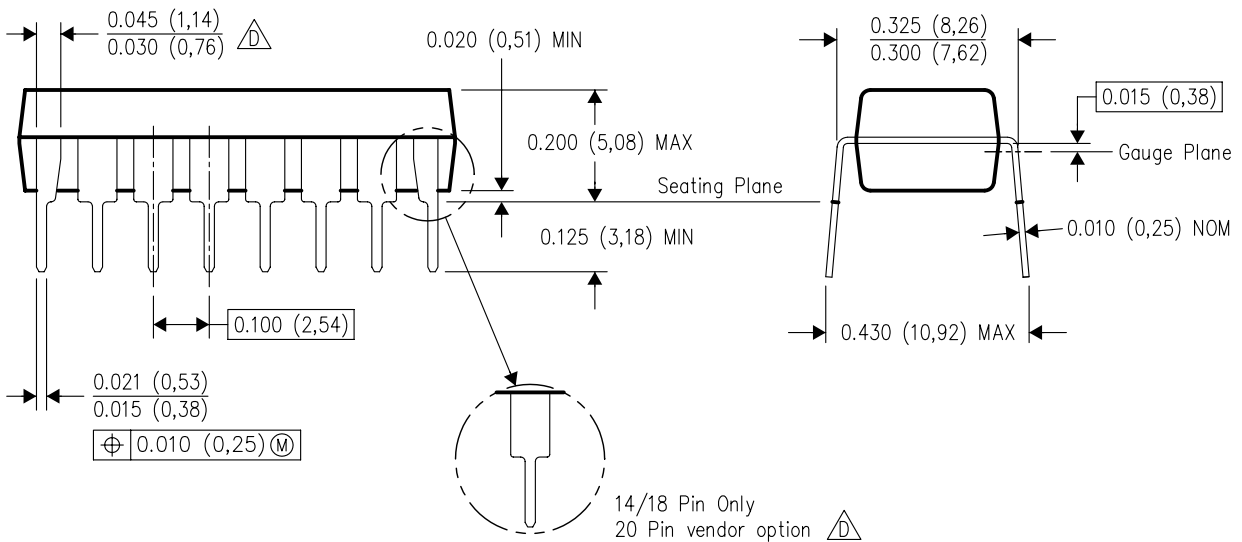
## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **             | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| DIM                 |                  |                  |                  |                  |
| 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               |



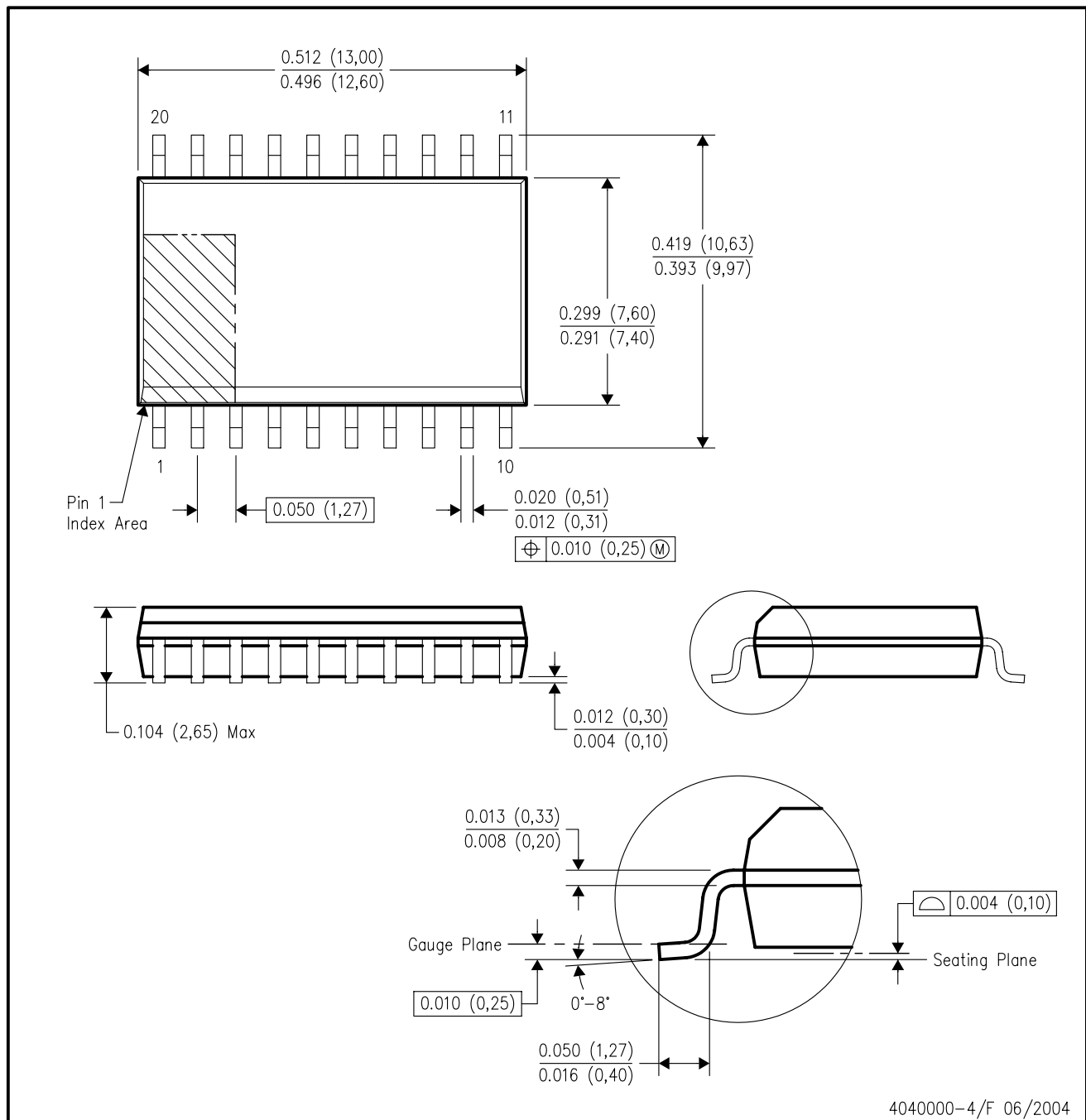
14/18 Pin Only  
20 Pin vendor option

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.

## DW (R-PDSO-G20)

## PLASTIC SMALL-OUTLINE PACKAGE



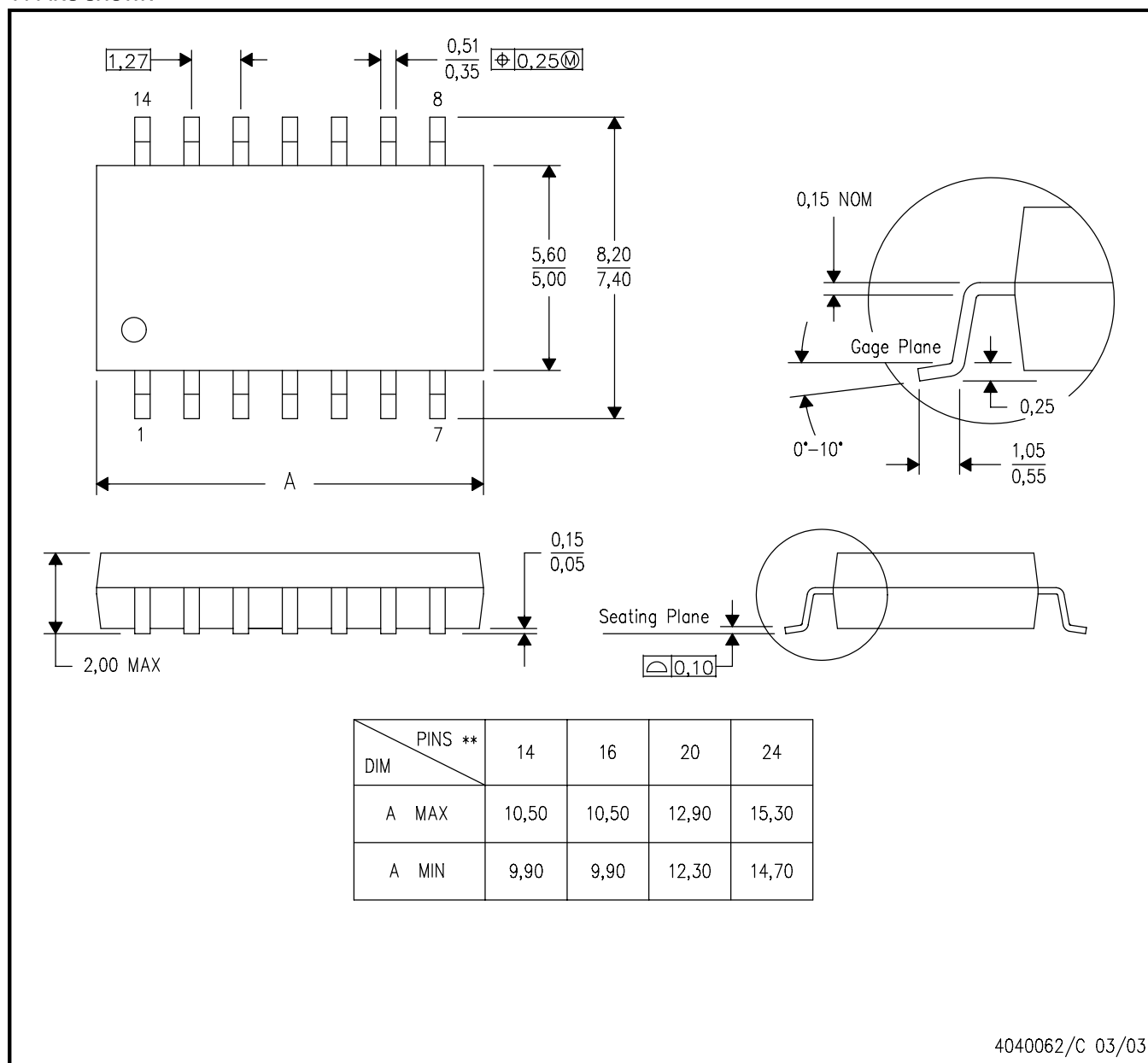
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-013 variation AC.

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



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

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