

# CD4016B Types CMOS Quad Bilateral Switch

## 1 Features

- 20V digital or  $\pm 10$ V peak-to-peak switching
- 280 $\Omega$  typical on-state resistance for 15V operation
- Switch on-state resistance matched to within 10 $\Omega$  typ over 15V signal-input range
- High on/off output-voltage ratio: 65dB typ at  $f_{is} = 10$ kHz,  $R_L = 10$ k $\Omega$
- High degree of linearity: <0.5% distortion typ at  $f_{is} = 1$ kHz,  $V_{is} = 5V_{p-p}$ ,  $V_{DD} - V_{SS} \leq 10$ V,  $R_L = 10$ k $\Omega$
- Extremely low off-state switch leakage resulting in very low offset current and high effective off-state resistance: 100pA typ. at  $V_{DD} - V_{SS} = 18$ V,  $T_A = 25^\circ\text{C}$
- Extremely high control input impedance (control circuit isolated from signal circuit:  $10^{12}\Omega$  typ.
- Low crosstalk between switches: -50dB typ at  $f_{is} = 0.9$ MHz,  $R_L = 1$ k $\Omega$
- Matched control-input to signal-output capacitance: Reduces output signal transients
- Frequency response, switch on = 40MHz (typical)
- 100% tested for quiescent current at 20V
- Maximum control input current of 1 $\mu$ A at 18V over full package temperature range; 100nA at 18V at 25 $^\circ\text{C}$
- 5V, 10V, and 15V parametric ratings

## 2 Applications

- Analog signal switching/multiplexing signal gating
- Modulator squelch control
- Demodulator chopper
- Commutating switch
- Digital signal switching/multiplexing
- CMOS logic implementation
- Analog-to-digital and digital-to-analog conversion
- Digital control of frequency, impedance, phase, and analog-signal gain

## 3 Description

For transmission or multiplexing of analog or digital signals high-voltage types (20V rating).

CD4016B *B* Series types are quad bilateral switches intended for the transmission or multiplexing of analog or digital signals. Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch on or off.

The CD4016B *B* Series types are supplied in 14-lead hermetic dual-in-line ceramic packages (F3A suffix), 14-lead dual-in-line plastic packages (E suffix), 14-lead small-outline packages (M, MT, M96, and NSR suffixes), and 14-lead thin shrink small-outline packages (PW and PWR suffixes).

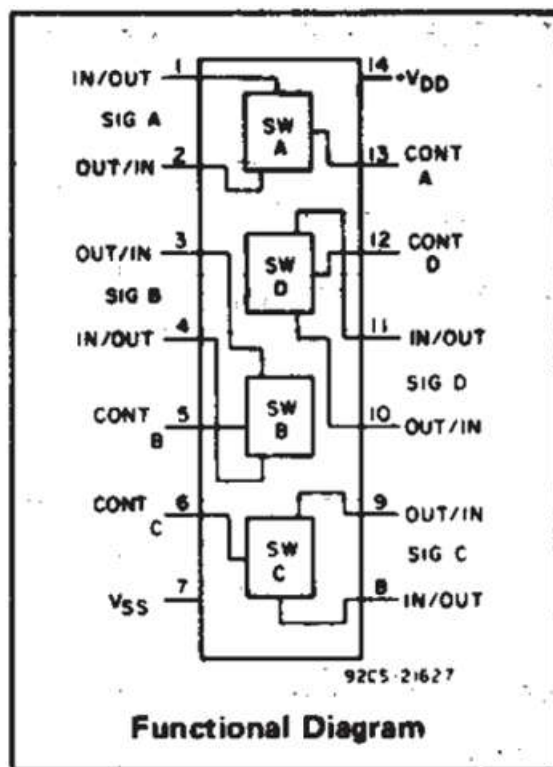
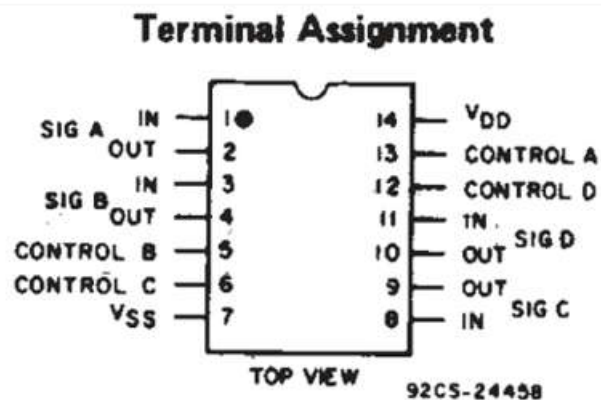
### Package Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | PACKAGE SIZE <sup>(2)</sup> |
|-------------|------------------------|-----------------------------|
| CD4016B     | N (PDIP, 14)           | 19.3mm $\times$ 9.4mm       |
|             | D (SOIC, 14)           | 8.65mm $\times$ 6mm         |

(1) For more information, see [Section 8](#).

(2) The package size (length  $\times$  width) is a nominal value and includes pins, where applicable.





Schematic Diagram - 1 of 4 Identical Sections

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## 4 Specifications

### 4.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1) (2)</sup>

|                       |                                                               | MIN          | MAX          | UNIT |
|-----------------------|---------------------------------------------------------------|--------------|--------------|------|
| $V_{DD} - V_{SS}$     | Supply voltage                                                |              | 20           | V    |
| $V_{DD}$              |                                                               | -0.5         | 20           | V    |
| $V_{SS}$              |                                                               | -20          | 0.5          | V    |
| $I_{SEL}$ or $I_{EN}$ | Logic control input pin current ( $\overline{EN}$ , Ax, SELx) | -30          | 30           | mA   |
| $V_S$ or $V_D$        | Source or drain voltage (Sx, D)                               | $V_{SS}-0.5$ | $V_{DD}+0.5$ | V    |
| $I_S$ or $I_D$ (CONT) | Source or drain continuous current (Sx, D)                    | -20          | 20           | mA   |
| $T_J$                 | Junction temperature                                          |              | 150          | °C   |
| $T_{stg}$             | Storage temperature                                           | -65          | 150          | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Rating* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to ground, unless otherwise specified.

### 4.2 ESD Ratings

|             |                         |                                                                                          | VALUE | UNIT |
|-------------|-------------------------|------------------------------------------------------------------------------------------|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>              | ±500  | V    |
|             |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | ±1500 |      |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 4.3 Recommended Operating Conditions

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

|                                  |                                                                | MIN      | NOM | MAX      | UNIT |
|----------------------------------|----------------------------------------------------------------|----------|-----|----------|------|
| $V_{DD} - V_{SS}$ <sup>(1)</sup> | Power supply voltage differential                              | 3        |     | 18       | V    |
| $V_{DD}$                         | Positive power supply voltage                                  | 3        |     | 18       | V    |
| $V_S$ or $V_D$                   | Signal path input/output voltage (source or drain pin) (Sx, D) | $V_{SS}$ |     | $V_{DD}$ | V    |
| $V_{SEL}$ or $V_{EN}$            | Address or enable pin voltage                                  | 0        |     | $V_{DD}$ | V    |
| $I_S$ or $I_D$ (CONT)            | Source or drain continuous current (Sx, D)                     | -10      |     | 10       | mA   |
| $T_A$                            | Ambient temperature                                            | -55      |     | 125      | °C   |

- (1)  $V_{DD}$  and  $V_{SS}$  can be any value as long as  $3V \leq (V_{DD} - V_{SS}) \leq 24V$ , and the minimum  $V_{DD}$  is met.

## 4.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | CD4016   |          | UNIT |
|-------------------------------|----------------------------------------------|----------|----------|------|
|                               |                                              | N (PDIP) | D (SOIC) |      |
|                               |                                              | 14 PINS  | 14 PINS  |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 93.7     | 109.7    | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 72.5     | 69.4     | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 68.0     | 67.9     | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 50.3     | 25.8     | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 67.3     | 67.1     | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 4.5 Electrical Characteristics

Over operating free-air temperature range,  $V_{SUPPLY} = \pm 5V$ , and  $R_L = 100\Omega$ , (unless otherwise noted)<sup>(1)</sup>

| PARAMETER                                                       |                          | TEST CONDITIONS                                     |                        |  |  | MIN | TYP | MAX | UNIT |
|-----------------------------------------------------------------|--------------------------|-----------------------------------------------------|------------------------|--|--|-----|-----|-----|------|
| SIGNAL INPUTS (V <sub>IS</sub> ) AND OUTPUTS (V <sub>OS</sub> ) |                          |                                                     |                        |  |  |     |     |     |      |
| I <sub>DD</sub>                                                 | Quiescent Device Current | V <sub>is</sub> = 0 to 5V<br>V <sub>DD</sub> = 5V   | T <sub>A</sub> = −55°C |  |  |     |     | 5   | μA   |
|                                                                 |                          |                                                     | T <sub>A</sub> = −40°C |  |  |     |     | 5   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 25°C  |  |  | 4.5 |     | 6   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 85°C  |  |  |     |     | 7.5 |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 125°C |  |  |     |     | 7.5 |      |
|                                                                 |                          | V <sub>is</sub> = 0 to 10V<br>V <sub>DD</sub> = 10V | T <sub>A</sub> = −55°C |  |  |     |     | 6   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = −40°C |  |  |     |     | 6   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 25°C  |  |  | 5   |     | 7   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 85°C  |  |  |     |     | 15  |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 125°C |  |  |     |     | 15  |      |
|                                                                 |                          | V <sub>is</sub> = 0 to 15V<br>V <sub>DD</sub> = 15V | T <sub>A</sub> = −55°C |  |  |     |     | 7   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = −40°C |  |  |     |     | 7.2 |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 25°C  |  |  | 6   |     | 8   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 85°C  |  |  |     |     | 30  |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 125°C |  |  |     |     | 30  |      |
|                                                                 |                          | V <sub>is</sub> = 0 to 20V<br>V <sub>DD</sub> = 20V | T <sub>A</sub> = −55°C |  |  |     |     | 8.5 |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = −40°C |  |  |     |     | 8.5 |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 25°C  |  |  | 6.5 |     | 9   |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 85°C  |  |  |     |     | 150 |      |
|                                                                 |                          |                                                     | T <sub>A</sub> = 125°C |  |  |     |     | 150 |      |

## 4.5 Electrical Characteristics (continued)

Over operating free-air temperature range,  $V_{\text{SUPPLY}} = \pm 5\text{V}$ , and  $R_L = 100\Omega$ , (unless otherwise noted)<sup>(1)</sup>

| PARAMETER        |                                                            | TEST CONDITIONS                                                                                                                                                             |                                                                                  |                        |  | MIN        | TYP  | MAX   | UNIT |
|------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------------|--|------------|------|-------|------|
| r <sub>ON</sub>  | ON Resistance r <sub>ON</sub> Max                          | to<br>(V <sub>DD</sub> +V <sub>SS</sub> )/2 ,<br>V <sub>C</sub> = V <sub>DD</sub> ,<br>RL = 10kΩ                                                                            | V <sub>DD</sub> = 10V<br>V <sub>is</sub> = V <sub>SS</sub> or<br>V <sub>DD</sub> | T <sub>A</sub> = −55°C |  |            |      | 600   | Ω    |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = −40°C |  |            |      | 610   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 25°C  |  |            | 250  | 660   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 85°C  |  |            |      | 840   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 125°C |  |            |      | 960   |      |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 10V<br>V <sub>is</sub> = 4.75 to<br>5.75V                      | T <sub>A</sub> = −55°C |  |            |      | 1870  |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = −40°C |  |            |      | 1900  |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 25°C  |  |            |      | 2000  |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 85°C  |  |            |      | 2380  |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 125°C |  |            |      | 2600  |      |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 15V<br>V <sub>is</sub> = V <sub>SS</sub> or<br>V <sub>DD</sub> | T <sub>A</sub> = −55°C |  |            |      | 360   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = −40°C |  |            |      | 370   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 25°C  |  |            | 200  | 400   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 85°C  |  |            |      | 520   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 125°C |  |            |      | 600   |      |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 15V<br>V <sub>is</sub> = 7.25 to<br>7.75V                      | T <sub>A</sub> = −55°C |  |            |      | 775   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = −40°C |  |            |      | 790   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 25°C  |  |            |      | 850   |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 85°C  |  |            |      | 1080  |      |
|                  |                                                            |                                                                                                                                                                             |                                                                                  | T <sub>A</sub> = 125°C |  |            |      | 1230  |      |
| r <sub>ON</sub>  | ON Resistance r <sub>ON</sub> Max                          | to<br>(V <sub>DD</sub> +V <sub>SS</sub> )/2 ,<br>V <sub>C</sub> = V <sub>DD</sub> ,<br>RL = 10kΩ                                                                            | V <sub>DD</sub> = 5V<br>V <sub>SS</sub> = 0V                                     | T <sub>A</sub> = 25°C  |  |            | 580  | 7000  | Ω    |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 7.5V<br>V <sub>SS</sub> = -7.5V                                | T <sub>A</sub> = 25°C  |  |            | 200  | 280   |      |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 5V<br>V <sub>SS</sub> = -5V                                    | T <sub>A</sub> = 25°C  |  |            | 250  | 580   |      |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 2.5V<br>V <sub>SS</sub> = -2.5V                                | T <sub>A</sub> = 25°C  |  |            | 520  | 30000 |      |
| ΔR <sub>ON</sub> | On-state resistance difference<br>between any two switches | R <sub>L</sub> = 10kΩ,<br>V <sub>C</sub> = V <sub>DD</sub>                                                                                                                  | V <sub>DD</sub> = 5V                                                             |                        |  |            | 15   |       | Ω    |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 10V                                                            |                        |  |            | 10   |       |      |
|                  |                                                            |                                                                                                                                                                             | V <sub>DD</sub> = 15V                                                            |                        |  |            | 5    |       |      |
| THD              | Total Harmonic Distortion                                  | V <sub>C</sub> = V <sub>DD</sub> = 5V, V <sub>SS</sub> = −5V, V <sub>is(p-p)</sub> = 5V (sine wave centered on 0V), R <sub>L</sub> = 10kΩ, f <sub>is</sub> = 1kHz sine wave |                                                                                  |                        |  |            | 0.4  |       | %    |
| BW               | −3-dB cutoff frequency (switch on)                         | V <sub>C</sub> = V <sub>DD</sub> = 5V, V <sub>SS</sub> = −5V, V <sub>is(p-p)</sub> = 5V (sine wave centered on 0V), R <sub>L</sub> = 1kΩ                                    |                                                                                  |                        |  |            | 40   |       | MHz  |
| OISO             | −50-dB feedthrough frequency (switch off)                  | V <sub>C</sub> = V <sub>DD</sub> = 5V, V <sub>SS</sub> = −5V, V <sub>is(p-p)</sub> = 5V (sine wave centered on 0V), R <sub>L</sub> = 1kΩ                                    |                                                                                  |                        |  |            | 1.25 |       | MHz  |
| I <sub>is</sub>  | Input/Output Leakage Current (switch off)                  | V <sub>DD</sub> = 18V<br>V <sub>C</sub> = 0V<br>V <sub>is</sub> = 18V, V <sub>os</sub> = 0V<br>V <sub>is</sub> = 0V, V <sub>os</sub> = 18V                                  | T <sub>A</sub> = −55°C                                                           |                        |  | -0.1       |      | 0.1   | μA   |
|                  |                                                            |                                                                                                                                                                             | T <sub>A</sub> = −40°C                                                           |                        |  | -0.1       |      | 0.1   |      |
|                  |                                                            |                                                                                                                                                                             | T <sub>A</sub> = 25°C                                                            |                        |  | 0.000<br>1 |      | 0.1   |      |
|                  |                                                            |                                                                                                                                                                             | T <sub>A</sub> = 85°C                                                            |                        |  | -1         |      | 1     |      |
|                  |                                                            |                                                                                                                                                                             | T <sub>A</sub> = 125°C                                                           |                        |  | -1         |      | 1     |      |
| XTALK            | −50-dB crosstalk frequency                                 | V <sub>C</sub> = V <sub>DD</sub> = 5V, V <sub>SS</sub> = −5V, V <sub>is(p-p)</sub> = 5V (sine wave centered on 0V), R <sub>L</sub> = 1kΩ                                    |                                                                                  |                        |  |            | 0.9  |       | MHz  |

## 4.5 Electrical Characteristics (continued)

Over operating free-air temperature range,  $V_{\text{SUPPLY}} = \pm 5\text{V}$ , and  $R_L = 100\Omega$ , (unless otherwise noted)<sup>(1)</sup>

| PARAMETER        |                                            |                                                                                                                                                                                                  | TEST CONDITIONS                                                                             |                           |  | MIN | TYP  | MAX | UNIT          |
|------------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------|--|-----|------|-----|---------------|
| $t_{\text{pd}}$  | Propagation delay                          | $V_C = V_{\text{DD}}, V_{\text{SS}} = \text{GND}$<br>$V_{\text{IS}} = \text{Square Wave 0 to } V_{\text{DD}}, C_L = 50\text{pF}, R_L = 200\text{k}\Omega$                                        | $V_{\text{DD}} = 5\text{V}$                                                                 |                           |  |     | 40   | 100 | ns            |
|                  |                                            |                                                                                                                                                                                                  | $V_{\text{DD}} = 10\text{V}$                                                                |                           |  |     | 20   | 40  |               |
|                  |                                            |                                                                                                                                                                                                  | $V_{\text{DD}} = 15\text{V}$                                                                |                           |  |     | 15   | 30  |               |
| $C_{\text{IS}}$  | Input capacitance                          |                                                                                                                                                                                                  | $V_{\text{DD}} = 5\text{V}, V_C = V_{\text{SS}} = -5\text{V}$                               |                           |  |     | 4    |     | pF            |
| $C_{\text{OS}}$  | Output capacitance                         |                                                                                                                                                                                                  | $V_{\text{DD}} = 5\text{V}, V_C = V_{\text{SS}} = -5\text{V}$                               |                           |  |     | 4    |     | pF            |
| $C_{\text{IOS}}$ | Feed through                               |                                                                                                                                                                                                  | $V_{\text{DD}} = 5\text{V}, V_C = V_{\text{SS}} = -5\text{V}$                               |                           |  |     | 0.2  |     | pF            |
| $V_{\text{ILC}}$ | Control input, low voltage (max)           | $ I_{\text{IS}}  < 10\mu\text{A}, V_{\text{IS}} = V_{\text{SS}}, V_{\text{OS}} = V_{\text{DD}}, \text{ and } V_{\text{IS}} = V_{\text{DD}}, V_{\text{OS}} = V_{\text{SS}}$                       | $V_{\text{DD}} = 5\text{V}$<br>$V_{\text{DD}} = 10\text{V}$<br>$V_{\text{DD}} = 15\text{V}$ | $T_A = -55^\circ\text{C}$ |  |     |      | 0.9 | V             |
|                  |                                            |                                                                                                                                                                                                  |                                                                                             | $T_A = -40^\circ\text{C}$ |  |     |      | 0.9 |               |
|                  |                                            |                                                                                                                                                                                                  |                                                                                             | $T_A = 25^\circ\text{C}$  |  |     |      | 0.7 |               |
|                  |                                            |                                                                                                                                                                                                  |                                                                                             | $T_A = 85^\circ\text{C}$  |  |     |      | 0.4 |               |
|                  |                                            |                                                                                                                                                                                                  |                                                                                             | $T_A = 125^\circ\text{C}$ |  |     |      | 0.4 |               |
| $V_{\text{IHC}}$ | Control input, high voltage                | See Figure 10                                                                                                                                                                                    | $V_{\text{DD}} = 5\text{V}$                                                                 |                           |  | 3.5 |      |     | V             |
|                  |                                            |                                                                                                                                                                                                  | $V_{\text{DD}} = 10\text{V}$                                                                |                           |  | 7   |      |     | V             |
|                  |                                            |                                                                                                                                                                                                  | $V_{\text{DD}} = 15\text{V}$                                                                |                           |  | 11  |      |     | V             |
| $I_{\text{IH}}$  | Input High Leakage                         |                                                                                                                                                                                                  | $V_{\text{DD}} = 18\text{V}$                                                                |                           |  |     | 0.5  | 1   | $\mu\text{A}$ |
| $I_{\text{IL}}$  | Input Low Leakage                          |                                                                                                                                                                                                  | $V_{\text{DD}} = 18\text{V}$                                                                |                           |  | -1  | -0.1 |     | $\mu\text{A}$ |
|                  | Crosstalk (control input to signal output) | $V_C = 10\text{V}$ (square wave), $t_r, t_f = 20\text{ns}, R_L = 10\text{k}\Omega, V_{\text{DD}} = 10\text{V}$                                                                                   | $V_{\text{DD}} = 10\text{V}$                                                                |                           |  |     | 50   |     | mV            |
|                  | Turn-on propagation delay                  | $t_r, t_f = 20\text{ns}$<br>$C_L = 50\text{pF}, R_L = 1\text{k}\Omega$                                                                                                                           | $V_{\text{DD}} = 5\text{V}$                                                                 |                           |  |     | 35   | 70  | ns            |
|                  |                                            |                                                                                                                                                                                                  | $V_{\text{DD}} = 10\text{V}$                                                                |                           |  |     | 20   | 40  | ns            |
|                  |                                            |                                                                                                                                                                                                  | $V_{\text{DD}} = 15\text{V}$                                                                |                           |  |     | 15   | 30  | ns            |
|                  | Maximum control input repetition rate      | $V_{\text{IN}} = V_{\text{DD}}, C_L = 50\text{pF}, R_L = 1\text{k}\Omega$<br>$V_C = 10\text{V}$ (square wave centered on 5V), $t_r, t_f = 20\text{ns}, V_{\text{OS}} = 1/2V_{\text{OS}}$ at 1kHz | $V_{\text{DD}} = 10\text{V}$                                                                |                           |  |     | 10   |     | MHz           |
| $C_{\text{IN}}$  | Input Capacitance                          |                                                                                                                                                                                                  |                                                                                             |                           |  |     | 5    | 7.5 | pF            |

## 4.5 Electrical Characteristics (continued)

Over operating free-air temperature range,  $V_{\text{SUPPLY}} = \pm 5\text{V}$ , and  $R_L = 100\Omega$ , (unless otherwise noted)<sup>(1)</sup>

| PARAMETER       |                       | TEST CONDITIONS                                              |                           |  |  | MIN  | TYP | MAX   | UNIT |
|-----------------|-----------------------|--------------------------------------------------------------|---------------------------|--|--|------|-----|-------|------|
| $I_{\text{IS}}$ | Switch input current  | $V_{\text{DD}} = 5\text{V}$<br>$V_{\text{IS}} = 0\text{V}$   | $T_A = -55^\circ\text{C}$ |  |  |      |     | 0.25  | mA   |
|                 |                       |                                                              | $T_A = -40^\circ\text{C}$ |  |  |      |     | 0.2   |      |
|                 |                       |                                                              | $T_A = 25^\circ\text{C}$  |  |  |      |     | 0.2   |      |
|                 |                       |                                                              | $T_A = 85^\circ\text{C}$  |  |  |      |     | 0.12  |      |
|                 |                       |                                                              | $T_A = 125^\circ\text{C}$ |  |  |      |     | 0.14  |      |
|                 |                       | $V_{\text{DD}} = 5\text{V}$<br>$V_{\text{IS}} = 5\text{V}$   | $T_A = -55^\circ\text{C}$ |  |  |      |     | -0.25 | mA   |
|                 |                       |                                                              | $T_A = -40^\circ\text{C}$ |  |  |      |     | -0.2  |      |
|                 |                       |                                                              | $T_A = 25^\circ\text{C}$  |  |  |      |     | -0.2  |      |
|                 |                       |                                                              | $T_A = 85^\circ\text{C}$  |  |  |      |     | -0.12 |      |
|                 |                       |                                                              | $T_A = 125^\circ\text{C}$ |  |  |      |     | -0.14 |      |
|                 |                       | $V_{\text{DD}} = 10\text{V}$<br>$V_{\text{IS}} = 0\text{V}$  | $T_A = -55^\circ\text{C}$ |  |  |      |     | 0.62  | mA   |
|                 |                       |                                                              | $T_A = -40^\circ\text{C}$ |  |  |      |     | 0.5   |      |
|                 |                       |                                                              | $T_A = 25^\circ\text{C}$  |  |  |      |     | 0.5   |      |
|                 |                       |                                                              | $T_A = 85^\circ\text{C}$  |  |  |      |     | 0.3   |      |
|                 |                       |                                                              | $T_A = 125^\circ\text{C}$ |  |  |      |     | 0.35  |      |
|                 |                       | $V_{\text{DD}} = 10\text{V}$<br>$V_{\text{IS}} = 10\text{V}$ | $T_A = -55^\circ\text{C}$ |  |  |      |     | -0.62 | mA   |
|                 |                       |                                                              | $T_A = -40^\circ\text{C}$ |  |  |      |     | -0.5  |      |
|                 |                       |                                                              | $T_A = 25^\circ\text{C}$  |  |  |      |     | -0.5  |      |
|                 |                       |                                                              | $T_A = 85^\circ\text{C}$  |  |  |      |     | -0.3  |      |
|                 |                       |                                                              | $T_A = 125^\circ\text{C}$ |  |  |      |     | -0.35 |      |
|                 |                       | $V_{\text{DD}} = 15\text{V}$<br>$V_{\text{IS}} = 0\text{V}$  | $T_A = -55^\circ\text{C}$ |  |  |      |     | 1.8   | mA   |
|                 |                       |                                                              | $T_A = -40^\circ\text{C}$ |  |  |      |     | 1.4   |      |
|                 |                       |                                                              | $T_A = 25^\circ\text{C}$  |  |  |      |     | 1.5   |      |
|                 |                       |                                                              | $T_A = 85^\circ\text{C}$  |  |  |      |     | 1     |      |
|                 |                       |                                                              | $T_A = 125^\circ\text{C}$ |  |  |      |     | 1.1   |      |
|                 |                       | $V_{\text{DD}} = 15\text{V}$<br>$V_{\text{IS}} = 15\text{V}$ | $T_A = -55^\circ\text{C}$ |  |  |      |     | -1.8  | mA   |
|                 |                       |                                                              | $T_A = -40^\circ\text{C}$ |  |  |      |     | -1.4  |      |
|                 |                       |                                                              | $T_A = 25^\circ\text{C}$  |  |  |      |     | -1.5  |      |
|                 |                       |                                                              | $T_A = 85^\circ\text{C}$  |  |  |      |     | -1    |      |
|                 |                       |                                                              | $T_A = 125^\circ\text{C}$ |  |  |      |     | -1.1  |      |
| $V_{\text{OS}}$ | Switch output voltage | $V_{\text{DD}} = 5\text{V}$<br>$V_{\text{IS}} = 0\text{V}$   |                           |  |  |      |     | 0.4   | V    |
|                 |                       | $V_{\text{DD}} = 5\text{V}$<br>$V_{\text{IS}} = 5\text{V}$   |                           |  |  | 4.6  |     |       | V    |
|                 |                       | $V_{\text{DD}} = 10\text{V}$<br>$V_{\text{IS}} = 0\text{V}$  |                           |  |  |      |     | 0.5   | V    |
|                 |                       | $V_{\text{DD}} = 10\text{V}$<br>$V_{\text{IS}} = 10\text{V}$ |                           |  |  | 9.5  |     |       | V    |
|                 |                       | $V_{\text{DD}} = 15\text{V}$<br>$V_{\text{IS}} = 0\text{V}$  |                           |  |  |      |     | 1.5   | V    |
|                 |                       | $V_{\text{DD}} = 15\text{V}$<br>$V_{\text{IS}} = 15\text{V}$ |                           |  |  | 13.5 |     |       | V    |

(1) Peak-to-Peak voltage symmetrical about  $(V_{\text{DD}} - V_{\text{EE}}) / 2$ .

## 4.6 Electrical Characteristics

| CHARACTERISTIC                                                                             | TEST CONDITIONS                                                                                                                                                                                           |                                                     |                     | LIMITS AT INDICATED TEMPERATURES (°C) |      |      |      |                   |      | UNITS |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------|---------------------------------------|------|------|------|-------------------|------|-------|
|                                                                                            |                                                                                                                                                                                                           | V <sub>IN</sub> (V)                                 | V <sub>DD</sub> (V) |                                       |      |      |      | +25               |      |       |
|                                                                                            |                                                                                                                                                                                                           |                                                     |                     | −55                                   | −40  | +85  | +125 | TYP               | MAX  |       |
| Quiescent Device Current, I <sub>DD</sub>                                                  |                                                                                                                                                                                                           | 0,5                                                 | 5                   | 025                                   | 0.25 | 7.5  | 7.5  | 0.01              | 0.25 | μA    |
|                                                                                            |                                                                                                                                                                                                           | 0,10                                                | 10                  | 0.5                                   | 0.5  | 15   | 15   | 0.01              | 0.5  |       |
|                                                                                            |                                                                                                                                                                                                           | 0,15                                                | 15                  | 1                                     | 1    | 30   | 30   | 0.01              | 1    |       |
|                                                                                            |                                                                                                                                                                                                           | 0,20                                                | 20                  | 5                                     | 5    | 150  | 150  | 0.02              | 5    |       |
| Signal Inputs (V <sub>is</sub> ) and Output (V <sub>os</sub> )                             |                                                                                                                                                                                                           |                                                     |                     |                                       |      |      |      |                   |      |       |
| On-State Resistance, r <sub>on</sub> MAX                                                   | V <sub>C</sub> =V <sub>DD</sub><br>R <sub>L</sub> =10kΩ Returned to <b>V<sub>DD</sub>−V<sub>SS</sub><br/>2</b>                                                                                            | V <sub>is</sub> =V <sub>DD</sub> or V <sub>SS</sub> | 10                  | 600                                   | 610  | 840  | 960  | −                 | 660  | Ω     |
|                                                                                            |                                                                                                                                                                                                           | V <sub>is</sub> =4.75 to 5.75V                      | 10                  | 1870                                  | 1900 | 2380 | 2600 | −                 | 2000 |       |
|                                                                                            |                                                                                                                                                                                                           | V <sub>is</sub> =V <sub>DD</sub> or V <sub>SS</sub> | 15                  | 360                                   | 370  | 520  | 600  | −                 | 400  |       |
|                                                                                            |                                                                                                                                                                                                           | V <sub>is</sub> =7.25 to 7.75V                      | 15                  | 775                                   | 790  | 1080 | 1230 | −                 | 850  |       |
| ΔOn-State Resistance Between Any 2 Switches, Δr <sub>on</sub>                              | R <sub>L</sub> =10kΩ, V <sub>C</sub> = V <sub>DD</sub>                                                                                                                                                    |                                                     | 5                   | −                                     | −    | −    | −    | 15                | −    | Ω     |
|                                                                                            |                                                                                                                                                                                                           |                                                     | 10                  | −                                     | −    | −    | −    | 10                | −    |       |
|                                                                                            |                                                                                                                                                                                                           |                                                     | 15                  | −                                     | −    | −    | −    | 5                 | −    |       |
| Total Harmonic Distortion, THD                                                             | V <sub>C</sub> =V <sub>DD</sub> =5V, V <sub>SS</sub> = −5V,V <sub>is</sub> (p-p) = 5V (Sine wave centered on 0V) R <sub>L</sub> = 10kΩ, f <sub>is</sub> = 1kHz sine wave                                  |                                                     |                     | −                                     | −    | −    | −    | 0.4               | −    | %     |
| −3dB Cutoff Frequency (Switch on)                                                          | V <sub>C</sub> =V <sub>DD</sub> =5V, V <sub>SS</sub> =−5V, V <sub>is</sub> (p-p) (Sine wave centered on 0V) R <sub>L</sub> =1kΩ,                                                                          |                                                     |                     | −                                     | −    | −    | −    | 40                | −    | MHz   |
| −50dB Feed-through Frequency (Switch off)                                                  | V <sub>C</sub> =V <sub>SS</sub> = −5V, V <sub>is</sub> (p-p)=5V (Sine wave centered on 0V) R <sub>L</sub> = 1 kΩ                                                                                          |                                                     |                     | −                                     | −    | −    | −    | 1.25              | −    | MHz   |
| Input/Output Leakage Current (Switch off) I <sub>is</sub> MAX                              | V <sub>C</sub> = 0V<br>V <sub>is</sub> = 18V, V <sub>OS</sub> = 0V;<br>V <sub>is</sub> = 0V, V <sub>OS</sub> = 18V                                                                                        |                                                     | 18                  | ±0.1                                  | ±0.1 | ±1   | ±1   | 10 <sup>−4</sup>  | ±0.1 | μA    |
| −50dB Crosstalk Frequency                                                                  | V <sub>C</sub> (A) = V <sub>DD</sub> = +5V, V <sub>C</sub> (B) = V <sub>SS</sub> =−5V, V <sub>is</sub> (A)= 5V <sub>p-p</sub> , 50Ω source<br>R <sub>L</sub> = 1kΩ                                        |                                                     |                     | −                                     | −    | −    | −    | 0.9               | −    | MHz   |
| Propagation Delay (Signal Input to Signal Output) t <sub>pd</sub>                          | R <sub>L</sub> = 200kΩ<br>V <sub>C</sub> = V <sub>DD</sub> , V <sub>SS</sub> = GND, C <sub>L</sub> = 50pF<br>V <sub>is</sub> = Square Wave 0 to V <sub>DD</sub><br>t <sub>r</sub> , t <sub>f</sub> = 20ns |                                                     | 5                   | −                                     | −    | −    | −    | 40                | 100  | ns    |
|                                                                                            |                                                                                                                                                                                                           |                                                     | 10                  | −                                     | −    | −    | −    | 20                | 40   |       |
|                                                                                            |                                                                                                                                                                                                           |                                                     | 15                  | −                                     | −    | −    | −    | 15                | 30   |       |
| Capacitance: Input, C <sub>is</sub> Output, C <sub>OS</sub> Feed-through, C <sub>ios</sub> | V <sub>DD</sub> = +5V<br>V <sub>C</sub> =V <sub>SS</sub> =−5V                                                                                                                                             |                                                     |                     | −                                     | −    | −    | −    | 4                 | −    | pF    |
|                                                                                            |                                                                                                                                                                                                           |                                                     |                     | −                                     | −    | −    | −    | 4                 | −    |       |
|                                                                                            |                                                                                                                                                                                                           |                                                     |                     | −                                     | −    | −    | −    | 0.2               | −    |       |
| Control (V <sub>C</sub> )                                                                  |                                                                                                                                                                                                           |                                                     |                     |                                       |      |      |      |                   |      |       |
| Control Input Low Voltage, V <sub>ILC</sub> (MAX)                                          | I <sub>is</sub>  < 10 μA<br>V <sub>is</sub> = V <sub>SS</sub> , V <sub>OS</sub> = V <sub>DD</sub> and V <sub>is</sub> = V <sub>DD</sub> , V <sub>OS</sub> = V <sub>SS</sub>                               |                                                     | 5,10, 15            | 0.9                                   | 0.9  | 0.4  | 0.4  | −                 | 0.7  | V     |
| Control Input High Voltage, V <sub>IHC</sub>                                               | See <a href="#">Figure 4-8</a>                                                                                                                                                                            |                                                     | 5                   | 3.5 (Min.)                            |      |      |      |                   |      | V     |
|                                                                                            |                                                                                                                                                                                                           |                                                     | 10                  | 7 (Min.)                              |      |      |      |                   |      |       |
|                                                                                            |                                                                                                                                                                                                           |                                                     | 15                  | 11 (Min.)                             |      |      |      |                   |      |       |
| Input Current, I <sub>IN</sub> (MAX)                                                       | Input Current, I <sub>IN</sub> (MAX) V <sub>is</sub> □ V <sub>DD</sub>                                                                                                                                    |                                                     | 18                  | ±0.1                                  | ±0.1 | ±1   | ±1   | ±10 <sup>−5</sup> | ±0.1 | μA    |
|                                                                                            | V <sub>DD</sub> − V <sub>SS</sub> = 18V                                                                                                                                                                   |                                                     |                     |                                       |      |      |      |                   |      |       |
|                                                                                            | V <sub>CC</sub> □ V <sub>DD</sub> − V <sub>SS</sub>                                                                                                                                                       |                                                     |                     |                                       |      |      |      |                   |      |       |
| Crosstalk (Control Input to Signal Output)                                                 | V <sub>C</sub> = 10V (Sq. Wave)                                                                                                                                                                           |                                                     | 10                  | −                                     | −    | −    | −    | 50                | −    | mV    |
|                                                                                            | t <sub>r</sub> , t <sub>f</sub> = 20ns                                                                                                                                                                    |                                                     |                     |                                       |      |      |      |                   |      |       |
|                                                                                            | R <sub>L</sub> = 10kΩ                                                                                                                                                                                     |                                                     |                     |                                       |      |      |      |                   |      |       |
| Turn-On Propagation Delay                                                                  | Turn-On Propagation Delay t <sub>r</sub> , t <sub>f</sub> = 20ns                                                                                                                                          |                                                     | 5                   | −                                     | −    | −    | −    | 35                | 70   | ns    |
|                                                                                            | C <sub>L</sub> = 50pF                                                                                                                                                                                     |                                                     | 10                  | −                                     | −    | −    | −    | 20                | 40   |       |
|                                                                                            | R <sub>L</sub> = 1kΩ                                                                                                                                                                                      |                                                     | 15                  | −                                     | −    | −    | −    | 15                | 30   |       |

## 4.6 Electrical Characteristics (continued)

| CHARACTERISTIC                        | TEST CONDITIONS                                                                                                                                                                                                                                                                                 |                     |                     | LIMITS AT INDICATED TEMPERATURES (°C) |     |     |      |     |     | UNITS |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------|-----|-----|------|-----|-----|-------|
|                                       |                                                                                                                                                                                                                                                                                                 | V <sub>IN</sub> (V) | V <sub>DD</sub> (V) |                                       |     |     |      | +25 |     |       |
|                                       |                                                                                                                                                                                                                                                                                                 |                     |                     | -55                                   | -40 | +85 | +125 | TYP | MAX |       |
| Maximum Control Input Repetition Rate | Maximum Control Input Repetition Rate<br>V <sub>is</sub> = V <sub>DD</sub> < V <sub>SS</sub> = GND, R <sub>L</sub> = 1kΩ to GND, C <sub>L</sub> = 50pF, V <sub>C</sub> = 10V(Square wave centered on 5V)<br>t <sub>r</sub> , t <sub>f</sub> = 20ns, V <sub>OS</sub> = ½ V <sub>OS</sub> at 1kHz | 10                  | —                   | —                                     | —   | —   | 10   | —   | MHz |       |
| Input Capacitance, C <sub>IN</sub>    |                                                                                                                                                                                                                                                                                                 |                     | —                   | —                                     | —   | —   | 5    | 7.5 | μF  |       |

## 4.7 Typical Characteristics

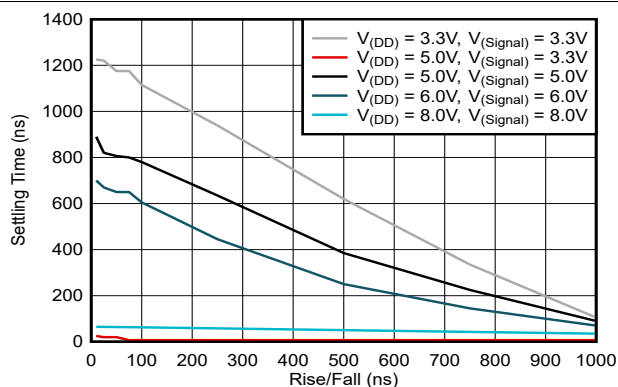


Figure 4-1. System Settling Time vs Signal Rise/Fall Time

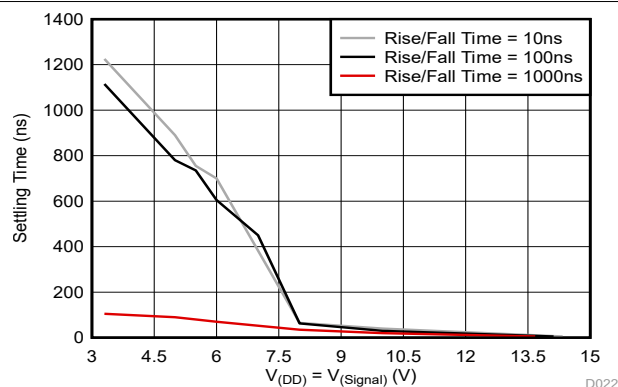


Figure 4-2. System Settling Time vs Signal Voltage

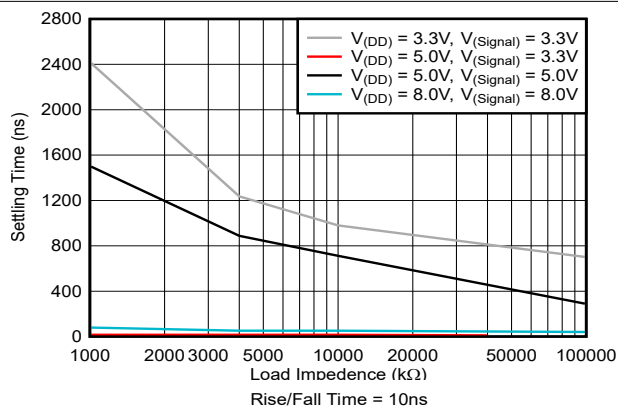
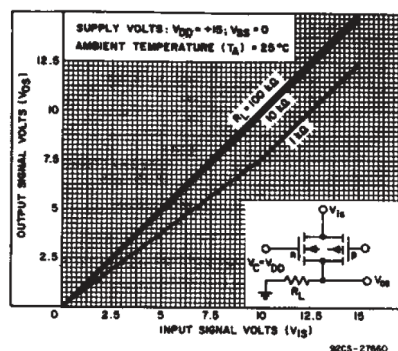
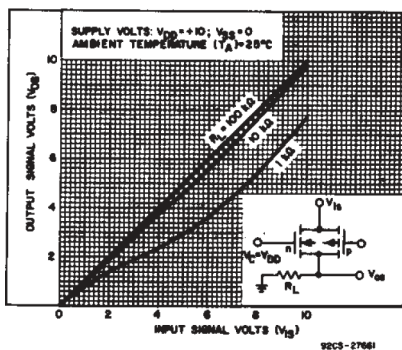
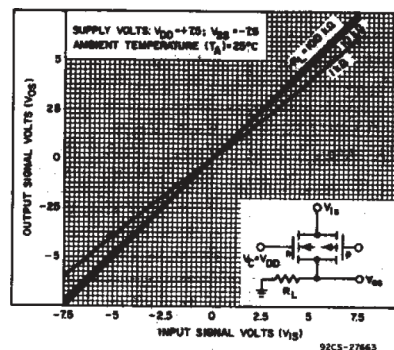


Figure 4-3. System Settling Time vs Signal Voltage

Figure 4-4. On-state Characteristics for 1 of 4 Switches with  $V_{DD} = +15\text{V}$ ,  $V_{SS} = 0\text{V}$ .Figure 4-5. On-state Characteristics for 1 of 4 Switches with  $V_{DD} = +10\text{V}$ ,  $V_{SS} = 0\text{V}$ .Figure 4-6. On-state Characteristics for 1 of 4 Switches with  $V_{DD} = +7.5\text{V}$ ,  $V_{SS} = -7.5\text{V}$ .

## 4.7 Typical Characteristics (continued)

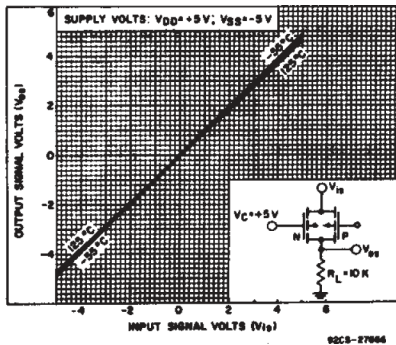


Figure 4-7. On-state Characteristics as a Function of Temp. for 1 of 4 Switches with  $v_{DD} = +5V$ ,  $v_{SS} = -5V$ .

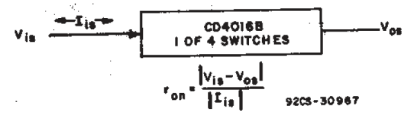


Figure 4-8. Determination of  $R_{ON}$  As a Test Condition for Control Input High Voltage Specification.

## 5 Parameter Measurement Information

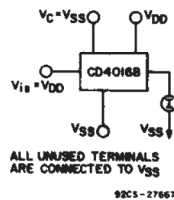


Figure 5-1. Off-state Switch Input or Output Leakage Current Test Circuit.

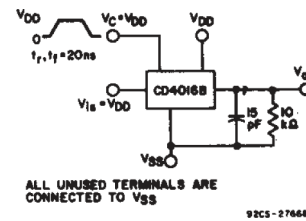


Figure 5-2. Test Circuit for Square-wave Response.

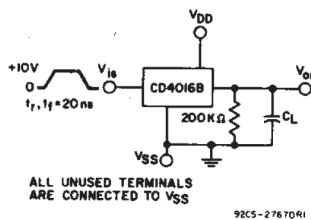


Figure 5-3. Propagation Delay Time Signal Input ( $v_I$ ) To Signal Output ( $v_O$ )

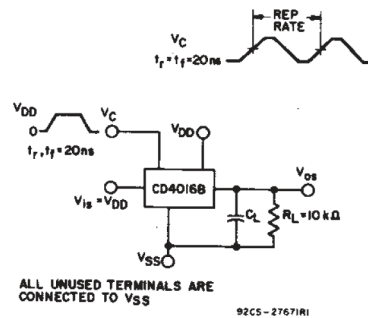
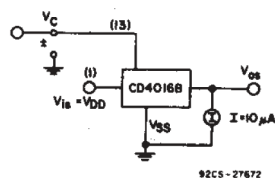


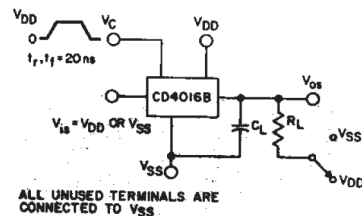
Figure 5-4. MAX Control-input Repetition Rate.



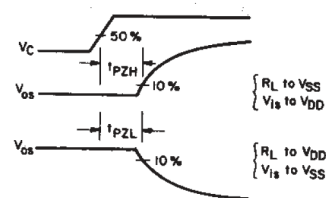
92CS-27672

SWITCH THRESHOLD VOLTAGE IS DEFINED AS THE VOLTAGE APPLIED TO A TRANSMISSION GATE CONTROL WHICH CAUSES 10  $\mu$ A OF TRANSMISSION GATE CURRENT.

Figure 5-5. Switch Threshold Voltage.



ALL UNUSED TERMINALS ARE CONNECTED TO V<sub>SS</sub>



92CM-28308

Figure 5-6. Turn-On Propagation Delay-control Input.

## 6 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 6.1 Documentation Support

#### 6.1.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

#### 6.1.2 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

#### 6.1.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

#### 6.1.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

#### 6.1.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>Changes from Revision D (May 2024) to Revision E (August 2024)</b> | <b>Page</b>        |
|-----------------------------------------------------------------------|--------------------|
| • Added Settling Time plots.....                                      | <a href="#">10</a> |

| <b>Changes from Revision C (September 2003) to Revision D (May 2024)</b> | <b>Page</b>       |
|--------------------------------------------------------------------------|-------------------|
| • Increased IDD max/typ for the lower Temperature cases.....             | <a href="#">5</a> |
| • Changed typical I <sub>IH</sub> to 0.5μA.....                          | <a href="#">5</a> |
| • Changed typical I <sub>IL</sub> to -0.1μA.....                         | <a href="#">5</a> |

## 8 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## PACKAGING INFORMATION

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)          |
|--------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|------------------------------|
| <a href="#">5962-9064001CA</a> | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9064001CA<br>CD4016BF3A |
| <a href="#">CD4016BE</a>       | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -55 to 125   | CD4016BE                     |
| CD4016BE.A                     | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -55 to 125   | CD4016BE                     |
| CD4016BEE4                     | Active        | Production           | PDIP (N)   14   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -55 to 125   | CD4016BE                     |
| <a href="#">CD4016BF</a>       | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | CD4016BF                     |
| CD4016BF.A                     | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | CD4016BF                     |
| <a href="#">CD4016BF3A</a>     | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9064001CA<br>CD4016BF3A |
| CD4016BF3A.A                   | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9064001CA<br>CD4016BF3A |
| <a href="#">CD4016BM</a>       | Obsolete      | Production           | SOIC (D)   14   | -                     | -           | Call TI                              | Call TI                           | -55 to 125   | CD4016BM                     |
| <a href="#">CD4016BM96</a>     | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CD4016BM                     |
| CD4016BM96.A                   | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CD4016BM                     |
| <a href="#">CD4016BMT</a>      | Obsolete      | Production           | SOIC (D)   14   | -                     | -           | Call TI                              | Call TI                           | -55 to 125   | CD4016BM                     |
| <a href="#">CD4016BNSR</a>     | NRND          | Production           | SOP (NS)   14   | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CD4016B                      |
| CD4016BNSR.A                   | NRND          | Production           | SOP (NS)   14   | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CD4016B                      |
| <a href="#">CD4016BPW</a>      | NRND          | Production           | TSSOP (PW)   14 | 90   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CM016B                       |
| CD4016BPW.A                    | NRND          | Production           | TSSOP (PW)   14 | 90   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CM016B                       |
| <a href="#">CD4016BPWR</a>     | NRND          | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CM016B                       |
| CD4016BPWR.A                   | NRND          | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | CM016B                       |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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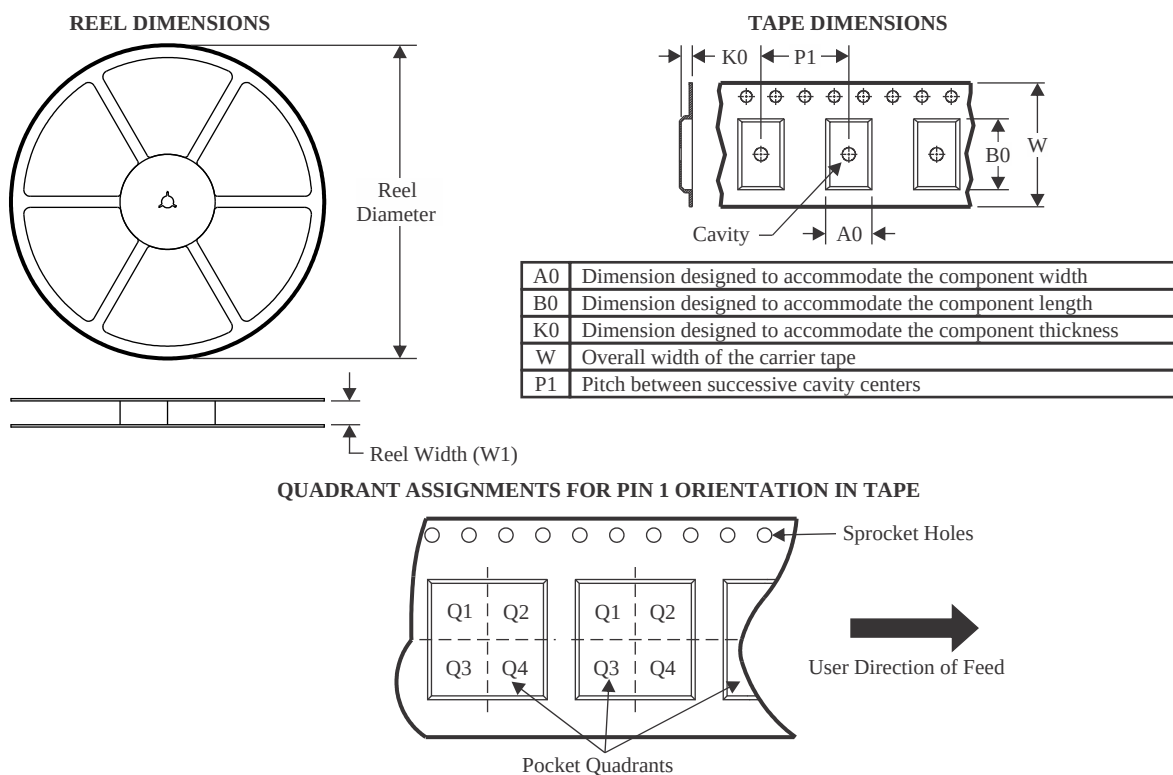
**OTHER QUALIFIED VERSIONS OF CD4016B, CD4016B-MIL :**

- Catalog : [CD4016B](#)
- Military : [CD4016B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

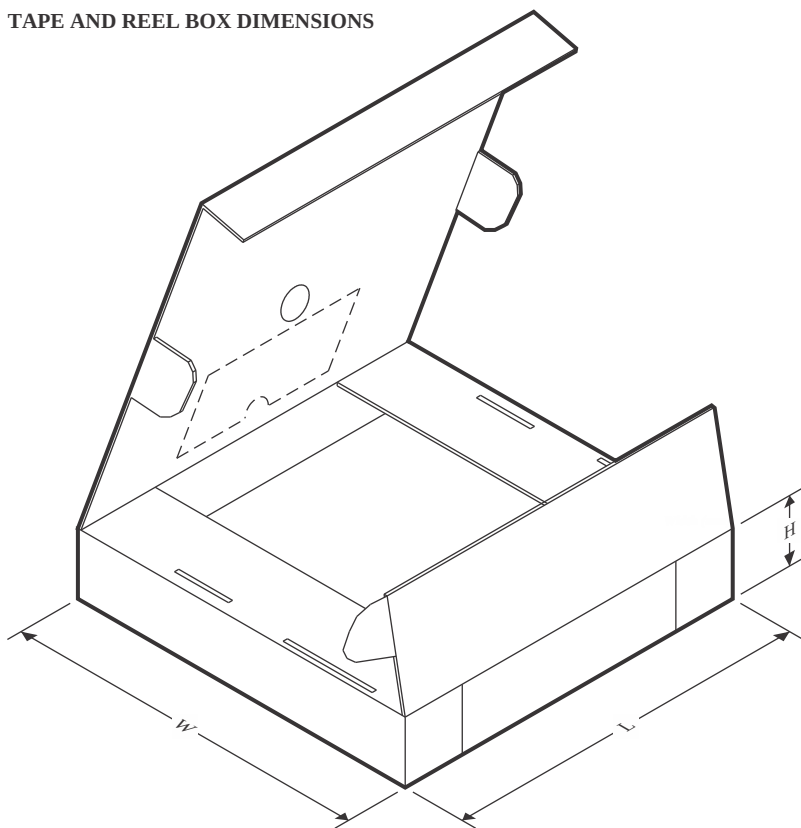
## TAPE AND REEL INFORMATION



\*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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4016BM96 | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| CD4016BNSR | SOP          | NS              | 14   | 2000 | 330.0              | 16.4               | 8.1     | 10.4    | 2.5     | 12.0    | 16.0   | Q1            |
| CD4016BPWR | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

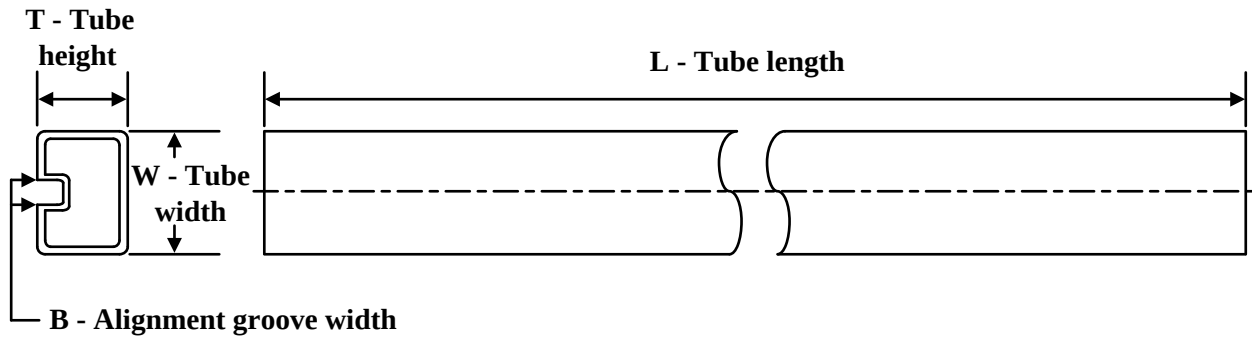
## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

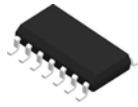
| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4016BM96 | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| CD4016BNSR | SOP          | NS              | 14   | 2000 | 353.0       | 353.0      | 32.0        |
| CD4016BPWR | TSSOP        | PW              | 14   | 2000 | 353.0       | 353.0      | 32.0        |

## TUBE

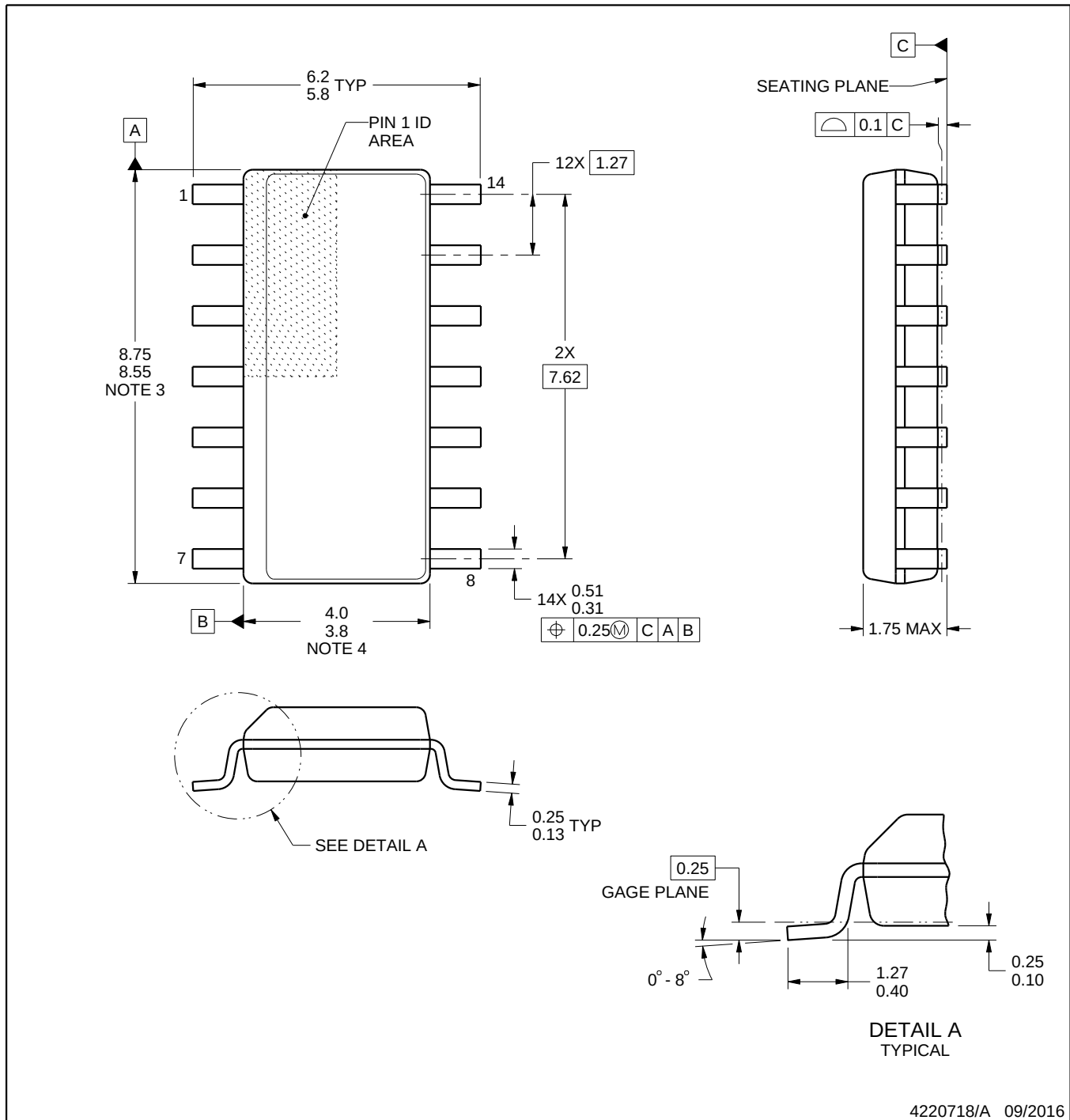


\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| CD4016BE    | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD4016BE.A  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD4016BEE4  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD4016BPW   | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| CD4016BPW.A | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |

**D0014A****PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT

**NOTES:**

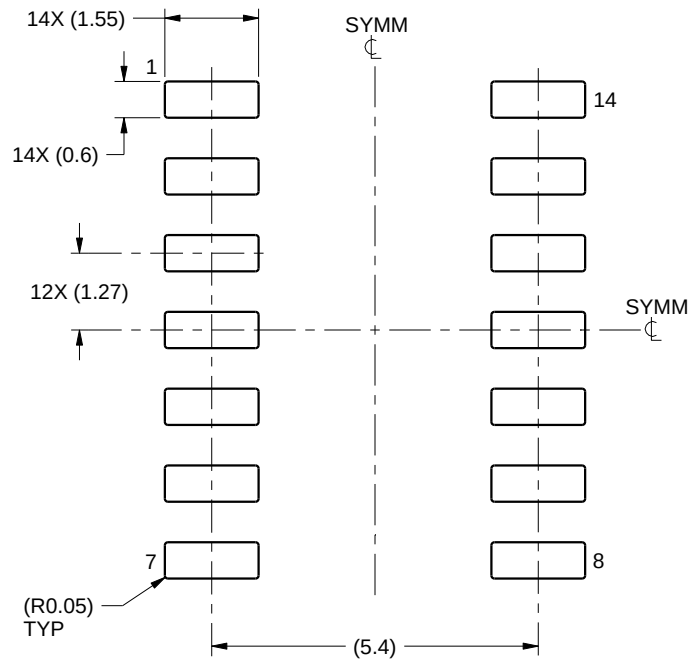
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

# EXAMPLE BOARD LAYOUT

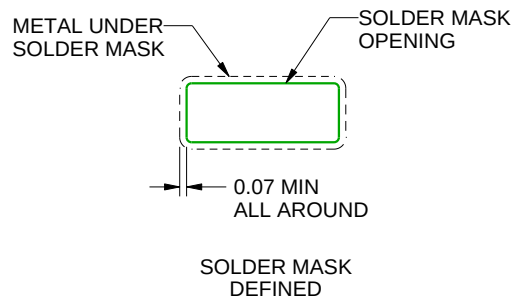
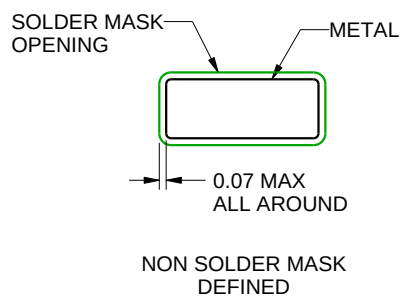
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

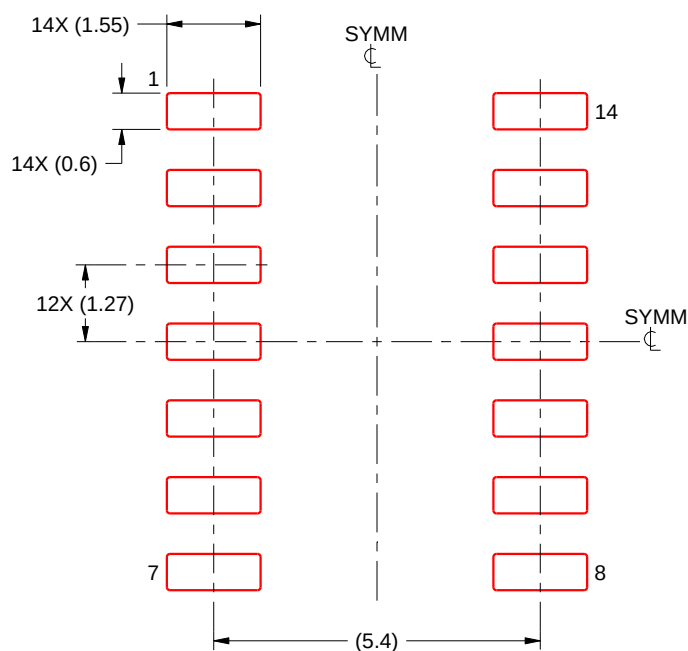
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

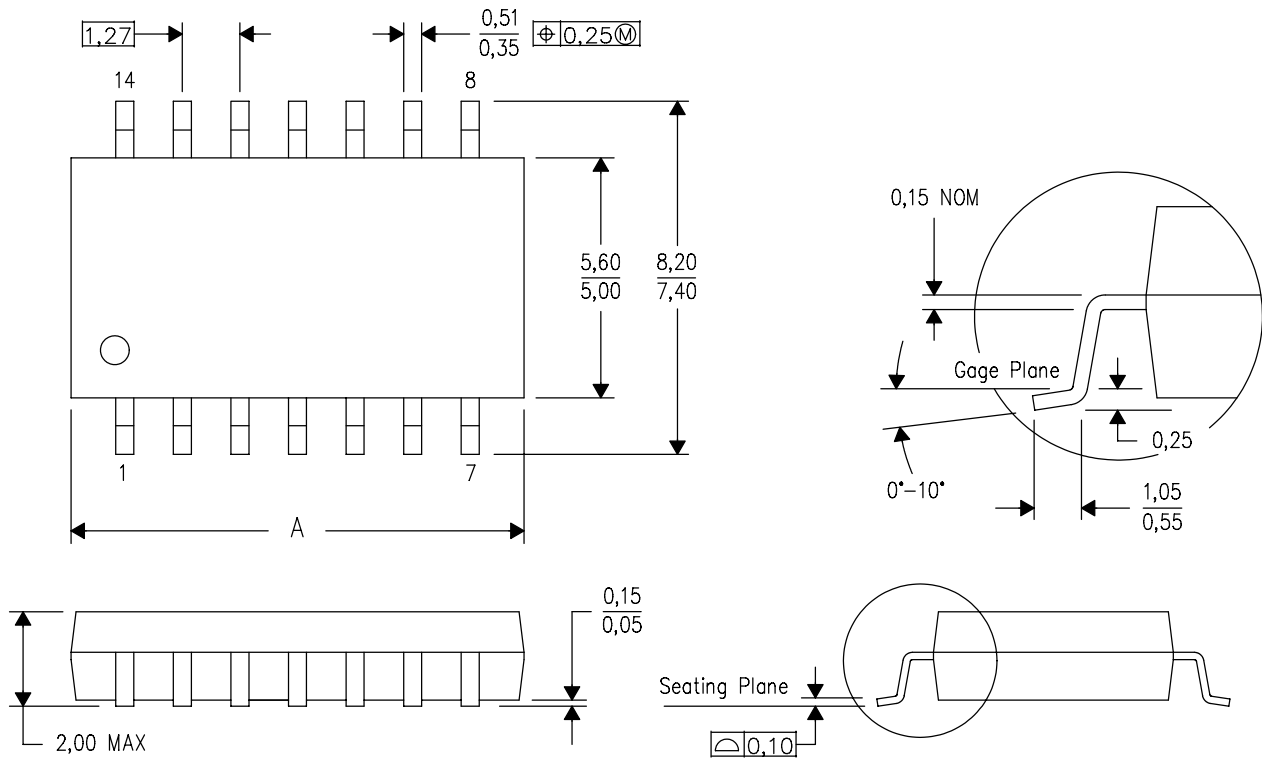
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

# 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

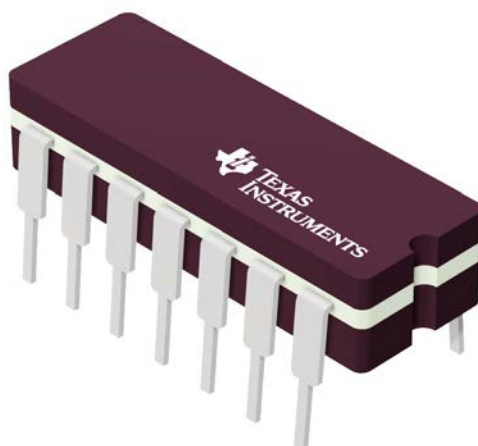
- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

**J 14**

## GENERIC PACKAGE VIEW

**CDIP - 5.08 mm max height**

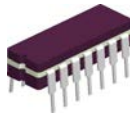
CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

4040083-5/G

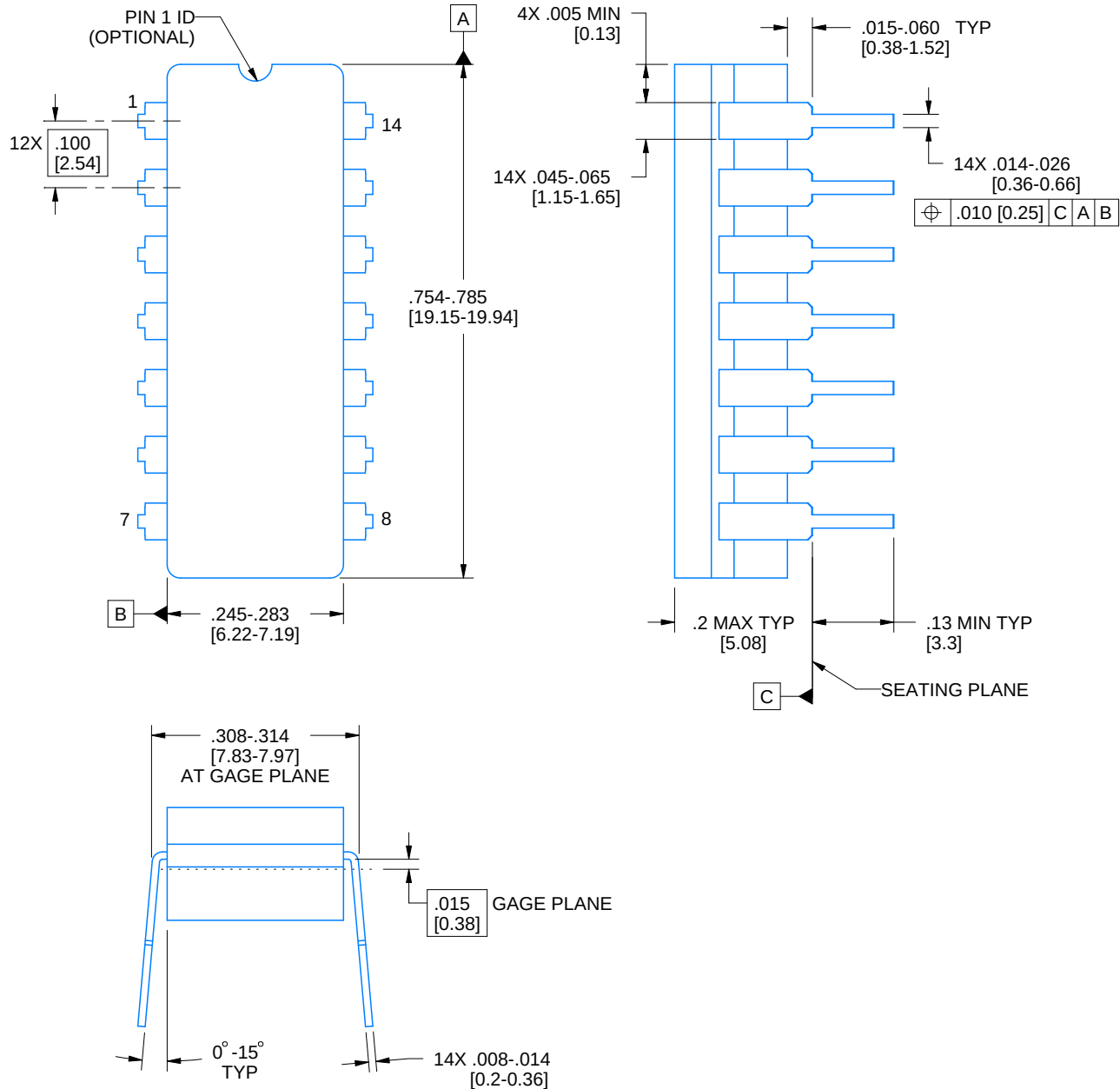
J0014A



## PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



4214771/A 05/2017

### NOTES:

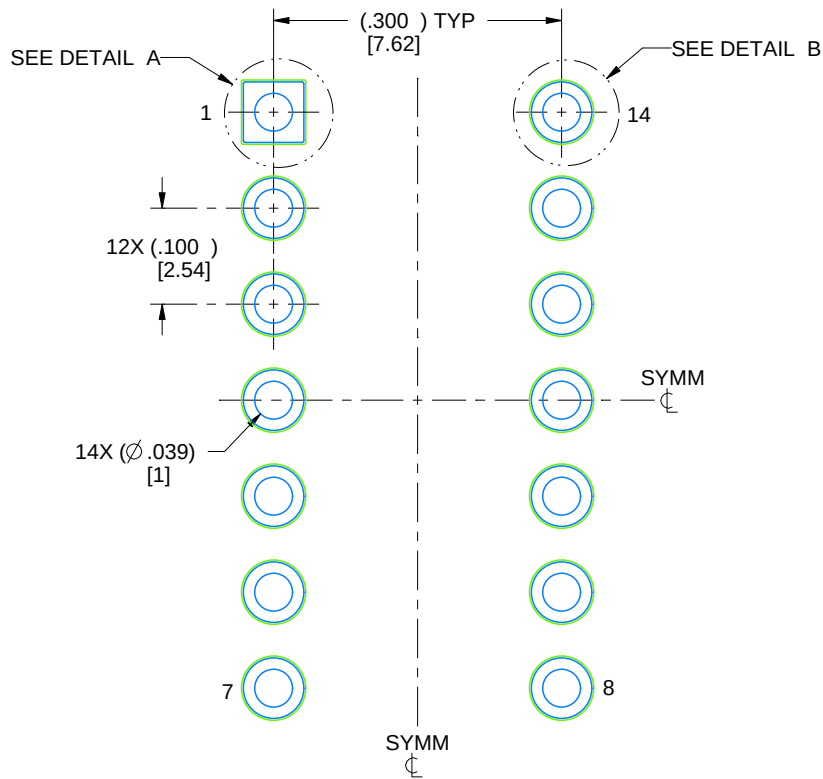
1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.

# EXAMPLE BOARD LAYOUT

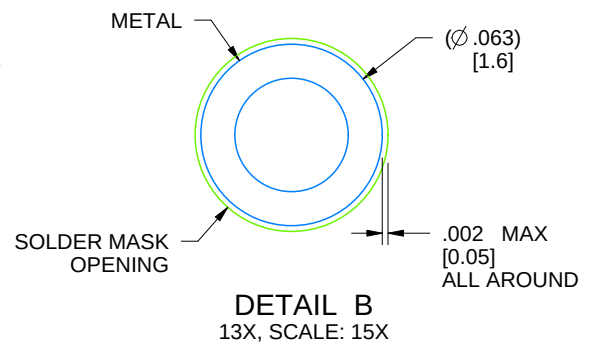
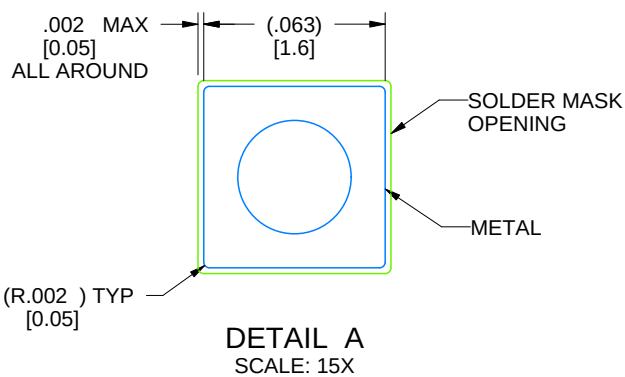
J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE  
NON-SOLDER MASK DEFINED  
SCALE: 5X

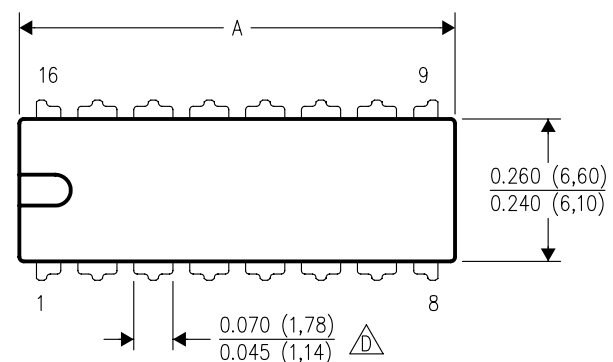


4214771/A 05/2017

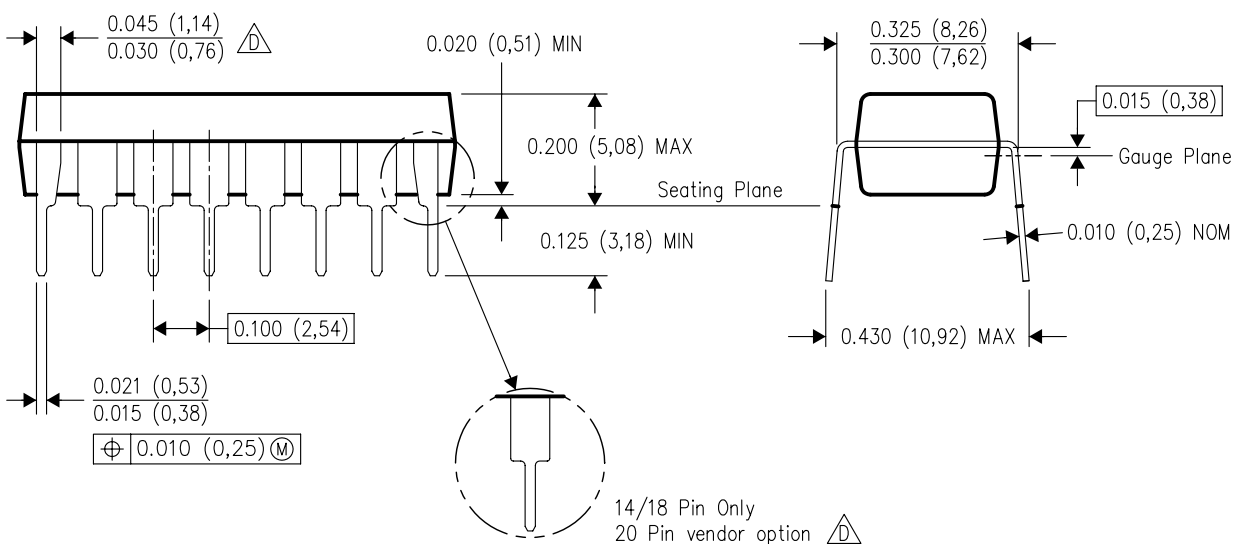
N (R-PDIP-T\*\*)

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:

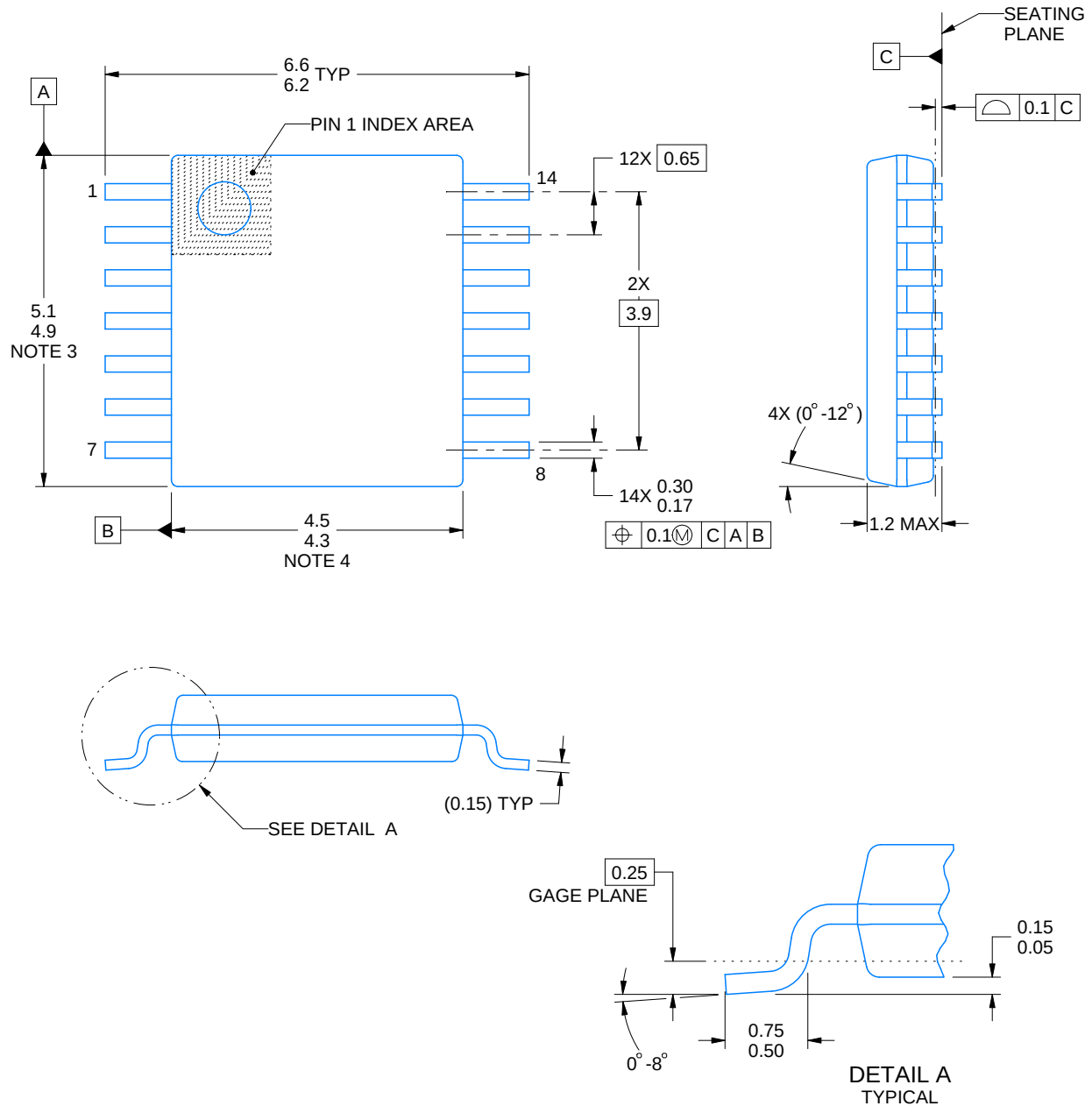
- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

**PW0014A**

## PACKAGE OUTLINE

**TSSOP - 1.2 mm max height**

SMALL OUTLINE PACKAGE



4220202/B 12/2023

NOTES:

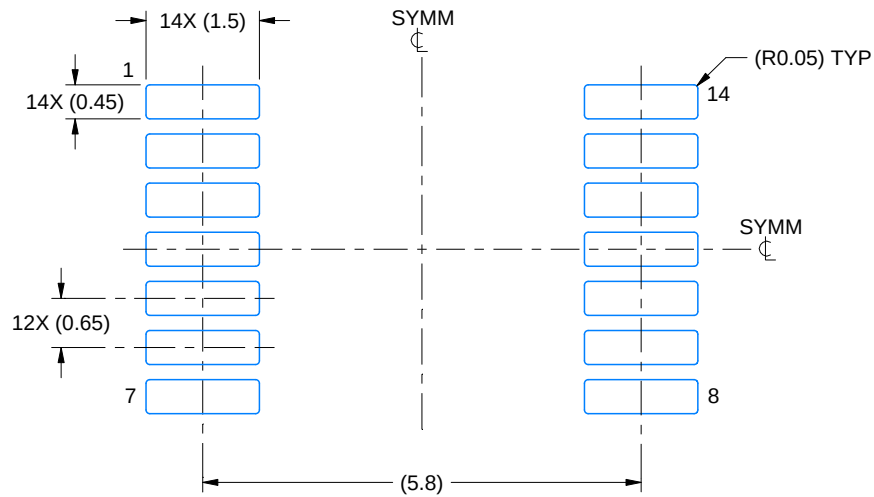
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

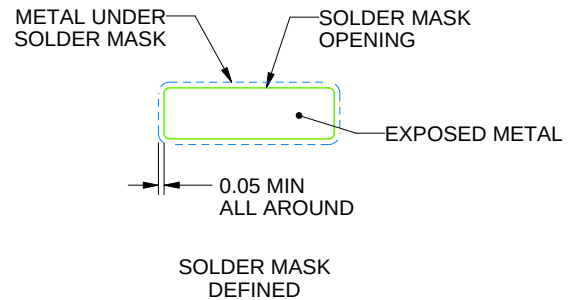
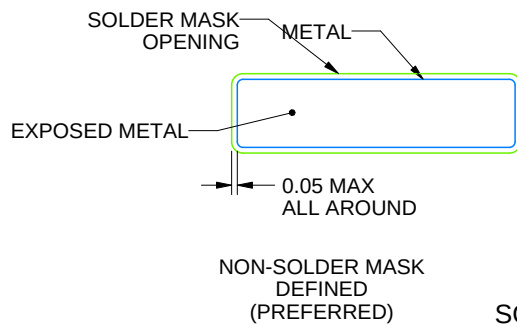
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

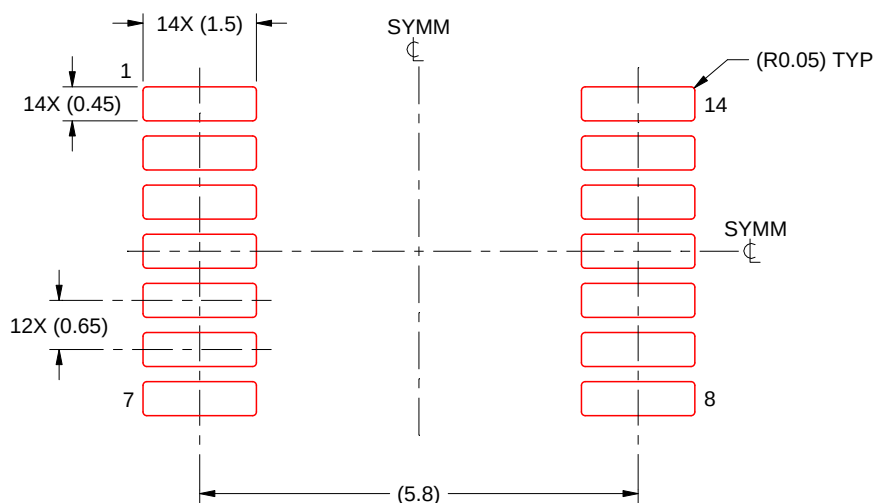
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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