

## SNx4HC165 8-Bit Parallel-Load Shift Registers

### 1 Features

- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up to 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Maximum  $I_{CC}$
- Typical  $t_{pd} = 13$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Maximum
- Complementary Outputs
- Direct Overriding Load (Data) Inputs
- Gated Clock Inputs
- Parallel-to-Serial Data Conversion
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

### 2 Applications

- Programmable Logic Controllers
- Appliances
- Video Display Systems
- Output Expander
- Keyboards

### 3 Description

The SNx4HC165 devices are 8-bit parallel-load shift registers that, when clocked, shift the data toward a serial ( $Q_H$ ) output. Parallel-in access to each stage is provided by eight individual direct data (A–H) inputs that are enabled by a low level at the shift/load (SH/LD) input. The SNx4HC165 devices also feature a clock-inhibit (CLK INH) function and a complementary serial ( $\bar{Q}_H$ ) output.

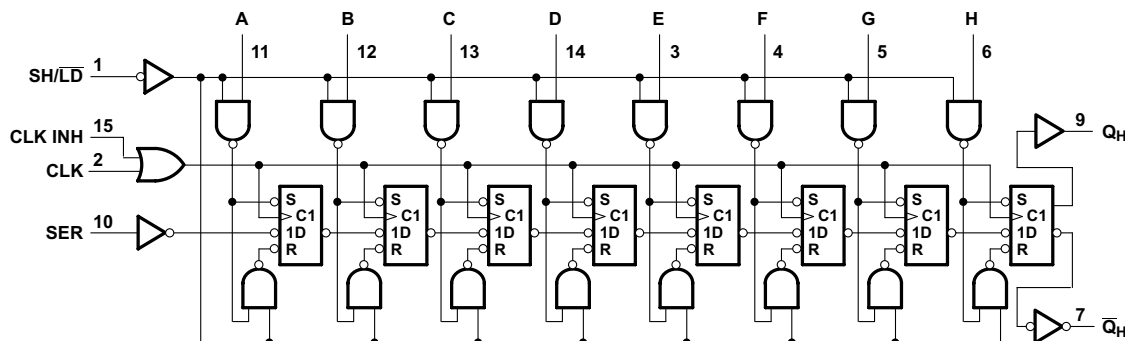
Clocking is accomplished by a low-to-high transition of the clock (CLK) input while SH/LD is held high and CLK INH is held low. The functions of CLK and CLK INH are interchangeable. Because a low CLK and a low-to-high transition of CLK INH also accomplish clocking, CLK INH must be changed to the high level only while CLK is high. Parallel loading is inhibited when SH/LD is held high. While SH/LD is low, the parallel inputs to the register are enabled independently of the levels of the CLK, CLK INH, or serial (SER) inputs.

Device Information<sup>(1)</sup>

| PART NUMBER | PACKAGE    | BODY SIZE (NOM)    |
|-------------|------------|--------------------|
| SN74HC165D  | SOIC (16)  | 10.00 mm x 6.20 mm |
| SN74HC165DB | SSOP (16)  | 8.20 mm x 6.50 mm  |
| SN74HC165N  | PDIP (16)  | 6.60 mm x 18.92 mm |
| SN74HC165NS | SO (16)    | 8.20 mm x 9.90 mm  |
| SN74HC165PW | TSSOP (16) | 6.60 mm x 5.10 mm  |
| SN54HC165FK | LCCC (20)  | 9.09 mm x 9.09 mm  |
| SN54HC165J  | CDIP (16)  | 21.34 mm x 7.52 mm |
| SN54HC165W  | CFP (16)   | 9.40 mm x 7.75 mm  |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Logic Diagram Positive Logic



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



## Table of Contents

|  |          |  |           |
|--|----------|--|-----------|
| <b>1 Features</b> .....  | <b>1</b> | <b>7 Parameter Measurement Information</b> .....                 | <b>11</b> |
| <b>2 Applications</b> .....                                    | <b>1</b> | <b>8 Detailed Description</b> .....                              | <b>12</b> |
| <b>3 Description</b> .....                                     | <b>1</b> | 8.1 Overview .....   | 12        |
| <b>4 Revision History</b> .....                                | <b>2</b> | 8.2 Functional Block Diagram .....                               | 12        |
| <b>5 Pin Configuration and Functions</b> .....                 | <b>3</b> | 8.3 Feature Description .....                                    | 13        |
| <b>6 Specifications</b> .....                                  | <b>4</b> | 8.4 Device Functional Table .....                                | 13        |
| 6.1 Absolute Maximum Ratings .....                             | 4        | <b>9 Application and Implementation</b> .....                    | <b>14</b> |
| 6.2 ESD Ratings .....  | 4        | 9.1 Application Information .....                                | 14        |
| 6.3 Recommended Operating Conditions .....                     | 4        | 9.2 Typical Application .....                                    | 14        |
| 6.4 Thermal Information .....                                  | 4        | <b>10 Power Supply Recommendations</b> .....                     | <b>15</b> |
| 6.5 Electrical Characteristics, $T_A = 25^\circ\text{C}$ ..... | 5        | <b>11 Layout</b> .....   | <b>15</b> |
| 6.6 Electrical Characteristics, SN54HC165 .....                | 5        | 11.1 Layout Guidelines .....                                     | 15        |
| 6.7 Electrical Characteristics, SN74HC165 .....                | 5        | 11.2 Layout Example .....  | 15        |
| 6.8 Switching Characteristics, $T_A = 25^\circ\text{C}$ .....  | 6        | <b>12 Device and Documentation Support</b> .....                 | <b>16</b> |
| 6.9 Switching Characteristics, SN54HC165 .....                 | 6        | 12.1 Documentation Support .....                                 | 16        |
| 6.10 Switching Characteristics, SN74HC165 .....                | 7        | 12.2 Related Links .....   | 16        |
| 6.11 Timing Requirements, $T_A = 25^\circ\text{C}$ .....       | 7        | 12.3 Community Resources .....                                   | 16        |
| 6.12 Timing Requirements, SN54HC165 .....                      | 8        | 12.4 Trademarks .....  | 16        |
| 6.13 Timing Requirements, SN74HC165 .....                      | 9        | 12.5 Electrostatic Discharge Caution .....                       | 16        |
| 6.14 Operating Characteristics .....                           | 10       | 12.6 Glossary .....  | 16        |
| 6.15 Typical Characteristics .....                             | 11       | <b>13 Mechanical, Packaging, and Orderable Information</b> ..... | <b>16</b> |

## 4 Revision History

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

### Changes from Revision G (August 2013) to Revision H

Page

|  |    |
|--|----|
| • Added <i>Applications</i> section, <i>Device Information</i> table, <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... | 1  |
| • Added Military Disclaimer to <i>Features</i> list .....  | 1  |
| • Added ESD warning .....  | 16 |

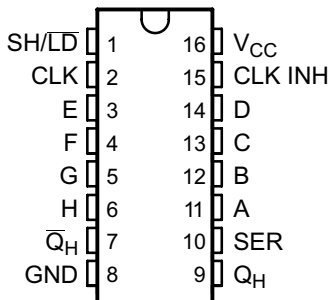
### Changes from Revision F (December 2010) to Revision G

Page

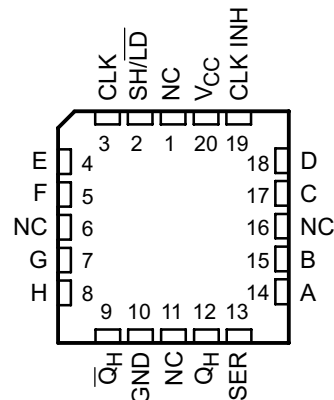
|   |   |
|---|---|
| • Updated document to new TI data sheet format - no specification changes .....                     | 1 |
| • Removed <i>Ordering Information</i> table .....   | 1 |
| • Added Handling Ratings table .....  | 4 |
| • Extended maximum temperature operating range from $85^\circ\text{C}$ to $125^\circ\text{C}$ ..... | 4 |

## 5 Pin Configuration and Functions

D, DB, N, NS, J, W, or PW Package  
16-Pin SOIC, SSOP, PDIP, SO, CDIP, CFP, or TSSOP  
Top View



FK Package  
20-Pin LCCC  
Top View



Pin Functions<sup>(1)</sup>

| NAME    | PIN                      |    | I/O | DESCRIPTION  |
|---------|--------------------------|----|-----|--|
|         | D, DB, N, NS, PW, J or W | FK |     |  |
| A       | 11                       | 14 | I   | Parallel Input   |
| B       | 12                       | 15 | I   | Parallel Input   |
| C       | 13                       | 17 | I   | Parallel Input   |
| CLK     | 2                        | 3  | I   | Clock input  |
| CLK INH | 15                       | 19 | I   | Clock Inhibit, when High No change in output   |
| D       | 14                       | 18 | I   | Parallel Input   |
| E       | 3                        | 4  | I   | Parallel Input   |
| F       | 4                        | 5  | I   | Parallel Input   |
| G       | 5                        | 7  | I   | Parallel Input   |
| GND     | 8                        | 10 | —   | Ground Pin   |
| H       | 6                        | 8  | I   | Parallel Input   |
| NC      | —                        | 1  | —   | Not Connected  |
|         |                          | 6  |     |  |
|         |                          | 11 |     |  |
|         |                          | 16 |     |  |
| QH      | 9                        | 12 | O   | Serial Output  |
| QH      | 7                        | 9  | O   | Complementary Serial Output  |
| SER     | 10                       | 13 | I   | Serial Input   |
| SH/LD   | 1                        | 2  | I   | Shift or Load input, When High Data, shifted. When Low data is loaded from parallel inputs |
| VCC     | 16                       | 20 | —   | Power Pin  |

(1) NC – No internal connection

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

|                  |   | MIN  | MAX | UNIT      |
|------------------|---|--|-----|-----------|
| V <sub>CC</sub>  | Supply voltage                                    | -0.5   | 7   | V         |
| I <sub>IK</sub>  | Input clamp current <sup>(2)</sup>                | V <sub>I</sub> < 0 or V <sub>I</sub> > V <sub>CC</sub> |     | ±20<br>mA |
| I <sub>OK</sub>  | Output clamp current <sup>(2)</sup>               | V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>CC</sub> |     | ±20<br>mA |
| I <sub>O</sub>   | Continuous output current                         | V <sub>O</sub> = 0 to V <sub>CC</sub>                  |     | ±25<br>mA |
|                  | Continuous current through V <sub>CC</sub> or GND |  |     | ±50<br>mA |
| T <sub>stg</sub> | Storage temperature                               | -65  | 150 | °C        |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

### 6.2 ESD Ratings

|                    |                         | VALUE   | UNIT       |
|--------------------|-------------------------|---|------------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup> | ±1500<br>V |

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

### 6.3 Recommended Operating Conditions

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

|                      |                                     | MIN                     | NOM  | MAX             | UNIT |
|----------------------|-------------------------------------|-------------------------|------|-----------------|------|
| V <sub>CC</sub>      | Supply voltage                      | 2                       | 5    | 6               | V    |
| V <sub>IH</sub>      | High-level input voltage            | V <sub>CC</sub> = 2 V   | 1.5  |                 | V    |
|                      |                                     | V <sub>CC</sub> = 4.5 V | 3.15 |                 |      |
|                      |                                     | V <sub>CC</sub> = 6 V   | 4.2  |                 |      |
| V <sub>IL</sub>      | Low level input voltage             | V <sub>CC</sub> = 2 V   |      | 0.5             | V    |
|                      |                                     | V <sub>CC</sub> = 4.5 V |      | 1.35            |      |
|                      |                                     | V <sub>CC</sub> = 6 V   |      | 1.8             |      |
| V <sub>I</sub>       | Input voltage                       | 0                       |      | V <sub>CC</sub> | V    |
| V <sub>O</sub>       | Output voltage                      | 0                       |      | V <sub>CC</sub> | V    |
| Δt/Δv <sup>(2)</sup> | Input transition rise and fall time | V <sub>CC</sub> = 2 V   |      | 1000            | ns/V |
|                      |                                     | V <sub>CC</sub> = 4.5 V |      | 500             |      |
|                      |                                     | V <sub>CC</sub> = 6 V   |      | 400             |      |
| T <sub>A</sub>       | Operating free-air temperature      | SN54HC165               | -55  | 125             | °C   |
|                      |                                     | SN74HC165               | -40  | 125             |      |

- (1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number [SCBA004](#).
- (2) If this device is used in the threshold region (from V<sub>IL</sub> max = 0.5 V to V<sub>IH</sub> min = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at t<sub>r</sub> = 1000 ns and V<sub>CC</sub> = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> | SN74HC165                              |           |         |         |            | UNIT |      |
|-------------------------------|--|-----------|---------|---------|------------|------|------|
|                               | D (SOIC)                               | DB (SSOP) | N (DIP) | NS (SO) | PW (TSSOP) |      |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance | 73        | 82      | 67      | 64         | 108  | °C/W |

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

### 6.5 Electrical Characteristics, $T_A = 25^\circ\text{C}$

over recommended operating free-air temperature range for both the SN74HC165 and SN54HC165 (unless otherwise noted)

| PARAMETER | TEST CONDITIONS            |                            | $V_{CC}$   | MIN  | TYP       | MAX       | UNIT          |
|-----------|----------------------------|----------------------------|------------|------|-----------|-----------|---------------|
| $V_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$ | $I_{OH} = -20 \mu\text{A}$ | 2 V        | 1.9  | 1.998     |           | V             |
|           |                            |                            | 4.5 V      | 4.4  | 4.499     |           |               |
|           |                            |                            | 6 V        | 5.9  | 5.999     |           |               |
|           |                            | $I_{OH} = -4 \text{ mA}$   | 4.5 V      | 3.98 | 4.3       |           |               |
|           |                            |                            | 6 V        | 5.48 | 5.8       |           |               |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$ | $I_{OL} = 20 \mu\text{A}$  | 2 V        |      | 0.002     | 0.1       | V             |
|           |                            |                            | 4.5 V      |      | 0.001     | 0.1       |               |
|           |                            |                            | 6 V        |      | 0.001     | 0.1       |               |
|           |                            | $I_{OL} = 4 \text{ mA}$    | 4.5 V      |      | 0.17      | 0.26      |               |
|           |                            |                            | 6 V        |      | 0.15      | 0.26      |               |
| $I_I$     | $V_I = V_{CC}$ or 0        |                            | 6 V        |      | $\pm 0.1$ | $\pm 100$ | nA            |
| $I_{CC}$  | $V_I = V_{CC}$ or 0,       | $I_O = 0$                  | 6 V        |      |           | 8         | $\mu\text{A}$ |
| $C_i$     |                            |                            | 2 V to 6 V |      | 3         | 10        | pF            |

### 6.6 Electrical Characteristics, SN54HC165

 over recommended operating free-air temperature range,  $T_A = -55^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

| PARAMETER | TEST CONDITIONS            |                            | $V_{CC}$   | MIN | TYP | MAX        | UNIT          |
|-----------|----------------------------|----------------------------|------------|-----|-----|------------|---------------|
| $V_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$ | $I_{OH} = -20 \mu\text{A}$ | 2 V        | 1.9 |     |            | V             |
|           |                            |                            | 4.5 V      | 4.4 |     |            |               |
|           |                            |                            | 6 V        | 5.9 |     |            |               |
|           |                            | $I_{OH} = -4 \text{ mA}$   | 4.5 V      | 3.7 |     |            |               |
|           |                            |                            | 6 V        | 5.2 |     |            |               |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$ | $I_{OL} = 20 \mu\text{A}$  | 2 V        |     |     | 0.1        | V             |
|           |                            |                            | 4.5 V      |     |     | 0.1        |               |
|           |                            |                            | 6 V        |     |     | 0.1        |               |
|           |                            | $I_{OL} = 4 \text{ mA}$    | 4.5 V      |     |     | 0.4        |               |
|           |                            |                            | 6 V        |     |     | 0.4        |               |
| $I_I$     | $V_I = V_{CC}$ or 0        |                            | 6 V        |     |     | $\pm 1000$ | nA            |
| $I_{CC}$  | $V_I = V_{CC}$ or 0,       | $I_O = 0$                  | 6 V        |     |     | 160        | $\mu\text{A}$ |
| $C_i$     |                            |                            | 2 V to 6 V |     |     | 10         | pF            |

### 6.7 Electrical Characteristics, SN74HC165

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

| PARAMETER  | TEST CONDITIONS            |                            | $V_{CC}$   | MIN  | TYP  | MAX  | UNIT |
|--|----------------------------|----------------------------|--|--|------|------|------|
| $V_{OH}$   | $V_I = V_{IH}$ or $V_{IL}$ | $I_{OH} = -20 \mu\text{A}$ | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 2 V  | 1.9  |      | V    |
|  |                            |                            |  | 4.5 V  | 4.4  |      |      |
|  |                            |                            |  | 6 V  | 5.9  |      |      |
|  |                            | $I_{OH} = -4 \text{ mA}$   | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 4.5 V  | 3.84 |      |      |
|  |                            |                            |  | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 3.7  |      |      |
|  |                            |                            | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 6 V  | 5.34 |      |      |
| $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |                            | 5.2                        |  |  |      |      |      |
| $V_{OL}$   | $V_I = V_{IH}$ or $V_{IL}$ | $I_{OL} = 20 \mu\text{A}$  | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 2 V  |      | 0.1  | V    |
|  |                            |                            |  | 4.5 V  |      | 0.1  |      |
|  |                            |                            |  | 6 V  |      | 0.1  |      |
|  |                            | $I_{OL} = 4 \text{ mA}$    | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 4.5 V  |      | 0.33 |      |
|  |                            |                            |  | 6 V  |      | 0.33 |      |
|  |                            |                            | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |  |      |      |      |

**Electrical Characteristics, SN74HC165 (continued)**

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

| PARAMETER       | TEST CONDITIONS   | V <sub>CC</sub> | MIN | TYP | MAX   | UNIT |
|-----------------|---|-----------------|-----|-----|-------|------|
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or 0, T <sub>A</sub> = -40°C to 125°C                    | 6 V             |     |     | ±1000 | nA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0, T <sub>A</sub> = -40°C to 85°C | 6 V             |     |     | 80    | μA   |
|                 | T <sub>A</sub> = -40°C to 125°C   |                 |     |     | 160   |      |
| C <sub>i</sub>  | Recommended T <sub>A</sub> = -40°C to 125°C   | 2 V to 6 V      |     |     | 10    | pF   |

**6.8 Switching Characteristics, T<sub>A</sub> = 25°C**

 over recommended operating free-air temperature range for both the SN74HC165 and SN54HC165, C<sub>L</sub> = 50 pF (unless otherwise noted) (see [Figure 2](#))

| PARAMETER        | FROM (INPUT)               | TO (OUTPUT)  | V <sub>CC</sub> | MIN | TYP | MAX | UNIT |
|------------------|----------------------------|--|-----------------|-----|-----|-----|------|
| f <sub>max</sub> |                            |  | 2 V             | 6   | 13  |     | MHz  |
|                  |                            |  | 4.5 V           | 31  | 50  |     |      |
|                  |                            |  | 6 V             | 36  | 62  |     |      |
| t <sub>pd</sub>  | SH/ $\overline{\text{LD}}$ | Q <sub>H</sub> or $\overline{\text{Q}}_{\text{H}}$ | 2 V             |     | 80  | 150 | ns   |
|                  |                            |  | 4.5 V           |     | 20  | 30  |      |
|                  |                            |  | 6 V             |     | 16  | 26  |      |
|                  | CLK                        | Q <sub>H</sub> or $\overline{\text{Q}}_{\text{H}}$ | 2 V             |     | 75  | 150 |      |
|                  |                            |  | 4.5 V           |     | 15  | 30  |      |
|                  |                            |  | 6 V             |     | 13  | 26  |      |
|                  | H                          | Q <sub>H</sub> or $\overline{\text{Q}}_{\text{H}}$ | 2 V             |     | 75  | 150 |      |
|                  |                            |  | 4.5 V           |     | 15  | 30  |      |
|                  |                            |  | 6 V             |     | 13  | 26  |      |
| t <sub>t</sub>   |                            | Any  | 2 V             |     | 38  | 75  | ns   |
|                  |                            |  | 4.5 V           |     | 8   | 15  |      |
|                  |                            |  | 6 V             |     | 6   | 13  |      |

**6.9 Switching Characteristics, SN54HC165**

 over recommended operating free-air temperature range, T<sub>A</sub> = -55°C to 125°C, C<sub>L</sub> = 50 pF (unless otherwise noted) (see [Figure 2](#))

| PARAMETER        | FROM (INPUT)               | TO (OUTPUT)  | V <sub>CC</sub> | MIN | MAX | UNIT |
|------------------|----------------------------|--|-----------------|-----|-----|------|
| f <sub>max</sub> |                            |  | 2 V             | 4.2 |     | MHz  |
|                  |                            |  | 4.5 V           | 21  |     |      |
|                  |                            |  | 6 V             | 25  |     |      |
| t <sub>pd</sub>  | SH/ $\overline{\text{LD}}$ | Q <sub>H</sub> or $\overline{\text{Q}}_{\text{H}}$ | 2 V             |     | 225 | ns   |
|                  |                            |  | 4.5 V           |     | 45  |      |
|                  |                            |  | 6 V             |     | 38  |      |
|                  | CLK                        | Q <sub>H</sub> or $\overline{\text{Q}}_{\text{H}}$ | 2 V             |     | 225 |      |
|                  |                            |  | 4.5 V           |     | 45  |      |
|                  |                            |  | 6 V             |     | 38  |      |
|                  | H                          | Q <sub>H</sub> or $\overline{\text{Q}}_{\text{H}}$ | 2 V             |     | 225 |      |
|                  |                            |  | 4.5 V           |     | 45  |      |
|                  |                            |  | 6 V             |     | 38  |      |
| t <sub>t</sub>   |                            | Any  | 2 V             |     | 110 | ns   |
|                  |                            |  | 4.5 V           |     | 22  |      |
|                  |                            |  | 6 V             |     | 19  |      |

## 6.10 Switching Characteristics, SN74HC165

 over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see [Figure 2](#))

| PARAMETER | FROM (INPUT)               | TO (OUTPUT)               | $V_{CC}$  | TEMPERATURE                                     | MIN | MAX | UNIT |
|-----------|----------------------------|---------------------------|---|---|-----|-----|------|
| $f_{max}$ |                            |                           | 2 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  | 5   |     | MHz  |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | 4.2 |     |      |
|           |                            |                           | 4.5 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  | 25  |     |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | 21  |     |      |
|           |                            |                           | 6 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  | 29  |     |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | 25  |     |      |
| $t_{pd}$  | SH/ $\overline{\text{LD}}$ | $Q_H$ or $\overline{Q}_H$ | 2 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |     | 190 | ns   |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |     | 225 |      |
|           |                            |                           | 4.5 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |     | 38  |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |     | 45  |      |
|           |                            |                           | 6 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |     | 32  |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |     | 38  |      |
|           | CLK                        | $Q_H$ or $\overline{Q}_H$ | 2 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |     | 190 |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |     | 225 |      |
|           |                            |                           | 4.5 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |     | 38  |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |     | 45  |      |
|           |                            |                           | 6 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |     | 32  |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |     | 38  |      |
| H         | $Q_H$ or $\overline{Q}_H$  | 2 V                       | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |   | 190 |     |      |
|           |                            |                           | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |   | 225 |     |      |
|           |                            | 4.5 V                     | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |   | 38  |     |      |
|           |                            |                           | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |   | 45  |     |      |
|           |                            | 6 V                       | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  |   | 32  |     |      |
|           |                            |                           | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ |   | 38  |     |      |
| $t_t$     |                            | Any                       | 2 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  | 95  | ns  |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | 110 |     |      |
|           |                            |                           | 4.5 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  | 19  |     |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | 22  |     |      |
|           |                            |                           | 6 V   | $T_A = -40^\circ\text{C to } 85^\circ\text{C}$  | 16  |     |      |
|           |                            |                           |   | $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | 19  |     |      |

## 6.11 Timing Requirements, $T_A = 25^\circ\text{C}$

over recommended operating free-air temperature range for both the SN74HC165 and SN54HC165 (unless otherwise noted)

|             |                                | $V_{CC}$ | MIN | MAX | UNIT |
|-------------|--------------------------------|----------|-----|-----|------|
| $f_{clock}$ | Clock frequency                | 2 V      |     | 6   | MHz  |
|             |                                | 4.5 V    |     | 31  |      |
|             |                                | 6 V      |     | 36  |      |
| $t_w$       | SH/ $\overline{\text{LD}}$ low | 2 V      | 80  | ns  |      |
|             |                                | 4.5 V    | 16  |     |      |
|             |                                | 6 V      | 14  |     |      |
|             | CLK high or low                | 2 V      | 80  |     |      |
|             |                                | 4.5 V    | 16  |     |      |
|             |                                | 6 V      | 14  |     |      |

**Timing Requirements,  $T_A = 25^\circ\text{C}$  (continued)**

over recommended operating free-air temperature range for both the SN74HC165 and SN54HC165 (unless otherwise noted)

|  |   | $V_{CC}$ | MIN | MAX | UNIT |
|--|---|----------|-----|-----|------|
| $t_{su}$                                     | SH/ $\overline{LD}$ high before CLK $\uparrow$  | 2 V      | 80  |     | ns   |
|  |   | 4.5 V    | 16  |     |      |
|  |   | 6 V      | 14  |     |      |
|  | SER before CLK $\uparrow$                       | 2 V      | 40  |     |      |
|  |   | 4.5 V    | 8   |     |      |
|  |   | 6 V      | 7   |     |      |
|  | CLK INH low before CLK $\uparrow$               | 2 V      | 100 |     |      |
|  |   | 4.5 V    | 20  |     |      |
|  |   | 6 V      | 17  |     |      |
|  | CLK INH high before CLK $\uparrow$              | 2 V      | 40  |     |      |
|  |   | 4.5 V    | 8   |     |      |
|  |   | 6 V      | 7   |     |      |
| Data before SH/ $\overline{LD}$ $\downarrow$ | 2 V   | 100      |     |     |      |
|  | 4.5 V   | 20       |     |     |      |
|  | 6 V   | 17       |     |     |      |
| $t_h$  | SER data after CLK $\uparrow$                   | 2 V      | 5   |     | ns   |
|  |   | 4.5 V    | 5   |     |      |
|  |   | 6 V      | 5   |     |      |
|  | PAR data after SH/ $\overline{LD}$ $\downarrow$ | 2 V      | 5   |     |      |
|  |   | 4.5 V    | 5   |     |      |
|  |   | 6 V      | 5   |     |      |

**6.12 Timing Requirements, SN54HC165**

 over recommended operating free-air temperature range,  $T_A = -55^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

|             |                         | $V_{CC}$ | MIN | MAX | UNIT |
|-------------|-------------------------|----------|-----|-----|------|
| $f_{clock}$ | Clock frequency         | 2 V      |     | 4.2 | MHz  |
|             |                         | 4.5 V    |     | 21  |      |
|             |                         | 6 V      |     | 25  |      |
| $t_w$       | SH/ $\overline{LD}$ low | 2 V      | 120 |     | ns   |
|             |                         | 4.5 V    | 24  |     |      |
|             |                         | 6 V      | 20  |     |      |
|             | CLK high or low         | 2 V      | 120 |     |      |
|             |                         | 4.5 V    | 24  |     |      |
|             |                         | 6 V      | 20  |     |      |



### Timing Requirements, SN54HC165 (continued)

 over recommended operating free-air temperature range,  $T_A = -55^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

|   |  | $V_{CC}$  | MIN   | MAX | UNIT |
|---|--|---|-------|-----|------|
| $t_{su}$  | Set-up time  | SH/ $\overline{\text{LD}}$ high before CLK $\uparrow$ | 2 V   | 120 | ns   |
|   |  |   | 4.5 V | 24  |      |
|   |  |   | 6 V   | 20  |      |
|   |  | SER before CLK $\uparrow$                             | 2 V   | 60  |      |
|   |  |   | 4.5 V | 12  |      |
|   |  |   | 6 V   | 10  |      |
|   | CLK INH low before CLK $\uparrow$                      | 2 V   | 150   |     |      |
|   |  | 4.5 V   | 30    |     |      |
|   |  | 6 V   | 25    |     |      |
|   | CLK INH high before CLK $\uparrow$                     | 2 V   | 60    |     |      |
|   |  | 4.5 V   | 12    |     |      |
|   |  | 6 V   | 10    |     |      |
| Data before SH/ $\overline{\text{LD}}$ $\downarrow$ | 2 V  | 150   |       |     |      |
|   | 4.5 V  | 30  |       |     |      |
|   | 6 V  | 26  |       |     |      |
| $t_h$   | Hold time  | SER data after CLK $\uparrow$                         | 2 V   | 5   | ns   |
|   |  |   | 4.5 V | 5   |      |
|   |  |   | 6 V   | 5   |      |
|   | PAR data after SH/ $\overline{\text{LD}}$ $\downarrow$ | 2 V   | 5     |     |      |
|   |  | 4.5 V   | 5     |     |      |
|   |  | 6 V   | 5     |     |      |

### 6.13 Timing Requirements, SN74HC165

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

| PARAMETER   |                 | $V_{CC}$                       | TEMPERATURE                                      | MIN  | MAX | UNIT |
|-------------|-----------------|--------------------------------|--|--|-----|------|
| $f_{clock}$ | Clock frequency | 2 V                            | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  |  | 5   | MHz  |
|             |                 |                                | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |  | 4.2 |      |
|             |                 | 4.5 V                          | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  |  | 25  |      |
|             |                 |                                | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |  | 21  |      |
|             |                 | 6 V                            | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  |  | 29  |      |
|             |                 |                                | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ |  | 25  |      |
| $t_w$       | Pulse duration  | SH/ $\overline{\text{LD}}$ low | 2 V  | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 100 | ns   |
|             |                 |                                |  | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 120 |      |
|             |                 |                                | 4.5 V  | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 20  |      |
|             |                 |                                |  | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 24  |      |
|             |                 |                                | 6 V  | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 17  |      |
|             |                 |                                |  | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 20  |      |
|             | CLK high or low | 2 V                            | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 100  |     |      |
|             |                 |                                | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 120  |     |      |
|             |                 | 4.5 V                          | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 20   |     |      |
|             |                 |                                | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 24   |     |      |
|             |                 | 6 V                            | $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$  | 17   |     |      |
|             |                 |                                | $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ | 20   |     |      |

**Timing Requirements, SN74HC165 (continued)**

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

| PARAMETER   |  | V <sub>CC</sub>                 | TEMPERATURE                     | MIN | MAX | UNIT |
|---|--|---------------------------------|---------------------------------|-----|-----|------|
| t <sub>su</sub>                                     | SH/ $\overline{\text{LD}}$ high before CLK $\uparrow$  | 2 V                             | T <sub>A</sub> = –40°C to 85°C  | 100 |     | ns   |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 120 |     |      |
|   |  | 4.5 V                           | T <sub>A</sub> = –40°C to 85°C  | 20  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 24  |     |      |
|   |  | 6 V                             | T <sub>A</sub> = –40°C to 85°C  | 17  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 20  |     |      |
|   | SER before CLK $\uparrow$                              | 2 V                             | T <sub>A</sub> = –40°C to 85°C  | 50  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 60  |     |      |
|   |  | 4.5 V                           | T <sub>A</sub> = –40°C to 85°C  | 10  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 12  |     |      |
|   |  | 6 V                             | T <sub>A</sub> = –40°C to 85°C  | 9   |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 10  |     |      |
|   | CLK INH low before CLK $\uparrow$                      | 2 V                             | T <sub>A</sub> = –40°C to 85°C  | 125 |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 150 |     |      |
|   |  | 4.5 V                           | T <sub>A</sub> = –40°C to 85°C  | 25  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 30  |     |      |
|   |  | 6 V                             | T <sub>A</sub> = –40°C to 85°C  | 21  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 25  |     |      |
|   | CLK INH high before CLK $\uparrow$                     | 2 V                             | T <sub>A</sub> = –40°C to 85°C  | 50  |     |      |
|   |  |                                 | T <sub>A</sub> = –40°C to 125°C | 60  |     |      |
| 4.5 V   |  | T <sub>A</sub> = –40°C to 85°C  | 10                              |     |     |      |
|   |  | T <sub>A</sub> = –40°C to 125°C | 12                              |     |     |      |
| 6 V   |  | T <sub>A</sub> = –40°C to 85°C  | 9                               |     |     |      |
|   |  | T <sub>A</sub> = –40°C to 125°C | 10                              |     |     |      |
| Data before SH/ $\overline{\text{LD}}$ $\downarrow$ | 2 V  | T <sub>A</sub> = –40°C to 85°C  | 125                             |     |     |      |
|   |  | T <sub>A</sub> = –40°C to 125°C | 150                             |     |     |      |
|   | 4.5 V  | T <sub>A</sub> = –40°C to 85°C  | 25                              |     |     |      |
|   |  | T <sub>A</sub> = –40°C to 125°C | 30                              |     |     |      |
|   | 6 V  | T <sub>A</sub> = –40°C to 85°C  | 21                              |     |     |      |
|   |  | T <sub>A</sub> = –40°C to 125°C | 26                              |     |     |      |
| t <sub>h</sub>                                      | SER data after CLK $\uparrow$                          | 2 V                             | T <sub>A</sub> = –40°C to 125°C | 5   | ns  |      |
|   |  | 4.5 V                           | T <sub>A</sub> = –40°C to 125°C | 5   |     |      |
|   |  | 6 V                             | T <sub>A</sub> = –40°C to 125°C | 5   |     |      |
|   | PAR data after SH/ $\overline{\text{LD}}$ $\downarrow$ | 2 V                             | T <sub>A</sub> = –40°C to 125°C | 5   |     |      |
|   |  | 4.5 V                           | T <sub>A</sub> = –40°C to 125°C | 5   |     |      |
|   |  | 6 V                             | T <sub>A</sub> = –40°C to 125°C | 5   |     |      |

**6.14 Operating Characteristics**

 T<sub>A</sub> = 25°C

| PARAMETER                                     | TEST CONDITIONS | TYP | UNIT |
|---|-----------------|-----|------|
| C <sub>pd</sub> Power dissipation capacitance | No load         | 75  | pF   |

### 6.15 Typical Characteristics

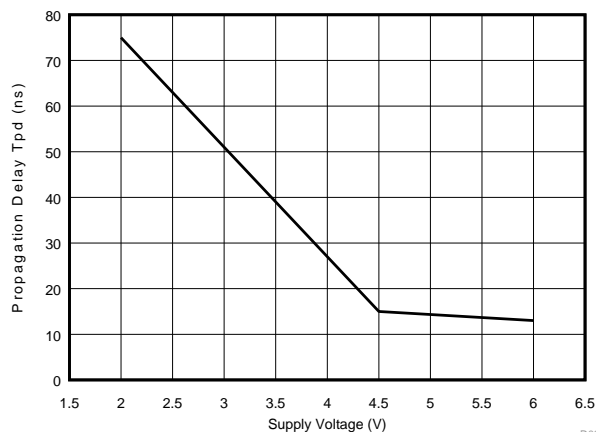
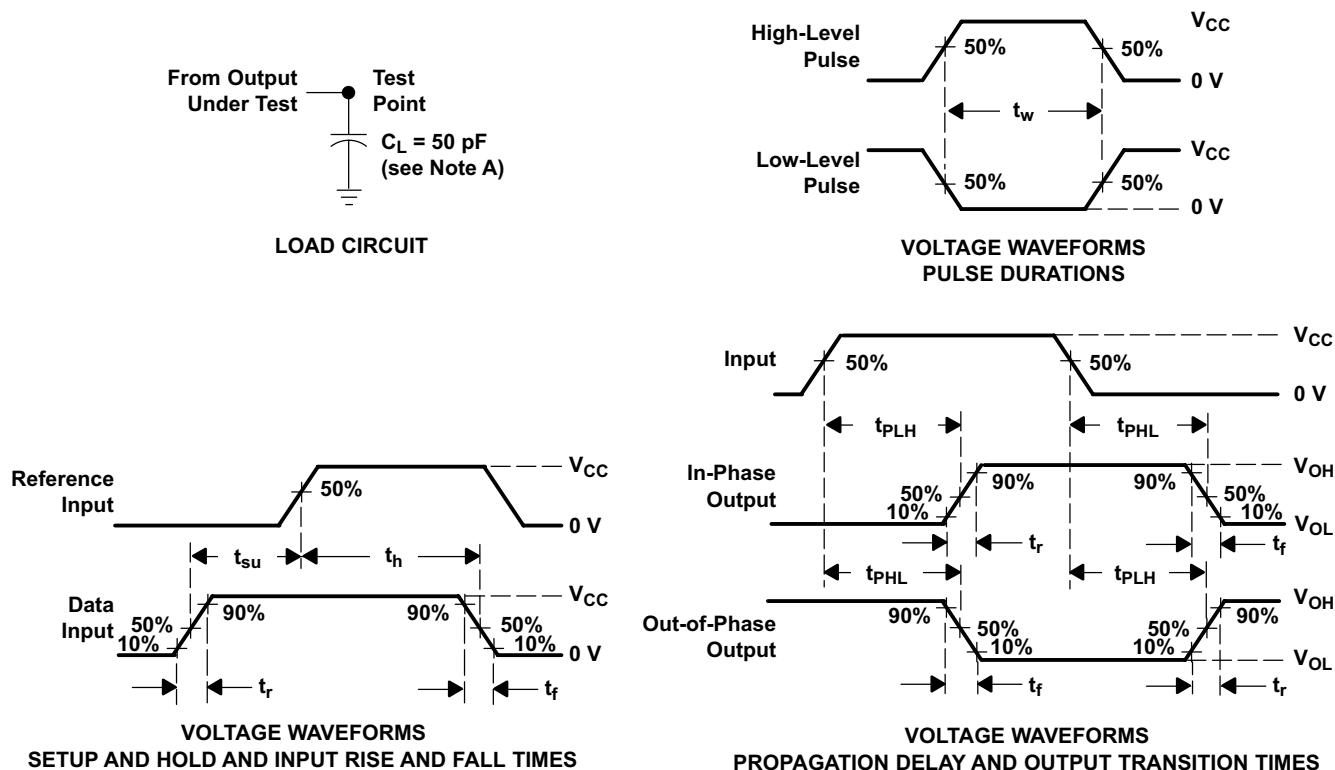


Figure 1. Propagation Delay vs Supply Voltage at  $T_A = 25^\circ\text{C}$

## 7 Parameter Measurement Information



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

Figure 2. Load Circuit and Voltage Waveforms

## 8 Detailed Description

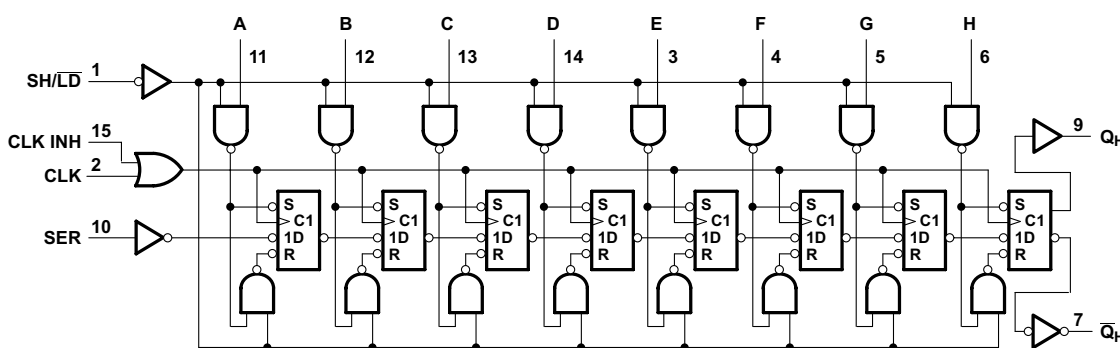
### 8.1 Overview

The SNx4HC165 is an 8-bit Parallel load shift register with 1 serial input and 8 parallel load input. The device loads all the 8 bits simultaneously through parallel load input when SH/LD is low. This will also ignore any input at CLK or CLK INH.

The device shifts the data when CLK toggles. The data is shifted on rising edge of the clock. Clock Inhibit (CLK INH) inhibits the clock function resulting in no change of the output. If SH/LD is low clock inputs are ignored. To realize the shift function, SH/LD should be high.

CLK and CLK INH functions are interchangeable. If CLK is low then change a clock signal at CLK INH pin causes a shift of data to Q<sub>H</sub>. If CLK INH is Low clock signal on CLK pin shifts the data out to Q<sub>H</sub>.

### 8.2 Functional Block Diagram



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

Figure 3. Logic Diagram Positive Logic

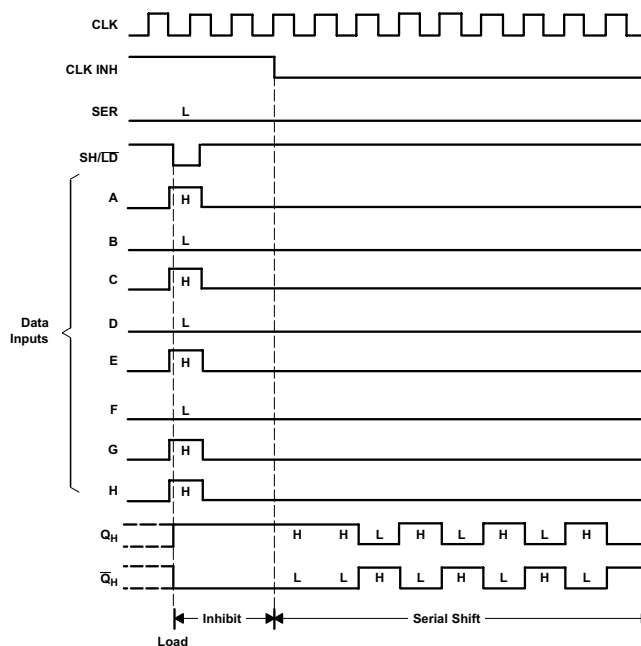


Figure 4. Typical Shift, Load, and Inhibit Sequence

### 8.3 Feature Description

The SNx4HC165 has a wide operating voltage range of 2 V to 6 V, outputs that can drive up to 10 LSTTL loads and Low Power Consumption, 80- $\mu$ A maximum I. It is typically  $t_{pd} = 13$  ns and has  $\pm 4$ -mA output drive at 5 V with low input current of 1- $\mu$ A maximum. The device features the direct overloading load of data input, meaning parallel data is loaded irrespective of clock signals.

### 8.4 Device Functional Table

Table 1 lists the functional modes of the SNx4HC165.

**Table 1. Function Table**

| SH/ $\overline{\text{LD}}$ | INPUTS     |            | FUNCTION             |
|----------------------------|------------|------------|----------------------|
|                            | CLK        | CLK INH    |                      |
| L                          | X          | X          | Parallel load        |
| H                          | H          | X          | No change            |
| H                          | X          | H          | No change            |
| H                          | L          | $\uparrow$ | Shift <sup>(1)</sup> |
| H                          | $\uparrow$ | L          | Shift <sup>(1)</sup> |

(1) Shift : Content of each internal register shifts towards serial output  $Q_H$ . Data at SER is shifted into the first register

## 9 Application and Implementation

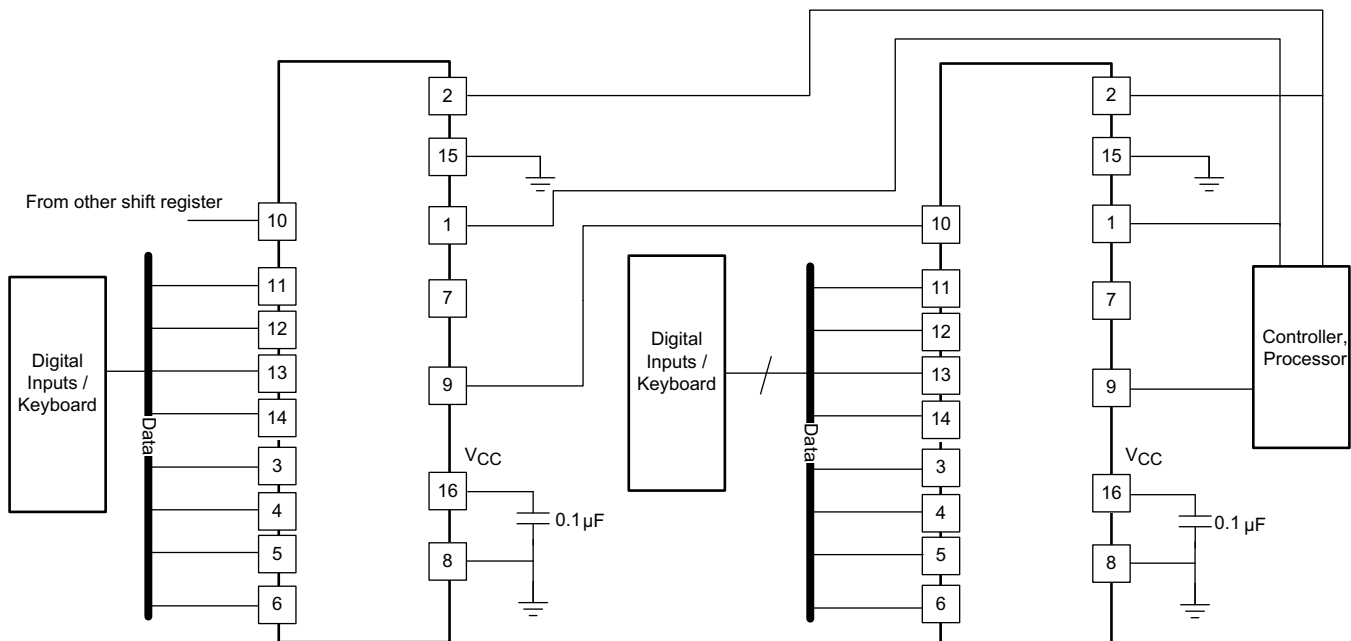
### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

The SNx4HC165 is an 8-bit shift register that can be used as a serializer in order to reduce the number of connection needed when transmitting signals between boards or to the device. SNx4HC165 can be used to expand inputs for processors with limited GPIOs for examples basic keyboard interface to the controller. SNx4HC165 allows inputs to be load into the shift registers and clock is used to shift data to the processor. Multiple SNx4HC165 can be cascaded together to allow more digital inputs to be interfaced with single processor by connecting output of the cascaded shift register  $Q_H$  to serial input SER of the SNx4HC165 and so on. Note this application does not allow the communication to be bi-direction in nature as data can only be read by the processor not written back.

### 9.2 Typical Application



**Figure 5. Typical Application Diagram for SN74HC165**

#### 9.2.1 Design Requirements

Ensure that the incoming clock rising edge meets the criteria in [Recommended Operating Conditions](#).

#### 9.2.2 Detailed Design Procedure

Ensure that input and output voltages do not exceed ratings in [Absolute Maximum Ratings](#).

Input voltage threshold information for each device can be found in the Electrical Characteristics tables in the [Specifications](#) section.

Detailed timing requirements for each device can be found in Timing Requirements tables in the [Specifications](#) section.

## Typical Application (continued)

### 9.2.3 Application Curve

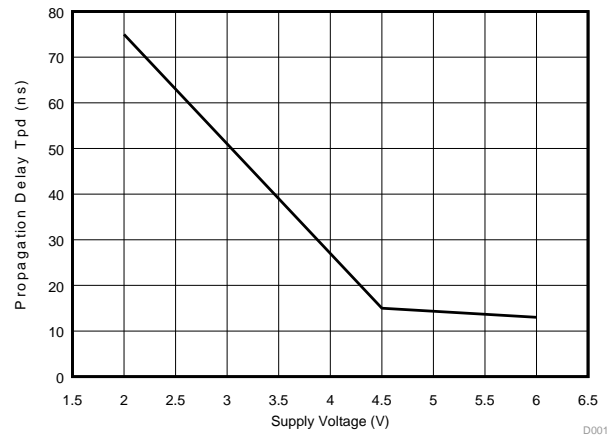


Figure 6. Propagation Delay vs Supply Voltage at  $T_A = 25^\circ\text{C}$

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#) table.

Each  $V_{CC}$  pin must have a good bypass capacitor in order to prevent power disturbance. For devices with a single supply, a 0.1- $\mu\text{F}$  capacitor is recommended and if there are multiple  $V_{CC}$  pins then a 0.01- $\mu\text{F}$  or 0.022- $\mu\text{F}$  capacitor is recommended for each power pin. It is ok to parallel multiple bypass caps to reject different frequencies of noise. 0.1- $\mu\text{F}$  and 1- $\mu\text{F}$  capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

## 11 Layout

### 11.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a  $90^\circ$  angle, a reflection can occur. This is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. [Figure 7](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

### 11.2 Layout Example

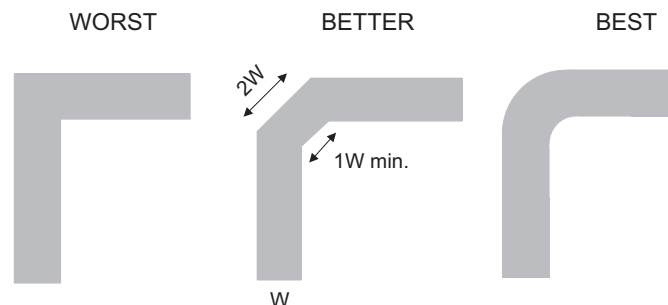


Figure 7. Trace Example

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

*Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).

### 12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 2. Related Links**

| PARTS     | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|-----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| SN54HC165 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| SN74HC165 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 12.3 Community Resources

The following links connect to TI community resources. Linked contents are 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](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.4 Trademarks

E2E is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 12.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms and definitions.

## 13 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 Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)  | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)       | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|-------------------------------|-------------------------|
| 84095012A        | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 84095012A<br>SNJ54HC<br>165FK | <a href="#">Samples</a> |
| 8409501EA        | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8409501EA<br>SNJ54HC165J      | <a href="#">Samples</a> |
| 8409501FA        | ACTIVE        | CFP          | W               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8409501FA<br>SNJ54HC165W      | <a href="#">Samples</a> |
| SN54HC165J       | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | SN54HC165J                    | <a href="#">Samples</a> |
| SN74HC165DBR     | ACTIVE        | SSOP         | DB              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165DR      | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green     | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165DRE4    | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165DRG3    | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green     | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165DRG4    | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165N       | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | -40 to 125   | SN74HC165N                    | <a href="#">Samples</a> |
| SN74HC165NE4     | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | -40 to 125   | SN74HC165N                    | <a href="#">Samples</a> |
| SN74HC165NSR     | ACTIVE        | SO           | NS              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165PWR     | ACTIVE        | TSSOP        | PW              | 16   | 2000        | RoHS & Green     | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165PWRG3   | ACTIVE        | TSSOP        | PW              | 16   | 2000        | RoHS & Green     | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SN74HC165PWRG4   | ACTIVE        | TSSOP        | PW              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC165                         | <a href="#">Samples</a> |
| SNJ54HC165FK     | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 84095012A<br>SNJ54HC<br>165FK | <a href="#">Samples</a> |
| SNJ54HC165J      | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8409501EA<br>SNJ54HC165J      | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)     | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)  | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|--------------------------|---------|
| SNJ54HC165W      | ACTIVE        | CFP          | W               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8409501FA<br>SNJ54HC165W | Samples |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

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

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

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

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

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

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN54HC165, SN74HC165 :**

- Catalog : [SN74HC165](#)
- Automotive : [SN74HC165-Q1](#), [SN74HC165-Q1](#)
- Enhanced Product : [SN74HC165-EP](#), [SN74HC165-EP](#)
- Military : [SN54HC165](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC165DBR   | SSOP         | DB              | 16   | 2000 | 330.0              | 16.4               | 8.35    | 6.6     | 2.4     | 12.0    | 16.0   | Q1            |
| SN74HC165DR    | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC165DR    | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC165DRG3  | SOIC         | D               | 16   | 2500 | 330.0              | 16.8               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC165DRG4  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC165DRG4  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC165NSR   | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74HC165NSR   | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.45    | 10.55   | 2.5     | 12.0    | 16.2   | Q1            |
| SN74HC165PWR   | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC165PWR   | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC165PWRG3 | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC165PWRG4 | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC165PWRG4 | TSSOP        | PW              | 16   | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC165DBR   | SSOP         | DB              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC165DR    | SOIC         | D               | 16   | 2500 | 356.0       | 356.0      | 35.0        |
| SN74HC165DR    | SOIC         | D               | 16   | 2500 | 356.0       | 356.0      | 35.0        |
| SN74HC165DRG3  | SOIC         | D               | 16   | 2500 | 364.0       | 364.0      | 27.0        |
| SN74HC165DRG4  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74HC165DRG4  | SOIC         | D               | 16   | 2500 | 356.0       | 356.0      | 35.0        |
| SN74HC165NSR   | SO           | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC165NSR   | SO           | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC165PWR   | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC165PWR   | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC165PWRG3 | TSSOP        | PW              | 16   | 2000 | 364.0       | 364.0      | 27.0        |
| SN74HC165PWRG4 | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC165PWRG4 | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |

**TUBE**


\*All dimensions are nominal

| Device       | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|--------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 84095012A    | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| 8409501FA    | W            | CFP          | 16   | 1   | 506.98 | 26.16  | 6220   | NA     |
| SN74HC165N   | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC165N   | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC165NE4 | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC165NE4 | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SNJ54HC165FK | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| SNJ54HC165W  | W            | CFP          | 16   | 1   | 506.98 | 26.16  | 6220   | NA     |

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP2-F16

## GENERIC PACKAGE VIEW

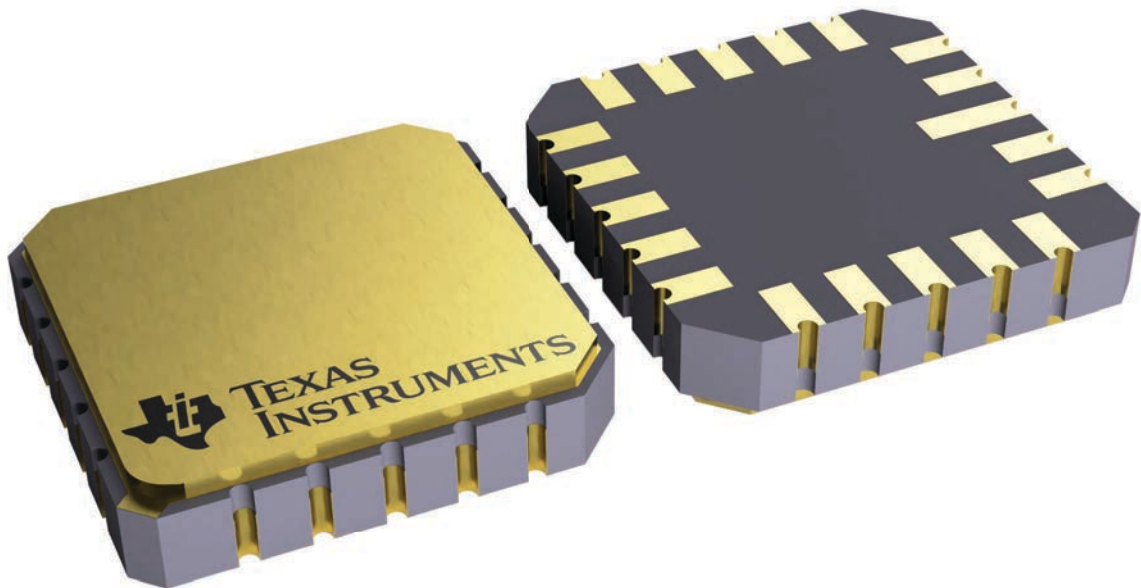
**FK 20**

**LCCC - 2.03 mm max height**

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4229370VA\



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

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



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



4040083/F 03/03

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

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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

4040049/E 12/2002

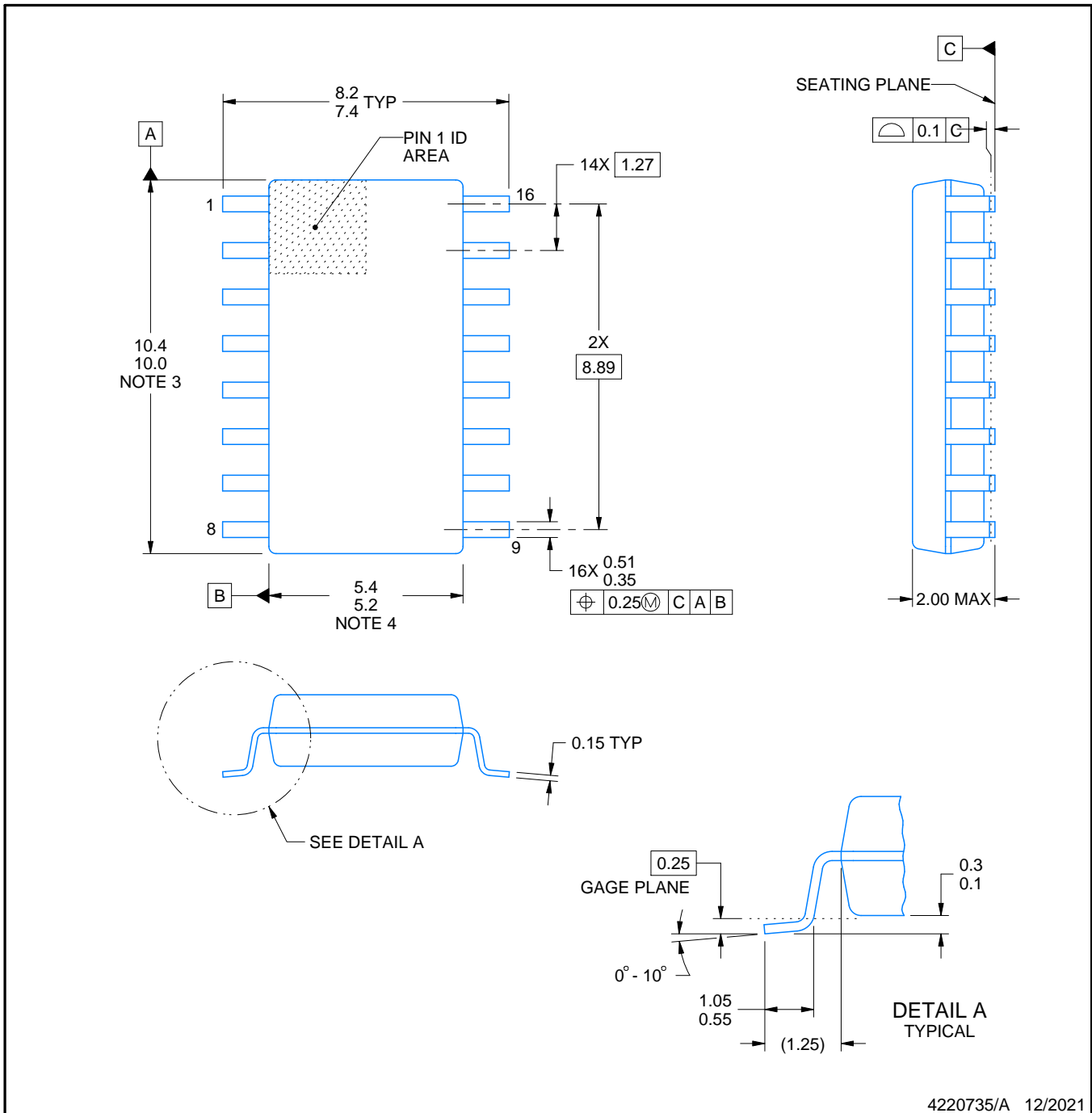


# PACKAGE OUTLINE

## NS0016A

### SOP - 2.00 mm max height

SOP



4220735/A 12/2021

#### NOTES:

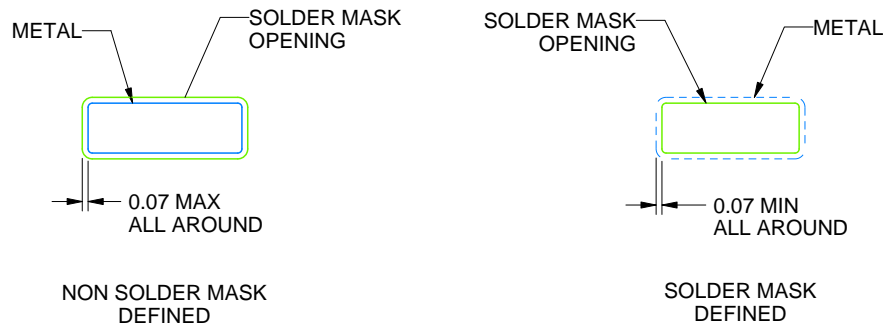
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate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

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER MASK DETAILS

4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

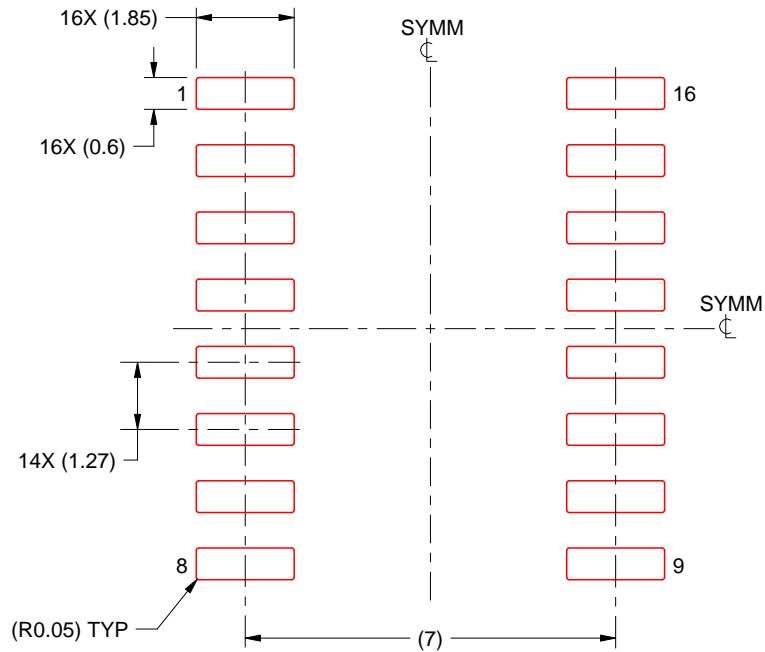
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

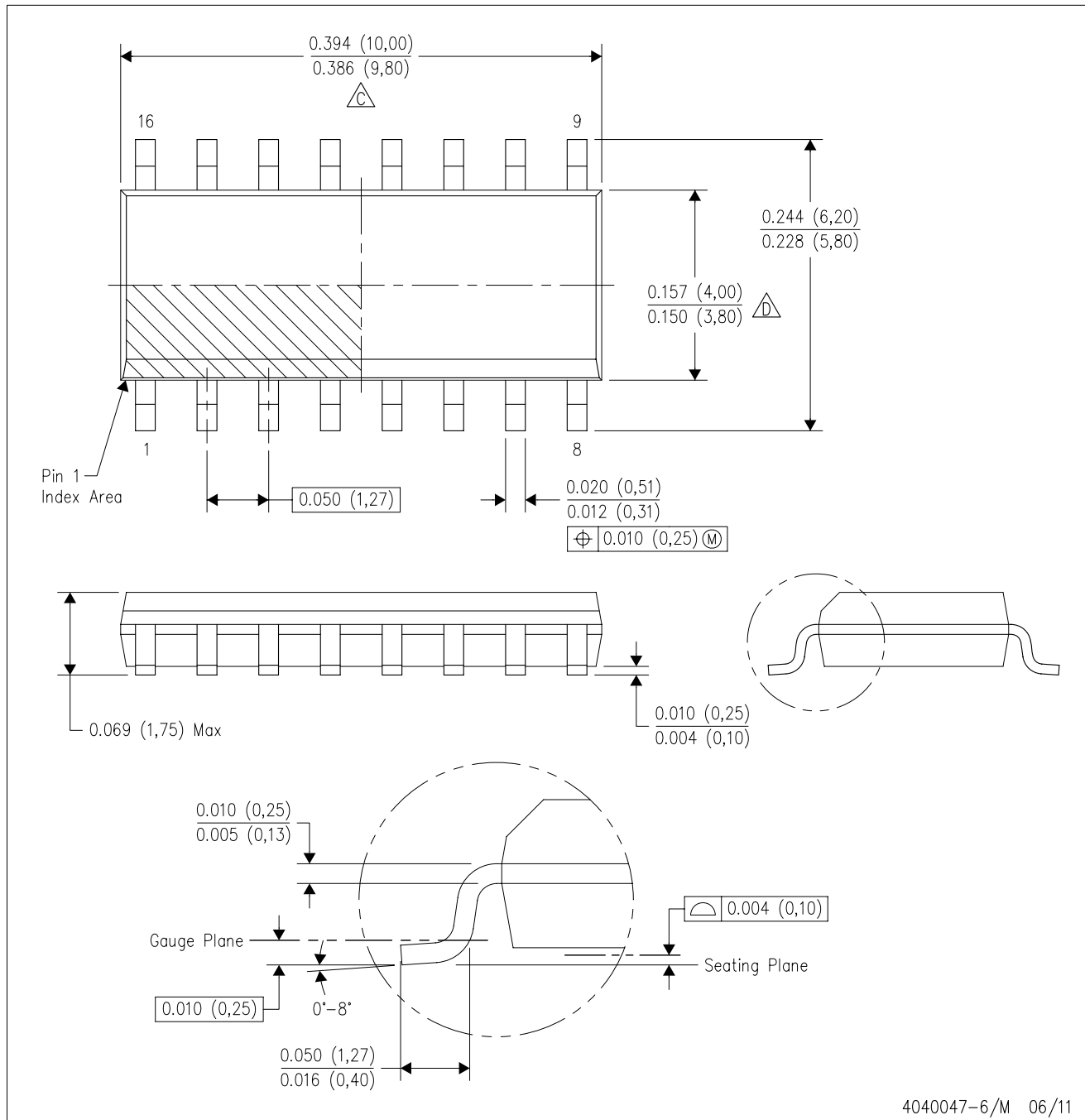
4220735/A 12/2021

NOTES: (continued)



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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.



4220204/A 02/2017

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

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

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

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220204/A 02/2017

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.

# DB0016A



# PACKAGE OUTLINE

## SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



### 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. Reference JEDEC registration MO-150.

# EXAMPLE BOARD LAYOUT

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220763/A 05/2022

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



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

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2023, Texas Instruments Incorporated