

## Low-Power RS-485 Line Driver and Receiver Pairs

### 1 Features

- Designed for high-speed multipoint Data transmission over long cables
- Operate with pulse durations as low as 30 ns
- Low supply current: 5 mA maximum
- Meet or exceed the requirements of ANSI standard RS-485 and ISO 8482:1987(E)
- 3-State outputs for party-line buses
- Common-mode voltage range of  $-7\text{ V}$  to  $12\text{ V}$
- Thermal shutdown protection prevents driver damage from bus contention
- Positive and negative output current limiting
- Pin compatible with the SN75ALS180

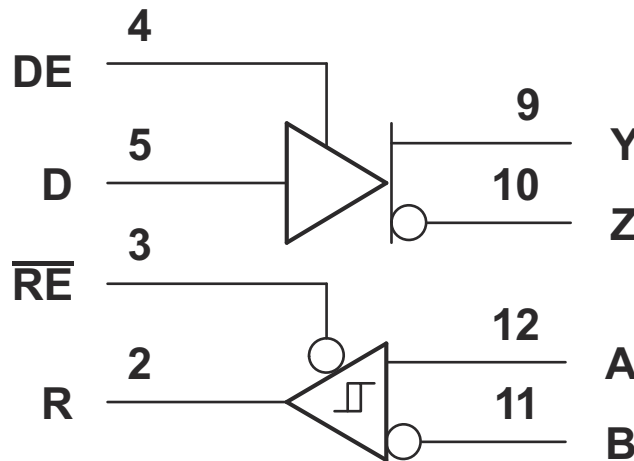
### 2 Description

The SN55LBC180, SN65LBC180 and SN75LBC180 differential driver and receiver pairs are monolithic integrated circuits designed for bidirectional data communication over long cables that take on the characteristics of transmission lines. They are balanced, or differential, voltage mode devices that meet or exceed the requirements of industry standards ANSI RS-485 and ISO 8482:1987(E). These devices are designed using the TI proprietary LinBiCMOS™ with the low-power consumption of CMOS and the precision and robustness of bipolar transistors in the same circuit.

#### Package Information

| PART NUMBER              | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM)   |
|--------------------------|------------------------|-------------------|
| SN75LBC180<br>SN65LBC180 | N (PDIP)               | 19.3 mm x 63.5 mm |
|                          | D (SOIC)               | 8.65 mm x 3.91 mm |
|                          | RSA (QFN)              | 4 mm x 4 mm       |
| SN55LBC180               | RSA (QFN)              | 4 mm x 4 mm       |

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



Logic Diagram (positive logic)



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

## Table of Contents

|                                                  |           |                                                                      |           |
|--------------------------------------------------|-----------|----------------------------------------------------------------------|-----------|
| <b>1 Features</b> .....                          | <b>1</b>  | <b>8 Detailed Description</b> .....                                  | <b>15</b> |
| <b>2 Description</b> .....                       | <b>1</b>  | 8.1 Function Tables.....                                             | 15        |
| <b>3 Description (Continued)</b> .....           | <b>2</b>  | 8.2 Schematics of Inputs and Outputs.....                            | 16        |
| <b>4 Revision History</b> .....                  | <b>3</b>  | <b>9 Application and Implementation</b> .....                        | <b>17</b> |
| <b>5 Pin Configuration and Functions</b> .....   | <b>4</b>  | 9.1 Application Information.....                                     | 17        |
| <b>6 Specifications</b> .....                    | <b>5</b>  | <b>10 Device and Documentation Support</b> .....                     | <b>18</b> |
| 6.1 Absolute Maximum Ratings.....                | 5         | 10.1 Receiving Notification of Documentation Updates..               | 18        |
| 6.2 Dissipation Rating Table.....                | 5         | 10.2 Support Resources.....                                          | 18        |
| 6.3 Recommended Operating Conditions.....        | 5         | 10.3 Trademarks.....                                                 | 18        |
| 6.4 Thermal Information Table.....               | 6         | 10.4 Electrostatic Discharge Caution.....                            | 18        |
| 6.5 Driver Section.....                          | 6         | 10.5 Glossary.....                                                   | 18        |
| 6.6 Receiver Section.....                        | 7         | <b>11 Mechanical, Packaging, and Orderable<br/>Information</b> ..... | <b>18</b> |
| 6.7 Typical Characteristics.....                 | 9         |                                                                      |           |
| <b>7 Parameter Measurement Information</b> ..... | <b>12</b> |                                                                      |           |

### 3 Description (Continued)

The SN55LBC180, SN65LBC180 and SN75LBC180 combine a differential line driver and receiver with 3-state outputs and operate from a single 5-V supply. The driver and receiver have active-high and active-low enables, respectively, which can be externally connected to function as a direction control. The driver differential outputs and the receiver differential inputs are connected to separate terminals for full-duplex operation and are designed to present minimum loading to the bus whether disabled or powered off ( $V_{CC} = 0$ ). These parts feature a wide common-mode voltage range making them suitable for point-to-point or multipoint data-bus applications.

The devices also provide positive and negative output-current limiting and thermal shutdown for protection from line fault conditions. The line driver shuts down at a junction temperature of approximately 172°C.

The SN75LBC180 is characterized for operation over the commercial temperature range of 0°C to 70°C. The SN65LBC180 is characterized over the industrial temperature range of –40°C to 85°C.

The SN55LBC180 is characterized for operation over the military temperature range of –55°C to 125°C.

## 4 Revision History

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

### Changes from Revision H (June 2022) to Revision I (October 2022) Page

- Changed RSA (QFN) values in the *Thermal Information Table* .....6

### Changes from Revision G (April 2009) to Revision H (June 2022) Page

- Changed the Ordering Information Table to the *Package Information* table.....1
- Added the *Pin Configuration and Functions* .....4
- Added the *Thermal Information Table* .....6
- Fixed the typo in the unit for the Receiver enable  $I_{IH}$  to change the unit from A to  $\mu A$ .....7
- Updated [Figure 6-1](#), [Figure 6-2](#), and [Figure 6-3](#), limiting the x-axis to a maximum of 70 mA driver output current.....9
- Updated [Figure 9-1](#) to remove legacy terminology .....17

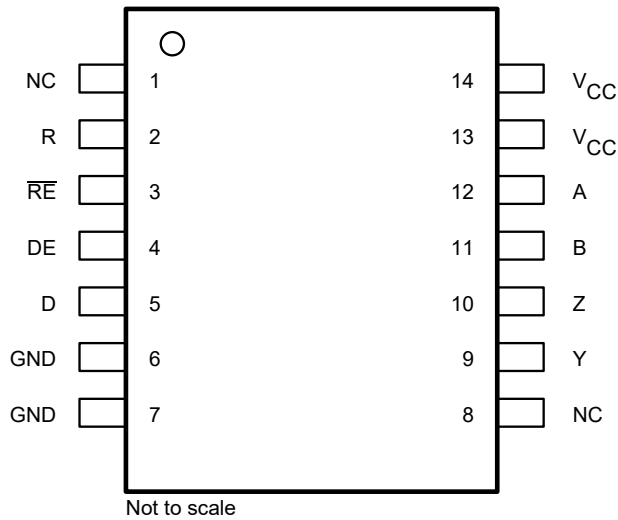
### Changes from Revision F (March 2009) to Revision G (April 2009) Page

- Added 3 ESD rows to the *Absolute Maximum Ratings* .....5

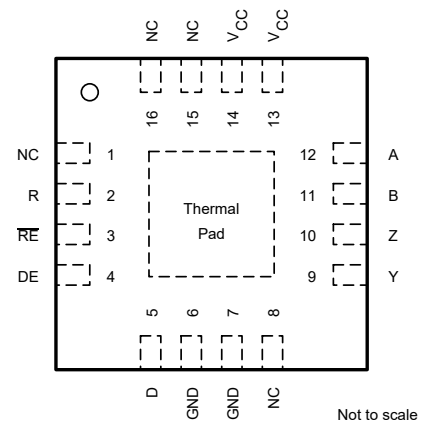
### Changes from Revision E (February 2006) to Revision F (March 2009) Page

- Changed Differential to RS-485 in the data sheet title.....1
- Added device number SN55LBC180 .....1
- Changed the word *both* to *these* .....1
- Added the Ordering Information Table.....1
- Changed the *Description (Continued)* section.....2
- Changed and moved the *Function Tables* from the front page to the *Description (Continued)* section.....2
- Deleted condition, moved cross reference.....5
- Added all symbols in text that were not appearing in the PDF.....5
- Deleted  $T_A$  row from the *Absolute Maximum Ratings* .....5
- Added the last column to *Dissipation Rating Table* .....5
- Added a row to  $T_A$  in the *Recommended Operating Conditions* for SN55LBC180.....5
- Added SN55LB180 to the  $|V_{OD}|$  row.....6
- Change: moved 5 max values to the min column (-1.5, -50, -100, -0.8, -0.8).....7
- Added the *Switching Characteristics: SN55LBC180* table .....8
- Changed moved schematics to the Typical Characteristics section.....16

## 5 Pin Configuration and Functions



**Figure 5-1. D OR N Package (SOIC)  
(Top View)**



**Figure 5-2. RSA Package (QFN)  
(Top View)**

**Table 5-1. Pin Functions**

| PIN NAME        | PIN NO |        | TYPE <sup>(1)</sup> | DESCRIPTION                                                          |
|-----------------|--------|--------|---------------------|----------------------------------------------------------------------|
|                 | D Or N | RSA    |                     |                                                                      |
| NC              | 1      | 1      | NC                  | No internal connection                                               |
| R               | 2      | 2      | O                   | Receiver output                                                      |
| RE              | 3      | 3      | I                   | Receiver enable input. Active low.                                   |
| DE              | 4      | 4      | I                   | Driver enable input. Active high                                     |
| D               | 5      | 5      | I                   | Driver input pin                                                     |
| GND             | 6, 7   | 6, 7   | G                   | Ground connection. Pins 6 and 7 are connected together internally.   |
| NC              | 8      | 8      | NC                  | No internal connection                                               |
| Y               | 9      | 9      | O                   | Bus output port (complementary to Z)                                 |
| Z               | 10     | 10     | O                   | Bus output port (complementary to Y)                                 |
| B               | 11     | 11     | I                   | Bus input port (complementary to A)                                  |
| A               | 12     | 12     | I                   | Bus input port (complementary to B)                                  |
| V <sub>CC</sub> | 13, 14 | 13, 14 | P                   | Supply input pins. Pins 13 and 14 are connected together internally. |
| NC              | N/A    | 15, 16 | NC                  | No internal connection                                               |

(1) Signal Types: I = Input, O = Output, P= Power input,

## 6 Specifications

### 6.1 Absolute Maximum Ratings

See note <sup>(1)</sup>

|                  |                                                           |                                           | UNIT   |
|------------------|-----------------------------------------------------------|-------------------------------------------|--------|
| V <sub>CC</sub>  | Supply voltage range <sup>(2)</sup>                       | –0.3 to 7                                 | V      |
| V <sub>BUS</sub> | Bus voltage range (A, B, Y, Z) <sup>(2)</sup>             | –10 to 15                                 | V      |
|                  | Voltage range at D, R, DE, $\overline{RE}$ <sup>(2)</sup> | –0.3 to V <sub>CC</sub> + 0.5             | V      |
|                  | Continuous total power dissipation <sup>(3)</sup>         | Internally limited                        |        |
|                  | Total power dissipation                                   | See Dissipation Rating Table              |        |
| T <sub>stg</sub> | Storage temperature range                                 | –65 to 150                                | °C     |
| I <sub>O</sub>   | Receiver output current range                             | –50 to 50                                 | mA     |
| ESD              | Electrostatic discharge                                   | HBM (Human Body Model) EIA/JESD22-A114    | ±4 kV  |
|                  |                                                           | MM (Machine Model) EIA/JESD22-A115        | 400 V  |
|                  |                                                           | CDM (Charge Device Model) EIA/JESD22-C101 | 1.5 kV |

- (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) All voltage values are with respect to GND.
- (3) The maximum operating junction temperature is internally limited. Use the dissipation rating table to operate below this temperature.

### 6.2 Dissipation Rating Table

| PACKAGE <sup>(1)</sup> | T <sub>A</sub> ≤ 25°C<br>POWER RATING | DERATING FACTOR<br>ABOVE T <sub>A</sub> = 25°C | T <sub>A</sub> = 70°C<br>POWER RATING | T <sub>A</sub> = 85°C<br>POWER RATING | T <sub>A</sub> = 125°C<br>POWER RATING |
|------------------------|---------------------------------------|------------------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|
| D                      | 950 mW                                | 7.6 mW/°C                                      | 608 mW                                | 494 mW                                | —                                      |
| N                      | 1150 mW                               | 9.2 mW/°C                                      | 736 mW                                | 598 mW                                | —                                      |
| RSA                    | 3333 mW                               | 26.67 mW/°C                                    | 2133 mW                               | 1733 mW                               | 400 mW                                 |

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at [www.ti.com](http://www.ti.com).

### 6.3 Recommended Operating Conditions

|                                                      |                                                         |                            | MIN               | NOM | MAX  | UNIT |
|------------------------------------------------------|---------------------------------------------------------|----------------------------|-------------------|-----|------|------|
| V <sub>CC</sub>                                      | Supply voltage                                          |                            | 4.75              | 5   | 5.25 | V    |
| V <sub>IH</sub>                                      | High-level input voltage                                | D, DE, and $\overline{RE}$ | 2                 |     |      | V    |
| V <sub>IL</sub>                                      | Low-level input voltage                                 | D, DE, and $\overline{RE}$ |                   |     | 0.8  | V    |
| V <sub>ID</sub>                                      | Differential input voltage                              |                            | –6 <sup>(1)</sup> |     | 6    | V    |
| V <sub>O</sub> , V <sub>I</sub> , or V <sub>IC</sub> | Voltage at any bus terminal (separately or common mode) | A, B, Y, or Z              | –7 <sup>(1)</sup> |     | 12   | V    |
| I <sub>OH</sub>                                      | High-level output current                               | Y or Z                     |                   |     | –60  | mA   |
|                                                      |                                                         | R                          |                   |     | –8   |      |
| I <sub>OL</sub>                                      | Low-level output current                                | Y or Z                     |                   |     | 60   | mA   |
|                                                      |                                                         | R                          |                   |     | 8    |      |
| T <sub>A</sub>                                       | Operating free-air temperature                          | SN55LBC180                 | –55               |     | 125  | °C   |
|                                                      |                                                         | SN65LBC180                 | –40               |     | 85   |      |
|                                                      |                                                         | SN75LBC180                 | 0                 |     | 70   |      |

- (1) The algebraic convention where the least positive (more negative) limit is designated minimum, is used in this data sheet for the differential input voltage, voltage at any bus terminal, operating temperature, input threshold voltage, and common-mode output voltage.

## 6.4 Thermal Information Table

| THERMAL METRIC <sup>(1)</sup> |                                              | D (SOIC) | N (PDIP) | RSA (QFN) | UNIT |
|-------------------------------|----------------------------------------------|----------|----------|-----------|------|
|                               |                                              | 14 Pins  | 14 Pins  | 16 Pins   |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 93.2     | 53.4     | 38.7      | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 47.5     | 40.0     | 35.6      | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 49.4     | 33.2     | 17.5      | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 11.2     | 19.0     | 1.1       | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 48.9     | 32.9     | 17.5      | °C/W |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | n/a      | n/a      | 7.9       | °C/W |

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

## 6.5 Driver Section

### 6.5.1 Electrical Characteristics

over recommended operating conditions (unless otherwise noted)

| PARAMETER        |                                                                   | TEST CONDITIONS                                               |                                       | MIN | TYP <sup>(1)</sup> | MAX  | UNIT |
|------------------|-------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------|-----|--------------------|------|------|
| $V_{IK}$         | Input clamp voltage                                               | $I_I = -18 \text{ mA}$                                        |                                       |     |                    | -1.5 | V    |
| $ V_{OD} $       | Differential output voltage magnitude <sup>(2)</sup>              | $R_L = 54 \Omega$ ,<br>See <a href="#">Figure 7-1</a>         | SN55LBC180                            | 1   | 2.5                | 5    | V    |
|                  |                                                                   |                                                               | SN65LBC180                            | 1.1 | 2.5                | 5    |      |
|                  |                                                                   |                                                               | SN75LBC180                            | 1.5 | 2.5                | 5    |      |
|                  |                                                                   | $R_L = 60 \Omega$ ,<br>See <a href="#">Figure 7-2</a>         | SN55LBC180                            | 1   | 2.5                | 5    |      |
|                  |                                                                   |                                                               | SN65LBC180                            | 1.1 | 2                  | 5    |      |
|                  |                                                                   |                                                               | SN75LBC180                            | 1.5 | 2                  | 5    |      |
| $\Delta V_{OD} $ | Change in magnitude of differential output voltage <sup>(3)</sup> | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> |                                       |     |                    | ±0.2 | V    |
| $V_{OC}$         | Common-mode output voltage                                        |                                                               |                                       | 1   | 2.5                | 3    | V    |
| $\Delta V_{OC} $ | Change in magnitude of common-mode output voltage <sup>(3)</sup>  | $R_L = 54 \Omega$ ,                                           | See <a href="#">Figure 7-1</a>        |     |                    | ±0.2 | V    |
| $I_O$            | Output current with power off                                     | $V_{CC} = 0$ ,                                                | $V_O = -7 \text{ V to } 12 \text{ V}$ |     |                    | ±100 | µA   |
| $I_{OZ}$         | High-impedance-state output current                               | $V_O = -7 \text{ V to } 12 \text{ V}$                         |                                       |     |                    | ±100 | µA   |
| $I_{IH}$         | High-level input current                                          | $V_I = 2.4 \text{ V}$                                         |                                       |     |                    | 100  | µA   |
| $I_{IL}$         | Low-level input current                                           | $V_I = 0.4 \text{ V}$                                         |                                       |     |                    | 100  | µA   |
| $I_{OS}$         | Short-circuit output current                                      | $-7 \text{ V} \leq V_O \leq 12 \text{ V}$                     |                                       |     |                    | ±250 | mA   |
| $I_{CC}$         | Supply current                                                    | Receiver disabled                                             | Outputs enabled                       |     |                    | 5    | mA   |
|                  |                                                                   |                                                               | Outputs disabled                      |     |                    | 3    |      |

- (1) All typical values are at  $V_{CC} = 5 \text{ V}$  and  $T_A = 25^\circ\text{C}$ .  
(2) The minimum  $V_{OD}$  specification may not fully comply with ANSI RS-485 at operating temperatures below  $0^\circ\text{C}$ . System designers should take the possibly lower output signal into account in determining the maximum signal-transmission distance.  
(3)  $\Delta|V_{OD}|$  and  $\Delta|V_{OC}|$  are the changes in the steady-state magnitude of  $V_{OD}$  and  $V_{OC}$ , respectively, that occur when the input is changed from a high level to a low level.

## 6.5.2 Switching Characteristics

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER                                       | TEST CONDITIONS                                      | MIN | TYP | MAX | UNIT |
|-------------------------------------------------|------------------------------------------------------|-----|-----|-----|------|
| $t_{d(OD)}$ Differential output delay time      | $R_L = 54\ \Omega$ , See <a href="#">Figure 7-3</a>  | 7   | 12  | 18  | ns   |
| $t_{l(OD)}$ Differential output transition time |                                                      | 5   | 10  | 20  | ns   |
| $t_{PZH}$ Output enable time to high level      | $R_L = 110\ \Omega$ , See <a href="#">Figure 7-4</a> |     |     | 35  | ns   |
| $t_{PZL}$ Output enable time to low level       | $R_L = 110\ \Omega$ , See <a href="#">Figure 7-5</a> |     |     | 35  | ns   |
| $t_{PHZ}$ Output disable time from high level   | $R_L = 110\ \Omega$ , See <a href="#">Figure 7-4</a> |     |     | 50  | ns   |
| $t_{PLZ}$ Output disable time from low level    | $R_L = 110\ \Omega$ , See <a href="#">Figure 7-5</a> |     |     | 35  | ns   |

## 6.5.3 Switching Characteristics: SN55LBC180

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER                                       | TEST CONDITIONS                                      | MIN | TYP | MAX | UNIT |
|-------------------------------------------------|------------------------------------------------------|-----|-----|-----|------|
| $t_{d(OD)}$ Differential output delay time      | $R_L = 54\ \Omega$ , See <a href="#">Figure 7-3</a>  |     | 15  |     | ns   |
| $t_{l(OD)}$ Differential output transition time |                                                      |     | 21  |     | ns   |
| $t_{PZH}$ Output enable time to high level      | $R_L = 110\ \Omega$ , See <a href="#">Figure 7-4</a> |     | 32  |     | ns   |
| $t_{PHZ}$ Output disable time from high level   |                                                      |     | 55  |     | ns   |
| $t_{PZL}$ Output enable time to low level       | $R_L = 110\ \Omega$ , See <a href="#">Figure 7-5</a> |     | 32  |     | ns   |
| $t_{PLZ}$ Output disable time from low level    |                                                      |     | 20  |     | ns   |

## 6.6 Receiver Section

### 6.6.1 Electrical Characteristics

over recommended operating conditions (unless otherwise noted)

| PARAMETER                                            | TEST CONDITIONS                                                  | MIN              | TYP  | MAX      | UNIT          |
|------------------------------------------------------|------------------------------------------------------------------|------------------|------|----------|---------------|
| $V_{IT+}$ Positive-going input threshold voltage     | $I_O = -8\text{ mA}$                                             |                  |      | 0.2      | V             |
| $V_{IT-}$ Negative-going input threshold voltage     | $I_O = 8\text{ mA}$                                              | -0.2             |      |          | V             |
| $V_{hys}$ Hysteresis voltage ( $V_{IT+} - V_{IT-}$ ) |                                                                  |                  | 45   |          | mV            |
| $V_{IK}$ Enable-input clamp voltage                  | $I_I = -18\text{ mA}$                                            | -1.5             |      |          | V             |
| $V_{OH}$ High-level output voltage                   | $V_{ID} = 200\text{ mV}$ , $I_{OH} = -8\text{ mA}$               | 3.5              | 4.5  |          | V             |
| $V_{OL}$ Low-level output voltage                    | $V_{ID} = -200\text{ mV}$ , $I_{OL} = 8\text{ mA}$               |                  | 0.3  | 0.5      | V             |
| $I_{OZ}$ High-impedance-state output current         | $V_O = 0\text{ V to } V_{CC}$                                    |                  |      | $\pm 20$ | $\mu\text{A}$ |
| $I_{IH}$ High-level enable-input current             | $V_{IH} = 2.4\text{ V}$                                          | -50              |      |          | $\mu\text{A}$ |
| $I_{IL}$ Low-level enable-input current              | $V_{IL} = 0.4\text{ V}$                                          | -100             |      |          | $\mu\text{A}$ |
| $I_I$ Bus input current                              | $V_I = 12\text{ V}$ , $V_{CC} = 5\text{ V}$ , Other input at 0 V |                  | 0.7  | 1        | mA            |
|                                                      | $V_I = 12\text{ V}$ , $V_{CC} = 0\text{ V}$ , Other input at 0 V |                  | 0.8  | 1        |               |
|                                                      | $V_I = -7\text{ V}$ , $V_{CC} = 5\text{ V}$ , Other input at 0 V | -0.8             | -0.5 |          |               |
|                                                      | $V_I = -7\text{ V}$ , $V_{CC} = 0\text{ V}$ , Other input at 0 V | -0.8             | -0.5 |          |               |
| $I_{CC}$ Supply current                              | Driver disabled                                                  | Outputs enabled  |      | 5        | mA            |
|                                                      |                                                                  | Outputs disabled |      | 3        |               |

## 6.6.2 Switching Characteristics

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER                                                   | TEST CONDITIONS                                                            | MIN | TYP | MAX | UNIT |
|-------------------------------------------------------------|----------------------------------------------------------------------------|-----|-----|-----|------|
| $t_{PHL}$ Propagation delay time, high- to low-level output | $V_{ID} = -1.5\text{ V to } 1.5\text{ V}$ , See <a href="#">Figure 7-6</a> | 11  | 22  | 33  | ns   |
| $t_{PLH}$ Propagation delay time, low- to high-level output |                                                                            | 11  | 22  | 33  | ns   |
| $t_{sk(p)}$ Pulse skew ( $ t_{PHL} - t_{PLH} $ )            |                                                                            |     | 3   | 6   | ns   |
| $t_t$ Transition time                                       |                                                                            |     | 5   | 8   | ns   |
| $t_{PZH}$ Output enable time to high level                  | See <a href="#">Figure 7-7</a>                                             |     |     | 35  | ns   |
| $t_{PZL}$ Output enable time to low level                   |                                                                            |     |     | 30  | ns   |
| $t_{PHZ}$ Output disable time from high level               |                                                                            |     |     | 35  | ns   |
| $t_{PLZ}$ Output disable time from low level                |                                                                            |     |     | 30  | ns   |

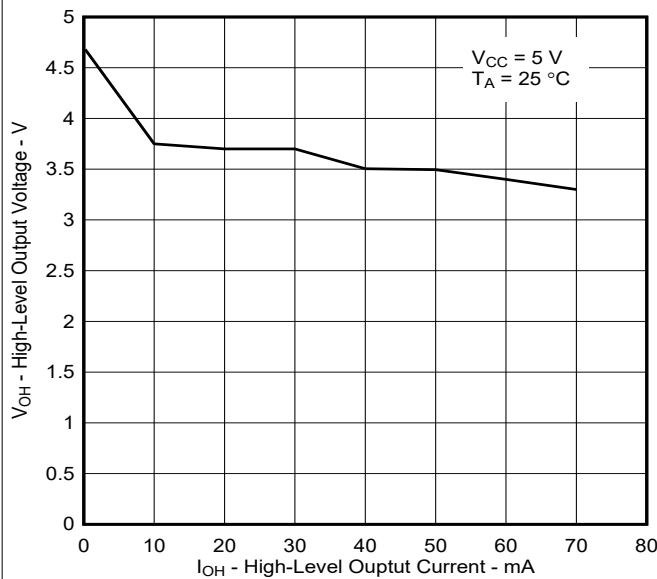
## 6.6.3 Switching Characteristics: SN55LBC180

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

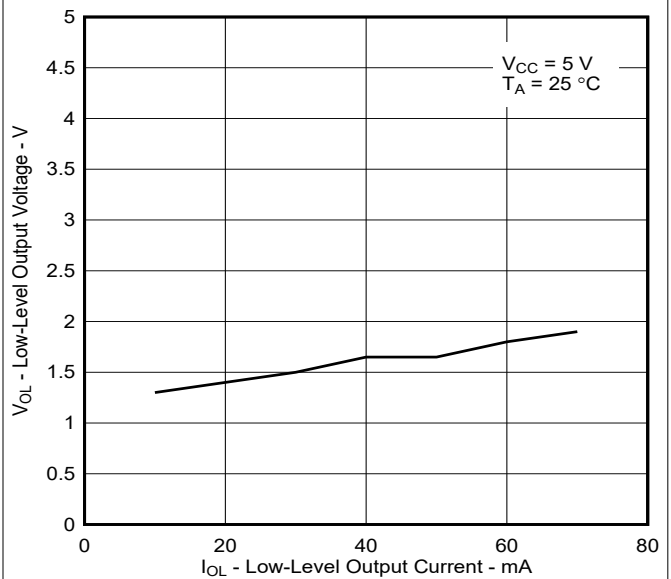
| PARAMETER                                                   | TEST CONDITIONS                                                            | MIN | TYP | MAX | UNIT |
|-------------------------------------------------------------|----------------------------------------------------------------------------|-----|-----|-----|------|
| $t_{PHL}$ Propagation delay time, high- to low-level output | $V_{ID} = -1.5\text{ V to } 1.5\text{ V}$ , See <a href="#">Figure 7-6</a> |     | 26  |     | ns   |
| $t_{PLH}$ Propagation delay time, low- to high-level output |                                                                            |     | 23  |     | ns   |
| $t_{sk(p)}$ Pulse skew ( $ t_{PHL} - t_{PLH} $ )            |                                                                            |     | 3   |     | ns   |
| $t_{sk(p)t}$ Transition time                                |                                                                            |     | 4   |     | ns   |
| $t_{PZH}$ Output enable time to high level                  | See <a href="#">Figure 7-4</a>                                             |     | 30  |     | ns   |
| $t_{PHZ}$ Output disable time from high level               |                                                                            |     | 26  |     | ns   |
| $t_{PZL}$ Output enable time to low level                   |                                                                            |     | 30  |     | ns   |
| $t_{PLZ}$ Output disable time from low level                |                                                                            |     | 30  |     | ns   |



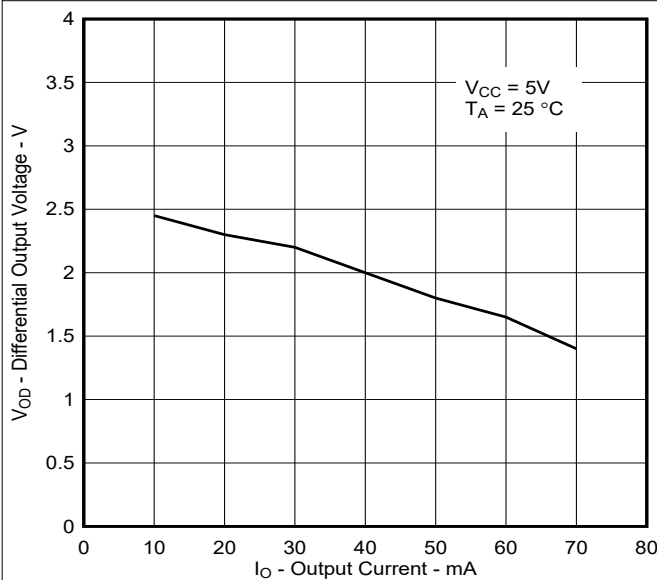
## 6.7 Typical Characteristics



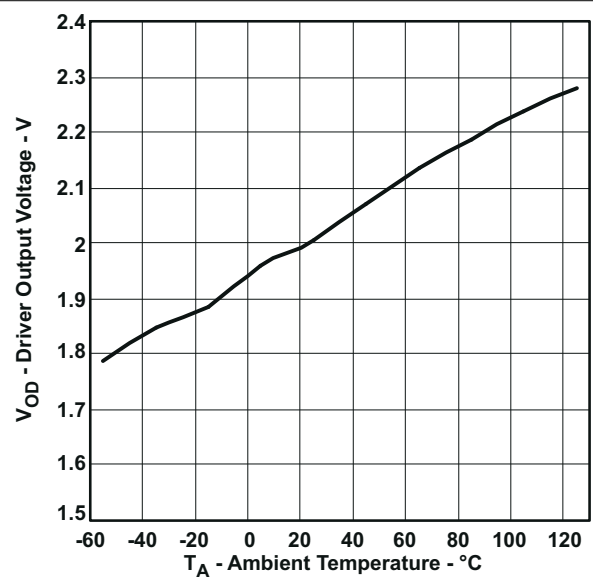
**Figure 6-1. Driver High-Level Output Voltage vs High-Level Output Current**



**Figure 6-2. Driver Low-Level Output Voltage vs Low-Level Output Current**



**Figure 6-3. Driver Differential Output Voltage vs Output Current**



**Figure 6-4. Driver Differential Output Voltage vs Free-Air Temperature**

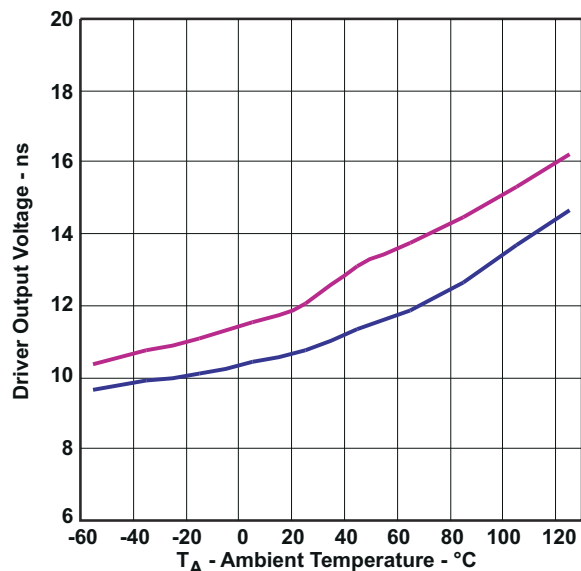


Figure 6-5. Driver Differential Delay Times vs Free-Air Temperature

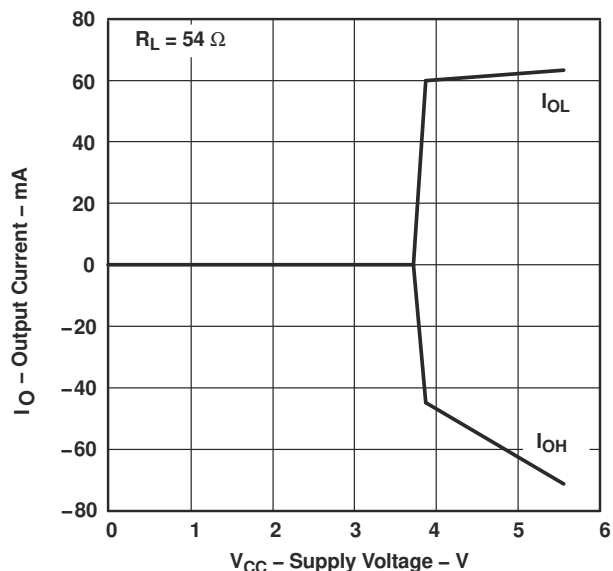


Figure 6-6. Driver Output Current vs Supply Voltage

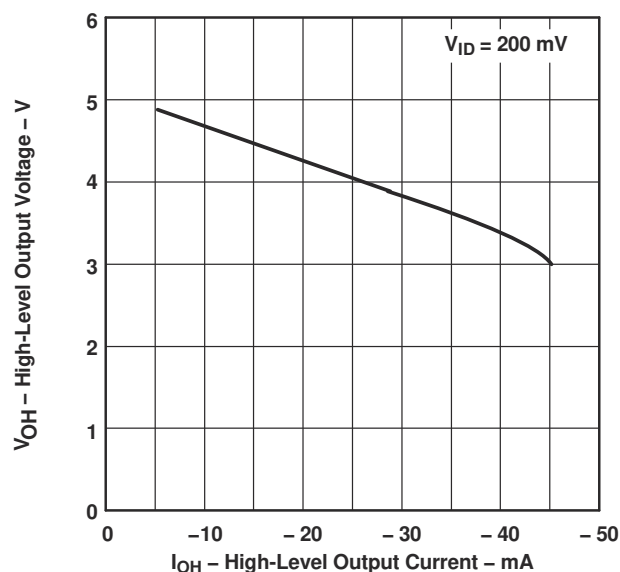


Figure 6-7. Receiver High-Level Output Voltage vs High-Level Output Current

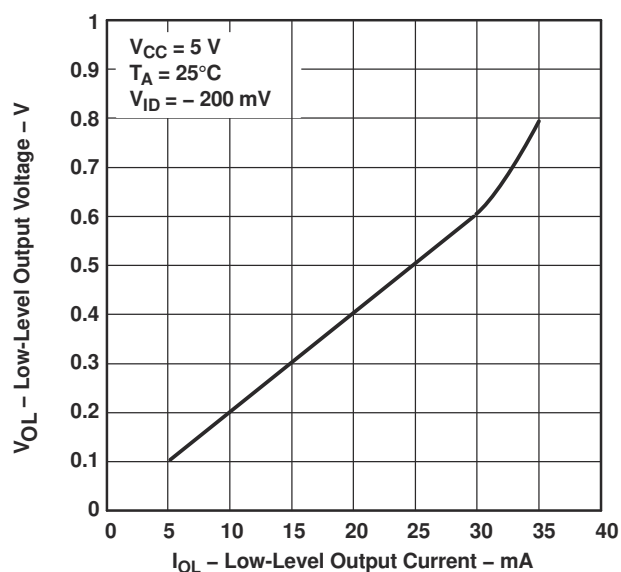
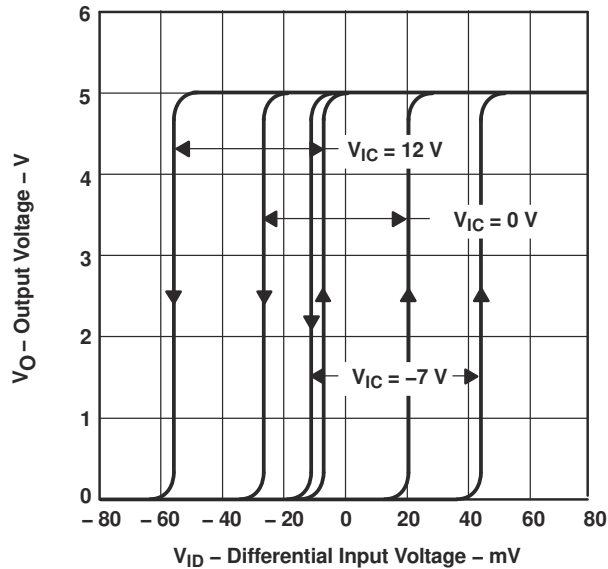
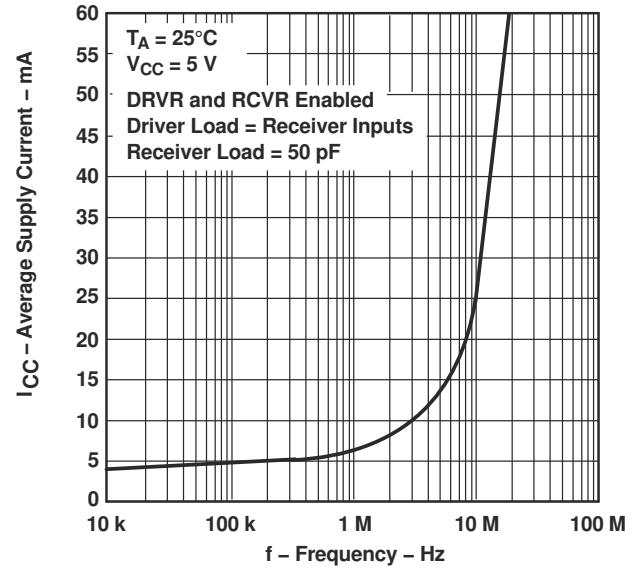


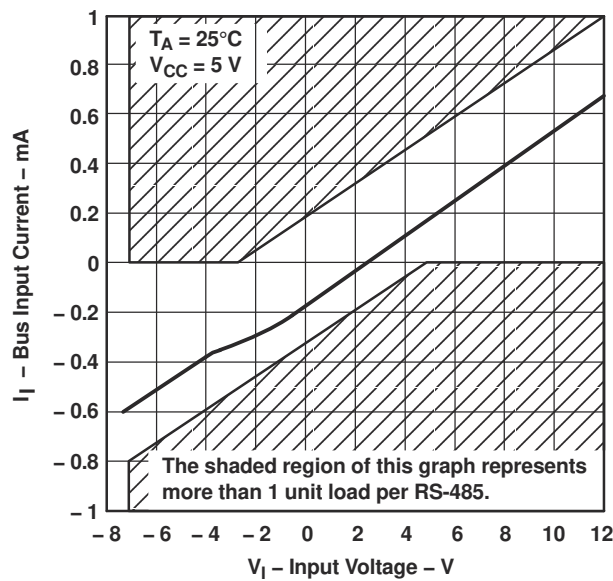
Figure 6-8. Receiver Low-Level Output Voltage vs Low-Level Output Current



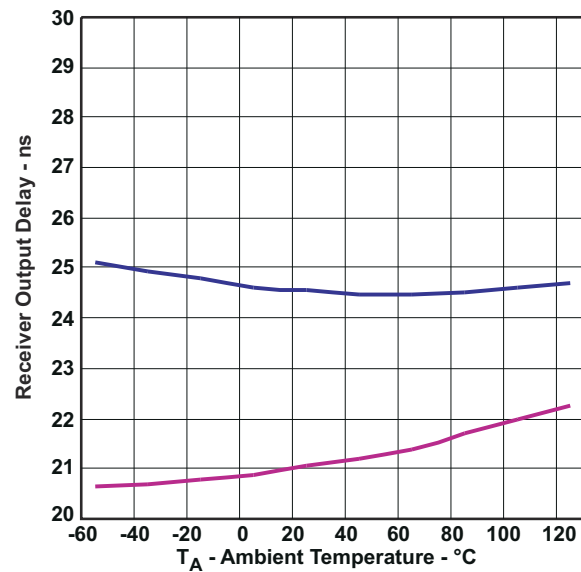
**Figure 6-9. Receiver Output Voltage vs Differential Input Voltage**



**Figure 6-10. Average Supply Current vs Frequency**



**Figure 6-11. Receiver Bus Input Current vs Input Voltage (Complementary Input at 0 V)**



**Figure 6-12. Receiver Propagation DELAY  $T_I$  vs Free-Air Temperature**

## 7 Parameter Measurement Information

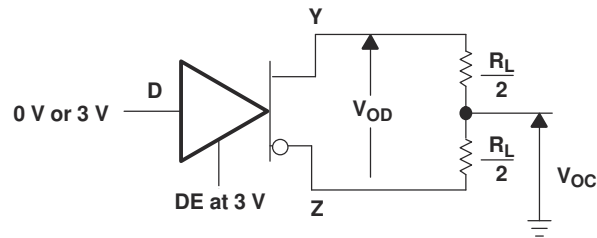


Figure 7-1. Differential and Common-Mode Output Voltages

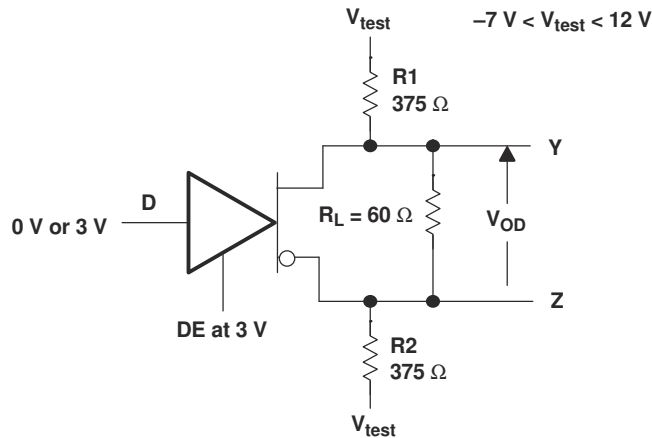
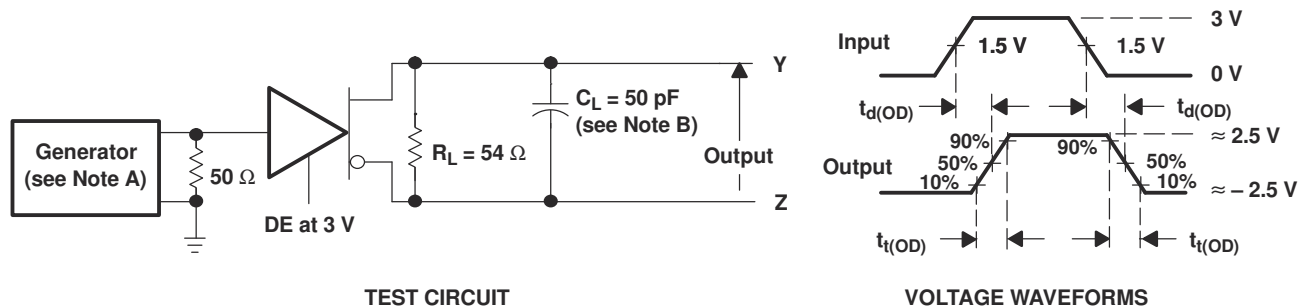


Figure 7-2. Driver  $V_{OD}$  Test Circuit



NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR > 1 MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.

Figure 7-3. Driver Test Circuit and Differential Output Delay and Transition Time Voltage Waveforms

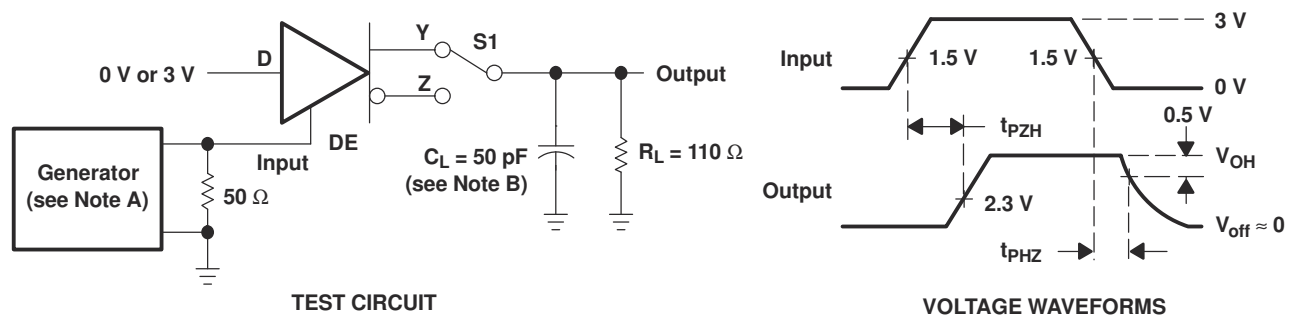
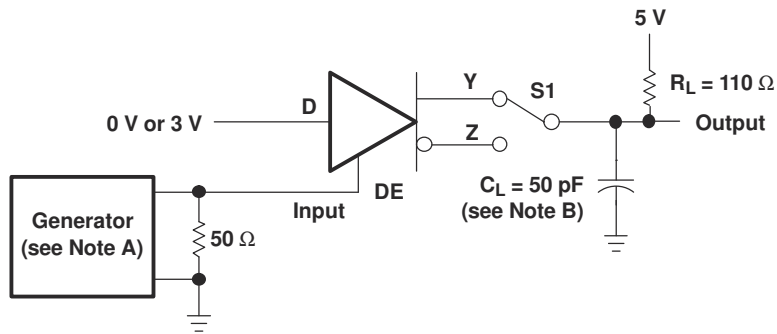
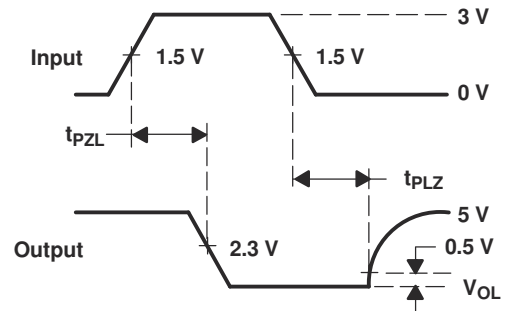


Figure 7-4. Driver Test Circuit and Enable and Disable Time Waveforms

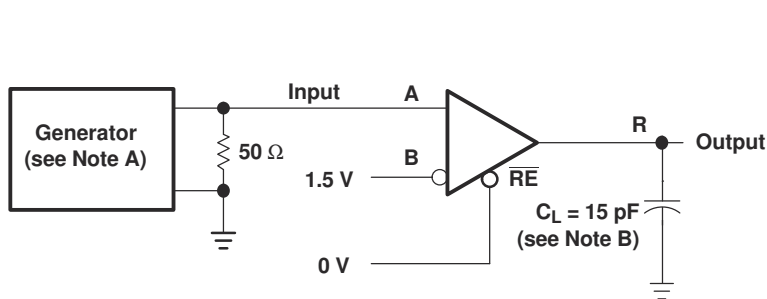


TEST CIRCUIT

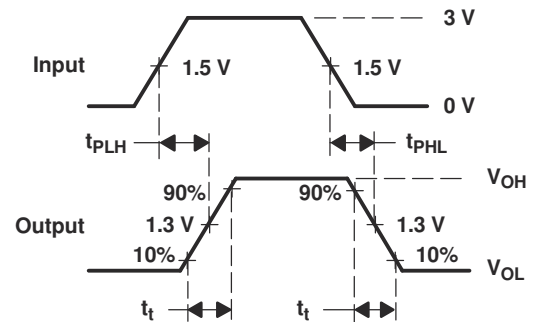


VOLTAGE WAVEFORMS

**Figure 7-5. Driver Test Circuit and Enable and Disable Time Voltage Waveforms**



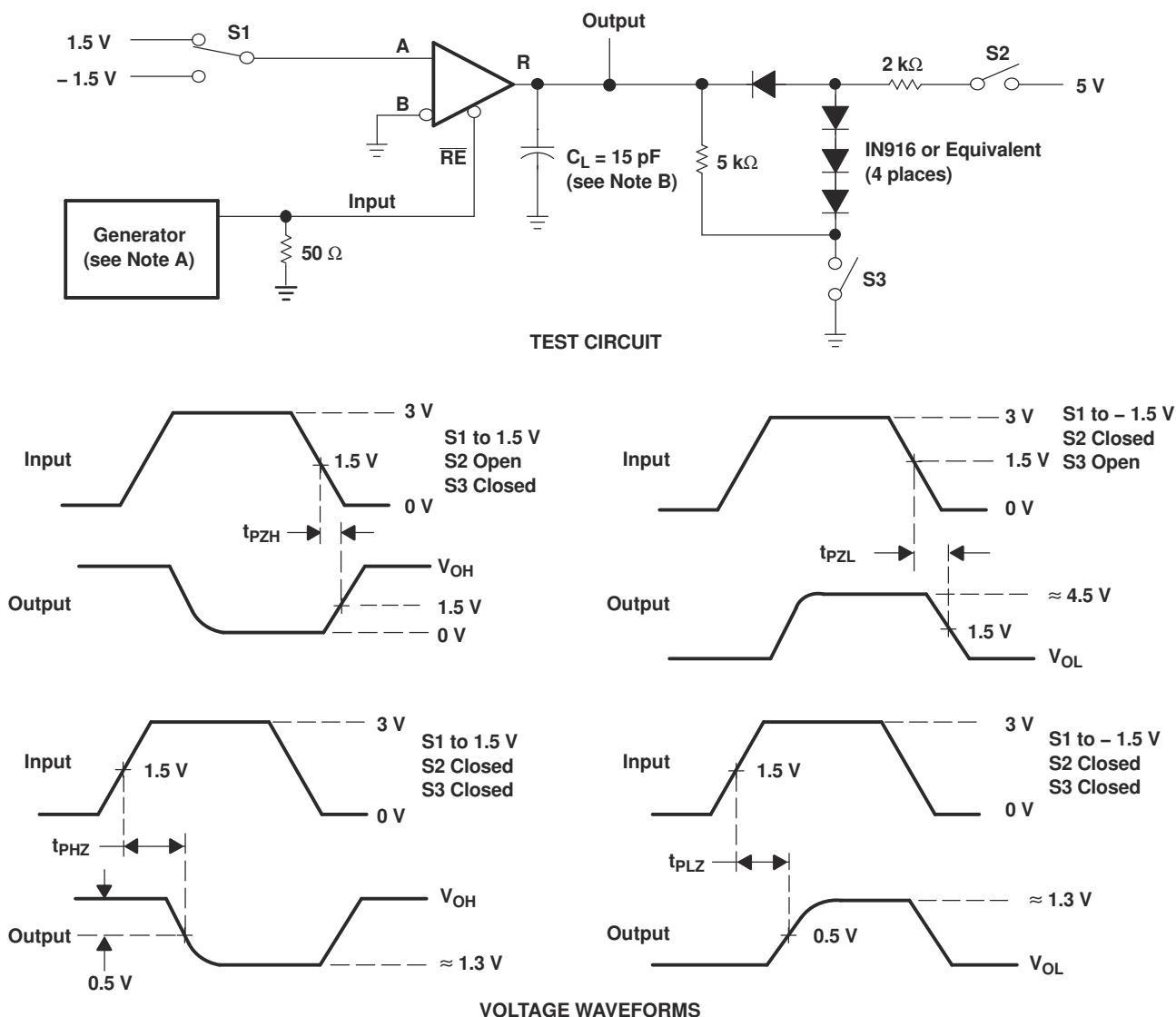
TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  1 MHz, 50% duty cycle,  $t_r \leq$  6 ns,  $t_f \leq$  6 ns,  $Z_O = 50 \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.

**Figure 7-6. Receiver Test Circuit and Propagation Delay Time Voltage Waveforms**



- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1 \text{ MHz}$ , 50% duty cycle,  $t_r \leq 6 \text{ ns}$ ,  $t_f \leq 6 \text{ ns}$ ,  $Z_O = 50 \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.

**Figure 7-7. Receiver Output Enable and Disable Times**

## 8 Detailed Description

### 8.1 Function Tables

**Table 8-1. DRIVER**

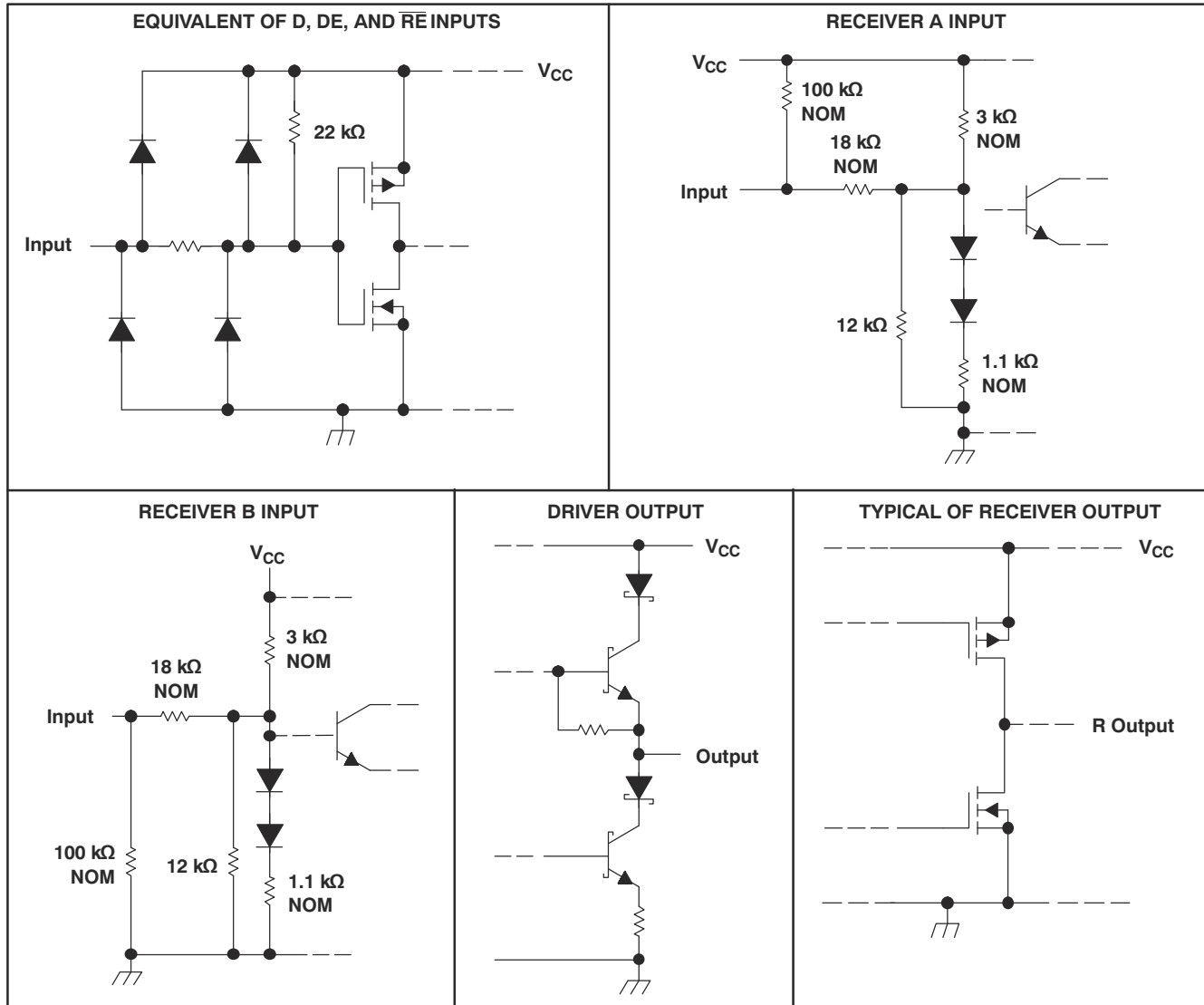
| INPUT<br>D <sup>(1)</sup> | ENABLE<br>DE | OUTPUTS |   |
|---------------------------|--------------|---------|---|
|                           |              | Y       | Z |
| H                         | H            | H       | L |
| L                         | H            | L       | H |
| X                         | L            | Z       | Z |

(1) H = high level, L = low level, ? = Indeterminate, X = irrelevant,  
Z = high impedance (off)

**Table 8-2. RECEIVER**

| DIFFERENTIAL INPUTS<br>A–B                | ENABLE<br>RE | OUTPUT<br>R |   |
|-------------------------------------------|--------------|-------------|---|
|                                           |              | Y           | Z |
| $V_{ID} \geq 0.2 \text{ V}$               | L            | H           |   |
| $-0.2 \text{ V} < V_{ID} < 0.2 \text{ V}$ | L            | ?           |   |
| $V_{ID} \leq -0.2 \text{ V}$              | L            | L           |   |
| X                                         | H            | Z           |   |
| Open circuit                              | L            | H           |   |

## 8.2 Schematics of Inputs and Outputs





## 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, as well as validating and testing their design implementation to confirm system functionality.

### 9.1 Application Information

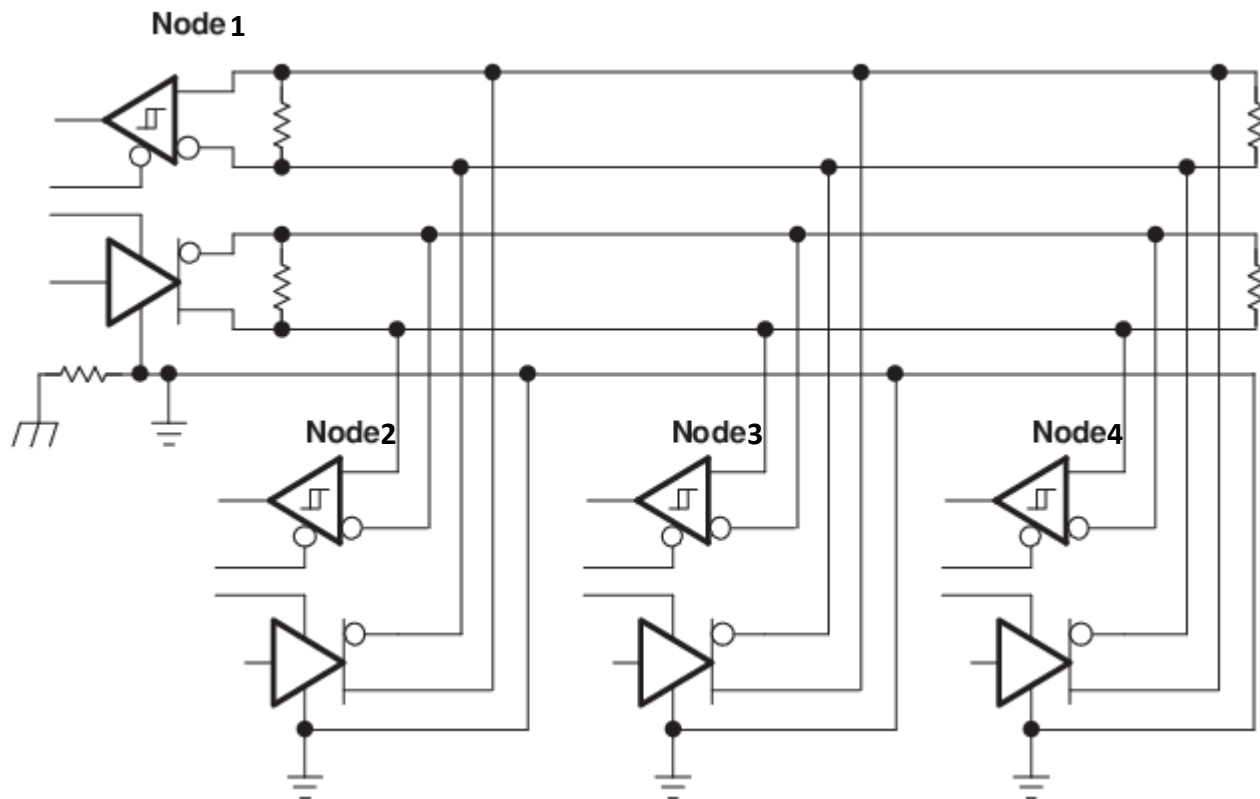


Figure 9-1. Full Duplex Application Circuit

## 10 Device and Documentation Support

### 10.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Subscribe to updates* 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.

### 10.2 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](#).

### 10.3 Trademarks

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TI E2E™ is a trademark of Texas Instruments.

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### 10.4 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.

### 10.5 Glossary

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

## 11 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="#">SN55LBC180RSAR</a> | Active        | Production           | QFN (RSA)   16 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -55 to 125   | SN55<br>LBC180      |
| <a href="#">SN65LBC180DR</a>   | Active        | Production           | SOIC (D)   14  | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 6LB180              |
| SN65LBC180DRG4                 | Active        | Production           | SOIC (D)   14  | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 6LB180              |
| <a href="#">SN65LBC180N</a>    | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | SN65LBC180N         |
| <a href="#">SN65LBC180RSAR</a> | Active        | Production           | QFN (RSA)   16 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 85    | BL180               |
| <a href="#">SN75LBC180N</a>    | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | SN75LBC180N         |

<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.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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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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.

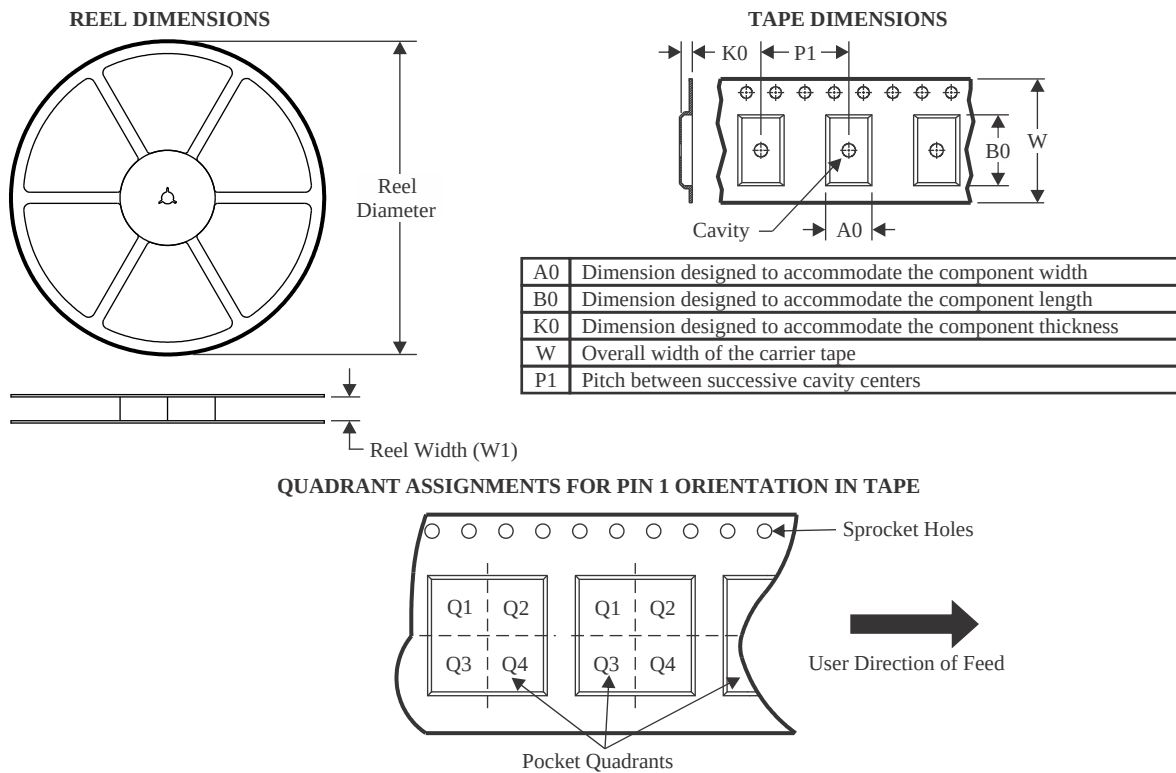
**OTHER QUALIFIED VERSIONS OF SN55LBC180, SN75LBC180 :**

- Catalog : [SN75LBC180](#)
- Military : [SN55LBC180](#)

## NOTE: Qualified Version Definitions:

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

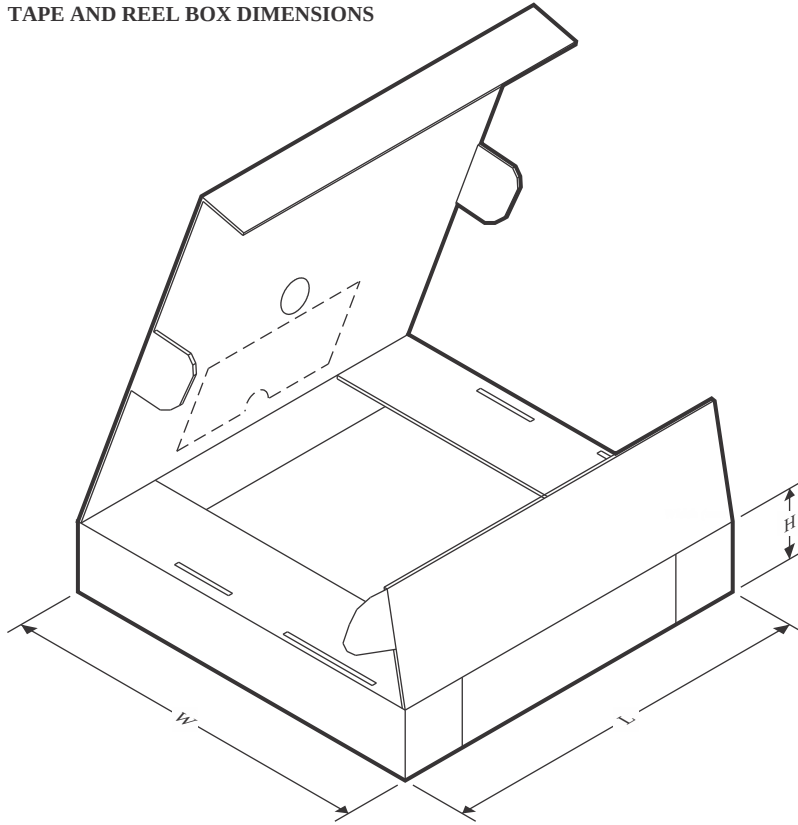
## TAPE AND REEL INFORMATION



\*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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN55LBC180RSAR | QFN          | RSA             | 16   | 3000 | 330.0              | 12.4               | 4.25    | 4.25    | 1.15    | 8.0     | 12.0   | Q2            |
| SN65LBC180DR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN65LBC180RSAR | QFN          | RSA             | 16   | 3000 | 330.0              | 12.4               | 4.25    | 4.25    | 1.15    | 8.0     | 12.0   | Q2            |

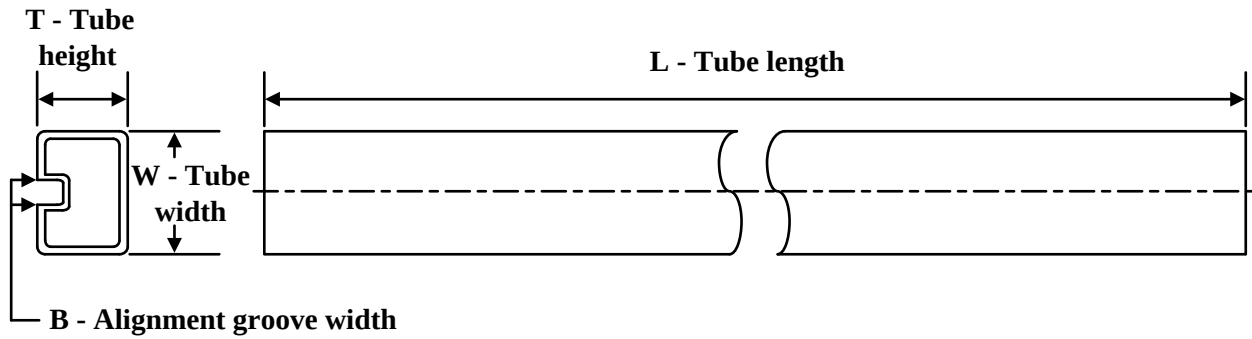
## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

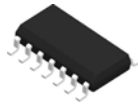
| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN55LBC180RSAR | QFN          | RSA             | 16   | 3000 | 367.0       | 367.0      | 35.0        |
| SN65LBC180DR   | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| SN65LBC180RSAR | QFN          | RSA             | 16   | 3000 | 367.0       | 367.0      | 35.0        |

## TUBE

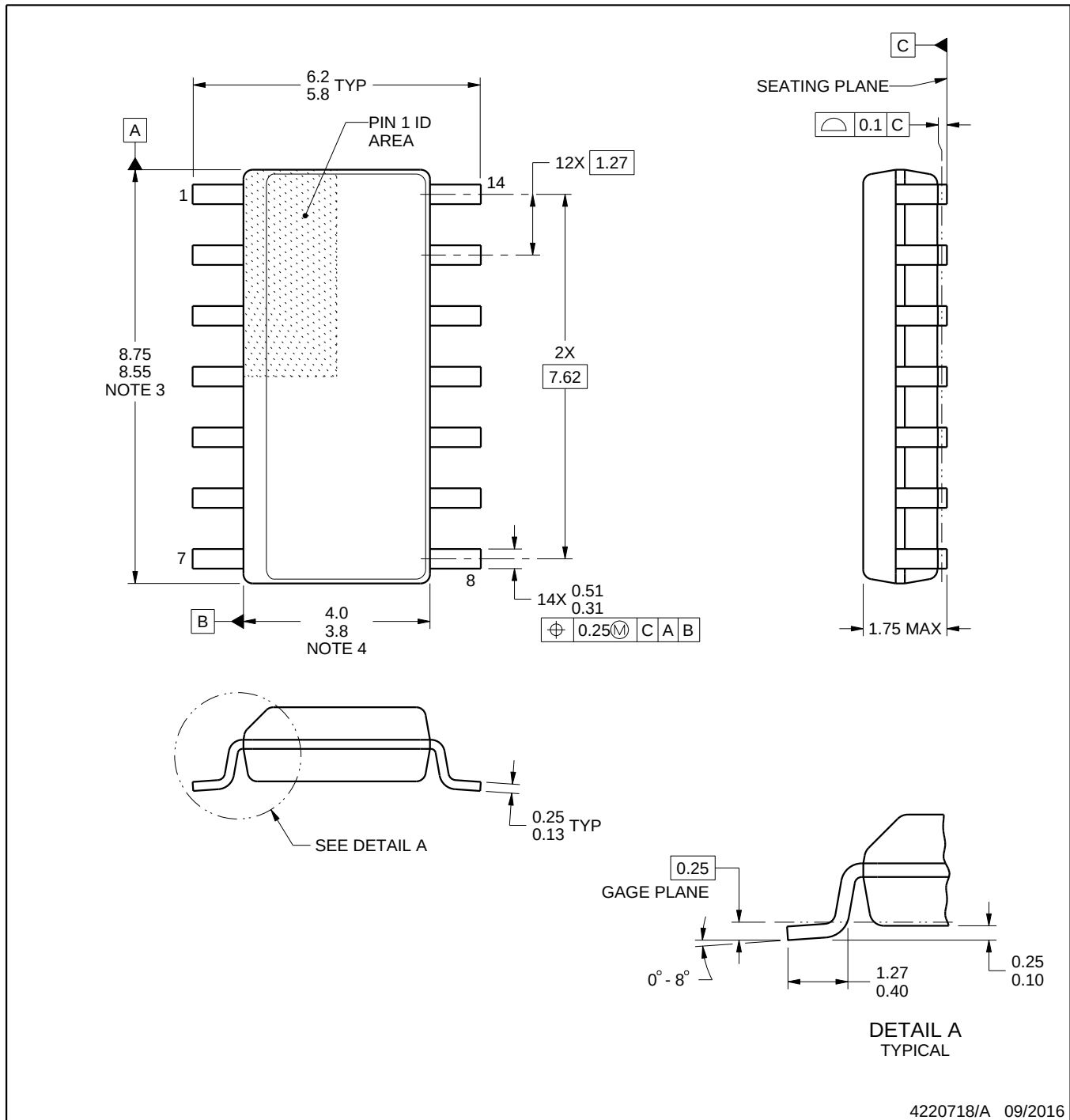


\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN65LBC180N | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN75LBC180N | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |

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

SMALL OUTLINE INTEGRATED CIRCUIT



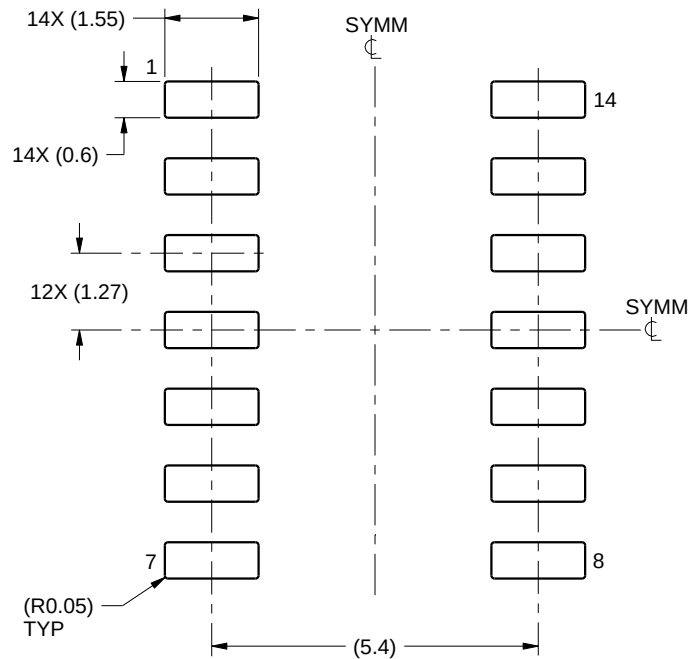


# EXAMPLE BOARD LAYOUT

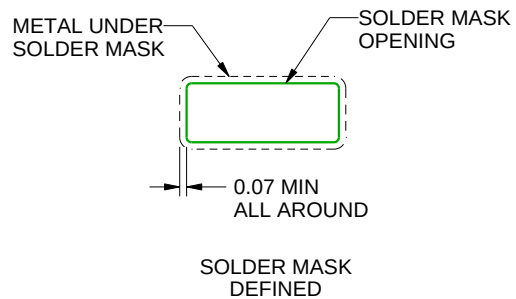
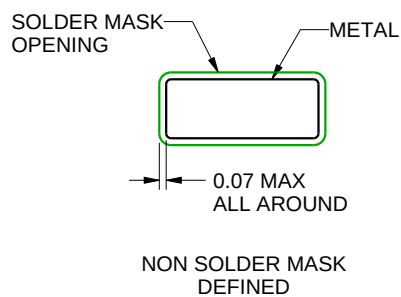
D0014A

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.

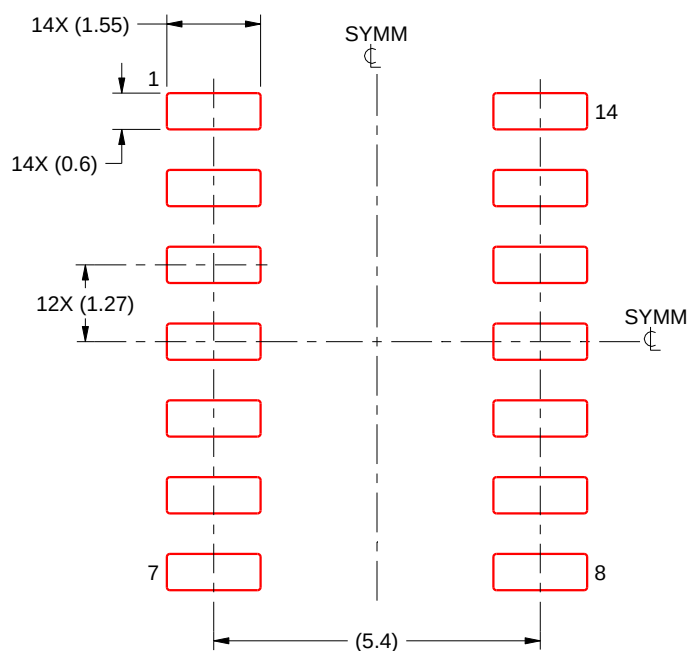
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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.

## GENERIC PACKAGE VIEW

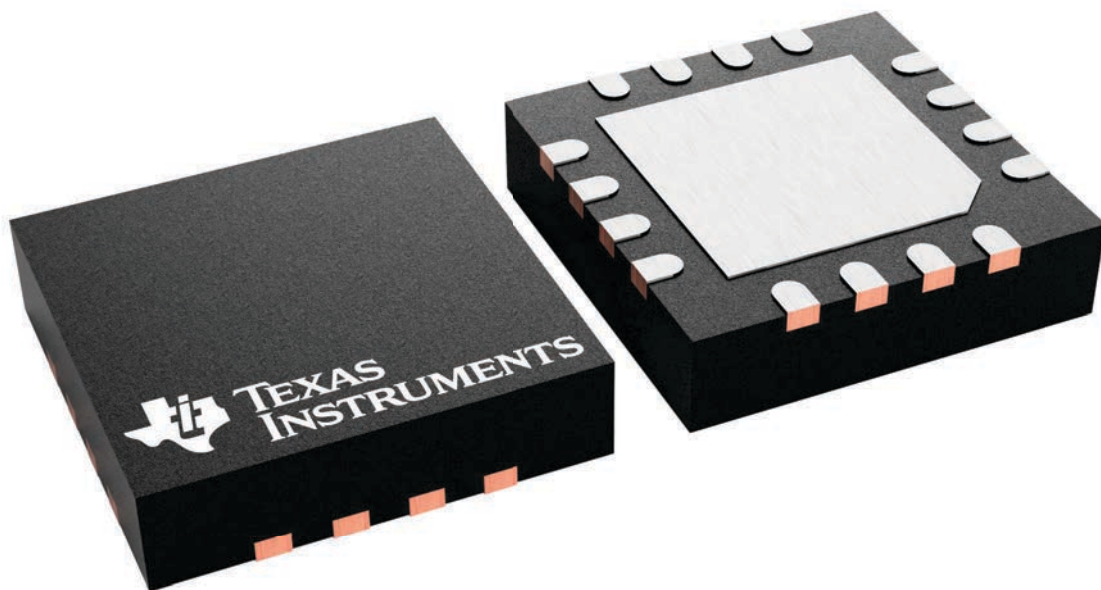
**RSA 16**

**VQFN - 1 mm max height**

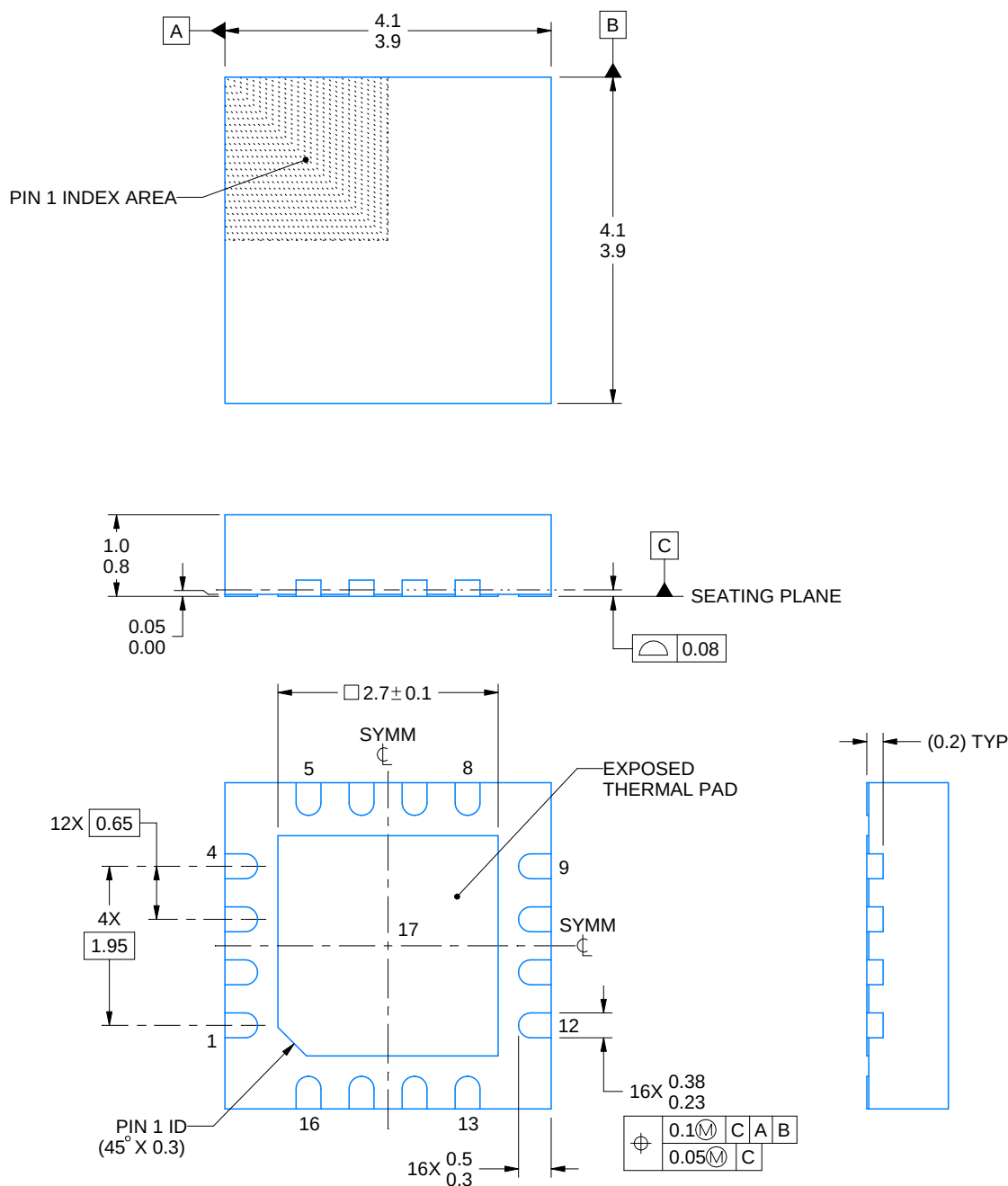
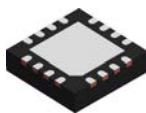
4 x 4, 0.65 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

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



4230969/A



4219093/A 08/2021

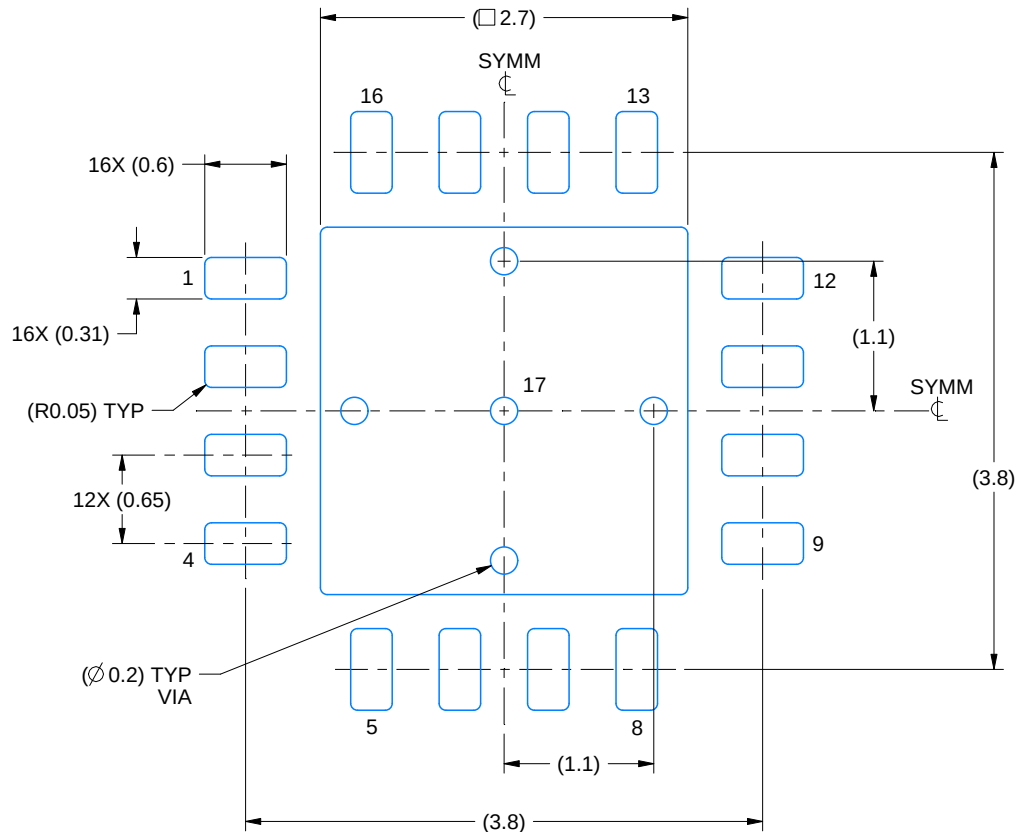
## NOTES:

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Reference JEDEC registration MO-220.

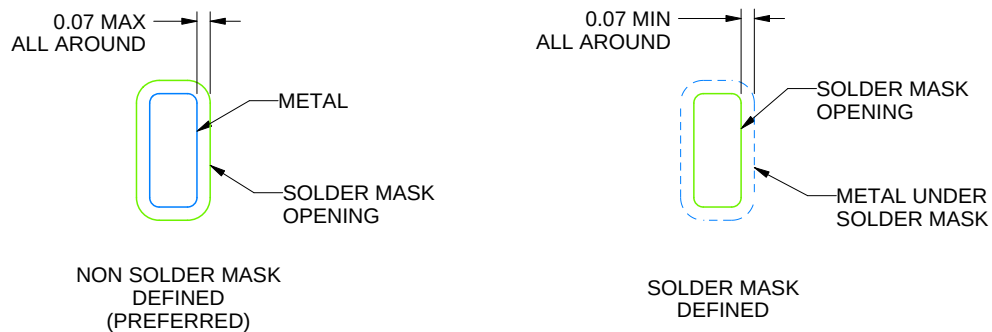
**RSA0016B**

## VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X



## SOLDER MASK DETAILS

4219093/A 08/2021

NOTES: (continued)

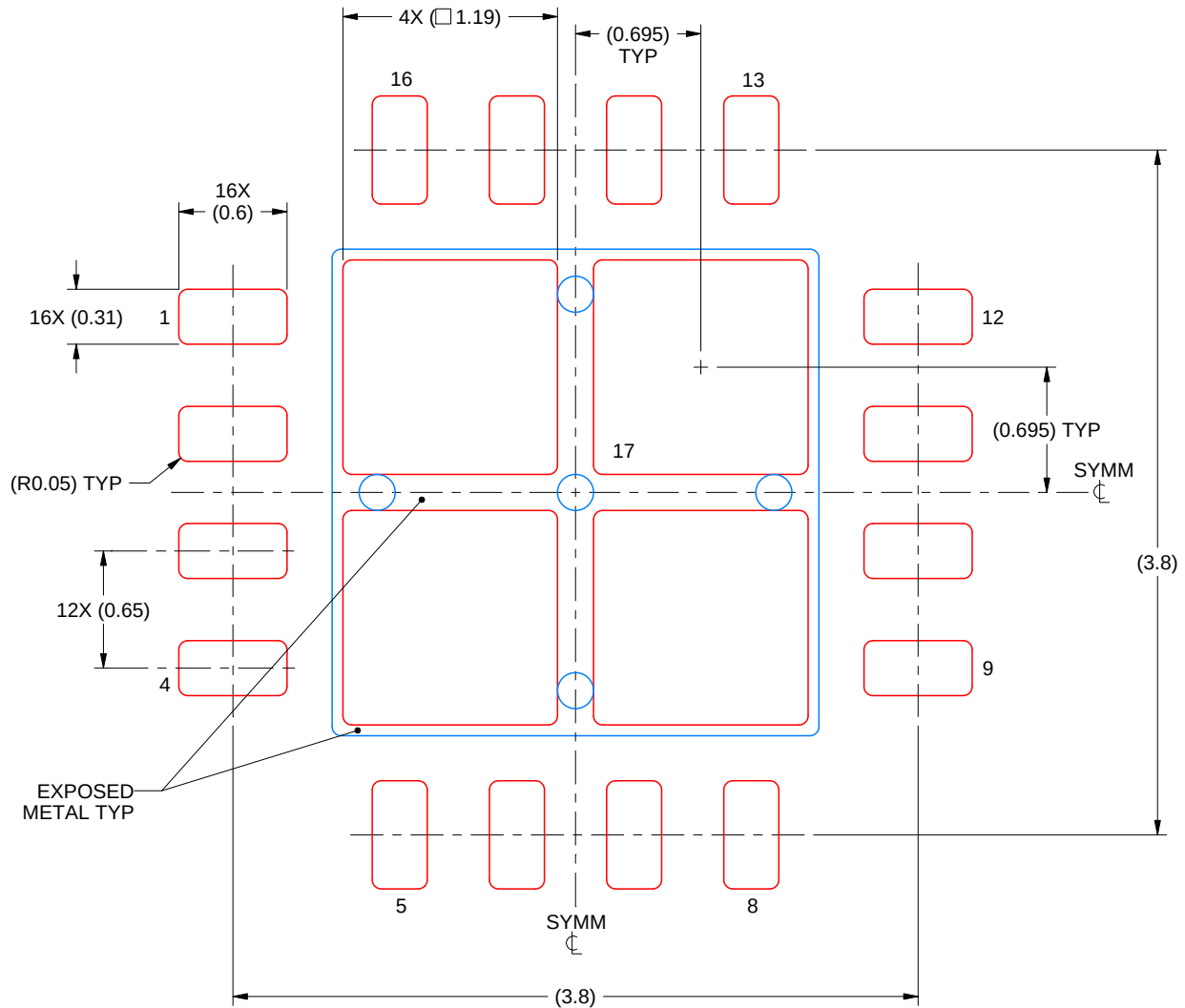
5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).
6. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

# EXAMPLE STENCIL DESIGN

RSA0016B

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



**SOLDER PASTE EXAMPLE**  
 BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD  
 77% PRINTED SOLDER COVERAGE BY AREA  
 SCALE:25X

4219093/A 08/2021

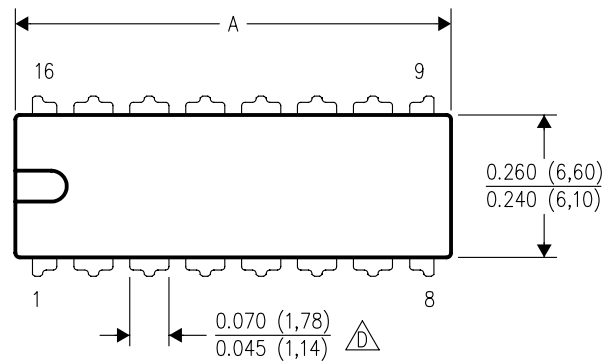
NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

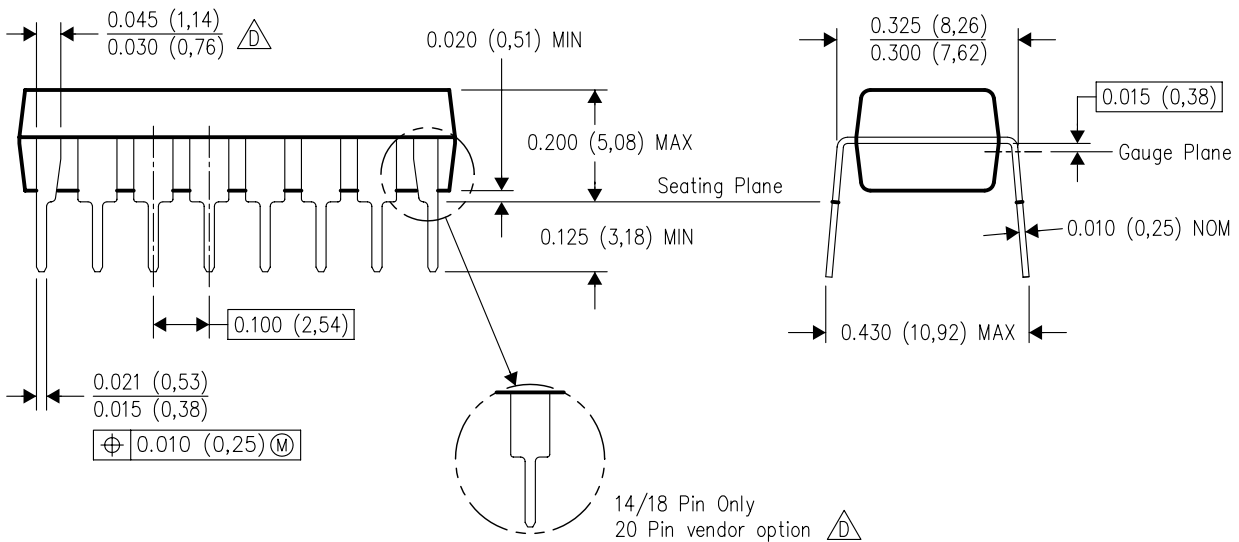
## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



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



4040049/E 12/2002

- 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.

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