

## SNx5LBC176 Differential Bus Transceivers

### 1 Features

- Bidirectional Transceiver
- Meets or Exceeds the Requirements of ANSI Standard TIA/EIA-485-A and ISO 8482:1987(E)
- High-Speed Low-Power LinBiCMOS™ Circuitry
- Designed for High-Speed Operation in Both Serial and Parallel Applications
- Low Skew
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- Very Low Disabled Supply Current . . . 200  $\mu$ A Maximum
- Wide Positive and Negative Input/Output Bus Voltage Ranges
- Thermal-Shutdown Protection
- Driver Positive-and Negative-Current Limiting
- Open-Circuit Failsafe Receiver Design
- Receiver Input Sensitivity . . .  $\pm 200$  mV Max
- Receiver Input Hysteresis . . . 50 mV Typ
- Operates From a Single 5-V Supply
- Glitch-Free Power-Up and Power-Down Protection
- Available in Q-Temp Automotive HighRel Automotive Applications Configuration Control / Print Support Qualification to Automotive Standards

### 2 Description

The SN55LBC176, SN65LBC176, SN65LBC176Q, and SN75LBC176 differential bus transceivers are monolithic, integrated circuits designed for bidirectional data communication on multipoint bus-transmission lines. They are designed for balanced transmission lines and meet ANSI Standard TIA/EIA-485-A (RS-485) and ISO 8482:1987(E).

The SN55LBC176, SN65LBC176, SN65LBC176Q, and SN75LBC176 combine a 3-state, differential line driver and a differential input line receiver, both of which operate from a single 5-V power supply. The driver and receiver have active-high and active-low enables, respectively, which can externally connect together to function as a direction control. The driver differential outputs and the receiver differential inputs connect internally to form a differential input/output (I/O) bus port that is designed to offer minimum loading to the bus whenever the driver is disabled or  $V_{CC} = 0$ . This port features wide positive and negative common-mode voltage ranges, making the device suitable for party-line applications. Low device supply current can be achieved by disabling the driver and the receiver.

#### Package Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM)   |
|-------------|------------------------|-------------------|
| SN55LBC176  | LCCC (20)              | 8.89 mm x 8.89 mm |
|             | CDIP (8)               | 9.60 mm x 6.67 mm |
| SN65LBC176  | SOIC (8)               | 4.90 mm x 3.91 mm |
|             | PDIP (8)               | 9.81 mm x 6.35 mm |
| SN75LBC176  | SOIC (8)               | 4.90 mm x 3.91 mm |
|             | PDIP (8)               | 9.81 mm x 6.35 mm |

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

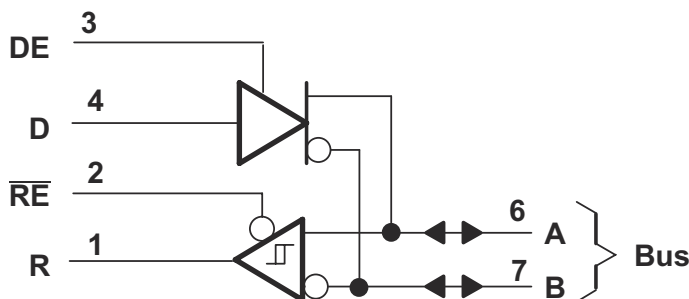


Figure 2-1. Logic Diagram (Positive Logic)



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## 3 Revision History

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

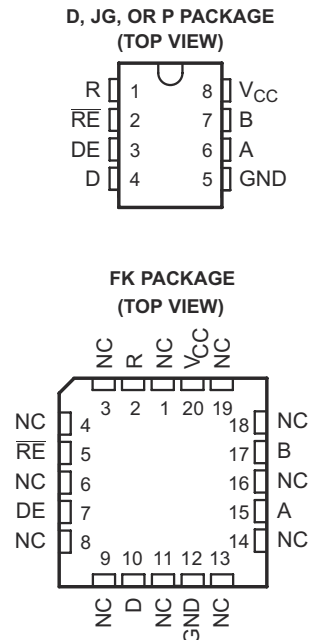
| <b>Changes from Revision H (December 2010) to Revision I (October 2022)</b>                                                                                                                                                                                                                 | <b>Page</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| • Added <i>Pin Configuration and Functions</i> section, <i>Thermal Information</i> tables, <i>Detailed Description</i> section, <i>Device Functional Modes</i> , <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... | <b>1</b>    |

## 4 Description (Continued)

These transceivers are suitable for ANSI Standard TIA/EIA-485 (RS-485) and ISO 8482 applications to the extent that they are specified in the operating conditions and characteristics section of this data sheet. Certain limits contained in TIA/EIA-485-A and ISO 8482:1987 (E) are not met or cannot be tested over the entire military temperature range.

The SN55LBC176 is characterized for operation from  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN65LBC176 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , and the SN65LBC176Q is characterized for operation from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN75LBC176 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

## 5 Pin Configuration and Functions



NC – No internal connection

**Table 5-1. Pin Functions**

| PIN             |                  |                               | TYPE | DESCRIPTION                     |
|-----------------|------------------|-------------------------------|------|---------------------------------|
| NAME            | SOIC, PDIP, CDIP | LCCC                          |      |                                 |
| R               | 1                | 2                             | O    | Logic output RS485 data         |
| RE              | 2                | 5                             | I    | Receiver enable/disable         |
| DE              | 3                | 7                             | I    | Driver enable/disable           |
| D               | 4                | 10                            | I    | Logic input RS485 data          |
| GND             | 5                | 12                            | -    | Ground                          |
| A               | 6                | 15                            | I/O  | RS485 bus pin;<br>Non-Inverting |
| B               | 7                | 17                            | I/O  | RS485 bus pin;<br>Inverted      |
| V <sub>CC</sub> | 8                | 20                            | -    | 5V Supply Voltage               |
| NC              | -                | 1,2,3,6,8,9,11,13,14,16,18,19 | -    | 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 |
|------------------------------------------------------|---------------------------------|----------------|------|
| Supply voltage, $V_{CC}$ <sup>(2)</sup>              |                                 | 7              | V    |
| Voltage range at any bus terminal                    | –10                             | 15             | V    |
| Input voltage, $V_I$ (D, DE, R, or $\overline{RE}$ ) | –0.3                            | $V_{CC} + 0.5$ | V    |
| Receiver output current, $I_O$                       | –10                             | 10             | mA   |
| Continuous total power dissipation                   | See <a href="#">Section 6.5</a> |                |      |
| Storage temperature range, $T_{stg}$                 | –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 [Section 6.2](#) is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential I/O bus voltage, are with respect to network ground terminal.

### 6.2 Recommended Operating Conditions

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

|                                                                            |                            | MIN  | NOM | MAX  | UNIT |
|----------------------------------------------------------------------------|----------------------------|------|-----|------|------|
| Supply voltage, $V_{CC}$                                                   |                            | 4.75 | 5   | 5.25 | V    |
| Voltage at any bus terminal (separately or common mode), $V_I$ or $V_{IC}$ |                            | –7   |     | 12   | V    |
| High-level input voltage, $V_{IH}$                                         | D, DE, and $\overline{RE}$ | 2    |     |      | V    |
| Low-level input voltage, $V_{IL}$                                          | D, DE, and $\overline{RE}$ |      |     | 0.8  | V    |
| Differential input voltage, $V_{ID}$ <sup>(1)</sup>                        |                            | –12  |     | 12   | V    |
| High-level output current, $I_{OH}$                                        | Driver                     | –60  |     |      | mA   |
|                                                                            | Receiver                   | –400 |     |      | μA   |
| Low-level output current, $I_{OL}$                                         | Driver                     |      |     | 60   | mA   |
|                                                                            | Receiver                   |      |     | 8    |      |
| Junction temperature, $T_J$                                                |                            |      |     | 140  | °C   |
| Operating free-air temperature, $T_A$                                      | SN55LBC176                 | –55  |     | 125  | °C   |
|                                                                            | SN65LBC176                 | –40  |     | 85   |      |
|                                                                            | SN65LBC176Q                | –40  |     | 125  |      |
|                                                                            | SN75LBC176                 | 0    |     | 70   |      |

- (1) Differential input/output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.

### 6.3 Thermal Information: SN55LBC176

| THERMAL METRIC <sup>(1)</sup> |                                              | FK      | JG     | UNIT |
|-------------------------------|----------------------------------------------|---------|--------|------|
|                               |                                              | 20 PINS | 8 PINS |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 61.6    | 99.5   | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 36.8    | 51.5   |      |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 36.1    | 86.5   |      |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 31.0    | 23.7   |      |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 36.0    | 80.2   |      |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | 4.2     | 11.6   |      |

## 6.4 Thermal Information: SN65LBC176, SN75LBC176

| THERMAL METRIC <sup>(1)</sup> |                                              | D      | P    | UNIT |
|-------------------------------|----------------------------------------------|--------|------|------|
|                               |                                              | 8 PINS |      |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 116.7  | 65.6 | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 56.3   | 54.6 |      |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 63.4   | 42.1 |      |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 8.8    | 22.9 |      |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 62.6   | 41.6 |      |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | n/a    | n/a  |      |

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

## 6.5 Dissipation Ratings

| PACKAGE | THERMAL MODEL         | T <sub>A</sub> < 25°C<br>POWER RATING | DERATING<br>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> = 110°C<br>POWER RATING |
|---------|-----------------------|---------------------------------------|---------------------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|
| D       | Low K <sup>(1)</sup>  | 526 mW                                | 5.0 mW/°C                                         | 301 mW                                | 226 mW                                | —                                      |
|         | High K <sup>(2)</sup> | 882 mW                                | 8.4 mW/°C                                         | 504 mW                                | 378 mW                                | —                                      |
| P       |                       | 840 mW                                | 8.0 mW/°C                                         | 480 mW                                | 360 mW                                | —                                      |
| JG      |                       | 1050 mW                               | 8.4 mW/°C                                         | 672 mW                                | 546 mW                                | 210 mW                                 |
| FK      |                       | 1375 mW                               | 11.0 mW/°C                                        | 880 mW                                | 715 mW                                | 440 mW                                 |

(1) In accordance with the low effective thermal conductivity metric definitions of EIA/JESD 51–3.

(2) In accordance with the high effective thermal conductivity metric definitions of EIA/JESD 51–7.

## 6.6 Driver Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER         |                                                        | TEST CONDITIONS                                            |                                     | MIN  | MAX | UNIT |
|-------------------|--------------------------------------------------------|------------------------------------------------------------|-------------------------------------|------|-----|------|
| V <sub>IK</sub>   | Input clamp voltage                                    | I <sub>I</sub> = –18 mA                                    |                                     | –1.5 |     | V    |
| V <sub>O</sub>    | Output voltage                                         | I <sub>O</sub> = 0                                         |                                     | 0    | 6   | V    |
| V <sub>OD1</sub>  | Differential output voltage                            | I <sub>O</sub> = 0                                         |                                     | 1.5  | 6   | V    |
| V <sub>OD2</sub>  | Differential output voltage                            | R <sub>L</sub> = 54 Ω, See (2)                             | 55LBC176,<br>65LBC176,<br>65LBC176Q | 1.1  |     | V    |
|                   |                                                        |                                                            | 75LBC176                            | 1.5  | 5   |      |
| V <sub>OD3</sub>  | Differential output voltage                            | V <sub>test</sub> = –7 V to 12 V, See Figure 2,<br>See (2) | 55LBC176,<br>65LBC176,<br>65LBC176Q | 1.1  |     | V    |
|                   |                                                        |                                                            | 75LBC176                            | 1.5  | 5   |      |
| Δ V <sub>OD</sub> | Change in magnitude of differential output voltage (1) | R <sub>L</sub> = 54 Ω or 100 Ω, See Figure 7-1             |                                     | –0.2 | 0.2 | V    |
| V <sub>OC</sub>   | Common-mode output voltage                             |                                                            |                                     | –1   | 3   | V    |
| Δ V <sub>OC</sub> | Change in magnitude of common-mode output voltage (1)  |                                                            |                                     | –0.2 | 0.2 | V    |
| I <sub>O</sub>    | Output current                                         | Output disabled,<br>See (3)                                | V <sub>O</sub> = 12 V               |      | 1   | mA   |
|                   |                                                        |                                                            | V <sub>O</sub> = –7 V               | –0.8 |     |      |
| I <sub>IH</sub>   | High-level input current                               | V <sub>I</sub> = 2.4 V                                     |                                     | –100 |     | μA   |
| I <sub>IL</sub>   | Low-level input current                                | V <sub>I</sub> = 0.4 V                                     |                                     | –100 |     | μA   |

## 6.6 Driver Electrical Characteristics (continued)

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER       |                              | TEST CONDITIONS                                    |                                         | MIN                    | MAX  | UNIT |
|-----------------|------------------------------|----------------------------------------------------|-----------------------------------------|------------------------|------|------|
| I <sub>OS</sub> | Short circuit output current | V <sub>O</sub> = -7 V                              |                                         | -250                   |      | mA   |
|                 |                              | V <sub>O</sub> = 0                                 |                                         | -150                   |      |      |
|                 |                              | V <sub>O</sub> = V <sub>CC</sub>                   |                                         |                        | 250  |      |
|                 |                              | V <sub>O</sub> = 12 V                              |                                         |                        |      |      |
| I <sub>CC</sub> | Supply current               | V <sub>I</sub> = 0 or V <sub>CC</sub> ,<br>No load | Receiver disabled<br>and driver enabled | 55LBC176,<br>65LBC176Q | 1.75 | mA   |
|                 |                              |                                                    |                                         | 65LBC176,<br>75LBC176  | 1.5  |      |
|                 |                              |                                                    | Receiver and driver<br>disabled         | 55LBC176,<br>65LBC176Q | 0.25 |      |
|                 |                              |                                                    |                                         | 65LBC176,<br>75LBC176  | 0.2  |      |

- (1)  $\Delta|V_{OD}|$  and  $\Delta|V_{OC}|$  are the changes in magnitude of V<sub>OD</sub> and V<sub>OC</sub>, respectively, that occur when the input changes from a high level to a low level.
- (2) This device meets the V<sub>OD</sub> requirements of TIA/EIA-485-A above 0°C only.
- (3) This applies for both power on and off; refer to TIA/EIA-485-A for exact conditions.

## 6.7 Driver Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature

| PARAMETER                                              | TEST CONDITIONS                                                 | SN55LBC176<br>SN65LBC176Q |     |     | SN65LBC176<br>SN75LBC176 |                    |     | UNIT |
|--------------------------------------------------------|-----------------------------------------------------------------|---------------------------|-----|-----|--------------------------|--------------------|-----|------|
|                                                        |                                                                 | MIN                       | TYP | MAX | MIN                      | TYP <sup>(1)</sup> | MAX |      |
| $t_{d(OD)}$ Differential output delay time             | $R_L = 54\ \Omega$ ,<br>See Figure 7-3<br>$C_L = 50\ \text{pF}$ | 8                         |     | 31  | 8                        |                    | 25  | ns   |
| $t_{t(OD)}$ Differential output transition time        |                                                                 |                           | 12  |     |                          | 12                 |     | ns   |
| $t_{sk(p)}$ Pulse skew ( $ t_{d(ODH)} - t_{d(ODL)} $ ) |                                                                 |                           |     | 6   |                          | 0                  | 6   | ns   |
| $t_{PZH}$ Output enable time to high level             | $R_L = 110\ \Omega$ , See Figure 7-4                            |                           |     | 65  |                          |                    | 35  | ns   |
| $t_{PZL}$ Output enable time to low level              | $R_L = 110\ \Omega$ , See Figure 7-5                            |                           |     | 65  |                          |                    | 35  | ns   |
| $t_{PHZ}$ Output disable time from high level          | $R_L = 110\ \Omega$ , See Figure 7-4                            |                           |     | 105 |                          |                    | 60  | ns   |
| $t_{PLZ}$ Output disable time from low level           | $R_L = 110\ \Omega$ , See Figure 7-5                            |                           |     | 105 |                          |                    | 35  | ns   |

(1) All typical values are at  $V_{CC} = 5\ \text{V}$ ,  $T_A = 25^\circ\text{C}$ .

**Table 6-1. Driver Symbol Equivalents**

| DATA SHEET PARAMETER | RS-485                                 |
|----------------------|----------------------------------------|
| $V_O$                | $V_{oa}, V_{ob}$                       |
| $ V_{OD1} $          | $V_o$                                  |
| $ V_{OD2} $          | $V_t (R_L = 54\ \Omega)$               |
| $ V_{OD} $           | $V_t$ (test termination measurement 2) |
| $\Delta  V_{OD} $    | $  V_t  -  \bar{V}_t  $                |
| $V_{OC}$             | $ V_{os} $                             |
| $\Delta  V_{OC} $    | $ V_{os} - \bar{V}_{os} $              |
| $I_{OS}$             | None                                   |
| $I_O$                | $I_{ia}, I_{ib}$                       |

## 6.8 Receiver Electrical Characteristics

over recommended ranges of common-mode input voltage, supply voltage, and operating free-air temperature (unless otherwise noted)

| PARAMETER |                                                             | TEST CONDITIONS                               |                                         | MIN                                       | TYP <sup>(1)</sup> | MAX  | UNIT          |
|-----------|-------------------------------------------------------------|-----------------------------------------------|-----------------------------------------|-------------------------------------------|--------------------|------|---------------|
| $V_{IT+}$ | Positive-going input threshold voltage                      | $V_O = 2.7\text{ V}$ ,                        | $I_O = -0.4\text{ mA}$                  |                                           |                    | 0.2  | V             |
| $V_{IT-}$ | Negative-going input threshold voltage                      | $V_O = 0.5\text{ V}$ ,                        | $I_O = 8\text{ mA}$                     | -0.2 <sup>(2)</sup>                       |                    |      | V             |
| $V_{hys}$ | Hysteresis voltage ( $V_{IT+} - V_{IT-}$ ) (see Figure 7-4) |                                               |                                         |                                           | 50                 |      | mV            |
| $V_{IK}$  | Enable-input clamp voltage                                  | $I_I = -18\text{ mA}$                         |                                         | -1.5                                      |                    |      | V             |
| $V_{OH}$  | High level output voltage                                   | $V_{ID} = 200\text{ mV}$ ,<br>See Figure 7-6  | $I_{OH} = -400\text{ }\mu\text{A}$ ,    | 2.7                                       |                    |      | V             |
| $V_{OL}$  | Low level output voltage                                    | $V_{ID} = -200\text{ mV}$ ,<br>See Figure 7-6 | $I_{OL} = 8\text{ mA}$ ,                |                                           |                    | 0.45 | V             |
| $I_{OZ}$  | High-impedance-state output current                         | $V_O = 0.4\text{ V to } 2.4\text{ V}$         |                                         | -20                                       |                    | 20   | $\mu\text{A}$ |
| $I_I$     | Line input current                                          | Other input = 0 V,<br>See (3)                 | $V_I = 12\text{ V}$                     |                                           |                    | 1    | mA            |
|           |                                                             |                                               | $V_I = -7\text{ V}$                     | -0.8                                      |                    |      |               |
| $I_{IH}$  | High-level enable-input current                             | $V_{IH} = 2.7\text{ V}$                       |                                         | -100                                      |                    |      | $\mu\text{A}$ |
| $I_{IL}$  | Low-level enable-input current                              | $V_{IL} = 0.4\text{ V}$                       |                                         | -100                                      |                    |      | $\mu\text{A}$ |
| $r_I$     | Input resistance                                            |                                               |                                         | 12                                        |                    |      | k $\Omega$    |
| $I_{CC}$  | Supply current                                              | $V_I = 0\text{ or } V_{CC}$ ,<br>No load      | Receiver enabled<br>and driver disabled |                                           |                    | 3.9  | mA            |
|           |                                                             |                                               | Receiver and<br>driver disabled         | SN55LBC176,<br>SN65LBC176,<br>SN65LBC176Q |                    | 0.25 |               |
|           |                                                             |                                               |                                         | SN75LBC176                                |                    | 0.2  |               |

(1) All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

(2) The algebraic convention, in which the less-positive (more-negative) limit is designated minimum, is used in this data sheet.

(3) This applies for both power on and power off. Refer to ANSI Standard RS-485 for exact conditions.

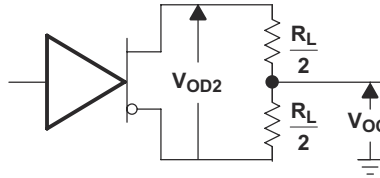
## 6.9 Receiver Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 15\text{ pF}$

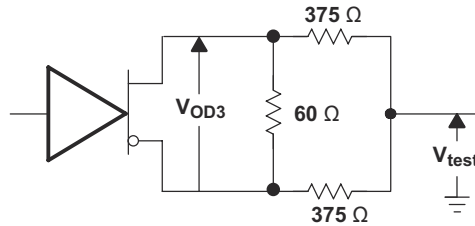
| PARAMETER   |                                                                | TEST CONDITIONS                                               | SN55LBC176<br>SN65LBC176Q |     | SN65LBC176<br>SN75LBC176 |                        | UNIT  |
|-------------|----------------------------------------------------------------|---------------------------------------------------------------|---------------------------|-----|--------------------------|------------------------|-------|
|             |                                                                |                                                               | MIN                       | MAX | MIN                      | TYP <sup>(1)</sup> MAX |       |
| $t_{PLH}$   | Propagation delay time, low- to high-level single-ended output | $V_{ID} = -1.5\text{ V to } 1.5\text{ V}$ ,<br>See Figure 7-7 | 11                        | 37  | 11                       |                        | 33 ns |
| $t_{PHL}$   | Propagation delay time, high- to low-level single-ended output |                                                               | 11                        | 37  | 11                       |                        | 33 ns |
| $t_{sk(p)}$ | Pulse skew ( $ t_{PLH} - t_{PHL} $ )                           |                                                               |                           | 10  |                          | 3 6                    | ns    |
| $t_{PZH}$   | Output enable time to high level                               | See Figure 7-8                                                |                           | 35  |                          |                        | 35 ns |
| $t_{PZL}$   | Output enable time to low level                                |                                                               |                           | 35  |                          |                        | 30 ns |
| $t_{PHZ}$   | Output disable time from high level                            | See Figure 7-8                                                |                           | 35  |                          |                        | 35 ns |
| $t_{PLZ}$   | Output disable time from low level                             |                                                               |                           | 35  |                          |                        | 30 ns |

(1) All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

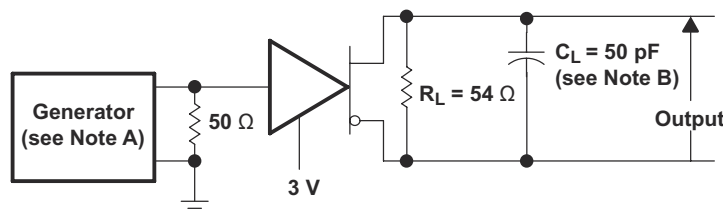
## 7 Parameter Measurement Information



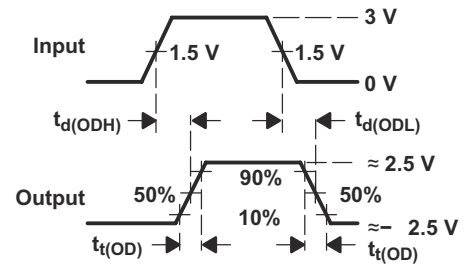
**Figure 7-1. Driver  $V_{OD}$  and  $V_{OC}$**



**Figure 7-2. Driver  $V_{OD3}$**

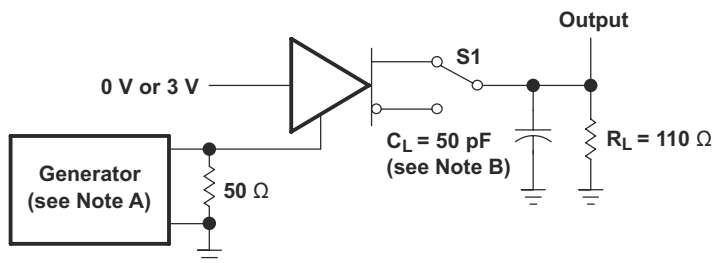


**TEST CIRCUIT**

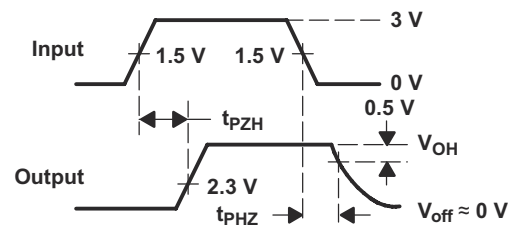


**VOLTAGE WAVEFORMS**

**Figure 7-3. Driver Test Circuit and Voltage Waveforms**



**TEST CIRCUIT**



**VOLTAGE WAVEFORMS**

**Figure 7-4. Driver Test Circuit and Voltage Waveforms**

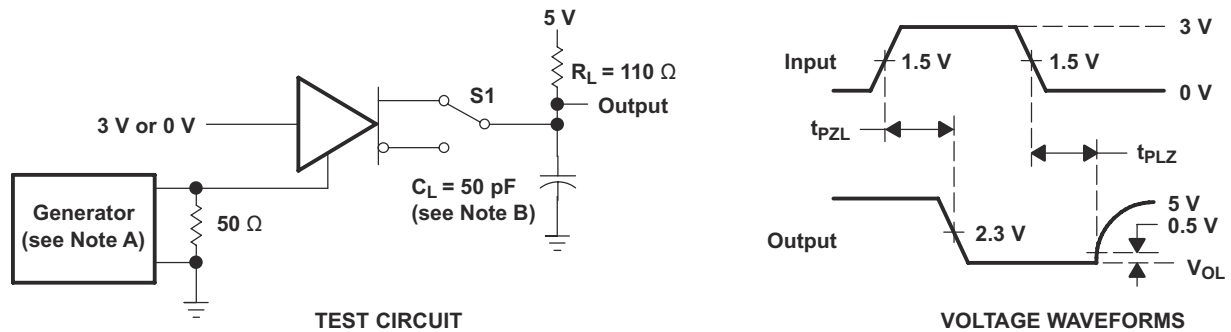


Figure 7-5. Driver Test Circuit and Voltage Waveforms

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

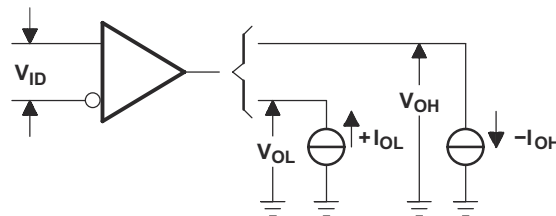


Figure 7-6. Receiver  $V_{OH}$  and  $V_{OL}$

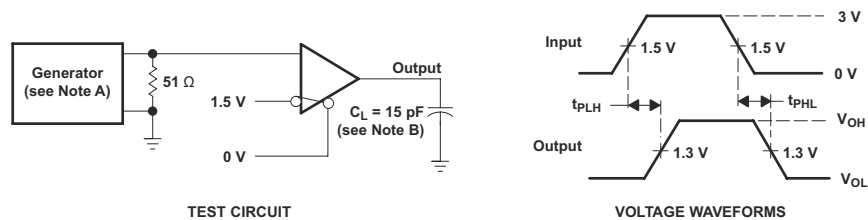
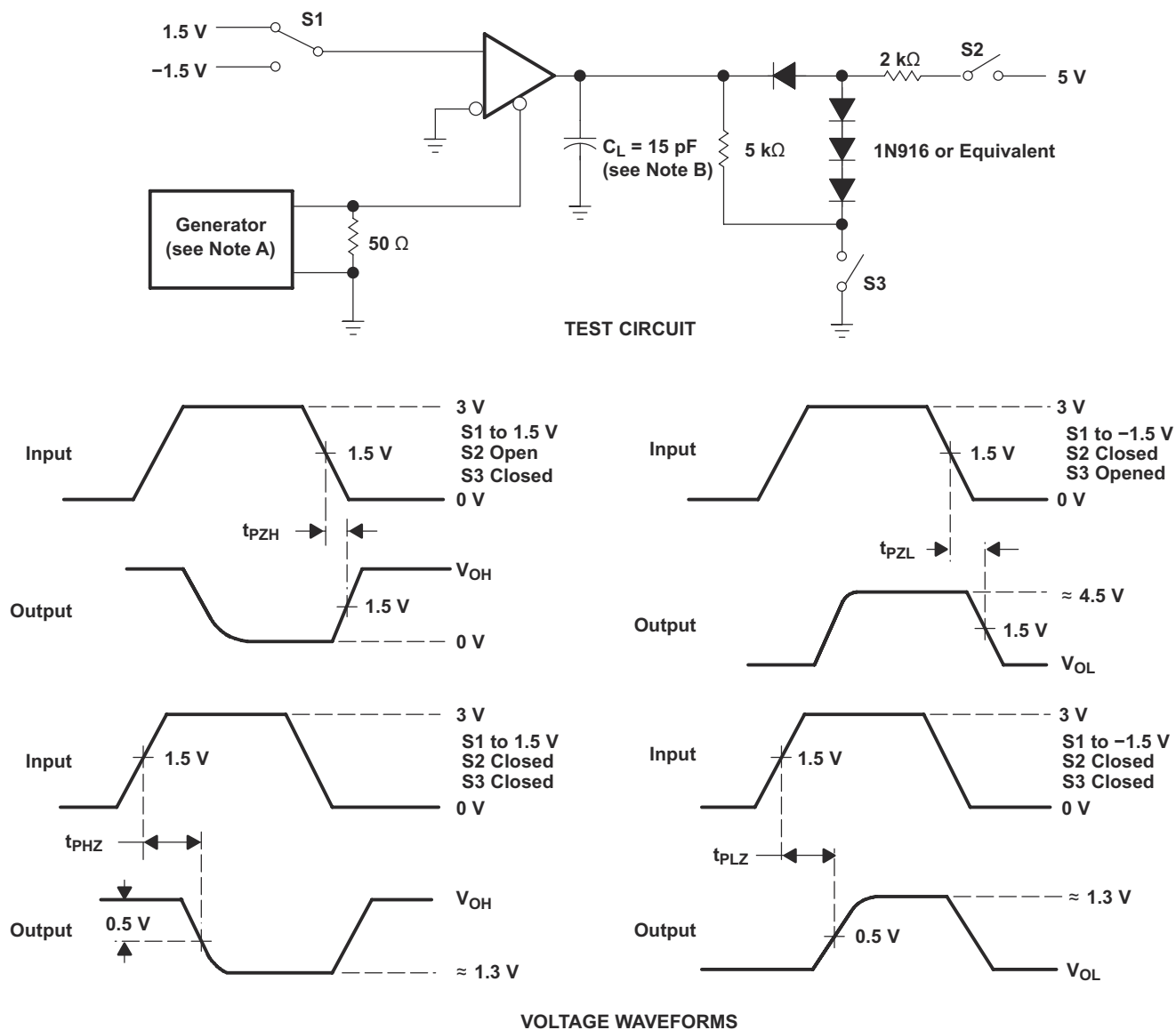


Figure 7-7. Receiver Test Circuit and Voltage Waveforms



- 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 7-8. Receiver Test Circuit and Voltage Waveforms**

## 8 Detailed Description

### 8.1 Functional Block Diagram

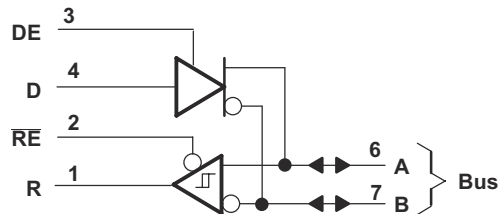
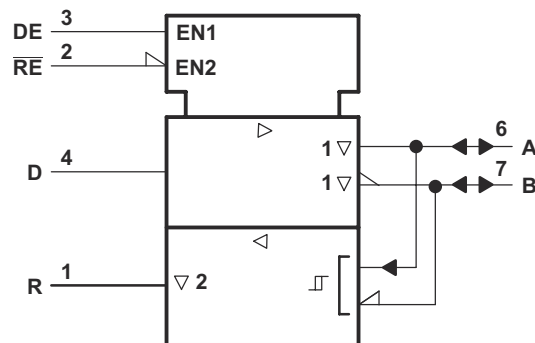


Figure 8-1. Logic Diagram (Positive Logic)



A. This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Figure 8-2. Logic Symbol(A)

### 8.2 Device Functional Modes

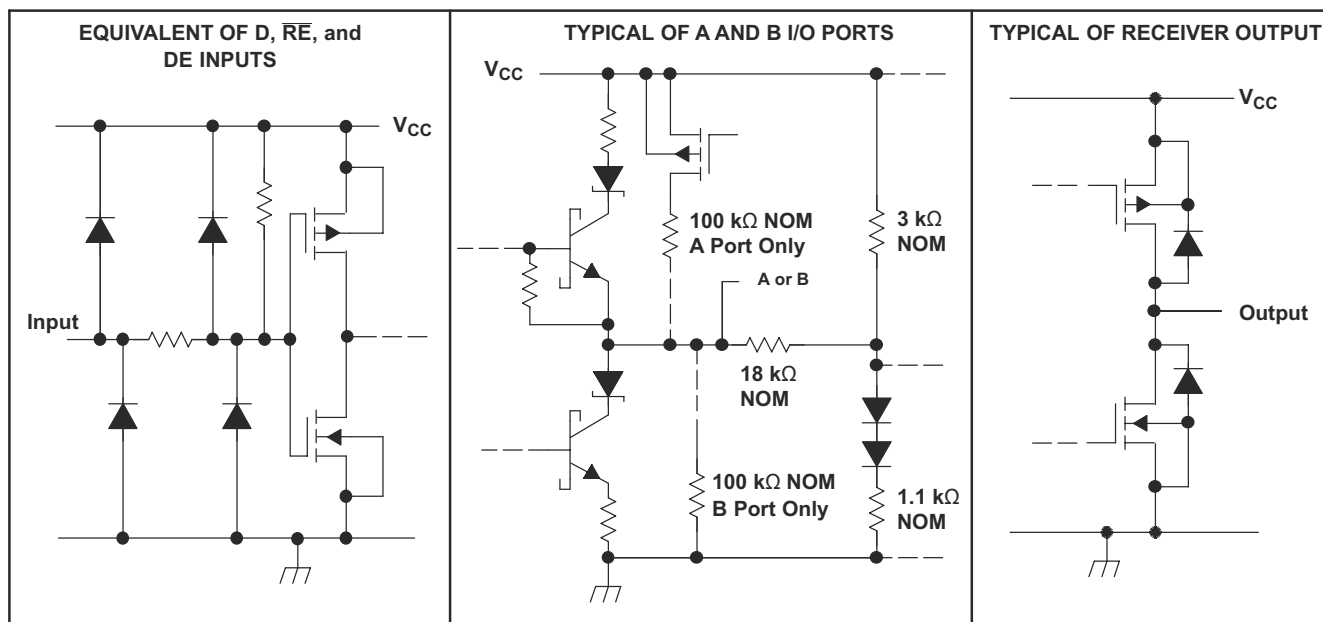
Table 8-1. Driver Function Tables<sup>(1)</sup>

| DRIVER     |              |         |   |
|------------|--------------|---------|---|
| INPUT<br>D | ENABLE<br>DE | OUTPUTS |   |
|            |              | A       | B |
| 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 Function Tables<sup>(1)</sup>

| RECEIVER                                          |  |              |              |
|---------------------------------------------------|--|--------------|--------------|
| DIFFERENTIAL INPUTS<br>$V_{ID} = V_{IA} - V_{IB}$ |  | ENABLE<br>RE | OUTPUTS<br>R |
| $V_{ID} \geq 0.2 \text{ V}$                       |  | 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                                              |  | L            | H            |



**Figure 8-3. Schematics of Inputs and Outputs**

## 9 Device and Documentation Support

### 9.1 Device Support

#### 9.1.1 Thermal Characteristics of IC Packages

$\theta_{JA}$  (Junction-to-Ambient Thermal Resistance) is defined as the difference in junction temperature to ambient temperature divided by the operating power.

$\theta_{JA}$  is NOT a constant and is a strong function of

- the PCB design (50% variation)
- altitude (20% variation)
- device power (5% variation)

$\theta_{JA}$  can be used to compare the thermal performance of packages if the specific test conditions are defined and used. Standardized testing includes specification of PCB construction, test chamber volume, sensor locations, and the thermal characteristics of holding fixtures.  $\theta_{JA}$  is often misused when it is used to calculate junction temperatures for other installations.

TI uses two test PCBs as defined by JEDEC specifications. The low-k board gives average in-use condition thermal performance and consists of a single trace layer 25 mm long and 2-oz thick copper. The high-k board gives best case in-use condition and consists of two 1-oz buried power planes with a single trace layer 25 mm long with 2-oz thick copper. A 4% to 50% difference in  $\theta_{JA}$  can be measured between these two test cards.

$\theta_{JC}$  (Junction-to-Case Thermal Resistance) is defined as difference in junction temperature to case divided by the operating power. It is measured by putting the mounted package up against a copper block cold plate to force heat to flow from die, through the mold compound into the copper block.

$\theta_{JC}$  is a useful thermal characteristic when a heatsink is applied to package. It is NOT a useful characteristic to predict junction temperature as it provides pessimistic numbers if the case temperature is measured in a non-standard system and junction temperatures are backed out. It can be used with  $\theta_{JB}$  in 1-dimensional thermal simulation of a package system.

$\theta_{JB}$  (Junction-to-Board Thermal Resistance) is defined to be the difference in the junction temperature and the PCB temperature at the center of the package (closest to the die) when the PCB is clamped in a cold-plate structure.  $\theta_{JB}$  is only defined for the high-k test card.

$\theta_{JB}$  provides an overall thermal resistance between the die and the PCB. It includes a bit of the PCB thermal resistance (especially for BGA's with thermal balls) and can be used for simple 1-dimensional network analysis of package system (see [Figure 9-1](#)).

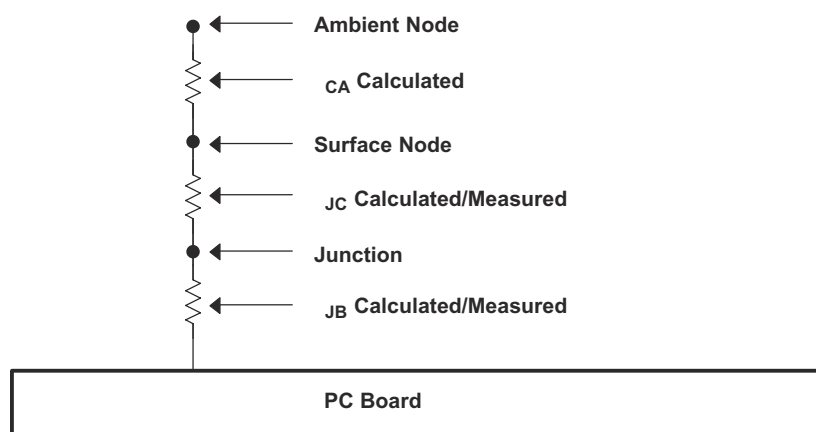


Figure 9-1. Thermal Resistance

### 9.2 Trademarks

LinBiCMOS™ is a trademark of Texas Instruments Incorporated.  
 All trademarks are the property of their respective owners.

### 9.3 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.

### 9.4 Glossary

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

## 10 Mechanical, Packaging, and Orderable Information

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

## PACKAGING INFORMATION

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)                      |
|---------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|------------------------------------------|
| <a href="#">5962-9318301Q2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9318301Q2A<br>SNJ55<br>LBC176FK |
| <a href="#">5962-9318301QPA</a> | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9318301QPA<br>SNJ55LBC176                |
| <a href="#">SN65LBC176DR</a>    | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 6LB176                                   |
| SN65LBC176DR.A                  | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 6LB176                                   |
| SN65LBC176DRG4                  | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 6LB176                                   |
| <a href="#">SN65LBC176P</a>     | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | 65LBC176                                 |
| SN65LBC176P.A                   | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | 65LBC176                                 |
| <a href="#">SN65LBC176QDR</a>   | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | LB176Q                                   |
| SN65LBC176QDR.A                 | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | LB176Q                                   |
| <a href="#">SN65LBC176QDRG4</a> | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (J176Q1, LB176Q)                         |
| SN65LBC176QDRG4.A               | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (J176Q1, LB176Q)                         |
| <a href="#">SN75LBC176D</a>     | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | 7LB176                                   |
| <a href="#">SN75LBC176P</a>     | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | 75LBC176                                 |
| SN75LBC176P.A                   | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | 75LBC176                                 |
| <a href="#">SNJ55LBC176FK</a>   | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9318301Q2A<br>SNJ55<br>LBC176FK |
| SNJ55LBC176FK.A                 | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9318301Q2A<br>SNJ55<br>LBC176FK |
| <a href="#">SNJ55LBC176JG</a>   | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9318301QPA<br>SNJ55LBC176                |
| SNJ55LBC176JG.A                 | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9318301QPA<br>SNJ55LBC176                |

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

(2) **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.

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

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

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

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

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

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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 SN55LBC176, SN65LBC176, SN75LBC176 :**

- Catalog : [SN75LBC176](#)
- Automotive : [SN65LBC176-Q1](#)
- Military : [SN55LBC176](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

- 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN65LBC176DR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN65LBC176DR | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |

## TUBE



\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-9318301Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| SN65LBC176P     | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| SN65LBC176P.A   | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| SN75LBC176P     | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| SN75LBC176P.A   | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| SNJ55LBC176FK   | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| SNJ55LBC176FK.A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |

## 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\



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

**D0008A**

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



## SOLDER MASK DETAILS

4214825/C 02/2019

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

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

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.

P (R-PDIP-T8)

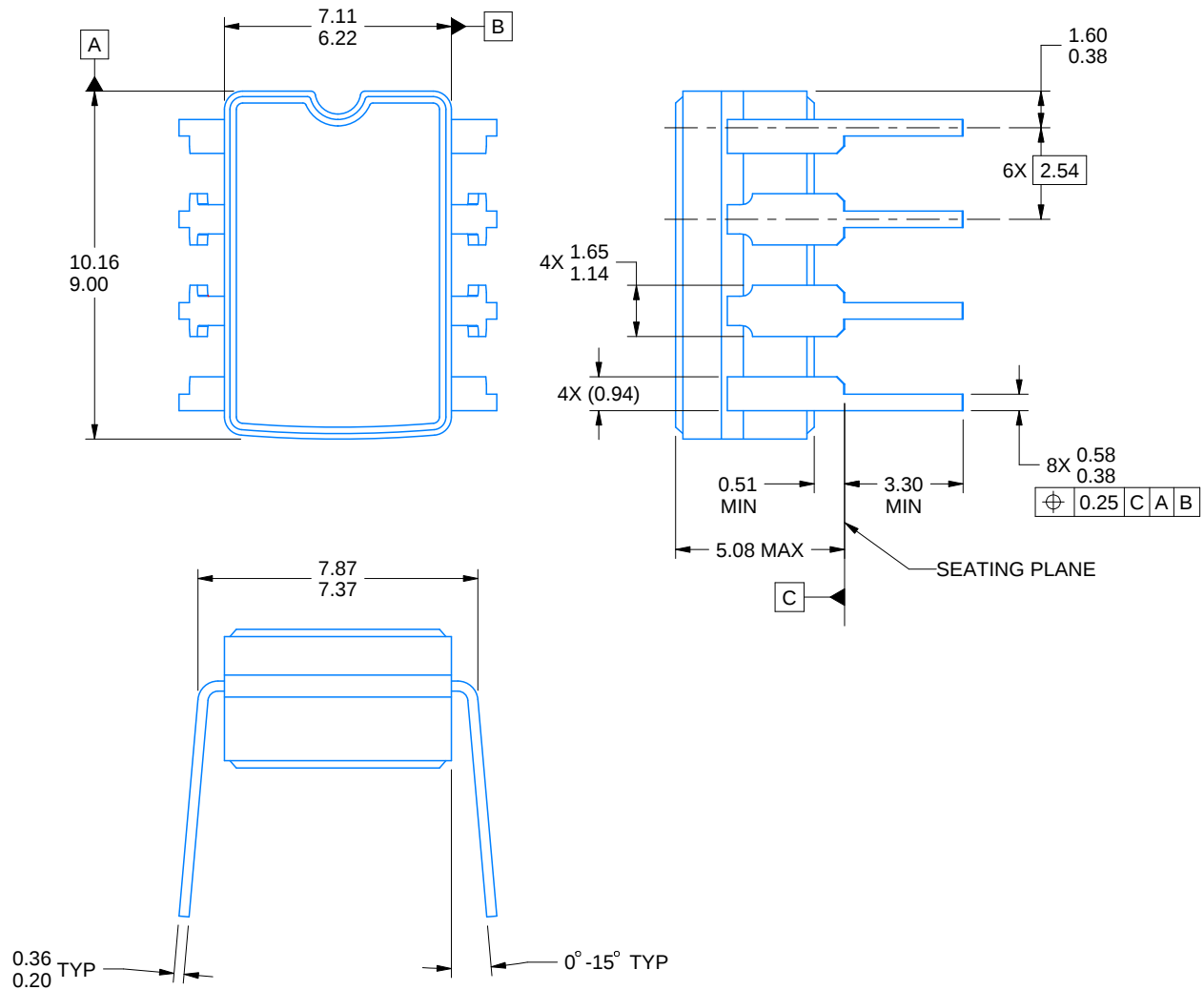
PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

**JG0008A****PACKAGE OUTLINE****CDIP - 5.08 mm max height**

CERAMIC DUAL IN-LINE PACKAGE



4230036/A 09/2023

**NOTES:**

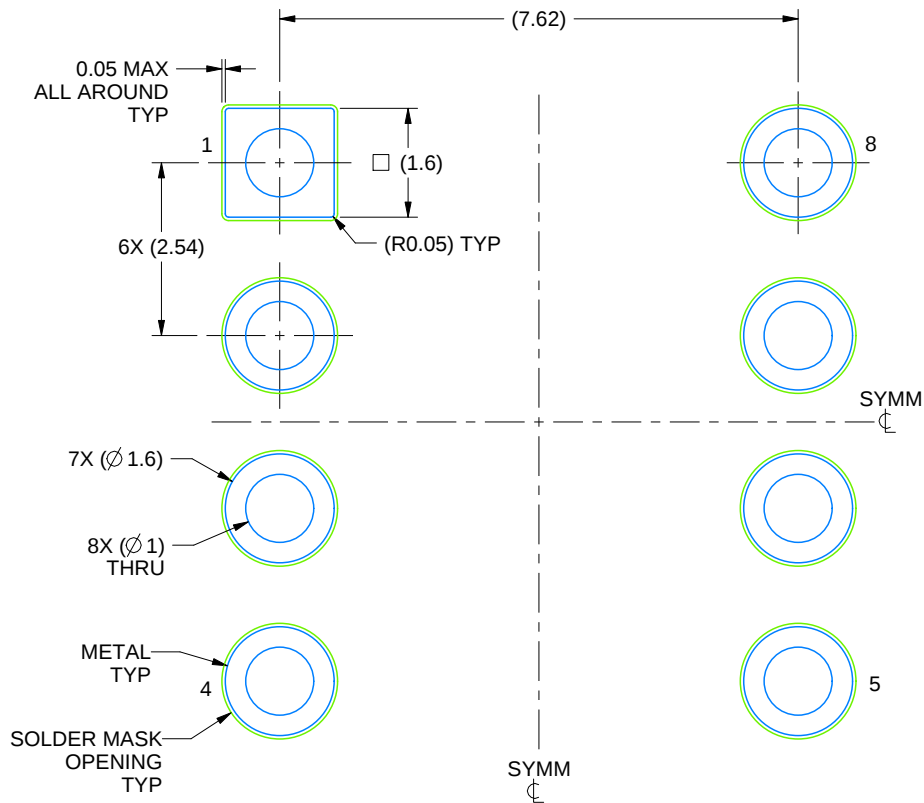
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package can be hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification.
5. Falls within MIL STD 1835 GDIP1-T8

# EXAMPLE BOARD LAYOUT

JG0008A

CDIP - 5.08 mm max height

CERAMIC DUAL IN-LINE PACKAGE



LAND PATTERN EXAMPLE  
NON SOLDER MASK DEFINED  
SCALE: 9X

4230036/A 09/2023

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