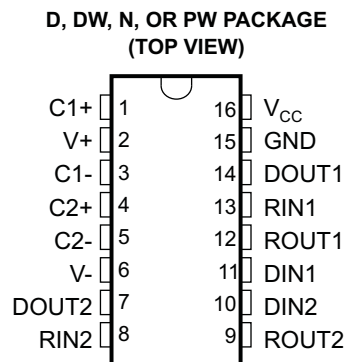


## FEATURES

- **ESD Protection for RS-232 Bus Pins**
  - $\pm 15$ -kV – Human-Body Model
- **Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards**
- **Operates at 5-V  $V_{CC}$  Supply**
- **Operates Up to 120 kbit/s**
- **External Capacitors . . .  $4 \times 0.1 \mu\text{F}$**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**

## APPLICATIONS

- **Battery-Powered Systems**
- **PDA's**
- **Notebooks**
- **Laptops**
- **Palmtop PCs**
- **Hand-Held Equipment**



## DESCRIPTION/ORDERING INFORMATION

The MAX202 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD protection pin to pin (serial-port connection pins, including GND). The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 5-V supply. The device operates at data signaling rates up to 120 kbit/s and a maximum of 30-V/ $\mu\text{s}$  driver output slew rate.

### ORDERING INFORMATION

| $T_A$         | PACKAGE <sup>(1)(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|---------------------------|--------------|-----------------------|------------------|
| 0°C to 70°C   | PDIP – N                  | Tube of 25   | MAX202CN              | MAX202CN         |
|               | SOIC – D                  | Tube of 40   | MAX202CD              | MAX202C          |
|               |                           | Reel of 2500 | MAX202CDR             |                  |
|               | SOIC – DW                 | Tube of 40   | MAX202CDW             | MAX202C          |
|               |                           | Reel of 2000 | MAX202CDWR            |                  |
|               | TSSOP – PW                | Tube of 90   | MAX202CPW             | MA202C           |
|               |                           | Reel of 2000 | MAX202CPWR            |                  |
| –40°C to 85°C | PDIP – N                  | Tube of 25   | MAX202IN              | MAX202IN         |
|               | SOIC – D                  | Tube of 40   | MAX202ID              | MAX202I          |
|               |                           | Reel of 2500 | MAX202IDR             |                  |
|               | SOIC – DW                 | Tube of 40   | MAX202IDW             | MAX202I          |
|               |                           | Reel of 2000 | MAX202IDWR            |                  |
|               | TSSOP – PW                | Tube of 90   | MAX202IPW             | MB202I           |
|               |                           | Reel of 2000 | MAX202IPWR            |                  |

- (1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).
- (2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).



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

# MAX202

## 5-V DUAL RS-232 LINE DRIVER/RECEIVER

### WITH $\pm 15$ -kV ESD PROTECTION

SLLS576E—JULY 2003—REVISED APRIL 2007

#### Function Tables

##### EACH DRIVER<sup>(1)</sup>

| INPUT<br>$D_{IN}$ | OUTPUT<br>$D_{OUT}$ |
|-------------------|---------------------|
| L                 | H                   |
| H                 | L                   |

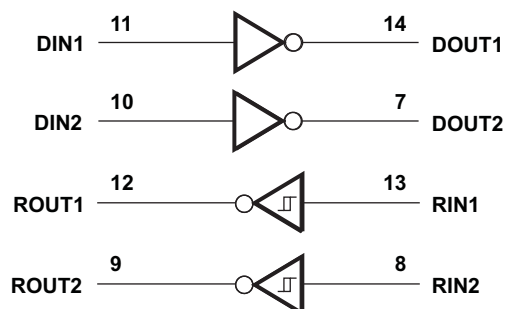
(1) H = high level, L = low level

##### EACH RECEIVER<sup>(1)</sup>

| INPUT<br>$R_{IN}$ | OUTPUT<br>$R_{OUT}$ |
|-------------------|---------------------|
| L                 | H                   |
| H                 | L                   |
| Open              | H                   |

(1) H = high level, L = low level,  
Open = input disconnected or  
connected driver off

#### LOGIC DIAGRAM (POSITIVE LOGIC)



## Absolute Maximum Ratings<sup>(1)</sup>

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

|               |   |            | MIN            | MAX            | UNIT |
|---------------|---|------------|----------------|----------------|------|
| $V_{CC}$      | Supply voltage range <sup>(2)</sup>               |            | –0.3           | 6              | V    |
| $V_{+}$       | Positive charge pump voltage range <sup>(2)</sup> |            | $V_{CC} - 0.3$ | 14             | V    |
| $V_{-}$       | Negative charge pump voltage range <sup>(2)</sup> |            | –14            | 0.3            | V    |
| $V_I$         | Input voltage range                               | Drivers    | –0.3           | $V_{+} + 0.3$  | V    |
|               |   | Receivers  |                | $\pm 30$       |      |
| $V_O$         | Output voltage range                              | Drivers    | $V_{-} - 0.3$  | $V_{+} + 0.3$  | V    |
|               |   | Receivers  | –0.3           | $V_{CC} + 0.3$ |      |
| $D_{OUT}$     | Short-circuit duration                            |            |                | Continuous     |      |
| $\theta_{JA}$ | Package thermal impedance <sup>(3)(4)</sup>       | D package  |                | 73             | °C/W |
|               |   | DW package |                | 57             |      |
|               |   | N package  |                | 67             |      |
|               |   | PW package |                | 108            |      |
| $T_J$         | Operating virtual junction temperature            |            |                | 150            | °C   |
| $T_{stg}$     | Storage temperature range                         |            | –65            | 150            | °C   |

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to network GND.
- (3) Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
- (4) The package thermal impedance is calculated in accordance with JEDEC 51-7.

## Recommended Operating Conditions<sup>(1)</sup>

(see [Figure 4](#))

|          |                                 |          | MIN | NOM | MAX | UNIT |
|----------|---------------------------------|----------|-----|-----|-----|------|
|          | Supply voltage                  |          | 4.5 | 5   | 5.5 | V    |
| $V_{IH}$ | Driver high-level input voltage | $D_{IN}$ | 2   |     |     | V    |
| $V_{IL}$ | Driver low-level input voltage  | $D_{IN}$ |     |     | 0.8 | V    |
| $V_I$    | Driver input voltage            | $D_{IN}$ | 0   |     | 5.5 | V    |
|          | Receiver input voltage          |          | –30 |     | 30  |      |
| $T_A$    | Operating free-air temperature  | MAX202C  | 0   |     | 70  | °C   |
|          |                                 | MAX202I  | –40 |     | 85  |      |

- (1) Test conditions are C1–C4 = 0.1  $\mu$ F at  $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ .

## Electrical Characteristics<sup>(1)</sup>

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 4](#))

| PARAMETER       |                | TEST CONDITIONS                | MIN | TYP <sup>(2)</sup> | MAX | UNIT |
|-----------------|----------------|--------------------------------|-----|--------------------|-----|------|
| I <sub>CC</sub> | Supply current | No load, V <sub>CC</sub> = 5 V |     | 8                  | 15  | mA   |

- (1) Test conditions are C1–C4 = 0.1  $\mu$ F at  $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ .
- (2) All typical values are at  $V_{CC} = 5 \text{ V}$ , and  $T_A = 25^\circ\text{C}$ .

# MAX202

## 5-V DUAL RS-232 LINE DRIVER/RECEIVER

### WITH $\pm 15$ -kV ESD PROTECTION

SLLS576E–JULY 2003–REVISED APRIL 2007

## DRIVER SECTION

### Electrical Characteristics<sup>(1)</sup>

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 4](#))

| PARAMETER                      | TEST CONDITIONS              | MIN   | TYP <sup>(2)</sup> | MAX      | UNIT     |
|--------------------------------|------------------------------|---|--------------------|----------|----------|
| V <sub>OH</sub>                | High-level output voltage    | D <sub>OUT</sub> at R <sub>L</sub> = 3 k $\Omega$ to GND, D <sub>IN</sub> = GND             | 5                  | 9        | V        |
| V <sub>OL</sub>                | Low-level output voltage     | D <sub>OUT</sub> at R <sub>L</sub> = 3 k $\Omega$ to GND, D <sub>IN</sub> = V <sub>CC</sub> | –5                 | –9       | V        |
| I <sub>IH</sub>                | High-level input current     | V <sub>I</sub> = V <sub>CC</sub>  | 15                 | 200      | $\mu$ A  |
| I <sub>IL</sub>                | Low-level input current      | V <sub>I</sub> at 0 V   | –15                | –200     | $\mu$ A  |
| I <sub>OS</sub> <sup>(3)</sup> | Short-circuit output current | V <sub>CC</sub> = 5.5 V V <sub>O</sub> = 0 V  | $\pm 10$           | $\pm 60$ | mA       |
| r <sub>O</sub>                 | Output resistance            | V <sub>CC</sub> , V <sub>+</sub> , and V <sub>–</sub> = 0 V V <sub>O</sub> = $\pm 2$ V      | 300                |          | $\Omega$ |

(1) Test conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

(2) All typical values are at V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

(3) Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output should be shorted at a time.

### Switching Characteristics<sup>(1)</sup>

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 4](#))

| PARAMETER           | TEST CONDITIONS   | MIN | TYP <sup>(2)</sup> | MAX | UNIT       |
|---------------------|---|-----|--------------------|-----|------------|
| Maximum data rate   | C <sub>L</sub> = 50 to 1000 pF, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ ,<br>One D <sub>OUT</sub> switching, See <a href="#">Figure 1</a>                             | 120 |                    |     | kbit/s     |
| t <sub>PLH(D)</sub> | Propagation delay time, low- to high-level output<br>C <sub>L</sub> = 2500 pF, R <sub>L</sub> = 3 k $\Omega$ ,<br>All drivers loaded, See <a href="#">Figure 1</a>          |     | 2                  |     | $\mu$ s    |
| t <sub>PHL(D)</sub> | Propagation delay time, high- to low-level output<br>C <sub>L</sub> = 2500 pF, R <sub>L</sub> = 3 k $\Omega$ ,<br>All drivers loaded, See <a href="#">Figure 1</a>          |     | 2                  |     | $\mu$ s    |
| t <sub>sk(p)</sub>  | Pulse skew <sup>(3)</sup><br>C <sub>L</sub> = 150 to 2500 pF, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ ,<br>See <a href="#">Figure 2</a>                               |     | 300                |     | ns         |
| SR(tr)              | Slew rate, transition region<br>(see <a href="#">Figure 1</a> )<br>C <sub>L</sub> = 50 to 1000 pF, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ ,<br>V <sub>CC</sub> = 5 V | 3   | 6                  | 30  | V/ $\mu$ s |

(1) Test conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

(2) All typical values are at V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

(3) Pulse skew is defined as |t<sub>PLH</sub> – t<sub>PHL</sub>| of each channel of the same device.

## ESD Protection

| PIN                                | TEST CONDITIONS  | TYP      | UNIT |
|------------------------------------|------------------|----------|------|
| D <sub>OUT</sub> , R <sub>IN</sub> | Human-body model | $\pm 15$ | kV   |

## RECEIVER SECTION

### Electrical Characteristics<sup>(1)</sup>

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 4](#))

| PARAMETER  | TEST CONDITIONS                              | MIN | TYP <sup>(2)</sup>    | MAX | UNIT       |
|--|--|-----|-----------------------|-----|------------|
| V <sub>OH</sub> High-level output voltage                                | I <sub>OH</sub> = -1 mA                      | 3.5 | V <sub>CC</sub> - 0.4 |     | V          |
| V <sub>OL</sub> Low-level output voltage                                 | I <sub>OL</sub> = 1.6 mA                     |     |                       | 0.4 | V          |
| V <sub>IT+</sub> Positive-going input threshold voltage                  | V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C |     | 1.7                   | 2.4 | V          |
| V <sub>IT-</sub> Negative-going input threshold voltage                  | V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C | 0.8 | 1.2                   |     | V          |
| V <sub>hys</sub> Input hysteresis (V <sub>IT+</sub> - V <sub>IT-</sub> ) |  | 0.2 | 0.5                   | 1   | V          |
| r <sub>i</sub> Input resistance  | V <sub>I</sub> = $\pm 3$ V to $\pm 25$ V     | 3   | 5                     | 7   | k $\Omega$ |

(1) Test conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

(2) All typical values are at V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

### Switching Characteristics<sup>(1)</sup>

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 3](#))

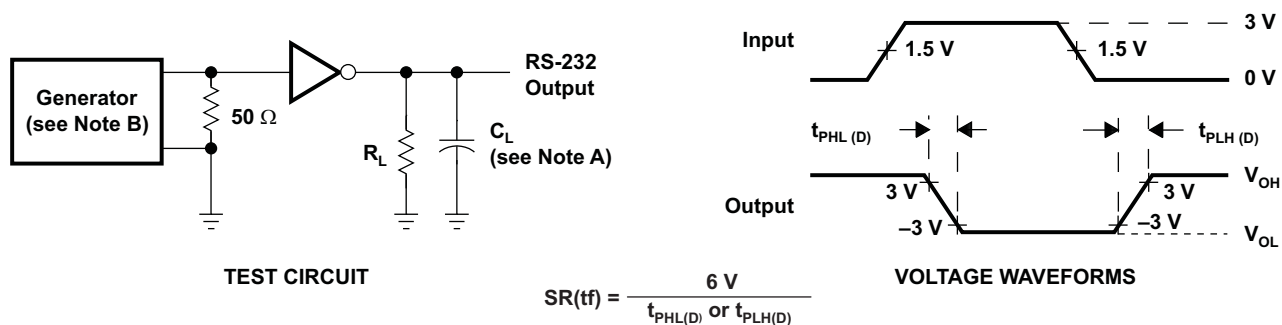
| PARAMETER   | TEST CONDITIONS         | MIN | TYP <sup>(2)</sup> | MAX | UNIT    |
|---|-------------------------|-----|--------------------|-----|---------|
| t <sub>PLH(R)</sub> Propagation delay time, low- to high-level output | C <sub>L</sub> = 150 pF |     | 0.5                | 10  | $\mu$ s |
| t <sub>PHL(R)</sub> Propagation delay time, high- to low-level output | C <sub>L</sub> = 150 pF |     | 0.5                | 10  | $\mu$ s |
| t <sub>sk(p)</sub> Pulse skew <sup>(3)</sup>                          |                         |     | 300                |     | ns      |

(1) Test conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

(2) All typical values are at V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

(3) Pulse skew is defined as |t<sub>PLH</sub> - t<sub>PHL</sub>| of each channel of the same device.

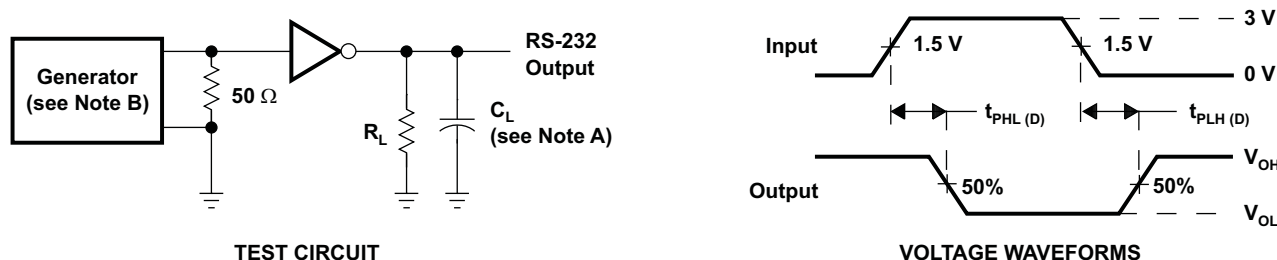
## PARAMETER MEASUREMENT INFORMATION



NOTES: A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 120 kbit/s,  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .

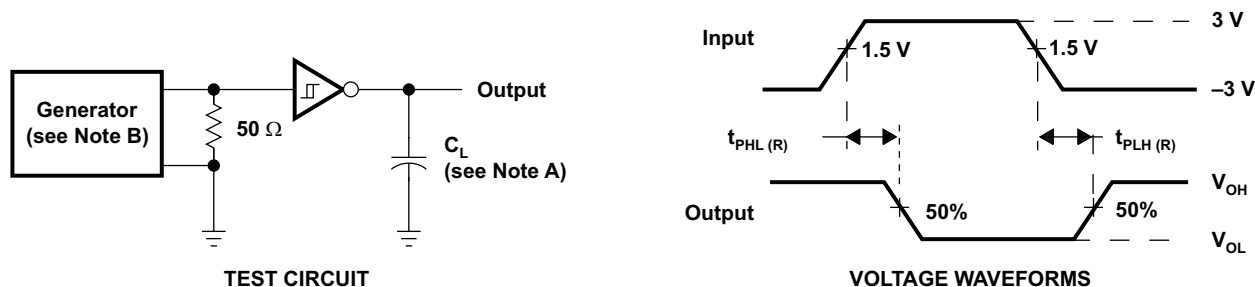
**Figure 1. Driver Slew Rate**



NOTES: A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 120 kbit/s,  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .

**Figure 2. Driver Pulse Skew**

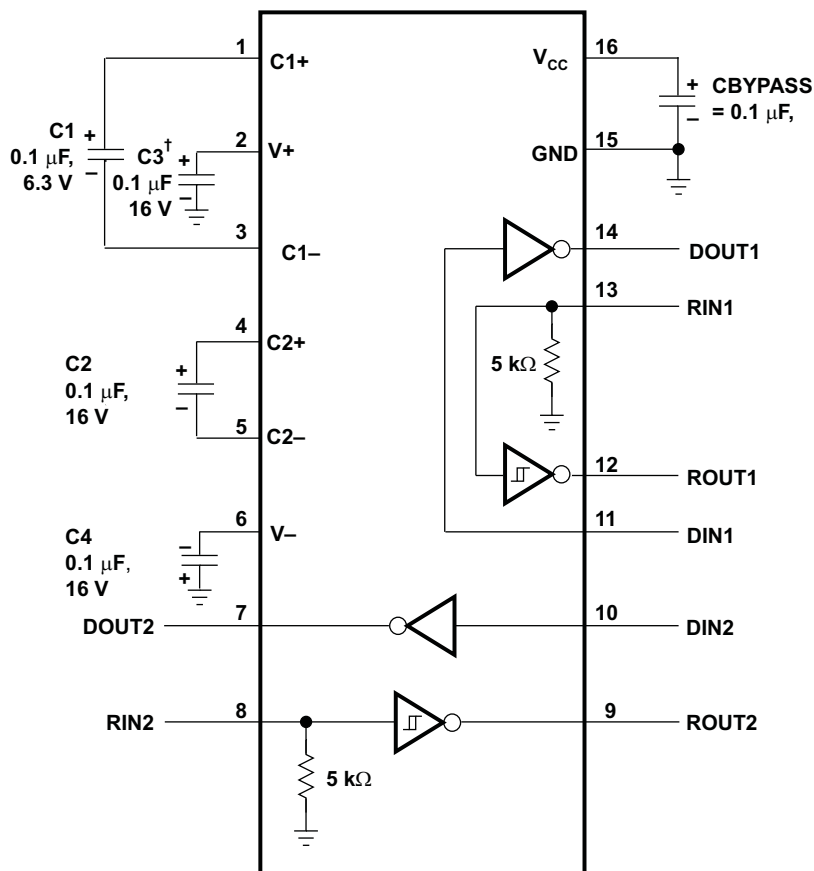


NOTES: A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics:  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .

**Figure 3. Receiver Propagation Delay Times**

## APPLICATION INFORMATION



<sup>†</sup> C3 can be connected to  $V_{CC}$  or GND.

NOTES: A. Resistor values shown are nominal.

B. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown.

**Figure 4. Typical Operating Circuit and Capacitor Values**

## Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation. The MAX202 requires 0.1-μF capacitors, although capacitors up to 10 μF can be used without harm. Ceramic dielectrics are suggested for the 0.1-μF capacitors. When using the minimum recommended capacitor values, make sure the capacitance value does not degrade excessively as the operating temperature varies. If in doubt, use capacitors with a larger (e.g., 2×) nominal value. The capacitors' effective series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V–.

Use larger capacitors (up to 10 μF) to reduce the output impedance at V+ and V–.

Bypass  $V_{CC}$  to ground with at least 0.1 μF. In applications sensitive to power-supply noise generated by the charge pumps, decouple  $V_{CC}$  to ground with a capacitor the same size as (or larger than) the charge-pump capacitors (C1–C4).

## ESD Protection

TI MAX202 devices have standard ESD protection structures incorporated on the pins to protect against electrostatic discharges encountered during assembly and handling. In addition, the RS232 bus pins (driver outputs and receiver inputs) of these devices have an extra level of ESD protection. Advanced ESD structures were designed to successfully protect these bus pins against ESD discharge of  $\pm 15$ -kV when powered down.

## APPLICATION INFORMATION (continued)

### ESD Test Conditions

Stringent ESD testing is performed by TI, based on various conditions and procedures. Please contact TI for a reliability report that documents test setup, methodology, and results.

### Human-Body Model (HBM)

The HBM of ESD testing is shown in Figure 5. Figure 6 shows the current waveform that is generated during a discharge into a low impedance. The model consists of a 100-pF capacitor, charged to the ESD voltage of concern, and subsequently discharged into the device under test (DUT) through a 1.5-k $\Omega$  resistor.

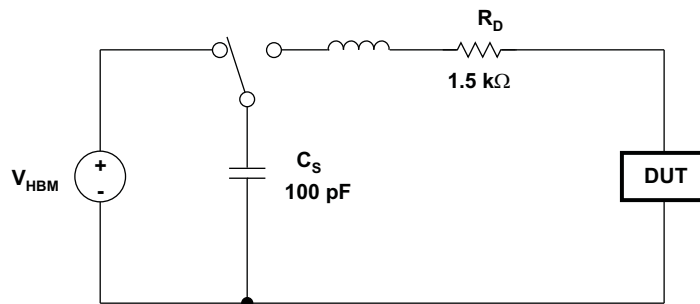


Figure 5. HBM ESD Test Circuit

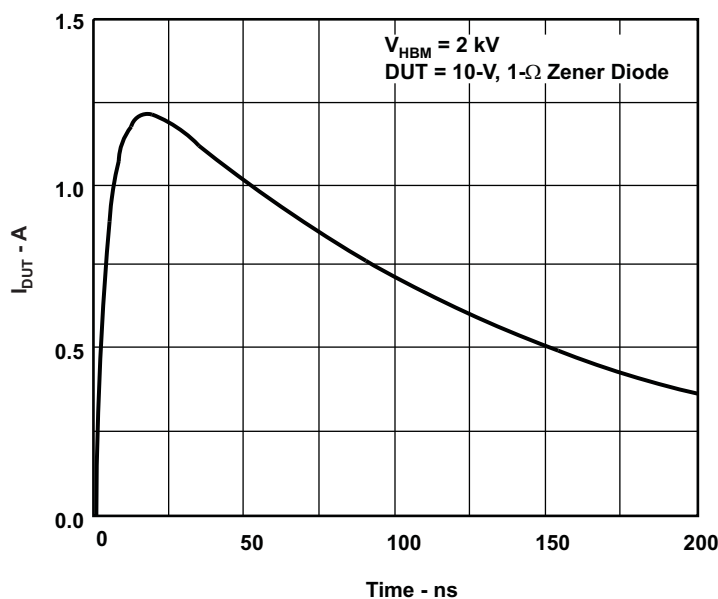


Figure 6. Typical HBM Current Waveform

### Machine Model (MM)

The MM ESD test applies to all pins using a 200-pF capacitor with no discharge resistance. The purpose of the MM test is to simulate possible ESD conditions that can occur during the handling and assembly processes of manufacturing. In this case, ESD protection is required for all pins, not just RS-232 pins. However, after PC board assembly, the MM test no longer is as pertinent to the RS-232 pins.



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| MAX202CD         | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDG4       | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDR        | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDRE4      | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDW        | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDWE4      | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDWG4      | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDWR       | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CDWRE4     | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MAX202C                 | <a href="#">Samples</a> |
| MAX202CPW        | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MA202C                  | <a href="#">Samples</a> |
| MAX202CPWG4      | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MA202C                  | <a href="#">Samples</a> |
| MAX202CPWR       | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | MA202C                  | <a href="#">Samples</a> |
| MAX202ID         | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDE4       | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDG4       | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDR        | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDRE4      | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| MAX202IDRG4      | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDW        | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDWG4      | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IDWR       | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MAX202I                 | <a href="#">Samples</a> |
| MAX202IPW        | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MB202I                  | <a href="#">Samples</a> |
| MAX202IPWG4      | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MB202I                  | <a href="#">Samples</a> |
| MAX202IPWR       | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MB202I                  | <a href="#">Samples</a> |
| MAX202IPWRE4     | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | MB202I                  | <a href="#">Samples</a> |

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

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

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

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

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

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

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

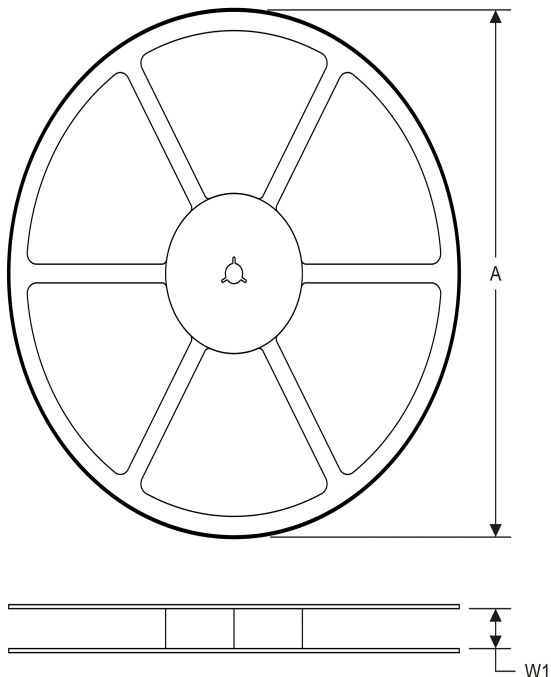
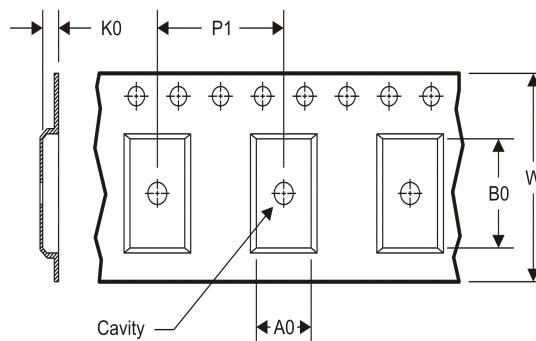
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

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

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**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


|    |   |
|----|---|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

**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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MAX202CDR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| MAX202CDWR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 12.0    | 16.0   | Q1            |
| MAX202CPWR | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| MAX202IDR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| MAX202IDWR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 12.0    | 16.0   | Q1            |
| MAX202IPWR | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

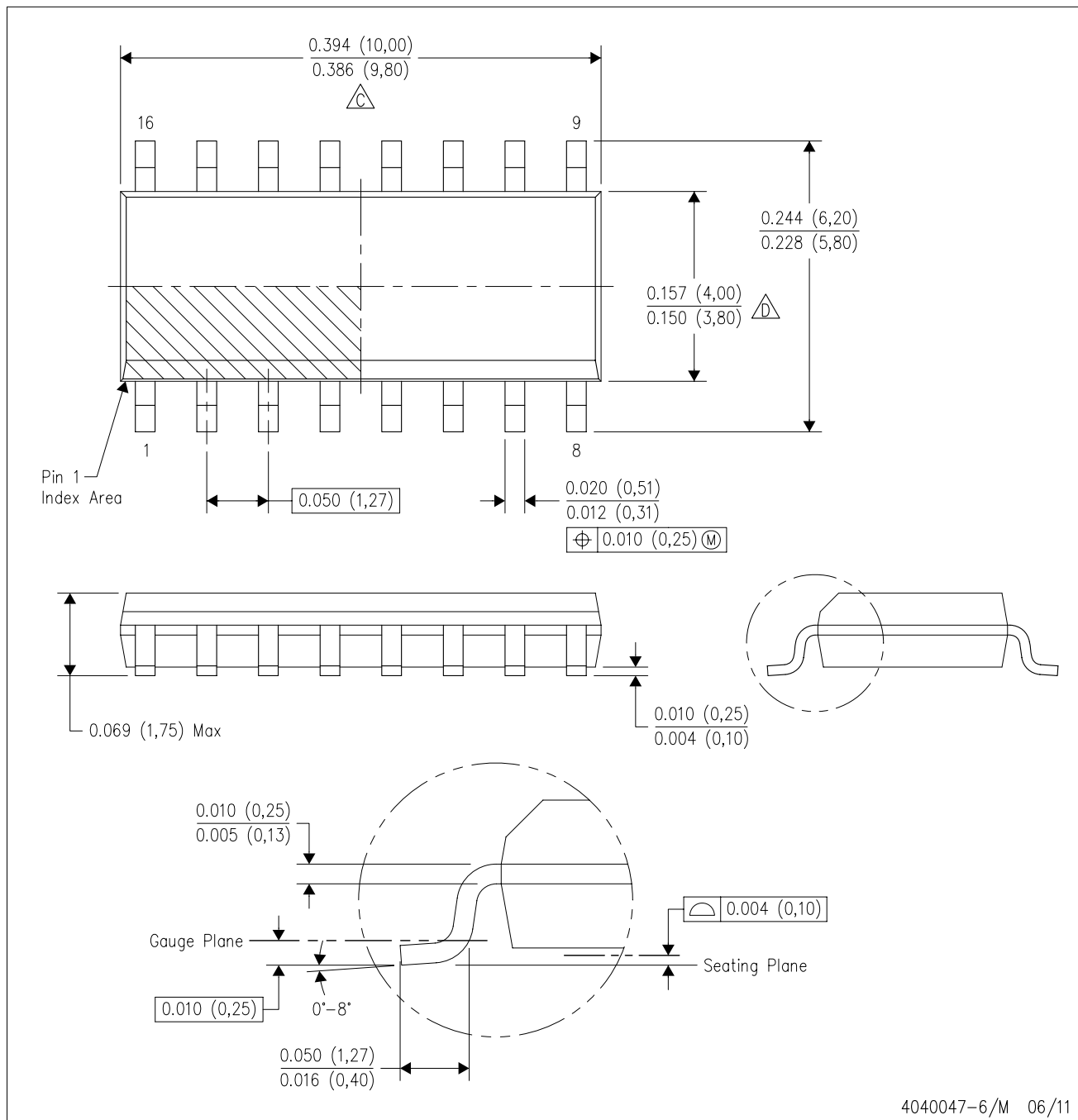


\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| MAX202CDR  | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| MAX202CDWR | SOIC         | DW              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| MAX202CPWR | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| MAX202IDR  | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| MAX202IDWR | SOIC         | DW              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| MAX202IPWR | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

NOTES:

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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040064-4/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153



PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

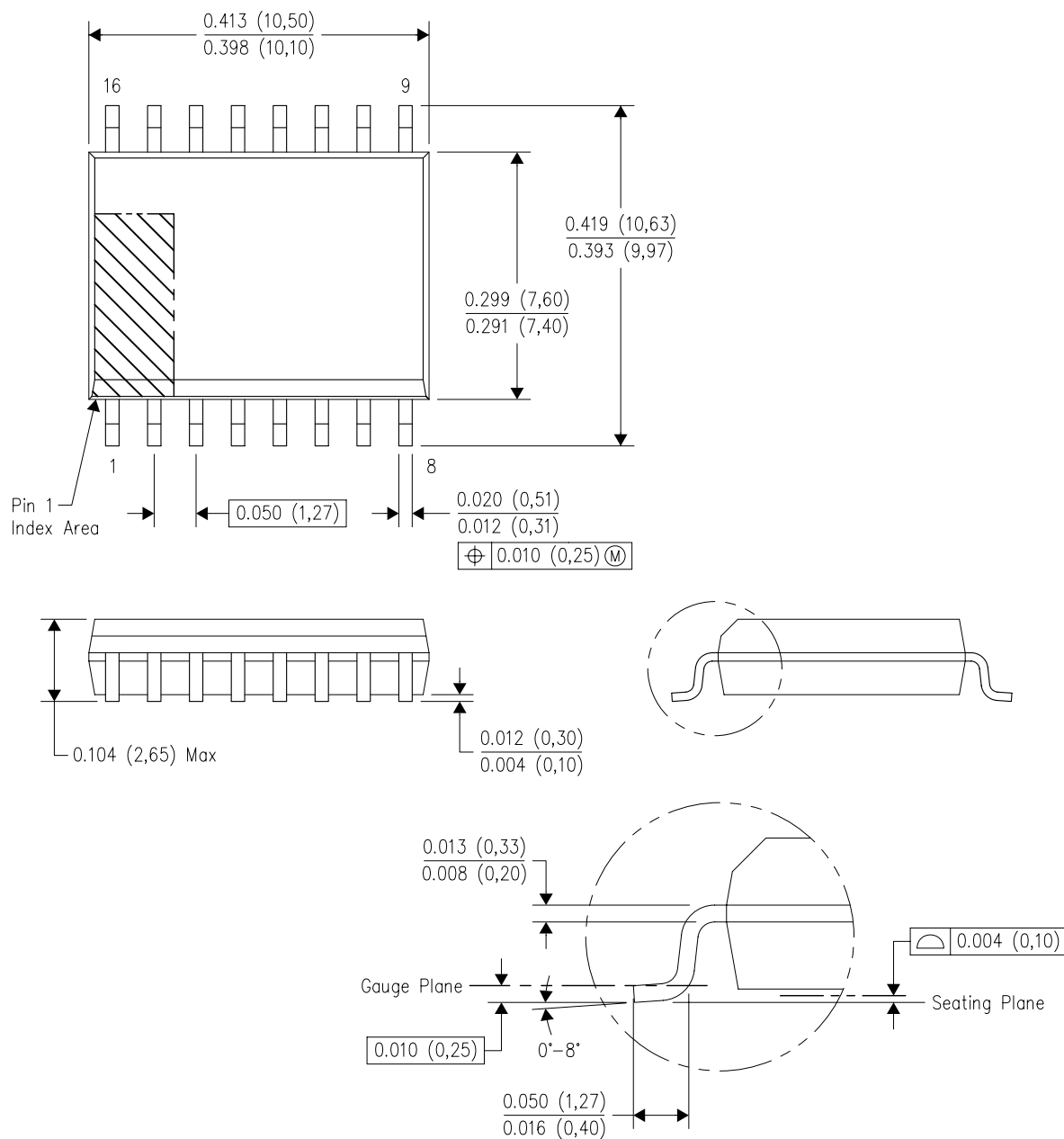


4211284-3/F 12/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DW (R-PDSO-G16)

## PLASTIC SMALL OUTLINE

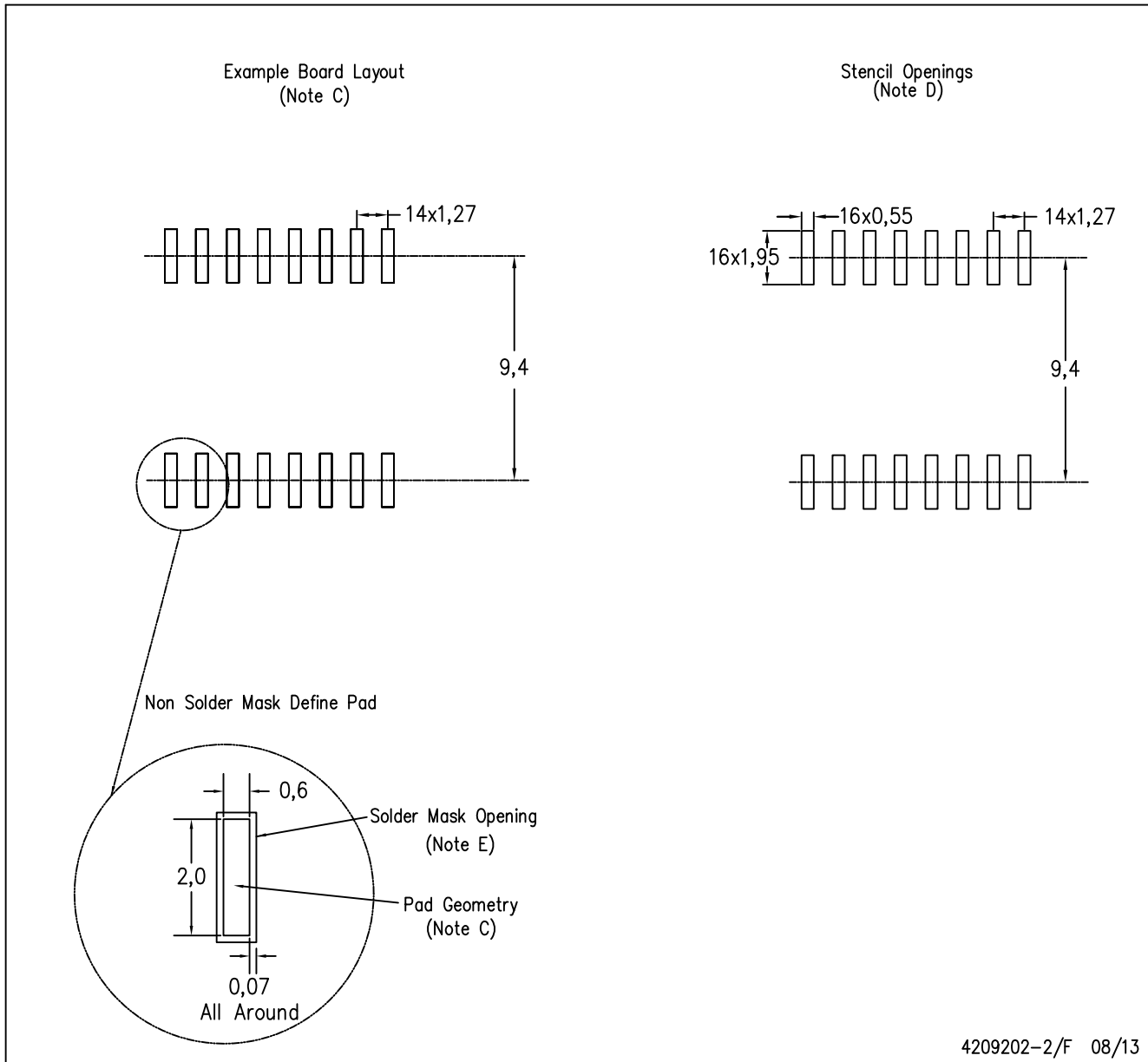


4040000-2/G 01/11

- NOTES: A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
D. Falls within JEDEC MS-013 variation AA.

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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