

## MAX202 具有 $\pm 15\text{kV}$ ESD 保护功能的 5V 双路 RS-232 线路驱动器和接收器

### 1 特性

- 符合或超出 TIA/EIA-232-F 和 ITU v.28 标准的要求
- 为 RS-232 总线引脚提供 ESD 保护： $\pm 15\text{kV}$  人体放电模型
- 由  $5\text{V } V_{\text{CC}}$  电源供电
- 速率高达  $120\text{kbit/s}$
- 两个驱动器和两个接收器
- 闩锁性能超过  $100\text{mA}$ ，符合 JESD 78 II 类规范的要求

### 2 应用

- 电池供电型系统
- 笔记本电脑
- 便携式计算机
- 掌上电脑
- 手持设备

### 3 说明

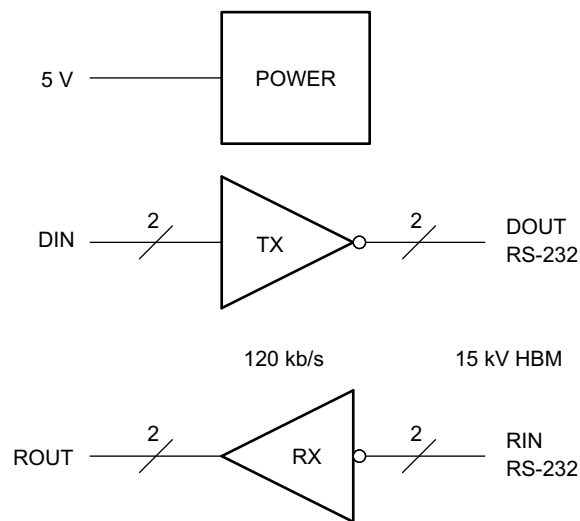
MAX202 器件由两个线路驱动器、两个线路接收器和一个双电荷泵电路组成，具有引脚对引脚（串行端口连接引脚，包括 GND） $\pm 15\text{kV}$  ESD 保护。该器件符合 TIA/EIA-232-F 的要求并在异步通信控制器与串行端口连接器之间提供电气接口。电荷泵和四个小型外部电容器支持由  $5\text{V}$  单电源供电。这些器件以高达  $120\text{kbit/s}$  的数据信号传输速率和最高  $30\text{V}/\mu\text{s}$  的驱动器输出压摆率运行。

#### 封装信息

| 器件型号   | 封装 <sup>(1)</sup>   | 封装尺寸 <sup>(2)</sup> |
|--------|---------------------|---------------------|
| MAX202 | SOIC (D) (16)       | 9.9mm x 6mm         |
|        | SOIC WIDE (DW) (16) | 10.4mm x 10.3mm     |
|        | TSSOP (PW) (16)     | 5mm x 6.4mm         |

(1) 如需更多信息，请参阅节 10。

(2) 封装尺寸（长 × 宽）为标称值，并包括引脚（如适用）。



Copyright © 2016, Texas Instruments Incorporated

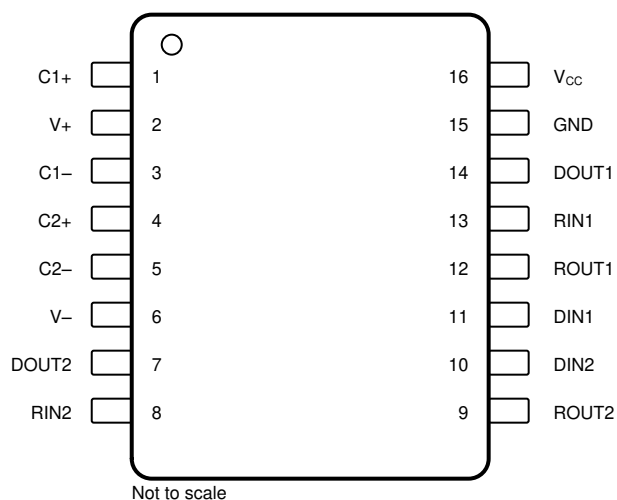
方框图



## Table of Contents

|                                                |          |                                                 |           |
|------------------------------------------------|----------|-------------------------------------------------|-----------|
| <b>1 特性</b> .....                              | <b>1</b> | 6.3 Feature Description.....                    | <b>9</b>  |
| <b>2 应用</b> .....                              | <b>1</b> | 6.4 Device Functional Modes.....                | <b>9</b>  |
| <b>3 说明</b> .....                              | <b>1</b> | <b>7 Application and Implementation</b> .....   | <b>11</b> |
| <b>4 Pin Configuration and Functions</b> ..... | <b>3</b> | 7.1 Application Information.....                | <b>11</b> |
| <b>5 Specifications</b> .....                  | <b>4</b> | 7.2 Typical Application.....                    | <b>11</b> |
| 5.1 Absolute Maximum Ratings.....              | <b>4</b> | 7.3 Power Supply Recommendations.....           | <b>13</b> |
| 5.2 ESD Ratings.....                           | <b>4</b> | 7.4 Layout.....                                 | <b>14</b> |
| 5.3 Recommended Operating Conditions.....      | <b>4</b> | <b>8 Device and Documentation Support</b> ..... | <b>15</b> |
| 5.4 Thermal Information.....                   | <b>4</b> | 8.1 接收文档更新通知.....                               | <b>15</b> |
| 5.5 Electrical Characteristics.....            | <b>5</b> | 8.2 支持资源.....                                   | <b>15</b> |
| 5.6 Switching Characteristics.....             | <b>5</b> | 8.3 Trademarks.....                             | <b>15</b> |
| 5.7 Typical Characteristics.....               | <b>6</b> | 8.4 静电放电警告.....                                 | <b>15</b> |
| <b>Parameter Measurement Information</b> ..... | <b>8</b> | 8.5 术语表.....                                    | <b>15</b> |
| <b>6 Detailed Description</b> .....            | <b>9</b> | <b>9 Revision History</b> .....                 | <b>15</b> |
| 6.1 Overview.....                              | <b>9</b> | <b>10 Mechanical, Packaging, and Orderable</b>  |           |
| 6.2 Functional Block Diagram.....              | <b>9</b> | <b>Information</b> .....                        | <b>15</b> |

## 4 Pin Configuration and Functions



**图 4-1. D, DW, or PW Package, 16-Pin SOIC or TSSOP  
(Top View)**

**表 4-1. Pin Functions**

| PIN |                 | TYPE | DESCRIPTION                                            |
|-----|-----------------|------|--------------------------------------------------------|
| NO. | NAME            |      |                                                        |
| 1   | C1+             | —    | Positive lead of C1 capacitor                          |
| 2   | V+              | O    | Positive charge pump output for storage capacitor only |
| 3   | C1 -            | —    | Negative lead of C1 capacitor                          |
| 4   | C2+             | —    | Positive lead of C2 capacitor                          |
| 5   | C2 -            | —    | Negative lead of C2 capacitor                          |
| 6   | V -             | O    | Negative charge pump output for storage capacitor only |
| 7   | DOUT2           | O    | RS-232 line data output (to remote RS-232 system)      |
| 8   | RIN2            | I    | RS-232 line data input (from remote RS-232 system)     |
| 9   | ROUT2           | O    | Logic data output (to UART)                            |
| 10  | DIN2            | I    | Logic data input (from UART)                           |
| 11  | DIN1            | I    | Logic data input (from UART)                           |
| 12  | ROUT1           | O    | Logic data output (to UART)                            |
| 13  | RIN1            | I    | RS-232 line data input (from remote RS-232 system)     |
| 14  | DOUT1           | O    | RS-232 line data output (to remote RS-232 system)      |
| 15  | GND             | —    | Ground                                                 |
| 16  | V <sub>CC</sub> | —    | Supply voltage, connect to external 5V power supply    |

## 5 Specifications

### 5.1 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>           |           | - 0.3          | 6              | V    |
| Positive charge pump voltage, $V+$ <sup>(2)</sup> |           | $V_{CC} - 0.3$ | 14             | V    |
| Negative charge pump voltage, $V-$ <sup>(2)</sup> |           | - 14           | 0.3            | V    |
| Input voltage, $V_I$                              | Drivers   | - 0.3          | $V+ + 0.3$     | V    |
|                                                   | Receivers |                | $\pm 30$       |      |
| Output voltage, $V_O$                             | Drivers   | $V- - 0.3$     | $V+ + 0.3$     | V    |
|                                                   | Receivers | - 0.3          | $V_{CC} + 0.3$ |      |
| Short-circuit duration, $D_{OUT}$                 |           | Continuous     |                |      |
| Operating junction temperature, $T_J$             |           |                | 150            | °C   |
| Storage temperature, $T_{stg}$                    |           | - 65           | 150            | °C   |

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

### 5.2 ESD Ratings

|                                     |                                                                                |                       | VALUE       | UNIT |
|-------------------------------------|--------------------------------------------------------------------------------|-----------------------|-------------|------|
| $V_{(ESD)}$ Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | Pins 7, 8, 13, and 14 | $\pm 15000$ | V    |
|                                     |                                                                                | All other pins        | $\pm 2000$  |      |
|                                     | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> |                       | $\pm 1500$  |      |

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

### 5.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>; see 图 7-1)

|                |                                              | 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  $V_{CC} = 5V \pm 0.5V$ .

### 5.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                            | D (SOIC) | DW (SOIC) | PW (TSSOP) | UNIT |
|-------------------------------|--------------------------------------------|----------|-----------|------------|------|
|                               |                                            | 16 PINS  | 16 PINS   | 16 PINS    |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance     | 84.6     | 71.7      | 107.5      | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance  | 43.5     | 37.6      | 38.4       | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance       | 43.2     | 36.8      | 53.7       | °C/W |
| $\psi_{JT}$                   | Junction-to-top characterization parameter | 10.4     | 13.       | 3.2        | °C/W |

## 5.4 Thermal Information (续)

| THERMAL METRIC <sup>(1)</sup>                            | D (SOIC) | DW (SOIC) | PW (TSSOP) | UNIT |
|----------------------------------------------------------|----------|-----------|------------|------|
|                                                          | 16 PINS  | 16 PINS   | 16 PINS    |      |
| $\psi_{JB}$ Junction-to-board characterization parameter | 42.8     | 36.4      | 53.1       | °C/W |

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

## 5.5 Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted; see [图 7-1](#))<sup>(1)</sup>

| PARAMETER                                            | TEST CONDITIONS                                         | MIN | TYP <sup>(2)</sup> | MAX      | UNIT       |
|------------------------------------------------------|---------------------------------------------------------|-----|--------------------|----------|------------|
| $I_{CC}$ Supply current                              | No load, $V_{CC} = 5V$                                  |     | 8                  | 15       | mA         |
| <b>DRIVER SECTION</b>                                |                                                         |     |                    |          |            |
| $V_{OH}$ High-level output voltage                   | $D_{OUT}$ at $R_L = 3k\Omega$ to GND, $D_{IN} = GND$    | 5   | 9                  |          | V          |
| $V_{OL}$ Low-level output voltage                    | $D_{OUT}$ at $R_L = 3k\Omega$ to GND, $D_{IN} = V_{CC}$ | - 5 | - 9                |          | V          |
| $I_{IH}$ High-level input current                    | $V_I = V_{CC}$                                          |     | 0                  | 200      | $\mu A$    |
| $I_{IL}$ Low-level input current                     | $V_I$ at 0V                                             |     | 0                  | - 200    | $\mu A$    |
| $I_{OS}$ <sup>(3)</sup> Short-circuit output current | $V_{CC} = 5.5V$ , $V_O = 0V$                            |     | $\pm 10$           | $\pm 60$ | mA         |
| $r_O$ Output resistance                              | $V_{CC}$ , $V+$ , and $V- = 0V$ , $V_O = \pm 2V$        | 300 |                    |          | $\Omega$   |
| <b>RECEIVER SECTION</b>                              |                                                         |     |                    |          |            |
| $V_{OH}$ High-level output voltage                   | $I_{OH} = - 1mA$                                        | 3.5 | $V_{CC} - 0.4$     |          | V          |
| $V_{OL}$ Low-level output voltage                    | $I_{OL} = 1.6mA$                                        |     |                    | 0.4      | V          |
| $V_{IT+}$ Positive-going input threshold voltage     | $V_{CC} = 5V$ , $T_A = 25^\circ C$                      |     | 1.7                | 2.4      | V          |
| $V_{IT-}$ Negative-going input threshold voltage     | $V_{CC} = 5V$ , $T_A = 25^\circ C$                      | 0.8 | 1.2                |          | V          |
| $V_{hys}$ Input hysteresis ( $V_{IT+} - V_{IT-}$ )   |                                                         | 0.2 | 0.5                | 1        | V          |
| $r_i$ Input resistance                               | $V_I = \pm 3V$ to $\pm 25V$                             | 3   | 5                  | 7        | k $\Omega$ |

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

## 5.6 Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted; see [图 7-1](#))<sup>(1)</sup>

| PARAMETER                                                         | TEST CONDITIONS                                                                                                 | MIN | TYP <sup>(2)</sup> | MAX | UNIT       |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----|--------------------|-----|------------|
| <b>DRIVER SECTION</b>                                             |                                                                                                                 |     |                    |     |            |
| Maximum data rate                                                 | $C_L = 50pF$ to $1000pF$ , $R_L = 3k\Omega$ to $7k\Omega$<br>one $D_{OUT}$ switching, see <a href="#">图 6-1</a> | 120 |                    |     | kbit/s     |
| $t_{PLH(D)}$ Propagation delay time,<br>low- to high-level output | $C_L = 2500pF$ , $R_L = 3k\Omega$ , all drivers loaded,<br>see <a href="#">图 6-1</a>                            |     | 2                  |     | $\mu s$    |
| $t_{PHL(D)}$ Propagation delay time,<br>high- to low-level output | $C_L = 2500pF$ , $R_L = 3k\Omega$ , all drivers loaded,<br>see <a href="#">图 6-1</a>                            |     | 2                  |     | $\mu s$    |
| $t_{sk(p)}$ Pulse skew <sup>(3)</sup>                             | $C_L = 150$ to $2500pF$ , $R_L = 3k\Omega$ to $7k\Omega$ ,<br>see <a href="#">图 6-2</a>                         |     | 300                |     | ns         |
| SR(tr) Slew rate, transition region                               | $C_L = 50$ to $1000pF$ , $R_L = 3k\Omega$ to $7k\Omega$ ,<br>$V_{CC} = 5V$ , see <a href="#">图 6-1</a>          | 3   | 6                  | 30  | V/ $\mu s$ |
| <b>RECEIVER SECTION (SEE <a href="#">图 6-3</a>)</b>               |                                                                                                                 |     |                    |     |            |
| $t_{PLH(R)}$ Propagation delay time,<br>low- to high-level output | $C_L = 150pF$                                                                                                   |     | 0.5                | 10  | $\mu s$    |
| $t_{PHL(R)}$ Propagation delay time,<br>high- to low-level output | $C_L = 150pF$                                                                                                   |     | 0.5                | 10  | $\mu s$    |

5.6 Switching Characteristics ( 续 )

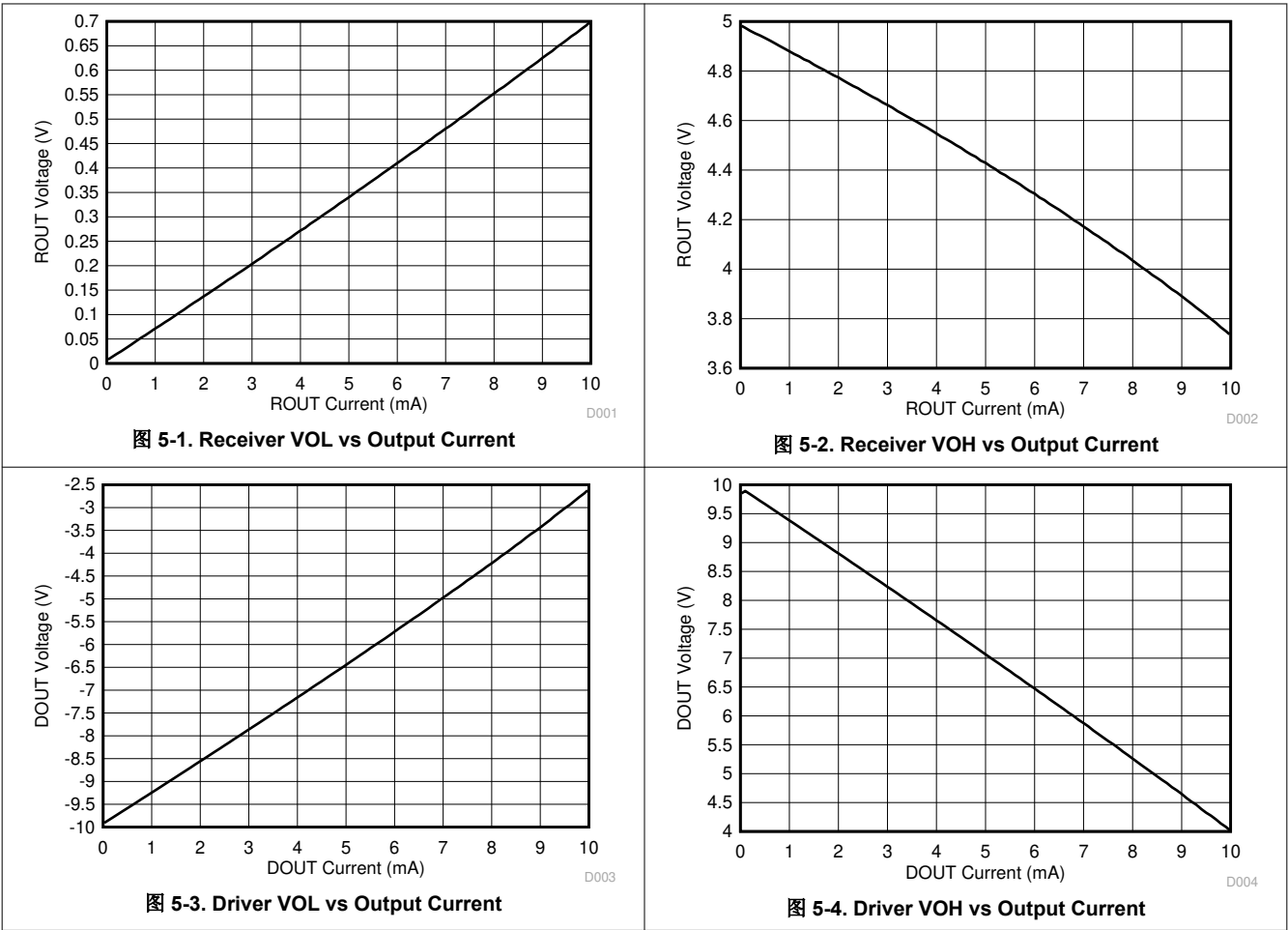
over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted; see 图 7-1)<sup>(1)</sup>

| PARAMETER   |                           | TEST CONDITIONS      | MIN | TYP <sup>(2)</sup> | MAX | UNIT |
|-------------|---------------------------|----------------------|-----|--------------------|-----|------|
| $t_{sk(p)}$ | Pulse skew <sup>(3)</sup> | $C_L = 150\text{pF}$ |     | 300                |     | ns   |

- (1) Test conditions are  $C_1 - C_4 = 0.1\mu\text{F}$  at  $V_{CC} = 5\text{V} \pm 0.5\text{V}$ .  
(2) All typical values are at  $V_{CC} = 5\text{V}$ , and  $T_A = 25^\circ\text{C}$ .  
(3) Pulse skew is defined as  $|t_{PLH} - t_{PHL}|$  of each channel of the same device.

5.7 Typical Characteristics

at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)



## 5.7 Typical Characteristics (continued)

at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

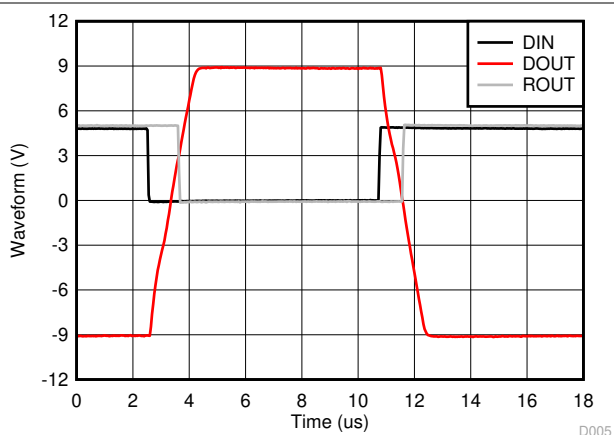
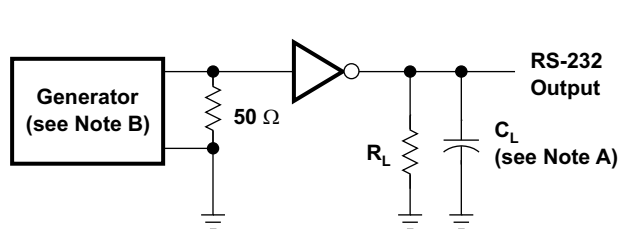


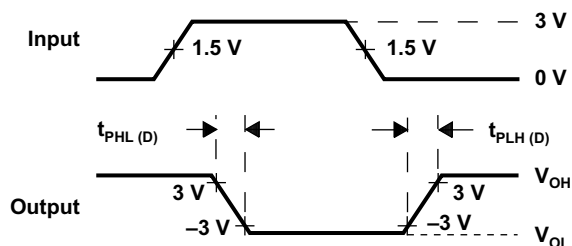
图 5-5. Driver and Receiver Loopback Waveforms

## Parameter Measurement Information



TEST CIRCUIT

$$SR(tf) = \frac{6\text{ V}}{t_{PHL(D)} \text{ or } t_{PLH(D)}}$$

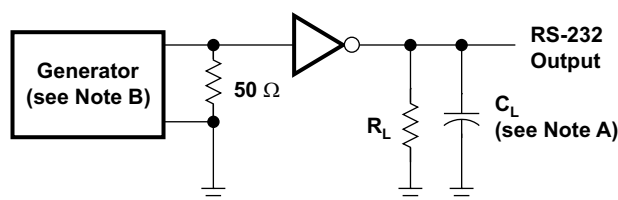


VOLTAGE WAVEFORMS

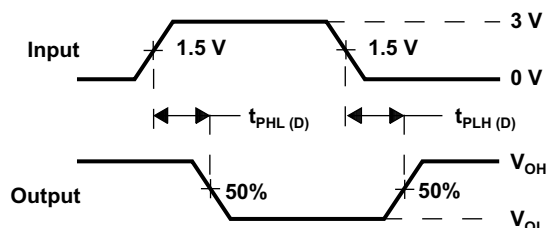
A.  $C_L$  includes probe and jig capacitance.

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

图 6-1. Driver Slew Rate



TEST CIRCUIT

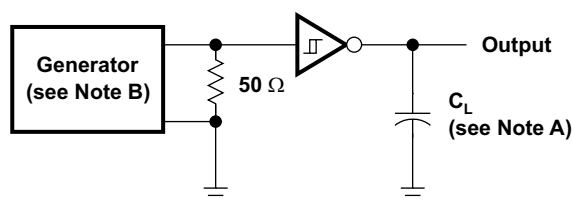


VOLTAGE WAVEFORMS

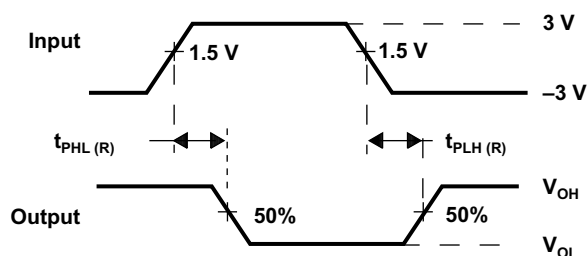
A.  $C_L$  includes probe and jig capacitance.

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

图 6-2. Driver Pulse Skew



TEST CIRCUIT



VOLTAGE WAVEFORMS

A.  $C_L$  includes probe and jig capacitance.

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

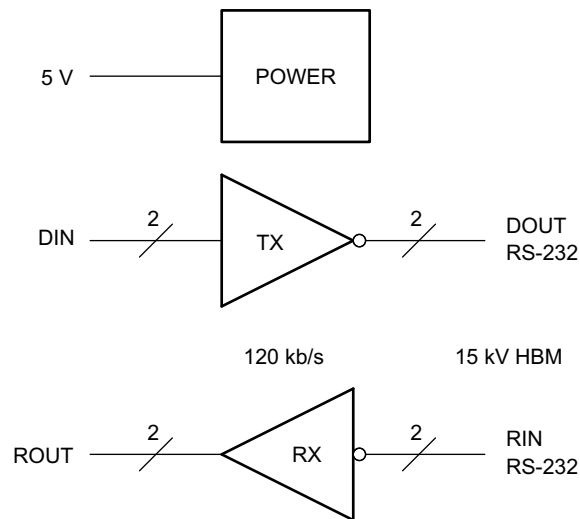
图 6-3. Receiver Propagation Delay Times

## 6 Detailed Description

### 6.1 Overview

The MAX202 is a dual driver and receiver that includes a capacitive voltage generator using four capacitors to supply TIA/EIA-232-F voltage levels from a single 5V supply. Each receiver converts TIA/EIA-232-F inputs to 5V TTL/CMOS levels. These receivers have shorted and open fail safe. The receiver can accept up to  $\pm 30\text{V}$  inputs and decode inputs as low as  $\pm 3\text{V}$ . Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels. Outputs are protected against shorts to ground.

### 6.2 Functional Block Diagram



Copyright © 2016, Texas Instruments Incorporated

### 6.3 Feature Description

#### 6.3.1 Power

The power block increases and inverts the 5V supply for the RS-232 driver using a charge pump that requires four 0.1 $\mu\text{F}$  external capacitors.

#### 6.3.2 RS-232 Driver

Two drivers interface standard logic levels to RS-232 levels. The driver inputs do not have internal pullup resistors. Do not float the driver inputs.

#### 6.3.3 RS-232 Receiver

Two Schmitt trigger receivers interface RS-232 levels to standard logic levels. Each receiver has an internal 5-k $\Omega$  load to ground. An open input results in a high output on ROUT.

### 6.4 Device Functional Modes

#### 6.4.1 V<sub>CC</sub> Powered by 5V

The device is in normal operation when powered by 5V.

#### 6.4.2 V<sub>CC</sub> Unpowered

When MAX202 is unpowered, it can be safely connected to an active remote RS-232 device.

6.4.3 Truth Tables

表 6-1 和 表 6-2 list the function for each driver and receiver (respectively).

表 6-1. Function Table for Each Driver

| INPUT<br>DIN <sup>(1)</sup> | OUTPUT<br>DOUT |
|-----------------------------|----------------|
| L                           | H              |
| H                           | L              |

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

表 6-2. Function Table for Each Receiver

| INPUT<br>RIN <sup>(1)</sup> | OUTPUT<br>ROUT |
|-----------------------------|----------------|
| L                           | H              |
| H                           | L              |
| Open                        | H              |

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

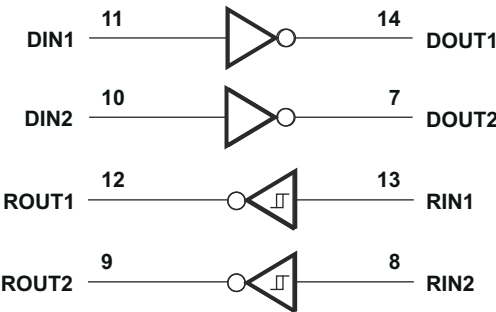


图 6-1. Logic Diagram (Positive Logic)

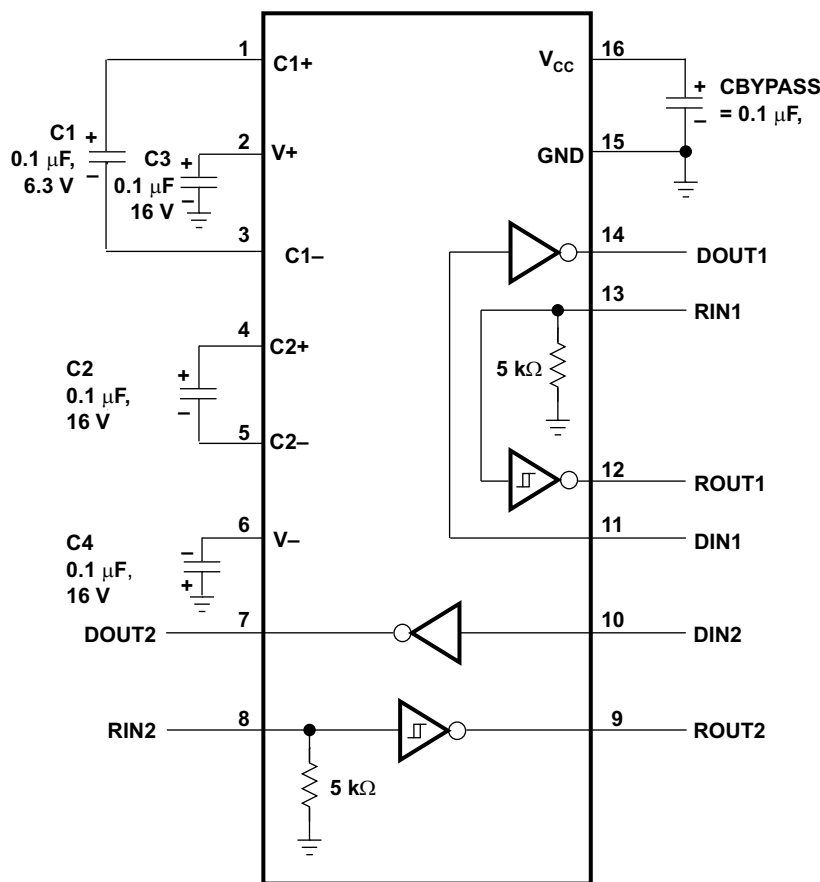
备注

以下应用部分中的信息不属于 TI 器件规格的范围, TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计, 以确保系统功能。

## 7.1 Application Information

For proper operation, add capacitors as shown in [Figure 7-1](#). Pins 9 through 12 connect to UART or general purpose logic lines. RS-232 lines on pins 7, 8, 13, and 14 connect to a connector or cable.

## 7.2 Typical Application



Copyright © 2016, Texas Instruments Incorporated

- A. C3 can be connected to  $V_{CC}$  or GND.
- B. Resistor values shown are nominal.
- C. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they must be connected as shown.

**图 7-1. Typical Operating Circuit and Capacitor Values**

### 7.2.1 Design Requirements

- $V_{CC}$  minimum is 4.5V and maximum is 5.5V.
- Maximum recommended bit rate is 120kbps.

## 7.2.2 Detailed Design Procedure

### 7.2.2.1 Capacitor Selection

The capacitor type used for C1 through C4 is not critical for proper operation. The MAX202 requires 0.1 $\mu$ F capacitors. Capacitors up to 10 $\mu$ F can be used without harm. Ceramic dielectrics are suggested for the 0.1 $\mu$ F 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 (for example, 2 $\times$ ) 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 $\mu$ F) to reduce the output impedance at V+ and V-.

Bypass V<sub>CC</sub> to ground with at least 0.1 $\mu$ F. In applications sensitive to power-supply noise generated by the charge pumps, decouple V<sub>CC</sub> to ground with a capacitor the same size as (or larger than) the charge-pump capacitors (C1 to C4).

### 7.2.2.2 ESD Protection

MAX202 devices have standard ESD protection structures incorporated on all pins to protect against electrostatic discharges encountered during assembly and handling. In addition, the RS-232 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.

### 7.2.2.3 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.

### 7.2.2.4 Human-Body Model (HBM)

The HBM of ESD testing is shown in 图 7-2. 图 7-3 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.

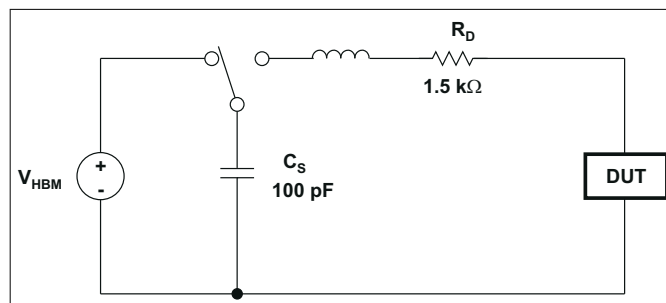


图 7-2. HBM ESD Test Circuit

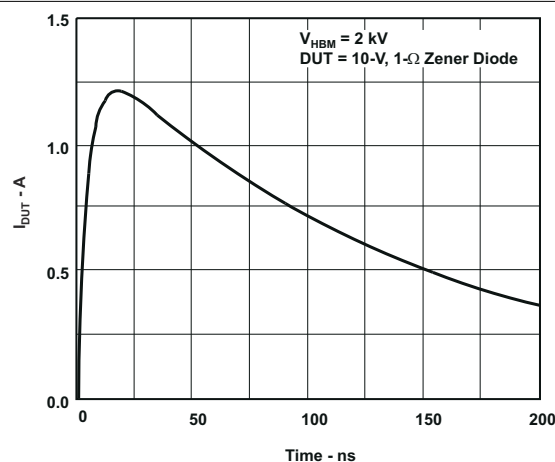


图 7-3. Typical HBM Current Waveform

### 7.2.3 Application Curve

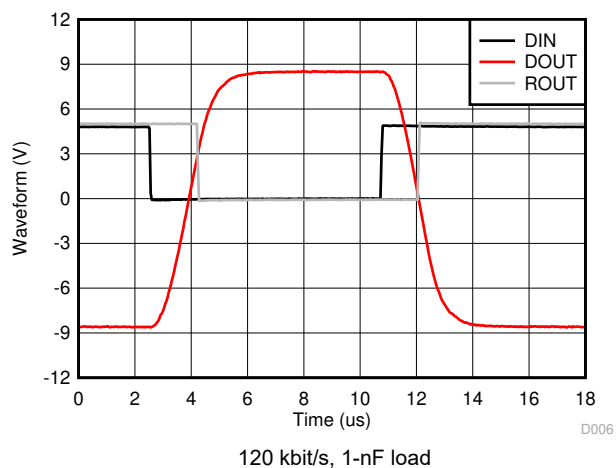


图 7-4. Driver and Receiver Loopback Signal

### 7.3 Power Supply Recommendations

The  $V_{CC}$  voltage must be connected to the same power source used for logic device connected to DIN and ROUT pins.  $V_{CC}$  must be between 4.5 V and 5.5 V.

## 7.4 Layout

### 7.4.1 Layout Guidelines

Keep the external capacitor traces short. This is more important on C1 and C2 nodes that have the fastest rise and fall times. For best ESD performance, make the impedance from MAX202 ground pin to the ground plane of the circuit board as low as possible. Use wide metal and multiple vias on both sides of ground pin.

### 7.4.2 Layout Example

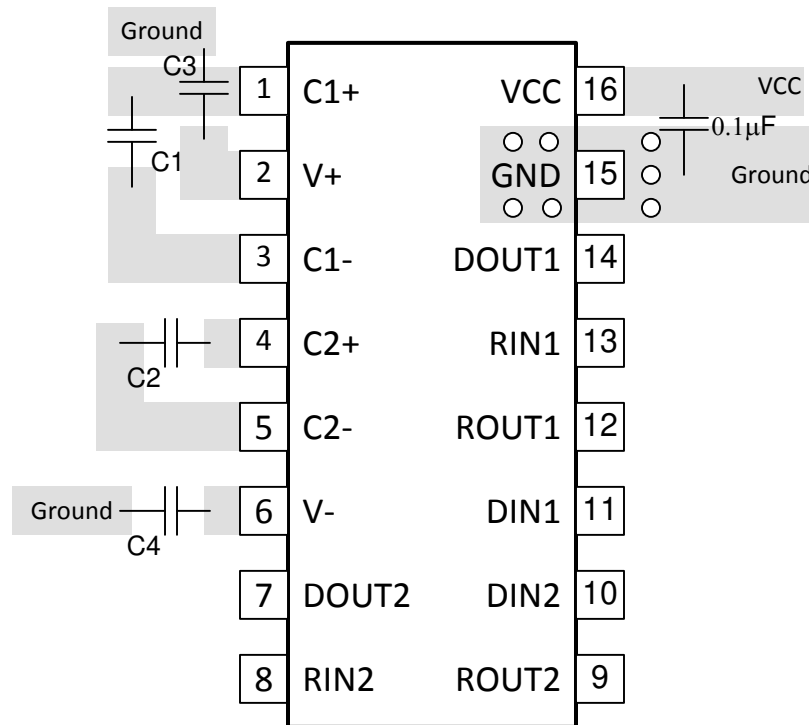


图 7-5. MAX202 Circuit Board Layout

## 8 Device and Documentation Support

### 8.1 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](https://ti.com) 上的器件产品文件夹。点击 [订阅更新](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 8.2 支持资源

**TI E2E™ 支持论坛**是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《[使用条款](#)》。

### 8.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

### 8.4 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 8.5 术语表

**TI 术语表** 本术语表列出并解释了术语、首字母缩略词和定义。

## 9 Revision History

注：以前版本的页码可能与当前版本的页码不同

| Changes from Revision F (September 2016) to Revision G (February 2024) | Page |
|------------------------------------------------------------------------|------|
| • 更改了 <i>封装信息</i> 表.....                                               | 1    |
| • Changed values in the <i>Thermal Information</i> table.....          | 4    |

| Changes from Revision E (April 2007) to Revision F (September 2016)                         | Page |
|---------------------------------------------------------------------------------------------|------|
| • 添加了 <i>ESD</i> 等级表、特性说明部分、器件功能模式、应用和实现部分、电源相关建议部分、布局部分、器件和文档支持部分以及机械、封装和可订购信息部分.....      | 1    |
| • 删除了 <i>订购信息</i> 表；请参阅数据表末尾的 POA.....                                                      | 1    |
| • Changed values in the <i>Thermal Information</i> table to align with JEDEC standards..... | 4    |

## 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="#">MAX202CD</a>   | Obsolete      | Production           | SOIC (D)   16   | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | MAX202C             |
| <a href="#">MAX202CDR</a>  | Obsolete      | Production           | SOIC (D)   16   | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | MAX202C             |
| <a href="#">MAX202CDW</a>  | Obsolete      | Production           | SOIC (DW)   16  | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | MAX202C             |
| <a href="#">MAX202CDWR</a> | Obsolete      | Production           | SOIC (DW)   16  | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | MAX202C             |
| <a href="#">MAX202CPW</a>  | Obsolete      | Production           | TSSOP (PW)   16 | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | MA202C              |
| <a href="#">MAX202CPWR</a> | Obsolete      | Production           | TSSOP (PW)   16 | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | MA202C              |
| <a href="#">MAX202ID</a>   | Obsolete      | Production           | SOIC (D)   16   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | MAX202I             |
| <a href="#">MAX202IDR</a>  | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MAX202I             |
| MAX202IDR.A                | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MAX202I             |
| MAX202IDRE4                | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MAX202I             |
| <a href="#">MAX202IDW</a>  | Obsolete      | Production           | SOIC (DW)   16  | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | MAX202I             |
| <a href="#">MAX202IDWR</a> | Active        | Production           | SOIC (DW)   16  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MAX202I             |
| MAX202IDWR.A               | Active        | Production           | SOIC (DW)   16  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MAX202I             |
| <a href="#">MAX202IPW</a>  | Obsolete      | Production           | TSSOP (PW)   16 | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | MB202I              |
| <a href="#">MAX202IPWR</a> | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | MB202I              |
| MAX202IPWR.A               | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | MB202I              |

<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.

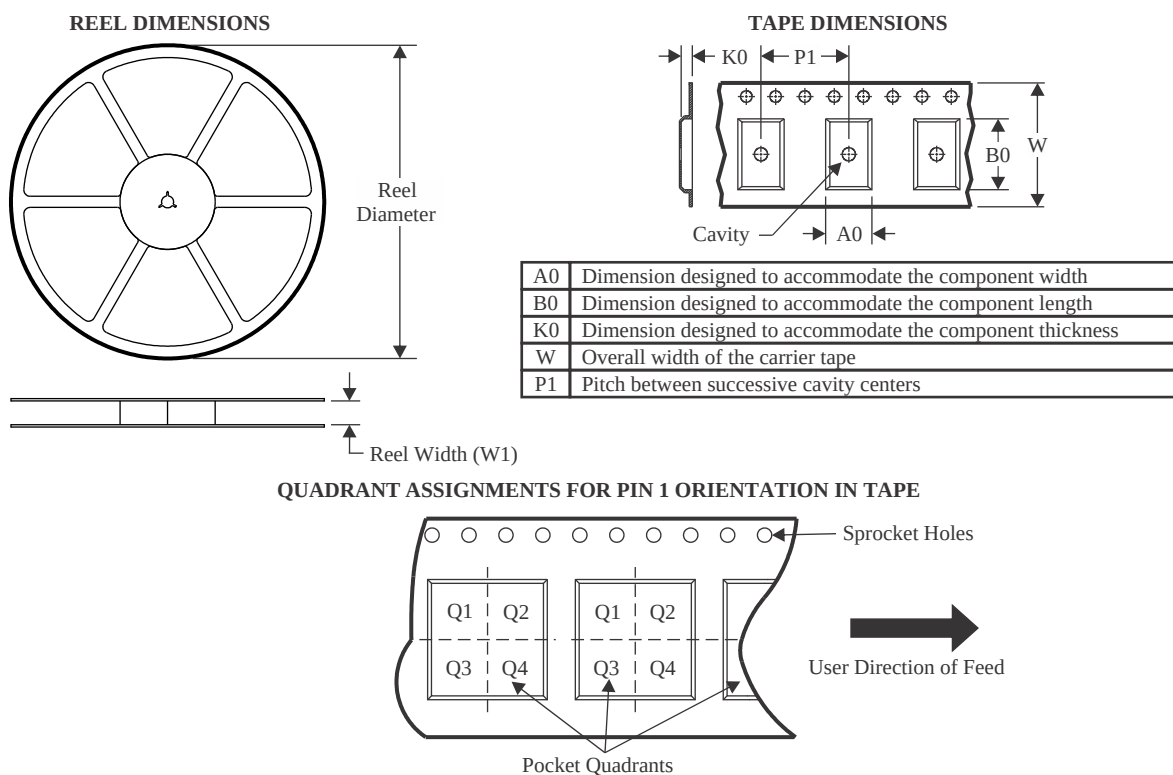
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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.

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

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

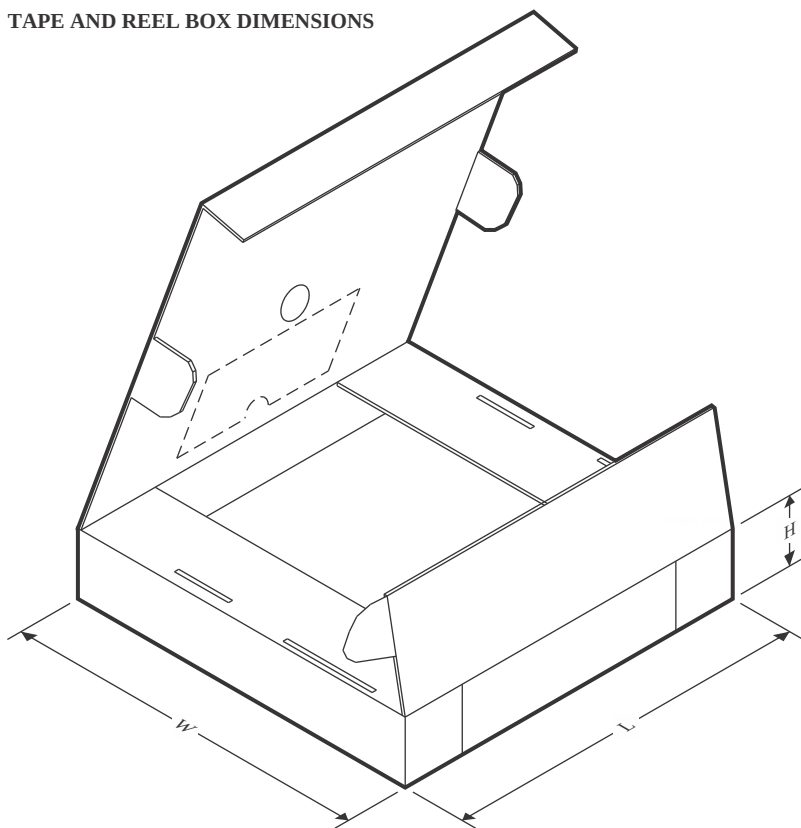
## TAPE AND REEL INFORMATION



\*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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MAX202IDR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | 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            |
| 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

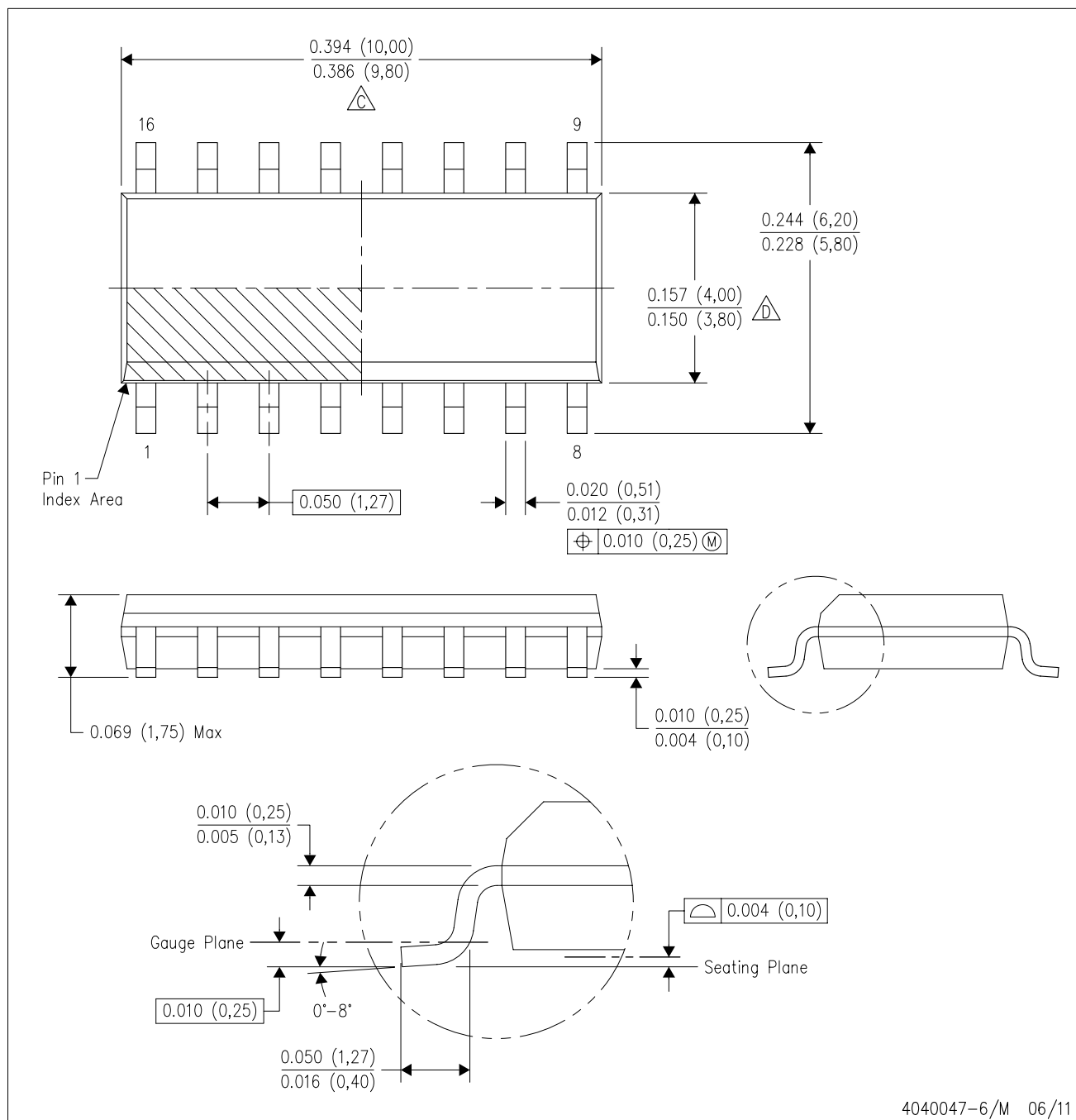


\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| MAX202IDR  | SOIC         | D               | 16   | 2500 | 353.0       | 353.0      | 32.0        |
| MAX202IDR  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| MAX202IDWR | SOIC         | DW              | 16   | 2000 | 350.0       | 350.0      | 43.0        |
| MAX202IPWR | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| MAX202IPWR | TSSOP        | PW              | 16   | 2000 | 353.0       | 353.0      | 32.0        |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



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.

## GENERIC PACKAGE VIEW

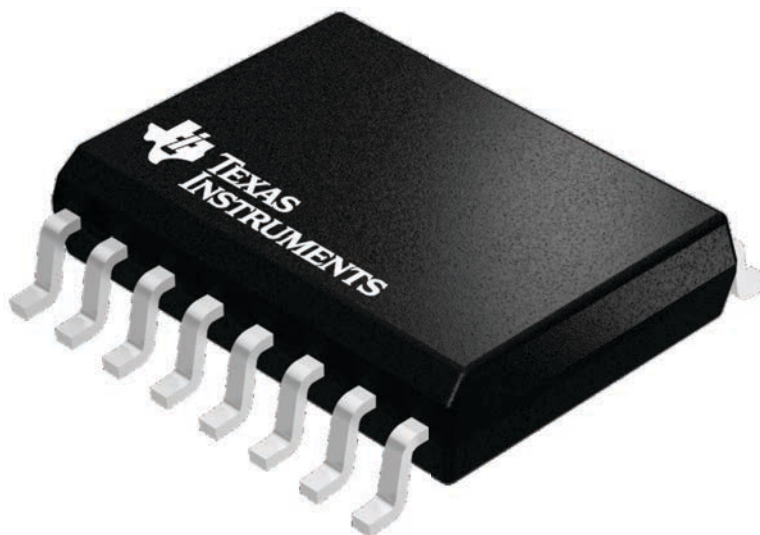
**DW 16**

**SOIC - 2.65 mm max height**

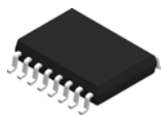
7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

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



4224780/A

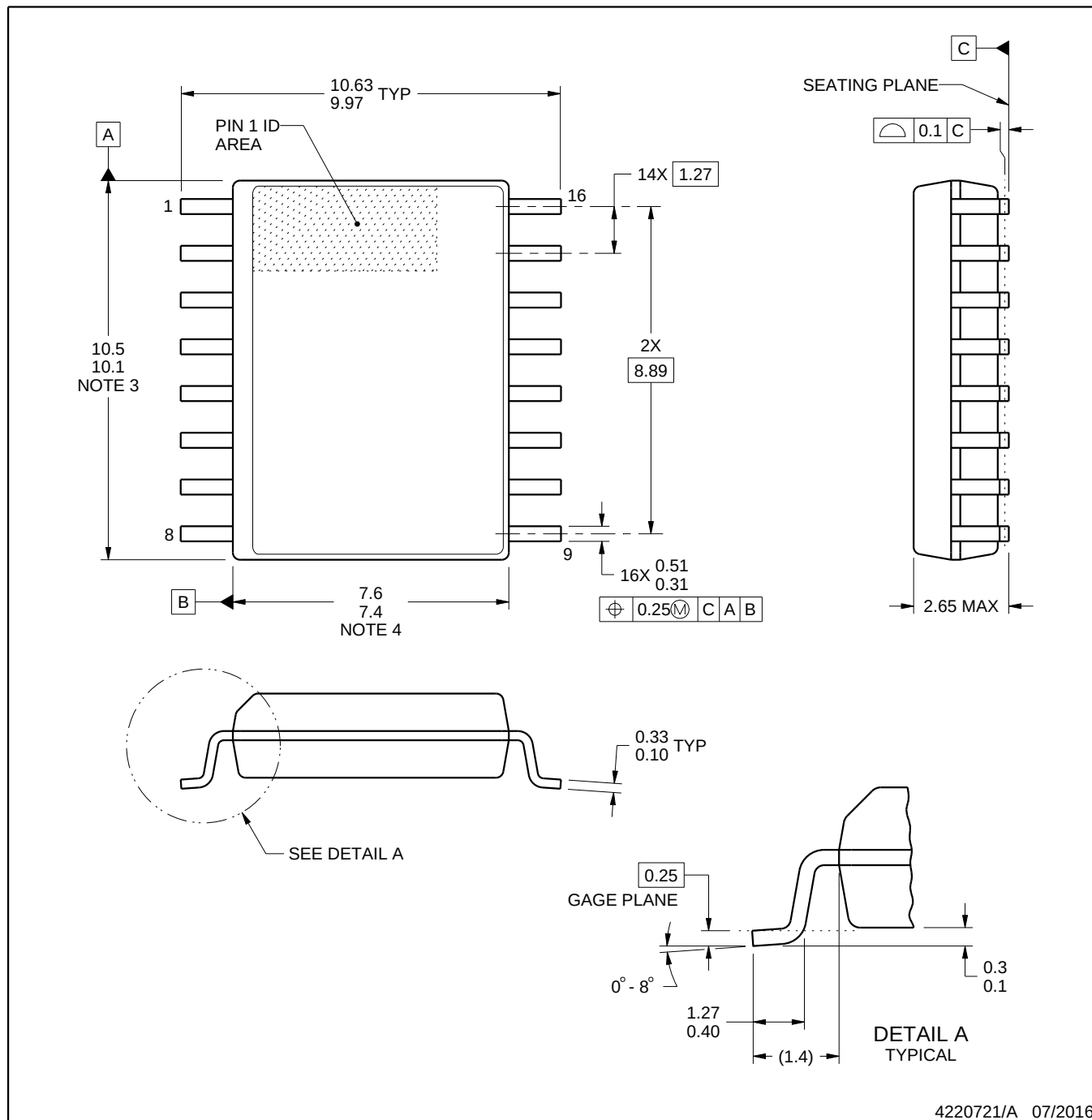


DW0016A

# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

### NOTES:

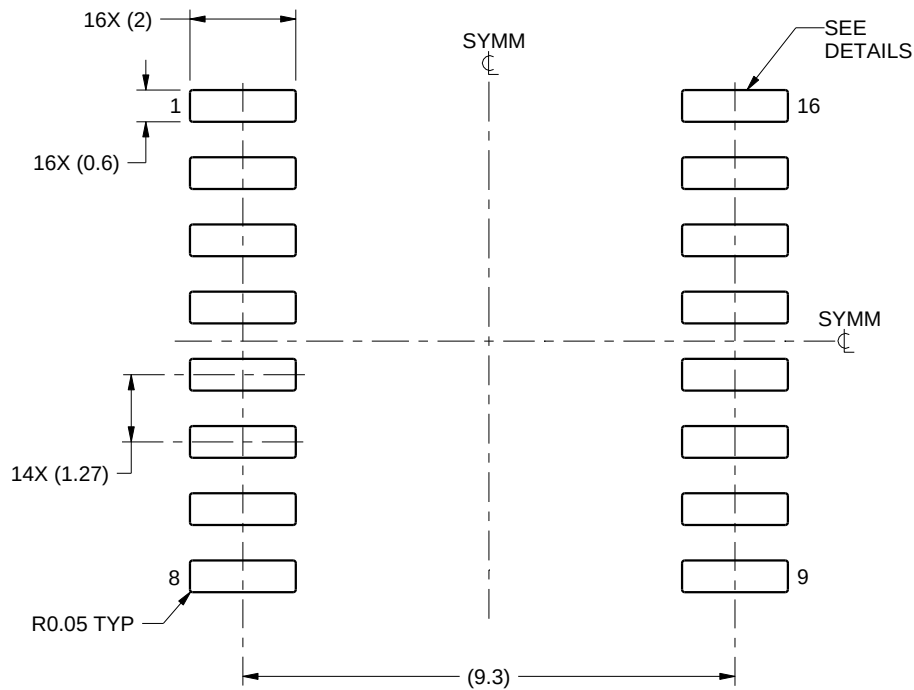
- All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.
- Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

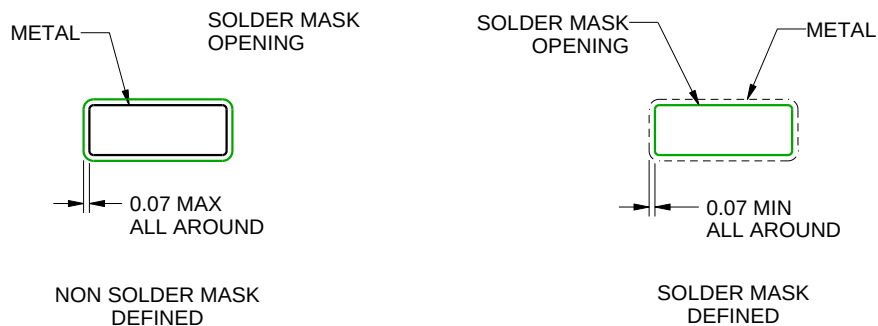
DW0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:7X



SOLDER MASK DETAILS

4220721/A 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

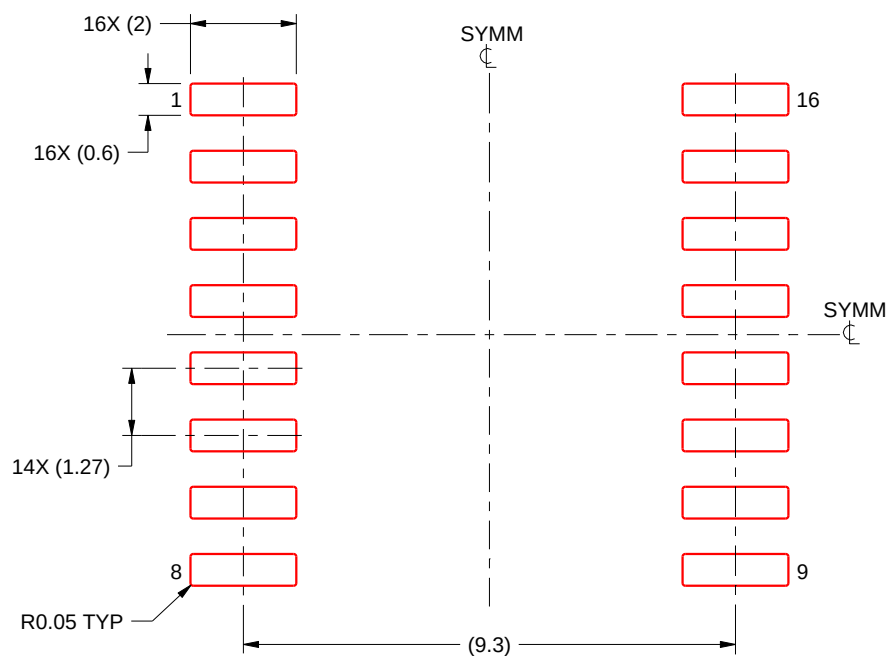
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0016A

SOIC - 2.65 mm max height

SOIC

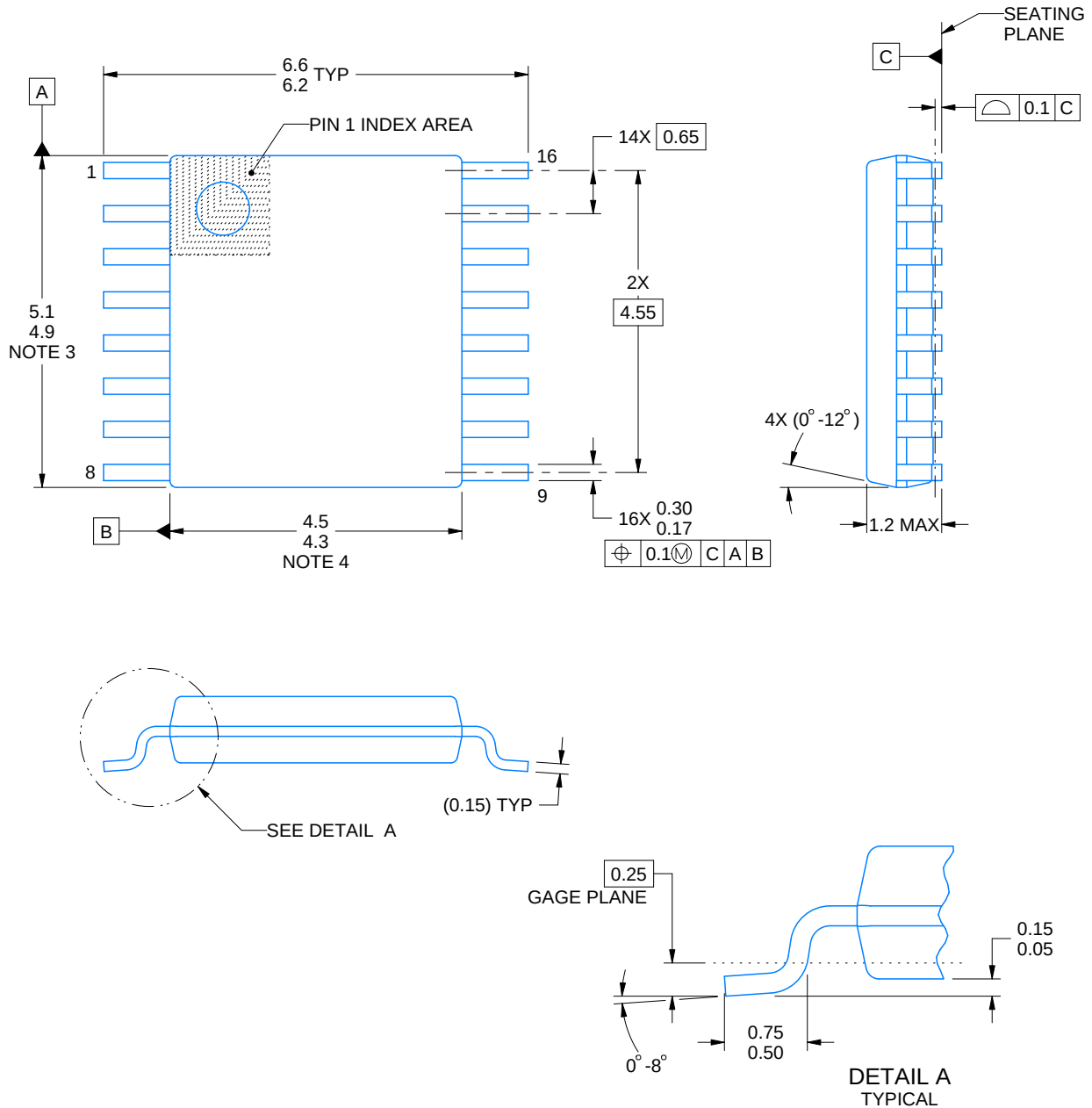
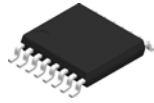


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220721/A 07/2016

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.



4220204/B 12/2023

## NOTES:

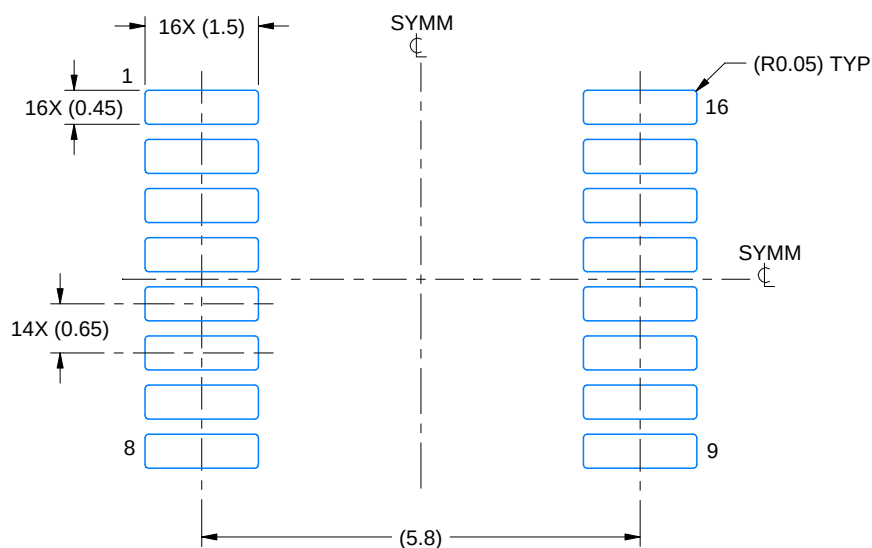
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

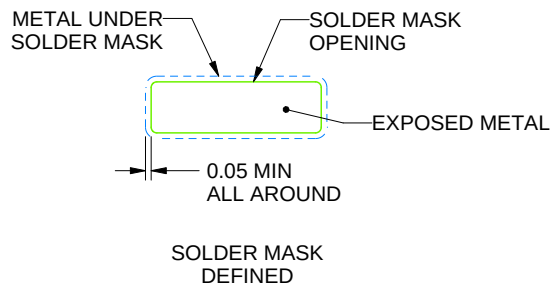
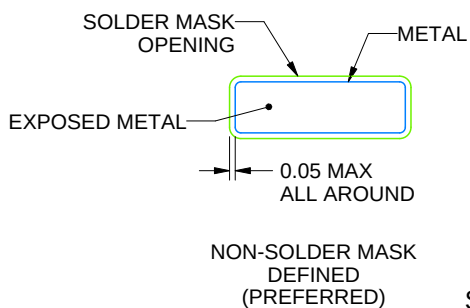
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

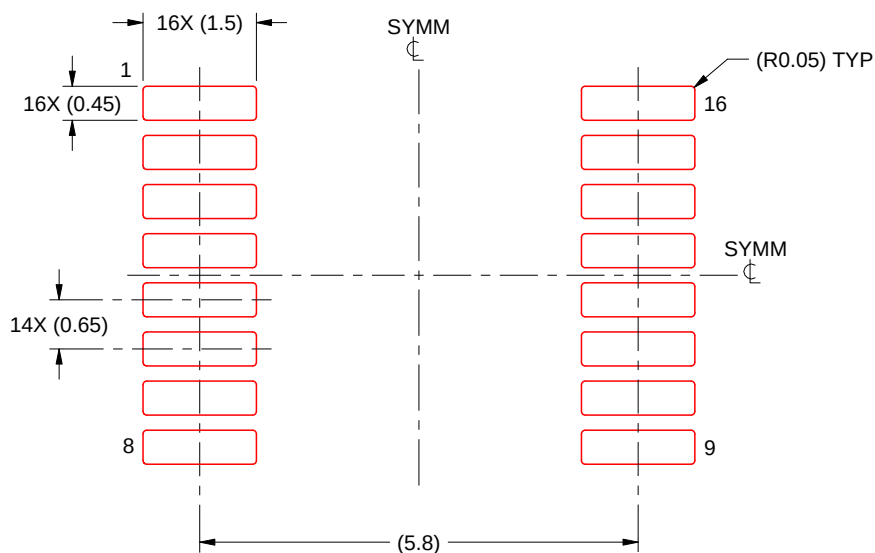
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220204/B 12/2023

NOTES: (continued)

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

## 重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、与某特定用途的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他安全、安保法规或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。对于因您对这些资源的使用而对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，您将全额赔偿，TI 对此概不负责。

TI 提供的产品受 [TI 销售条款](#)、[TI 通用质量指南](#) 或 [ti.com](#) 上其他适用条款或 TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。除非德州仪器 (TI) 明确将某产品指定为定制产品或客户特定产品，否则其产品均为按确定价格收入目录的标准通用器件。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

版权所有 © 2026，德州仪器 (TI) 公司

最后更新日期：2025 年 10 月