

## RS-232 TRANSCEIVER WITH SPLIT SUPPLY PIN FOR LOGIC SIDE

Check for Samples: [MAX3386E](#)

### FEATURES

- $V_L$  Pin for Compatibility With Mixed-Voltage Systems Down to 2.5 V on Logic Side
- Enhanced ESD Protection on RIN Inputs and DOUT Outputs
  - $\pm 15$ -kV Human-Body Model
  - $\pm 15$ -kV IEC 61000-4-2, Air-Gap Discharge
  - $\pm 8$ -kV IEC 61000-4-2, Contact Discharge
- Low 300- $\mu$ A Supply Current
- Specified 250-kbps Data Rate
- 1- $\mu$ A Low-Power Shutdown
- Meets EIA/TIA-232 Specifications Down to 3 V

### APPLICATIONS

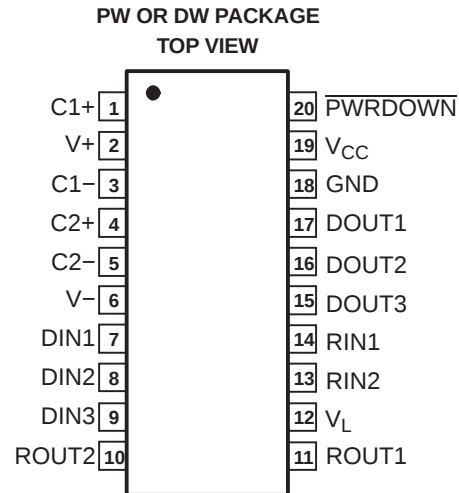
- Hand-Held Equipment
- PDAs
- Cell Phones
- Battery-Powered Equipment
- Data Cables

### DESCRIPTION/ORDERING INFORMATION

The MAX3386E is a three-driver and two-receiver RS-232 interface device, with split supply pins for mixed-signal operations. All RS-232 inputs and outputs are protected to  $\pm 15$  kV using the IEC 61000-4-2 Air-Gap Discharge method,  $\pm 8$  kV using the IEC 61000-4-2 Contact Discharge method, and  $\pm 15$  kV using the Human-Body Model.

The charge pump requires only four small 0.1- $\mu$ F capacitors for operation from a 3.3-V supply. The MAX3386E is capable of running at data rates up to 250 kbps, while maintaining RS-232-compliant output levels.

The MAX3386E has a unique  $V_L$  pin that allows operation in mixed-logic voltage systems. Both driver in (DIN) and receiver out (ROUT) logic levels are pin programmable through the  $V_L$  pin. The MAX3386E is available in a space-saving thin shrink small-outline package (TSSOP).



### ORDERING INFORMATION

| $T_A$         | PACKAGE <sup>(1)</sup> (2) | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|----------------------------|-----------------------|------------------|
| 0°C to 70°C   | TSSOP – PW                 | MAX3386ECPWR          | MP386EC          |
|               | SOIC – DW                  | MAX3386ECDW           | MAX3386EC        |
| –40°C to 85°C | TSSOP – PW                 | MAX3386EIPWR          | MP386EI          |
|               | SOIC – DW                  | MAX3386EIDW           | MAX3386EI        |

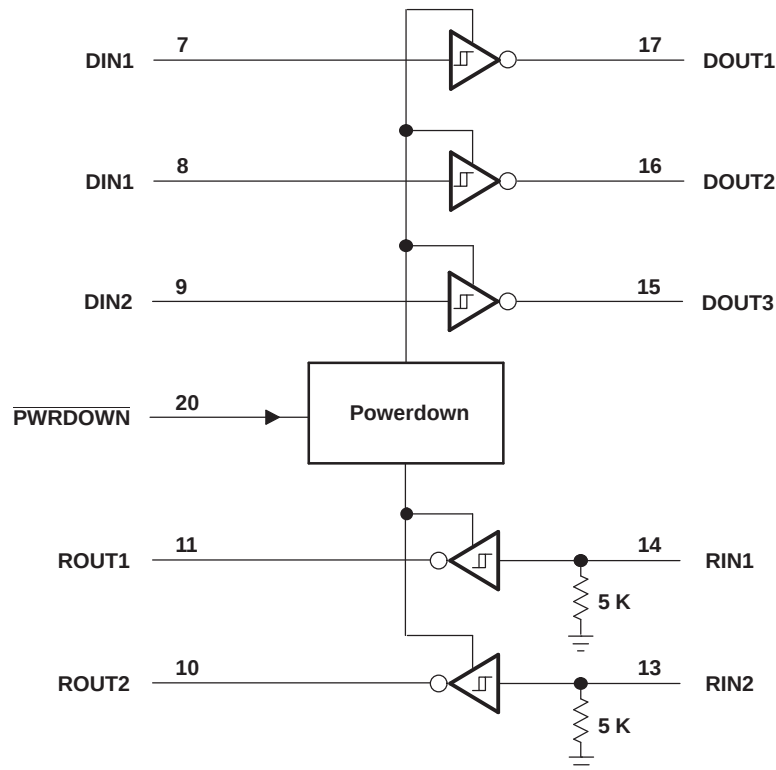
- (1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).
- (2) For the most current package and ordering information, see the Package Option Addendum at the end of this document,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

**Table 1. TRUTH TABLE (SHUTDOWN FUNCTION)**

| $\overline{\text{PWRDWN}}$ | DRIVER OUTPUTS | RECEIVER OUTPUTS | CHARGE PUMP |
|----------------------------|----------------|------------------|-------------|
| L                          | High-Z         | High-Z           | Inactive    |
| H                          | Active         | Active           | Active      |

**FUNCTIONAL BLOCK DIAGRAM****TERMINAL FUNCTIONS**

| TERMINAL                |                | DESCRIPTION                                                                    |
|-------------------------|----------------|--------------------------------------------------------------------------------|
| NAME                    | NO.            |                                                                                |
| C1+                     | 1              | Positive terminal of the voltage-doubler charge-pump capacitor                 |
| V+                      | 2              | 5.5-V supply generated by the charge pump                                      |
| C1–                     | 3              | Negative terminal of the voltage-doubler charge-pump capacitor                 |
| C2+                     | 4              | Positive terminal of the inverting charge-pump capacitor                       |
| C2–                     | 5              | Negative terminal of the inverting charge-pump capacitor                       |
| V–                      | 6              | –5.5-V supply generated by the charge pump                                     |
| DIN1<br>DIN2<br>DIN3    | 7<br>8<br>9    | Driver inputs                                                                  |
| ROUT2<br>ROUT1          | 10<br>11       | Receiver outputs. Swing between 0 and $V_L$ .                                  |
| $V_L$                   | 12             | Logic-level supply. All CMOS inputs and outputs are referenced to this supply. |
| RIN2<br>RIN1            | 13<br>14       | RS-232 receiver inputs                                                         |
| DOUT3<br>DOUT2<br>DOUT1 | 15<br>16<br>17 | RS-232 driver outputs                                                          |
| GND                     | 18             | Ground                                                                         |

**TERMINAL FUNCTIONS (continued)**

| TERMINAL                   |     | DESCRIPTION                                              |
|----------------------------|-----|----------------------------------------------------------|
| NAME                       | NO. |                                                          |
| V <sub>CC</sub>            | 19  | 3-V to 5.5-V supply voltage                              |
| $\overline{\text{PWRDWN}}$ | 20  | Powerdown input<br>L = Powerdown<br>H = Normal operation |

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

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

|                                    |                           |                                                                    | MIN  | MAX                   | UNIT |
|------------------------------------|---------------------------|--------------------------------------------------------------------|------|-----------------------|------|
| V <sub>CC</sub> to GND             |                           |                                                                    | −0.3 | 6                     | V    |
| V <sub>L</sub> to GND              |                           |                                                                    | −0.3 | V <sub>CC</sub> + 0.3 | V    |
| V+ to GND                          |                           |                                                                    | −0.3 | 7                     | V    |
| V− to GND                          |                           |                                                                    | 0.3  | −7                    | V    |
| V+ +  V−  <sup>(2)</sup>           |                           |                                                                    |      | 13                    | V    |
| V <sub>I</sub>                     | Input voltage             | DIN, $\overline{\text{PWRDWN}}$ to GND                             | −0.3 | 6                     | V    |
|                                    |                           | RIN to GND                                                         |      | ±25                   |      |
| V <sub>O</sub>                     | Output voltage            | DOUT to GND                                                        |      | ±13.2                 | V    |
|                                    |                           | ROUT                                                               | −0.3 | V <sub>L</sub> + 0.3  |      |
| Short-circuit duration DOUT to GND |                           |                                                                    |      | Continuous            |      |
| Continuous power dissipation       |                           | T <sub>A</sub> = 70°C, 20-pin TSSOP<br>(derate 7 mW/°C above 70°C) |      | 559                   | mW   |
| T <sub>J</sub>                     | Junction temperature      |                                                                    |      | 150                   | °C   |
| T <sub>stg</sub>                   | Storage temperature range |                                                                    | −65  | 150                   | °C   |
| Lead temperature (soldering, 10 s) |                           |                                                                    |      | 300                   | °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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
- (2) V+ and V– can have maximum magnitudes of 7 V, but their absolute difference cannot exceed 13 V.

**Recommended Operating Conditions**

|                            |                                 |                               |              | MIN  | MAX             | UNIT |
|----------------------------|---------------------------------|-------------------------------|--------------|------|-----------------|------|
| V <sub>CC</sub>            | Supply voltage                  |                               |              | 3    | 5.5             | V    |
| V <sub>L</sub>             | Supply voltage                  |                               |              | 2.25 | V <sub>CC</sub> | V    |
| Input logic threshold low  | DIN, $\overline{\text{PWRDWN}}$ | V <sub>L</sub> = 3 V or 5.5 V |              | 0.8  |                 | V    |
|                            |                                 | V <sub>L</sub> = 2.3 V        |              | 0.6  |                 |      |
| Input logic threshold high | DIN, $\overline{\text{PWRDWN}}$ | V <sub>L</sub> = 5.5 V        |              | 2.4  |                 | V    |
|                            |                                 | V <sub>L</sub> = 3 V          |              | 2.0  |                 |      |
|                            |                                 | V <sub>L</sub> = 2.7 V        |              | 1.4  |                 |      |
| Operating temperature      |                                 |                               | MAX3386ECPWR | 0    | 70              | °C   |
|                            |                                 |                               | MAX3386EIPWR | −40  | 85              |      |
| Receiver input voltage     |                                 |                               |              | −25  | 25              | V    |

**Electrical Characteristics**

over operating free-air temperature range, V<sub>CC</sub> = V<sub>L</sub> = 3 V to 5.5 V, C1–C4 = 0.1 μF (tested at 3.3 V ± 10%), C1 = 0.047 μF, C2–C4 = 0.33 μF (tested at 5 V ± 10%) (unless otherwise noted)

| PARAMETER                                                                       | TEST CONDITIONS                                                        | MIN | TYP <sup>(1)</sup> | MAX | UNIT |
|---------------------------------------------------------------------------------|------------------------------------------------------------------------|-----|--------------------|-----|------|
| <b>DC Characteristics (V<sub>CC</sub> = 3.3 V or 5 V, T<sub>A</sub> = 25°C)</b> |                                                                        |     |                    |     |      |
| Powerdown supply current                                                        | $\overline{\text{PWRDWN}}$ = GND, All inputs at V <sub>CC</sub> or GND |     | 1                  | 10  | μA   |

- (1) Typical values are at V<sub>CC</sub> = V<sub>L</sub> = 3.3 V, T<sub>A</sub> = 25°C.

## Electrical Characteristics (continued)

over operating free-air temperature range,  $V_{CC} = V_L = 3\text{ V}$  to  $5.5\text{ V}$ ,  $C1\text{--}C4 = 0.1\text{ }\mu\text{F}$  (tested at  $3.3\text{ V} \pm 10\%$ ),  $C1 = 0.047\text{ }\mu\text{F}$ ,  $C2\text{--}C4 = 0.33\text{ }\mu\text{F}$  (tested at  $5\text{ V} \pm 10\%$ ) (unless otherwise noted)

| PARAMETER      | TEST CONDITIONS                               | MIN | TYP <sup>(1)</sup> | MAX | UNIT |
|----------------|-----------------------------------------------|-----|--------------------|-----|------|
| Supply current | $\overline{\text{PWRDWN}} = V_{CC}$ , No load |     | 0.3                | 1   | mA   |

## ESD Protection

| PARAMETER | TEST CONDITIONS                 | TYP      | UNIT |
|-----------|---------------------------------|----------|------|
| RIN, DOUT | Human-Body Model                | $\pm 15$ | kV   |
|           | IEC 61000-4-2 Air-Gap Discharge | $\pm 15$ |      |
|           | IEC 61000-4-2 Contact Discharge | $\pm 8$  |      |

## RECEIVER SECTION

### Electrical Characteristics

over operating free-air temperature range,  $V_{CC} = V_L = 3\text{ V}$  to  $5.5\text{ V}$ ,  $C1\text{--}C4 = 0.1\text{ }\mu\text{F}$  (tested at  $3.3\text{ V} \pm 10\%$ ),  $C1 = 0.047\text{ }\mu\text{F}$ ,  $C2\text{--}C4 = 0.33\text{ }\mu\text{F}$  (tested at  $5\text{ V} \pm 10\%$ ),  $T_A = T_{MIN}$  to  $T_{MAX}$  (unless otherwise noted)

| PARAMETER        |                        | TEST CONDITIONS           |                        | MIN                  | TYP <sup>(1)</sup>   | MAX | UNIT |
|------------------|------------------------|---------------------------|------------------------|----------------------|----------------------|-----|------|
| I <sub>off</sub> | Output leakage current | ROUT, receivers disabled  |                        |                      | ±0.05                | ±10 | µA   |
| V <sub>OL</sub>  | Output voltage low     | I <sub>OUT</sub> = 1.6 mA |                        |                      |                      | 0.4 | V    |
| V <sub>OH</sub>  | Output voltage high    | I <sub>OUT</sub> = −1 mA  |                        | V <sub>L</sub> − 0.6 | V <sub>L</sub> − 0.1 |     | V    |
| V <sub>IT−</sub> | Input threshold low    | T <sub>A</sub> = 25°C     | V <sub>L</sub> = 5 V   | 0.8                  | 1.2                  |     | V    |
|                  |                        |                           | V <sub>L</sub> = 3.3 V | 0.6                  | 1.5                  |     |      |
| V <sub>IT+</sub> | Input threshold high   | T <sub>A</sub> = 25°C     | V <sub>L</sub> = 5 V   |                      | 1.8                  | 2.4 | V    |
|                  |                        |                           | V <sub>L</sub> = 3.3 V |                      | 1.5                  | 2.4 |      |
| V <sub>hys</sub> | Input hysteresis       |                           |                        |                      | 0.5                  |     | V    |
|                  | Input resistance       | T <sub>A</sub> = 25°C     |                        | 3                    | 5                    | 7   | kΩ   |

(1) Typical values are at  $V_{CC} = V_L = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$

### Switching Characteristics

over operating free-air temperature range,  $V_{CC} = V_L = 3\text{ V}$  to  $5.5\text{ V}$ ,  $C1\text{--}C4 = 0.1\text{ }\mu\text{F}$  (tested at  $3.3\text{ V} \pm 10\%$ ),  $C1 = 0.047\text{ }\mu\text{F}$ ,  $C2\text{--}C4 = 0.33\text{ }\mu\text{F}$  (tested at  $5\text{ V} \pm 10\%$ ),  $T_A = T_{MIN}$  to  $T_{MAX}$  (unless otherwise noted)

| PARAMETER           |                              | TEST CONDITIONS                                          | TYP <sup>(1)</sup> | UNIT          |
|---------------------|------------------------------|----------------------------------------------------------|--------------------|---------------|
| $t_{PHL}$           | Receiver propagation delay   | Receiver input to receiver output, $C_L = 150\text{ pF}$ | 0.15               | $\mu\text{s}$ |
| $t_{PLH}$           |                              |                                                          | 0.15               |               |
| $t_{PHL} - t_{PLH}$ | Receiver skew                |                                                          | 50                 | ns            |
| $t_{en}$            | Receiver output enable time  | From $\overline{\text{PWRDWN}}$                          | 200                | ns            |
| $t_{dis}$           | Receiver output disable time | From $\overline{\text{PWRDWN}}$                          | 200                | ns            |

(1) Typical values are at  $V_{CC} = V_L = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

## DRIVER SECTION

### Electrical Characteristics

over operating free-air temperature range,  $V_{CC} = V_L = 3\text{ V}$  to  $5.5\text{ V}$ ,  $C_1$ – $C_4 = 0.1\text{ }\mu\text{F}$  (tested at  $3.3\text{ V} \pm 10\%$ ),  $C_1 = 0.047\text{ }\mu\text{F}$ ,  $C_2$ – $C_4 = 0.33\text{ }\mu\text{F}$  (tested at  $5\text{ V} \pm 10\%$ ),  $T_A = T_{MIN}$  to  $T_{MAX}$  (unless otherwise noted)

| PARAMETER                             | TEST CONDITIONS                                                                                     | MIN     | TYP <sup>(1)</sup> | MAX      | UNIT          |
|---------------------------------------|-----------------------------------------------------------------------------------------------------|---------|--------------------|----------|---------------|
| $V_{OH}$ Output voltage swing         | All driver outputs loaded with $3\text{ k}\Omega$ to ground                                         | $\pm 5$ | $\pm 5.4$          |          | V             |
| $r_o$ Output resistance               | $V_{CC} = V_+ = V_- = 0$ , Driver output = $\pm 2\text{ V}$                                         | 300     | 10M                |          | $\Omega$      |
| $I_{OS}$ Output short-circuit current | $V_{T\_OUT} = 0$                                                                                    |         |                    | $\pm 60$ | mA            |
| $I_{OZ}$ Output leakage current       | $V_{T\_OUT} = \pm 12\text{ V}$ , Driver disabled,<br>$V_{CC} = 0$ or $3\text{ V}$ to $5.5\text{ V}$ |         |                    | $\pm 25$ | $\mu\text{A}$ |
| Driver input hysteresis               |                                                                                                     |         |                    | 0.5      | V             |
| Input leakage current                 | DIN, $\overline{\text{PWRDWN}}$                                                                     |         | $\pm 0.01$         | $\pm 1$  | $\mu\text{A}$ |

(1) Typical values are at  $V_{CC} = V_L = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$

### Timing Requirements

over operating free-air temperature range,  $V_{CC} = V_L = 3\text{ V}$  to  $5.5\text{ V}$ ,  $C_1$ – $C_4 = 0.1\text{ }\mu\text{F}$  (tested at  $3.3\text{ V} \pm 10\%$ ),  $C_1 = 0.047\text{ }\mu\text{F}$ ,  $C_2$ – $C_4 = 0.33\text{ }\mu\text{F}$  (tested at  $5\text{ V} \pm 10\%$ ),  $T_A = T_{MIN}$  to  $T_{MAX}$  (unless otherwise noted)

| PARAMETER                                        | TEST CONDITIONS                                                                                                                                                                                | MIN                                       | TYP <sup>(1)</sup> | MAX | UNIT             |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------|-----|------------------|
| Maximum data rate                                | $R_L = 3\text{ k}\Omega$ , $C_L = 1000\text{ pF}$ , One driver switching                                                                                                                       | 250                                       |                    |     | kbps             |
| Time-to-exit powerdown                           | $ V_{T\_OUT}  > 3.7\text{ V}$                                                                                                                                                                  |                                           | 100                |     | $\mu\text{s}$    |
| $ t_{PHL} - t_{PLH} $ Driver skew <sup>(2)</sup> |                                                                                                                                                                                                |                                           | 100                |     | ns               |
| Transition-region slew rate                      | $V_{CC} = 3.3\text{ V}$ ,<br>$T_A = 25^\circ\text{C}$ ,<br>$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$ ,<br>Measured from $3\text{ V}$<br>to $-3\text{ V}$ or $-3\text{ V}$ to $3\text{ V}$ | $C_L = 150\text{ pF}$ to $1000\text{ pF}$ | 6                  | 30  | V/ $\mu\text{s}$ |
|                                                  |                                                                                                                                                                                                | $C_L = 150\text{ pF}$ to $2500\text{ pF}$ | 4                  | 30  |                  |

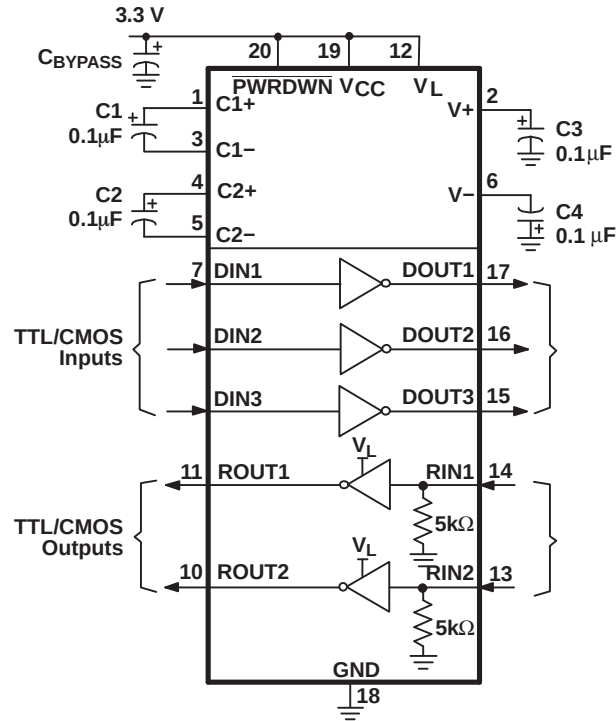
(1) Typical values are at  $V_{CC} = V_L = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

(2) Driver skew is measured at the driver zero crosspoint.

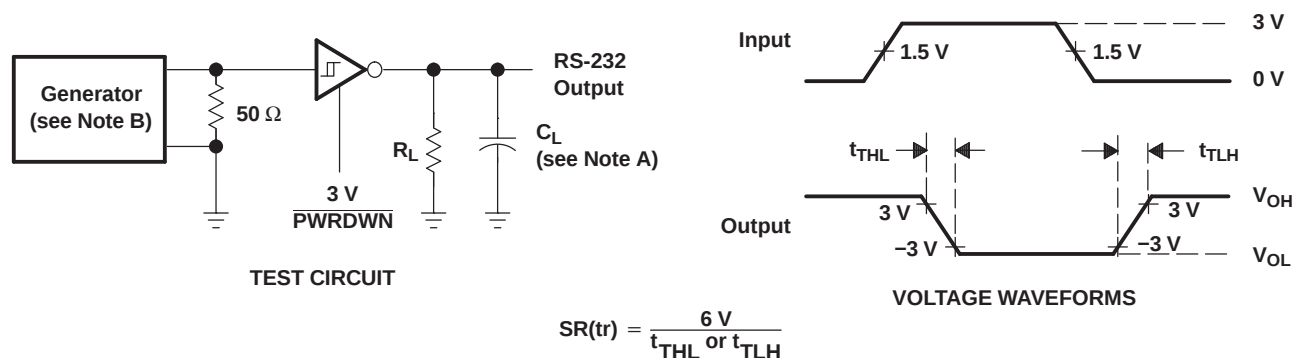
### ESD Protection

| PARAMETER | TEST CONDITIONS                 | TYP      | UNIT |
|-----------|---------------------------------|----------|------|
| RIN, DOUT | Human-Body Model                | $\pm 15$ | kV   |
|           | IEC 61000-4-2 Air-Gap Discharge | $\pm 15$ |      |
|           | IEC 61000-4-2 Contact Discharge | $\pm 8$  |      |

## APPLICATION INFORMATION



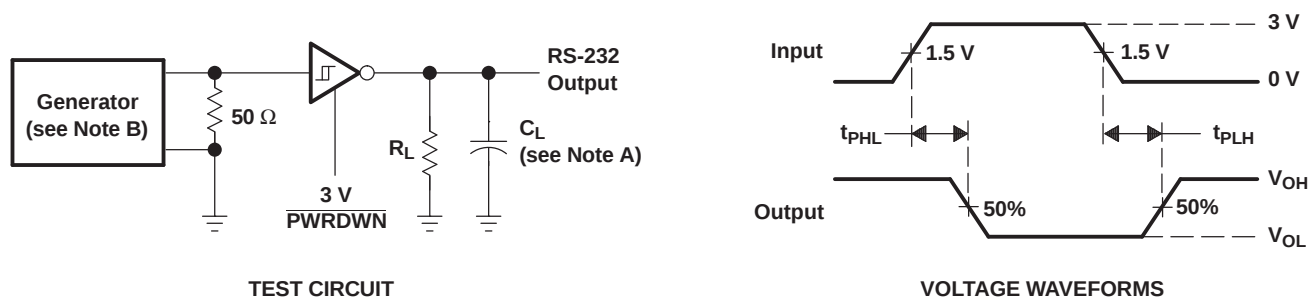
## PARAMETER MEASUREMENT INFORMATION



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

B. The pulse generator has the following characteristics: PRR = 250 kbit/s,  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .

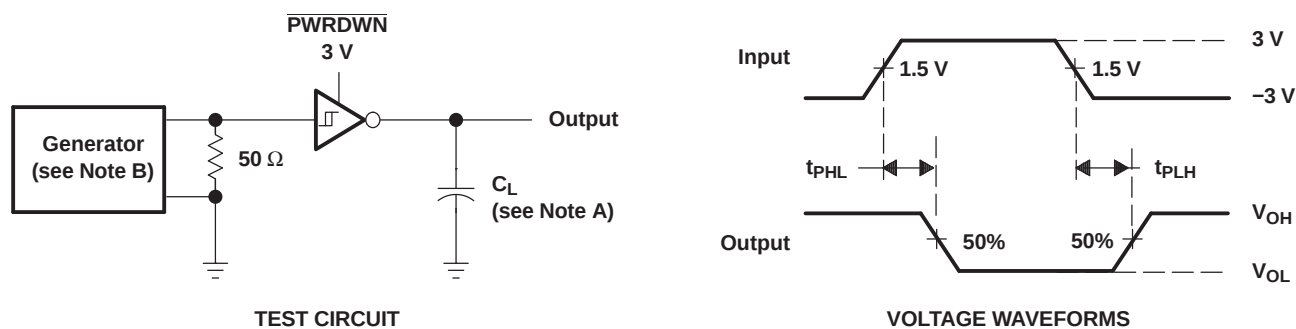
**Figure 1. Driver Slew Rate**



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

B. The pulse generator has the following characteristics: PRR = 250 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**

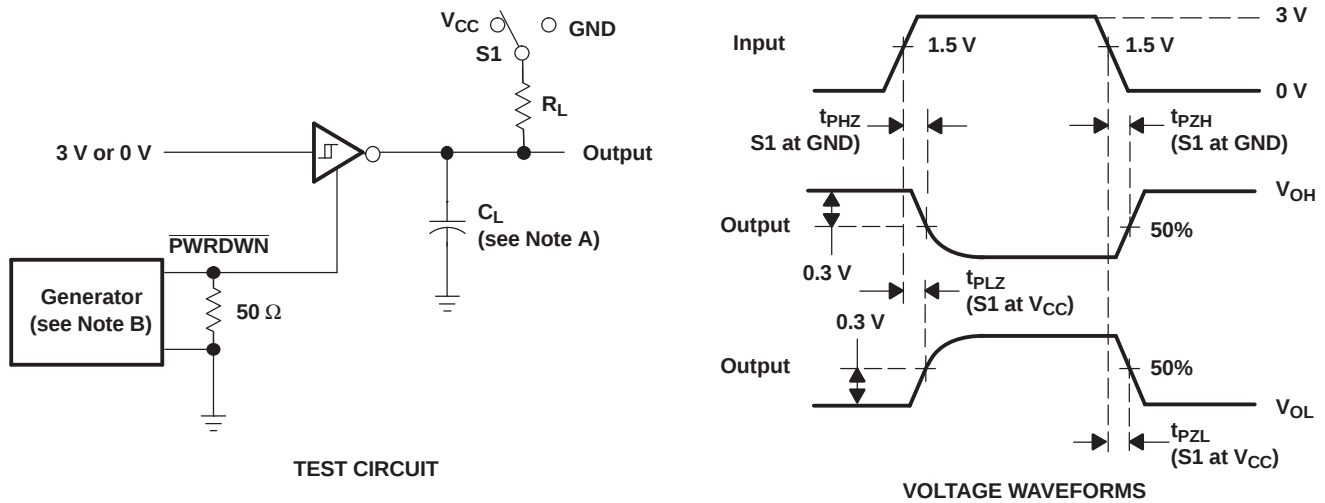


NOTES: A.  $C_L$  includes probe and jig capacitance.

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**

## PARAMETER MEASUREMENT INFORMATION



- 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 4. Receiver Enable and Disable Times**

## REVISION HISTORY

| Changes from Revision A (November 2008) to Revision B                                                                     | Page |
|---------------------------------------------------------------------------------------------------------------------------|------|
| • Changed $V_L$ Pin for Compatibility With Mixed-Voltage Systems Down to 2.5 V (originally 1.8 V) on the Logic Side ..... | 1    |
| • Changed $V_L$ Supply MIN value from 1.65 V to 2.25 V. ....                                                              | 3    |
| • Deleted $V_L = 1.65V$ parameter from Input logic threshold low. ....                                                    | 3    |
| • Deleted $V_L = 1.95V$ parameter from Input logic threshold high. ....                                                   | 3    |

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| MAX3386ECDWR     | ACTIVE        | SOIC         | DW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | MAX3386EC               | <a href="#">Samples</a> |
| MAX3386ECPW      | ACTIVE        | TSSOP        | PW                 | 20   | 70             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | MP386EC                 | <a href="#">Samples</a> |
| MAX3386ECPWR     | ACTIVE        | TSSOP        | PW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | MP386EC                 | <a href="#">Samples</a> |
| MAX3386EIDW      | ACTIVE        | SOIC         | DW                 | 20   | 25             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | MAX3386EI               | <a href="#">Samples</a> |
| MAX3386EIDWR     | ACTIVE        | SOIC         | DW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | MAX3386EI               | <a href="#">Samples</a> |
| MAX3386EIPW      | ACTIVE        | TSSOP        | PW                 | 20   | 70             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | MP386EI                 | <a href="#">Samples</a> |
| MAX3386EIPWR     | ACTIVE        | TSSOP        | PW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | MP386EI                 | <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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

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

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

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

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

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

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

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

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

**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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MAX3386ECDWR | SOIC         | DW              | 20   | 2000 | 330.0              | 24.4               | 10.8    | 13.3    | 2.7     | 12.0    | 24.0   | Q1            |
| MAX3386ECPWR | TSSOP        | PW              | 20   | 2000 | 330.0              | 16.4               | 6.95    | 7.0     | 1.4     | 8.0     | 16.0   | Q1            |
| MAX3386EIDWR | SOIC         | DW              | 20   | 2000 | 330.0              | 24.4               | 10.8    | 13.3    | 2.7     | 12.0    | 24.0   | Q1            |
| MAX3386EIPWR | TSSOP        | PW              | 20   | 2000 | 330.0              | 16.4               | 6.95    | 7.0     | 1.4     | 8.0     | 16.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| MAX3386ECDWR | SOIC         | DW              | 20   | 2000 | 367.0       | 367.0      | 45.0        |
| MAX3386ECPWR | TSSOP        | PW              | 20   | 2000 | 853.0       | 449.0      | 35.0        |
| MAX3386EIDWR | SOIC         | DW              | 20   | 2000 | 367.0       | 367.0      | 45.0        |
| MAX3386EIPWR | TSSOP        | PW              | 20   | 2000 | 853.0       | 449.0      | 35.0        |

## TUBE



\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| MAX3386ECPW | PW           | TSSOP        | 20   | 70  | 530    | 10.2   | 3600   | 3.5    |
| MAX3386EIDW | DW           | SOIC         | 20   | 25  | 507    | 12.83  | 5080   | 6.6    |
| MAX3386EIPW | PW           | TSSOP        | 20   | 70  | 530    | 10.2   | 3600   | 3.5    |



# EXAMPLE BOARD LAYOUT

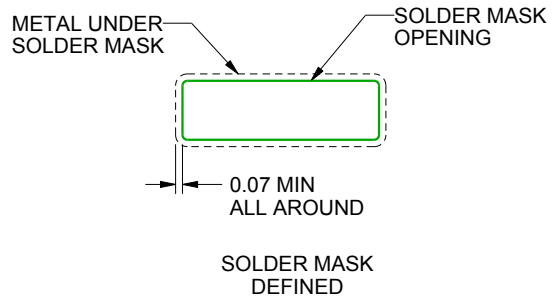
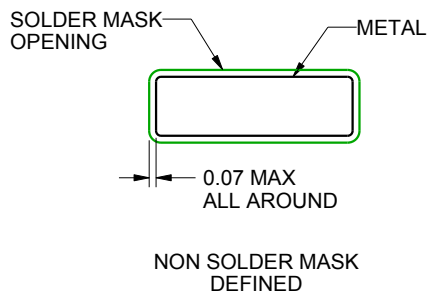
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

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

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

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.



4220206/A 02/2017

## NOTES:

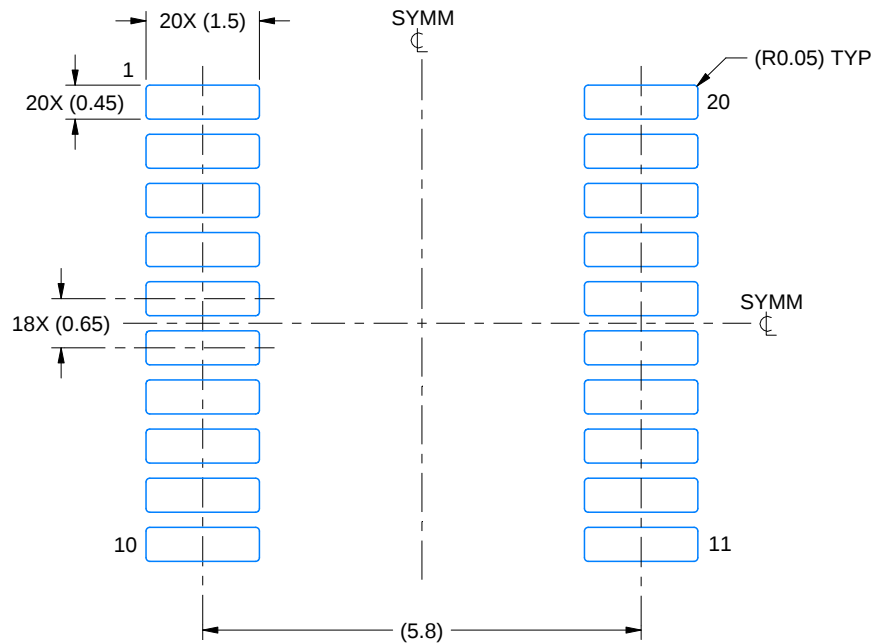
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

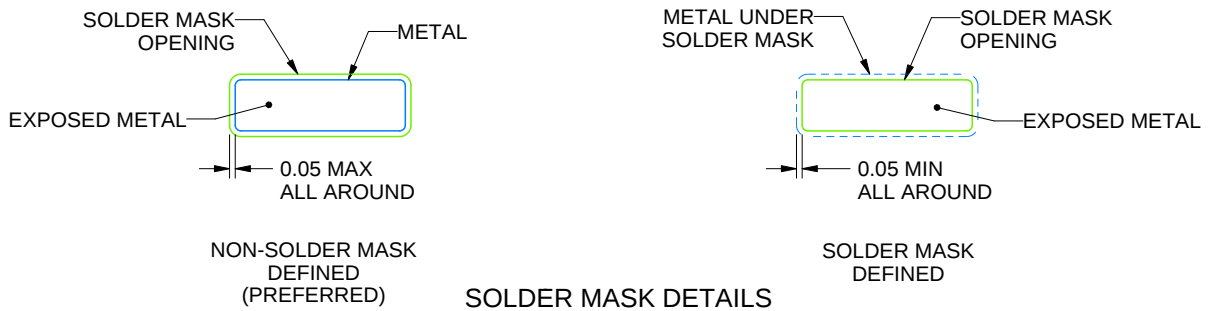
PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220206/A 02/2017

NOTES: (continued)

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

## EXAMPLE STENCIL DESIGN

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

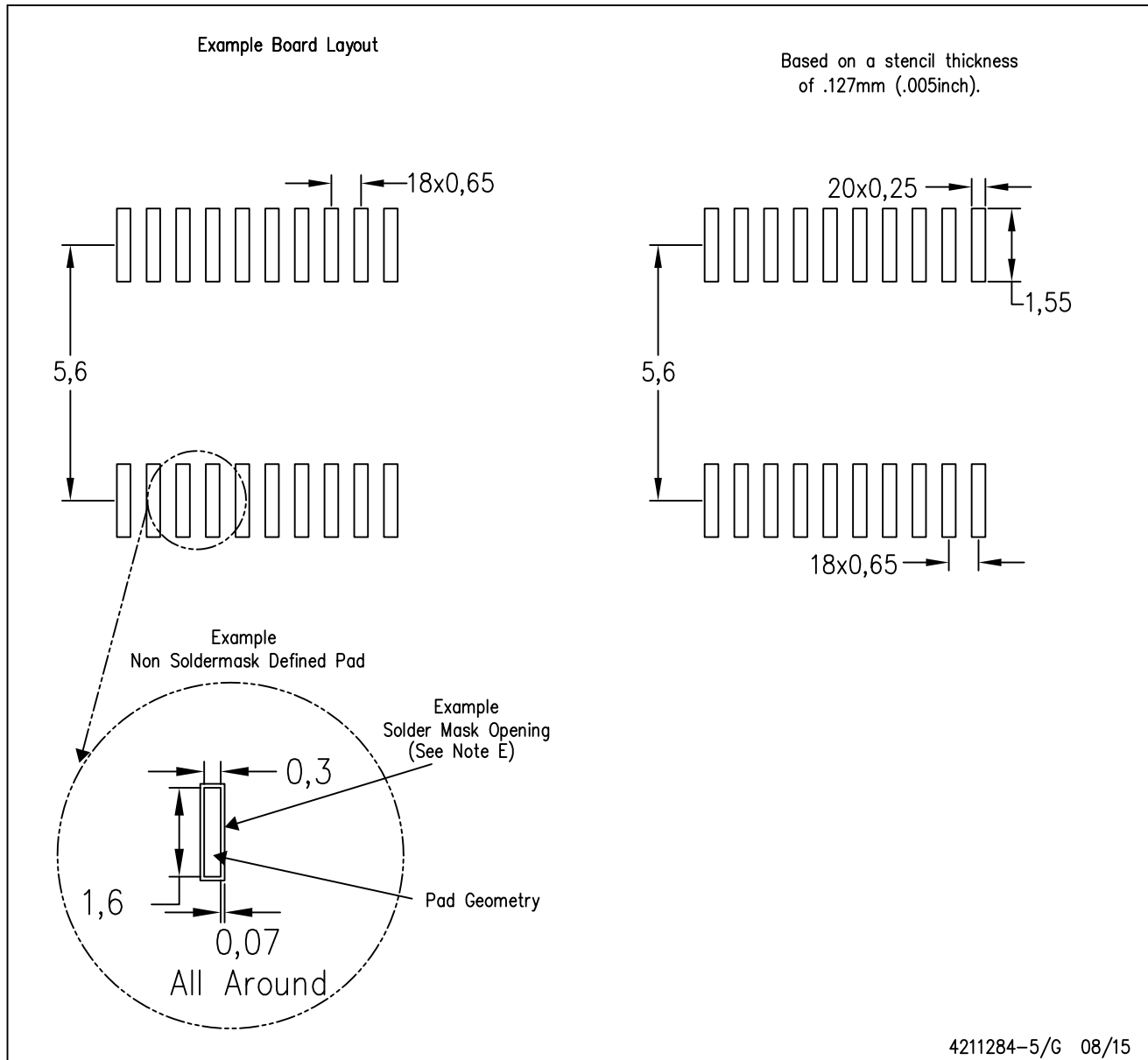
4220206/A 02/2017

NOTES: (continued)

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

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- 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 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 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## IMPORTANT NOTICE AND DISCLAIMER

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

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

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

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

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

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2022, Texas Instruments Incorporated