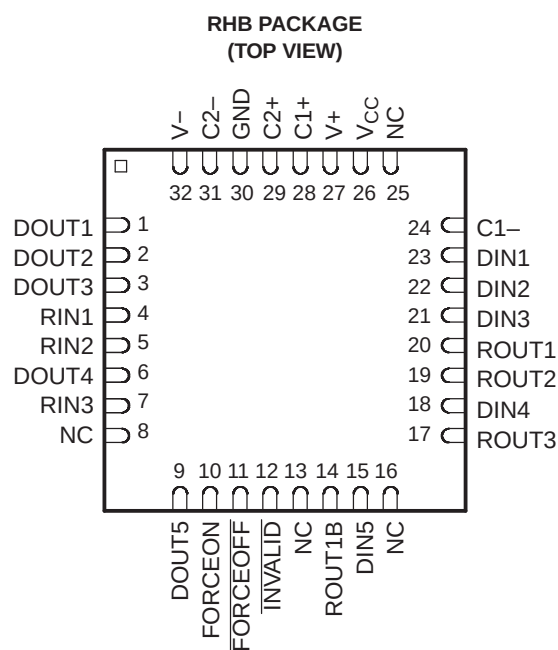
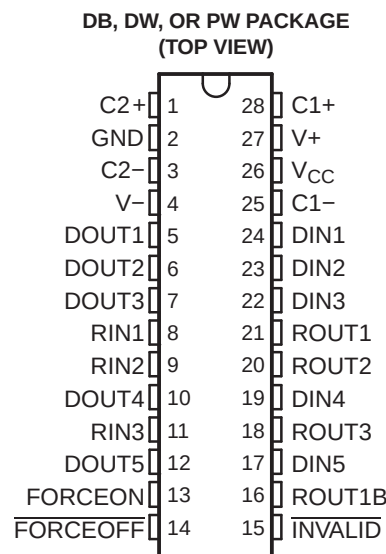


## FEATURES

- RS-232 Bus-Pin ESD Protection Exceeds  $\pm 15$  kV Using Human-Body Model (HBM)
- Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards
- Operates With 3-V to 5.5-V  $V_{CC}$  Supply
- Operates up to 1000 kbit/s
- Five Drivers and Three Receivers
- Auto-Powerdown Plus Feature Enables Flexible Power-Down Mode
- Low Standby Current . . . 1  $\mu$ A Typical
- External Capacitors . . .  $4 \times 0.1 \mu$ F
- Accept 5-V Logic Input With 3.3-V Supply
- Always-Active Noninverting Receiver Output (ROUT1B)
- ESD Protection for RS-232 Interface Pins
  - $\pm 15$ -kV Human-Body Model (HBM)
  - $\pm 8$ -kV IEC61000-4-2, Contact Discharge
  - $\pm 15$ -kV IEC61000-4-2, Air-Gap Discharge

## APPLICATIONS

- Battery-Powered Systems
- PDAs
- Notebooks
- Subnotebooks
- Laptops
- Palmtop PCs
- Hand-Held Equipment
- Modems
- Printers



## DESCRIPTION/ORDERING INFORMATION

The TRSF3238E consists of five line drivers, three line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD (HBM) protection on the driver output (DOUT) and receiver input (RIN) terminals. The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between notebook and subnotebook computer applications. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. In addition, the device includes an always-active noninverting output (ROUT1B), which allows applications using the ring indicator to transmit data while the device is powered down. The TRSF3238E operates at data signaling rates up to 1000 kbit/s.



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.

**TRSF3238E**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH  $\pm 15$ -kV ESD (HBM) PROTECTION**

SLLS826 – AUGUST 2007

## DESCRIPTION/ORDERING INFORMATION (CONTINUED)

Flexible control options for power management are featured when the serial port and driver inputs are inactive. The auto-powerdown plus feature functions when  $\overline{\text{FORCEON}}$  is low and  $\overline{\text{FORCEOFF}}$  is high. During this mode of operation, if the device does not sense valid signal transitions on all receiver and driver inputs for approximately 30 s, the built-in charge pump and drivers are powered down, reducing the supply current to 1  $\mu\text{A}$ . By disconnecting the serial port or placing the peripheral drivers off, auto-powerdown plus occurs if there is no activity in the logic levels for the driver inputs. Auto-powerdown plus can be disabled when  $\overline{\text{FORCEON}}$  and  $\overline{\text{FORCEOFF}}$  are high. With auto-powerdown plus enabled, the device activates automatically when a valid signal is applied to any receiver or driver input.  $\overline{\text{INVALID}}$  is high (valid data) if any receiver input voltage is greater than 2.7 V or less than  $-2.7$  V, or has been between  $-0.3$  V and 0.3 V for less than 30  $\mu\text{s}$ .  $\overline{\text{INVALID}}$  is low (invalid data) if all receiver input voltages are between  $-0.3$  V and 0.3 V for more than 30  $\mu\text{s}$ . Refer to [Figure 5](#) for receiver input levels.

## ORDERING INFORMATION

| $T_A$         | PACKAGE <sup>(1)(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|---------------------------|--------------|-----------------------|------------------|
| 0°C to 70°C   | QFN – RHB                 | Reel of 2000 | TRSF3238ECRHBR        | RS38EC           |
|               |                           | Tube of 50   | TRSF3238ECDW          | TRS3238EC        |
|               | SOIC – DW                 | Reel of 2000 | TRSF3238ECDWR         |                  |
|               |                           | Tube of 50   | TRSF3238ECDB          | TRS3238EC        |
|               | SSOP – DB                 | Reel of 2000 | TRSF3238ECDBR         |                  |
|               |                           | Tube of 50   | TRSF3238ECPW          | RS38EC           |
| –40°C to 85°C | TSSOP – PW                | Reel of 2000 | TRSF3238ECPWR         |                  |
|               |                           | Tube of 50   | TRSF3238EIRHBR        | RS38EI           |
|               | QFN – RHB                 | Reel of 2000 | TRSF3238EIDW          | TRS3238EI        |
|               |                           | Tube of 50   | TRSF3238EIDWR         |                  |
|               | SOIC – DW                 | Reel of 2000 | TRSF3238EIDB          | TRS3238EI        |
|               |                           | Tube of 50   | TRSF3238EIDBR         |                  |
|               | SSOP – DB                 | Reel of 2000 | TRSF3238EIPW          | RS38EI           |
|               |                           | Tube of 50   | TRSF3238EIPWR         |                  |
|               | TSSOP – PW                | Reel of 2000 |                       |                  |
|               |                           | Tube of 50   |                       |                  |

(1) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

(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).

## FUNCTION TABLES

### Each Driver<sup>(1)</sup>

| INPUTS |         |          |                                                  | OUTPUT<br>DOUT | DRIVER STATUS                                         |
|--------|---------|----------|--------------------------------------------------|----------------|-------------------------------------------------------|
| DIN    | FORCEON | FORCEOFF | TIME ELAPSED SINCE LAST<br>RIN OR DIN TRANSITION |                |                                                       |
| X      | X       | L        | X                                                | Z              | Powered off                                           |
| L      | H       | H        | X                                                | H              | Normal operation with<br>auto-powerdown plus disabled |
| H      | H       | H        | X                                                | L              |                                                       |
| L      | L       | H        | <30 s                                            | H              | Normal operation with<br>auto-powerdown plus enabled  |
| H      | L       | H        | <30 s                                            | L              |                                                       |
| L      | L       | H        | >30 s                                            | Z              | Powered off by<br>auto-powerdown plus feature         |
| H      | L       | H        | >30 s                                            | Z              |                                                       |

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

### Each Receiver<sup>(1)</sup>

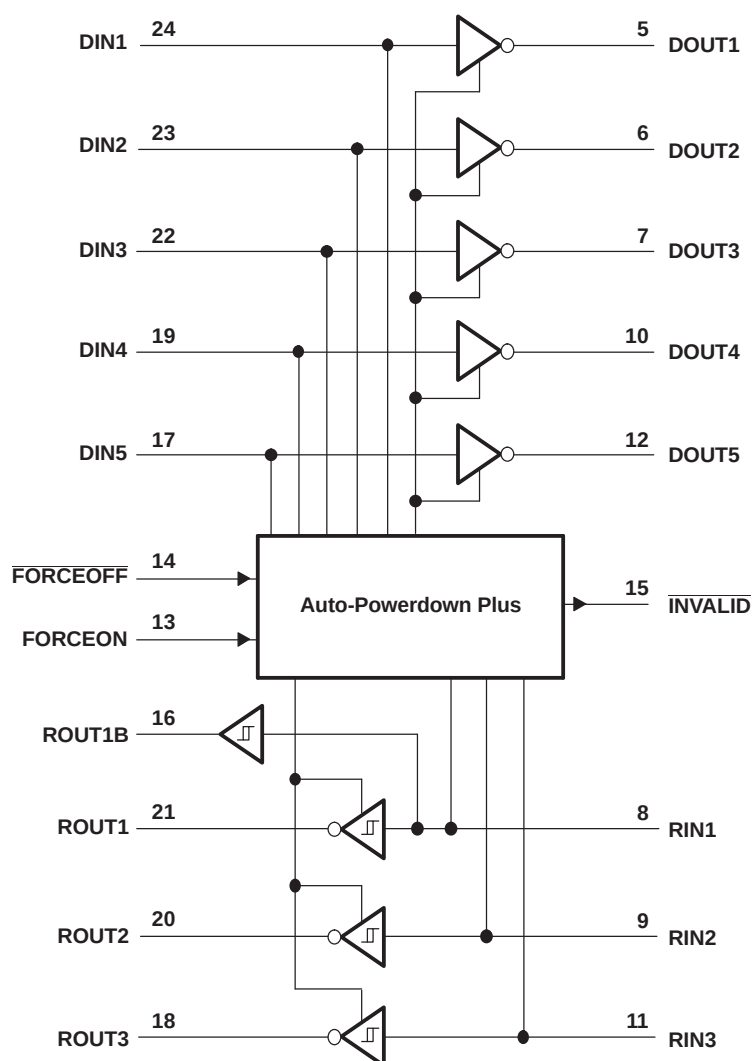
| INPUTS |                  |          |                                                  | OUTPUTS |                    | RECEIVER STATUS                                                  |
|--------|------------------|----------|--------------------------------------------------|---------|--------------------|------------------------------------------------------------------|
| RIN1   | RIN2 AND<br>RIN3 | FORCEOFF | TIME ELAPSED SINCE LAST<br>RIN OR DIN TRANSITION | ROUT1B  | ROUT2 AND<br>ROUT3 |                                                                  |
| L      | X                | L        | X                                                | L       | Z                  | Powered off while<br>ROUT1B is active                            |
| H      | X                | L        | X                                                | H       | Z                  |                                                                  |
| L      | L                | H        | <30 s                                            | L       | H                  | Normal operation with<br>auto-powerdown plus<br>disabled/enabled |
| L      | H                | H        | <30 s                                            | L       | L                  |                                                                  |
| H      | L                | H        | <30 s                                            | H       | H                  |                                                                  |
| H      | H                | H        | <30 s                                            | H       | L                  |                                                                  |
| Open   | Open             | H        | <30 s                                            | L       | H                  |                                                                  |

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

**TRSF3238E**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH  $\pm 15$ -kV ESD (HBM) PROTECTION**

SLLS826 – AUGUST 2007

**LOGIC DIAGRAM (POSITIVE LOGIC)**



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

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

|                  |                                                     |                                     | MIN   | MAX                   | UNIT |
|------------------|-----------------------------------------------------|-------------------------------------|-------|-----------------------|------|
| V <sub>CC</sub>  | Supply voltage range <sup>(2)</sup>                 |                                     | −0.3  | 6                     | V    |
| V+               | Positive-output supply voltage range <sup>(2)</sup> |                                     | −0.3  | 7                     | V    |
| V−               | Negative-output supply voltage range <sup>(2)</sup> |                                     | 0.3   | −7                    | V    |
| V+ − V−          | Supply voltage difference <sup>(2)</sup>            |                                     |       | 13                    | V    |
| V <sub>I</sub>   | Input voltage range                                 | Driver ( <u>FORCEOFF</u> , FORCEON) | −0.3  | 6                     | V    |
|                  |                                                     | Receiver                            | −25   | 25                    |      |
| V <sub>O</sub>   | Output voltage range                                | Driver                              | −13.2 | 13.2                  | V    |
|                  |                                                     | Receiver ( <u>INVALID</u> )         | −0.3  | V <sub>CC</sub> + 0.3 |      |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(3)(4)</sup>         | DB package                          |       | 62                    | °C/W |
|                  |                                                     | DW package                          |       | 46                    |      |
|                  |                                                     | PW package                          |       | 62                    |      |
|                  |                                                     | RHB package                         |       | TBD                   |      |
| T <sub>J</sub>   | Operating virtual junction temperature              |                                     |       | 150                   | °C   |
| T <sub>stg</sub> | 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<sub>J</sub>(max),  $\theta_{JA}$ , and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J</sub>(max) – T<sub>A</sub>)/ $\theta_{JA}$ . Operating at the absolute maximum T<sub>J</sub> 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 6

|                 |                                             |                                             | MIN                     | NOM | MAX | UNIT |
|-----------------|---------------------------------------------|---------------------------------------------|-------------------------|-----|-----|------|
| Supply voltage  |                                             | V <sub>CC</sub> = 3.3 V                     | 3                       | 3.3 | 3.6 | V    |
|                 |                                             | V <sub>CC</sub> = 5 V                       | 4.5                     | 5   | 5.5 |      |
| V <sub>IH</sub> | Driver and control high-level input voltage | DIN, $\overline{\text{FORCEOFF}}$ , FORCEON | V <sub>CC</sub> = 3.3 V | 2   | 5.5 | V    |
|                 |                                             |                                             | V <sub>CC</sub> = 5 V   | 2.4 | 5.5 |      |
| V <sub>IL</sub> | Driver and control low-level input voltage  | DIN, $\overline{\text{FORCEOFF}}$ , FORCEON | 0                       |     | 0.8 | V    |
| V <sub>I</sub>  | Receiver input voltage                      |                                             | –25                     |     | 25  | V    |
| T <sub>A</sub>  | Operating free-air temperature              | TRSF3238EC                                  | 0                       |     | 70  | °C   |
|                 |                                             | TRSF3238EI                                  | –40                     |     | 85  |      |

- (1) Testing supply conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.15 V; C1–C4 = 0.22  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.3 V; and C1 = 0.047  $\mu$ F and C2–C4 = 0.33  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

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

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 6)

| PARAMETER       |                                           |                              | TEST CONDITIONS                                                                           | MIN | TYP <sup>(2)</sup> | MAX | UNIT |
|-----------------|-------------------------------------------|------------------------------|-------------------------------------------------------------------------------------------|-----|--------------------|-----|------|
| I <sub>I</sub>  | Input leakage current                     | FORCEOFF, FORCEON            |                                                                                           |     | ±0.01              | ±1  | µA   |
| I <sub>CC</sub> | Supply current<br>(T <sub>A</sub> = 25°C) | Auto-powerdown plus disabled | No load,<br>FORCEOFF and FORCEON at V <sub>CC</sub> ,<br>V <sub>CC</sub> at 3.3 V or 5 V  |     | 0.5                | 2   | mA   |
|                 |                                           | Powered off                  | No load, FORCEOFF at GND                                                                  |     | 1                  | 10  | µA   |
|                 |                                           | Auto-powerdown plus enabled  | No load, FORCEOFF at V <sub>CC</sub> ,<br>FORCEON at GND,<br>All RIN are open or grounded |     | 1                  | 10  |      |

- (1) Testing supply conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.15 V; C1–C4 = 0.22  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.3 V; and C1 = 0.047  $\mu$ F and C2–C4 = 0.33  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.
- (2) All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

# TRSF3238E

## 3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

### WITH $\pm 15$ -kV ESD (HBM) PROTECTION

SLLS826 – AUGUST 2007

## DRIVER SECTION

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

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 6](#))

| PARAMETER       | TEST CONDITIONS                             |                                                                                         | MIN | TYP <sup>(2)</sup> | MAX       | UNIT     |
|-----------------|---------------------------------------------|-----------------------------------------------------------------------------------------|-----|--------------------|-----------|----------|
| V <sub>OH</sub> | High-level output voltage                   | All DOUT at R <sub>L</sub> = 3 k $\Omega$ to GND                                        | 5   | 5.4                |           | V        |
| V <sub>OL</sub> | Low-level output voltage                    | All DOUT at R <sub>L</sub> = 3 k $\Omega$ to GND                                        | –5  | –5.4               |           | V        |
| I <sub>IH</sub> | High-level input current                    | V <sub>I</sub> = V <sub>CC</sub>                                                        |     | $\pm 0.01$         | $\pm 1$   | $\mu$ A  |
| I <sub>IL</sub> | Low-level input current                     | V <sub>I</sub> at GND                                                                   |     | $\pm 0.01$         | $\pm 1$   | $\mu$ A  |
| I <sub>OS</sub> | Short-circuit output current <sup>(3)</sup> | V <sub>O</sub> = 0 V                                                                    |     | $\pm 35$           | $\pm 60$  | mA       |
|                 |                                             | V <sub>CC</sub> = 3.6 V                                                                 |     |                    |           |          |
|                 |                                             | V <sub>CC</sub> = 5.5 V                                                                 |     | $\pm 40$           | $\pm 100$ |          |
| 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 | 10M                |           | $\Omega$ |
| I <sub>OZ</sub> | Output leakage current                      | $\overline{\text{FORCEOFF}}$ = GND                                                      |     |                    | $\pm 25$  | $\mu$ A  |
|                 |                                             | V <sub>O</sub> = $\pm 12$ V, V <sub>CC</sub> = 3 V to 3.6 V                             |     |                    |           |          |
|                 |                                             | V <sub>O</sub> = $\pm 10$ V, V <sub>CC</sub> = 4.5 V to 5.5 V                           |     |                    | $\pm 25$  |          |

(1) Testing supply conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.15 V; C1–C4 = 0.22  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.3 V; and C1 = 0.047  $\mu$ F and C2–C4 = 0.33  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or 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 6](#))

| PARAMETER                                            | TEST CONDITIONS                                                    |                                                                                                                  | MIN | TYP <sup>(2)</sup> | MAX | UNIT       |
|------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----|--------------------|-----|------------|
| Maximum data rate<br>(see <a href="#">Figure 1</a> ) | R <sub>L</sub> = 3 k $\Omega$ ,<br>One DOUT switching              | C <sub>L</sub> = 1000 pF                                                                                         |     | 250                |     | kbit/s     |
|                                                      |                                                                    | C <sub>L</sub> = 250 pF, V <sub>CC</sub> = 3 V to 4.5 V                                                          |     | 1000               |     |            |
|                                                      |                                                                    | C <sub>L</sub> = 1000 pF, V <sub>CC</sub> = 4.5 V to 5.5 V                                                       |     | 1000               |     |            |
| t <sub>sk(p)</sub>                                   | Pulse skew <sup>(3)</sup>                                          | C <sub>L</sub> = 150 pF to 2500 pF, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ , See <a href="#">Figure 2</a> |     | 25                 |     | ns         |
| SR(tr)                                               | Slew rate,<br>transition region<br>(see <a href="#">Figure 1</a> ) | C <sub>L</sub> = 150 pF to 1000 pF, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ , V <sub>CC</sub> = 3.3 V      |     | 18                 | 150 | V/ $\mu$ s |

(1) Testing supply conditions are C1–C4 = 0.1  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.15 V; C1–C4 = 0.22  $\mu$ F at V<sub>CC</sub> = 3.3 V  $\pm$  0.3 V; and C1 = 0.047  $\mu$ F and C2–C4 = 0.33  $\mu$ F at V<sub>CC</sub> = 5 V  $\pm$  0.5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or 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

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

## RECEIVER SECTION

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

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 6](#))

| PARAMETER        |                                                         | TEST CONDITIONS                | MIN                   | TYP <sup>(2)</sup>    | MAX | UNIT |
|------------------|---------------------------------------------------------|--------------------------------|-----------------------|-----------------------|-----|------|
| V <sub>OH</sub>  | High-level output voltage                               | I <sub>OH</sub> = –1 mA        | V <sub>CC</sub> – 0.6 | V <sub>CC</sub> – 0.1 |     | 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> = 3.3 V        |                       | 1.5                   | 2.4 | V    |
|                  |                                                         | V <sub>CC</sub> = 5 V          |                       | 1.8                   | 2.4 |      |
| V <sub>IT–</sub> | Negative-going input threshold voltage                  | V <sub>CC</sub> = 3.3 V        | 0.6                   | 1.2                   |     | V    |
|                  |                                                         | V <sub>CC</sub> = 5 V          | 0.8                   | 1.5                   |     |      |
| V <sub>hys</sub> | Input hysteresis (V <sub>IT+</sub> – V <sub>IT–</sub> ) |                                |                       | 0.3                   |     | V    |
| I <sub>OZ</sub>  | Output leakage current (except ROUT1B)                  | FORCEOFF = 0 V                 |                       | ±0.05                 | ±10 | μA   |
| r <sub>i</sub>   | Input resistance                                        | V <sub>i</sub> = ±3 V to ±25 V | 3                     | 5                     | 7   | kΩ   |

(1) Testing supply conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.15 V; C1–C4 = 0.22 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; and C1 = 0.047 μF and C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or 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)

| PARAMETER          |                                                   | TEST CONDITIONS                                                              | TYP <sup>(2)</sup> | UNIT |
|--------------------|---------------------------------------------------|------------------------------------------------------------------------------|--------------------|------|
| t <sub>PLH</sub>   | Propagation delay time, low- to high-level output | C <sub>L</sub> = 150 pF, See <a href="#">Figure 3</a>                        | 150                | ns   |
| t <sub>PHL</sub>   | Propagation delay time, high- to low-level output | C <sub>L</sub> = 150 pF, See <a href="#">Figure 3</a>                        | 150                | ns   |
| t <sub>en</sub>    | Output enable time                                | C <sub>L</sub> = 150 pF, R <sub>L</sub> = 3 kΩ, See <a href="#">Figure 4</a> | 200                | ns   |
| t <sub>dis</sub>   | Output disable time                               | C <sub>L</sub> = 150 pF, R <sub>L</sub> = 3 kΩ, See <a href="#">Figure 4</a> | 200                | ns   |
| t <sub>sk(p)</sub> | Pulse skew <sup>(3)</sup>                         | See <a href="#">Figure 3</a>                                                 | 50                 | ns   |

(1) Testing supply conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.15 V; C1–C4 = 0.22 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; and C1 = 0.047 μF and C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or 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

| PARAMETER | TEST CONDITIONS                  | TYP | UNIT |
|-----------|----------------------------------|-----|------|
| RIN       | HBM                              | ±15 | kV   |
|           | IEC 61000-4-2, Air-Gap Discharge | ±15 |      |
|           | IEC 61000-4-2, Contact Discharge | ±8  |      |

**TRSF3238E**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH  $\pm 15$ -kV ESD (HBM) PROTECTION**

SLLS826 – AUGUST 2007

## AUTO-POWERDOWN PLUS SECTION

### Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 5](#))

| PARAMETER        |                                                                             | TEST CONDITIONS                                                  | MIN            | MAX | UNIT |
|------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------|----------------|-----|------|
| $V_{T+(valid)}$  | Receiver input threshold for $\overline{INVALID}$ high-level output voltage | FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$                    |                | 2.7 | V    |
| $V_{T-(valid)}$  | Receiver input threshold for $\overline{INVALID}$ high-level output voltage | FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$                    | -2.7           |     | V    |
| $V_{T(invalid)}$ | Receiver input threshold for $\overline{INVALID}$ low-level output voltage  | FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$                    | -0.3           | 0.3 | V    |
| $V_{OH}$         | $\overline{INVALID}$ high-level output voltage                              | $I_{OH} = -1$ mA, FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$  | $V_{CC} - 0.6$ |     | V    |
| $V_{OL}$         | $\overline{INVALID}$ low-level output voltage                               | $I_{OL} = 1.6$ mA, FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$ |                | 0.4 | V    |

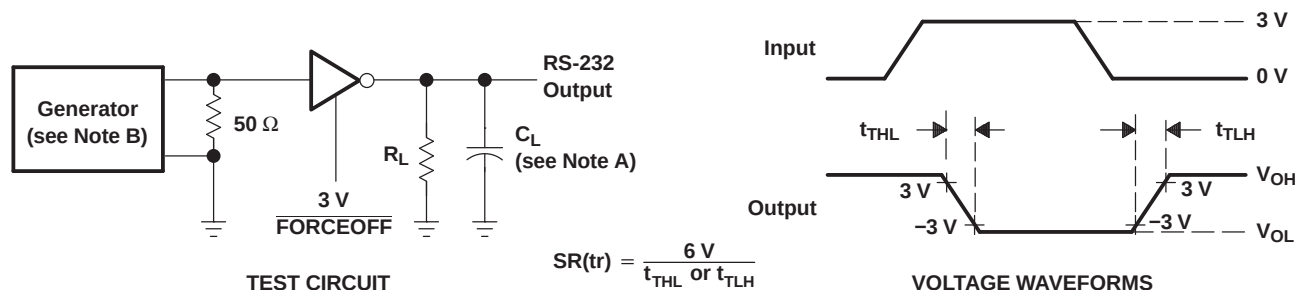
### Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 5](#))

| PARAMETER     |                                                   | MIN | TYP <sup>(1)</sup> | MAX | UNIT    |
|---------------|---------------------------------------------------|-----|--------------------|-----|---------|
| $t_{valid}$   | Propagation delay time, low- to high-level output |     | 0.1                |     | $\mu$ s |
| $t_{invalid}$ | Propagation delay time, high- to low-level output |     | 50                 |     | $\mu$ s |
| $t_{en}$      | Supply enable time                                |     | 25                 |     | $\mu$ s |
| $t_{dis}$     | Receiver or driver edge to auto-powerdown plus    | 15  | 30                 | 60  | s       |

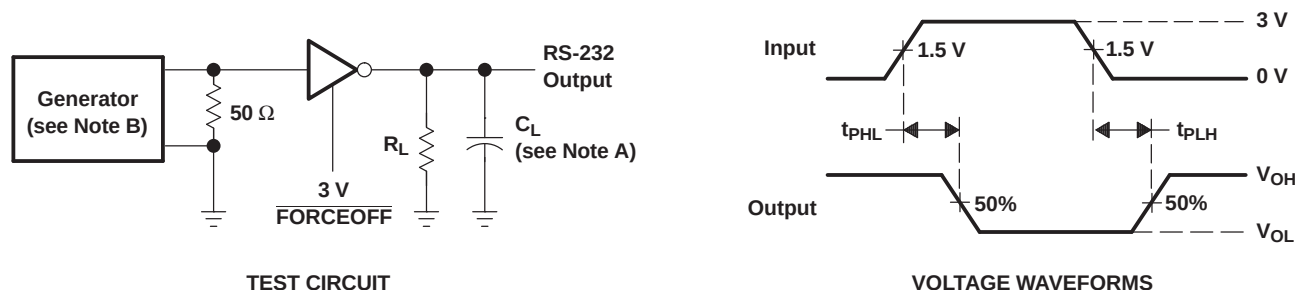
(1) All typical values are at  $V_{CC} = 3.3$  V or  $V_{CC} = 5$  V, and  $T_A = 25^\circ\text{C}$ .

## PARAMETER MEASUREMENT INFORMATION



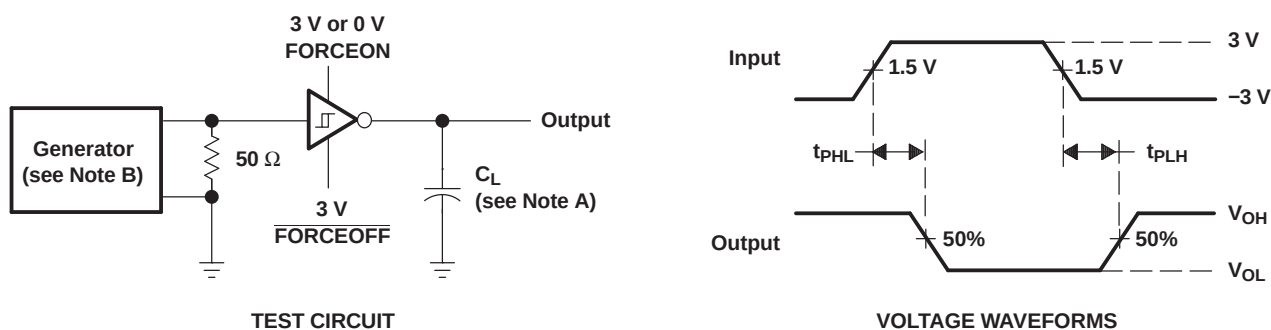
- A.  $C_L$  includes probe and jig capacitance.
- B. The pulse generator has the following characteristics: PRR = 250 kbit/s,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns.

Figure 1. Driver Slew Rate



- 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,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns.

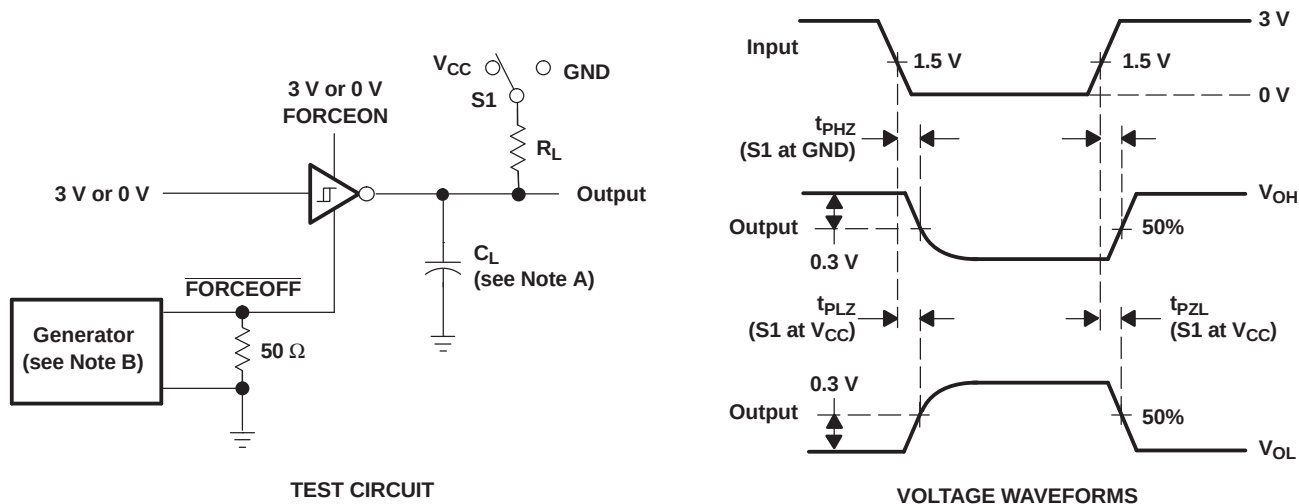
Figure 2. Driver Pulse Skew



- A.  $C_L$  includes probe and jig capacitance.
- B. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns.

Figure 3. Receiver Propagation Delay Times

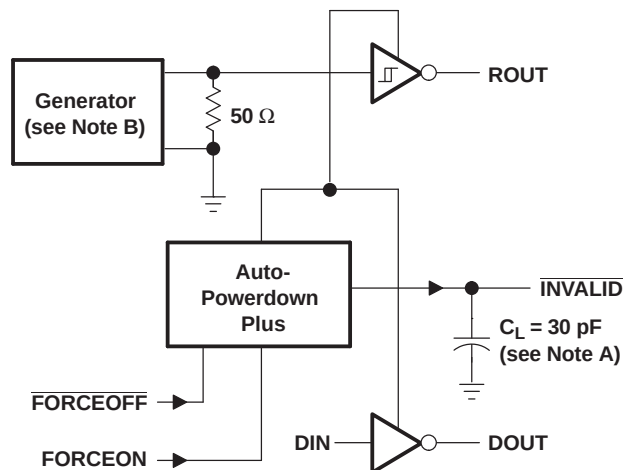
**PARAMETER MEASUREMENT INFORMATION (continued)**



- A.  $C_L$  includes probe and jig capacitance.
- B. The pulse generator has the following characteristics:  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\ \text{ns}$ ,  $t_f \leq 10\ \text{ns}$ .
- C.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- D.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .

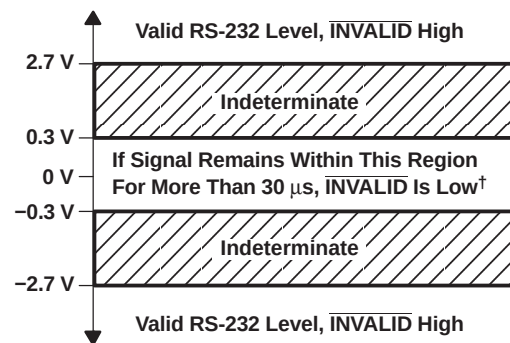
**Figure 4. Receiver Enable and Disable Times**

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics: PRR = 5 kbit/s,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10 \text{ ns}$ ,  $t_f \leq 10 \text{ ns}$ .



<sup>†</sup> Auto-powerdown plus disables drivers and reduces supply current to 1  $\mu\text{A}$ .

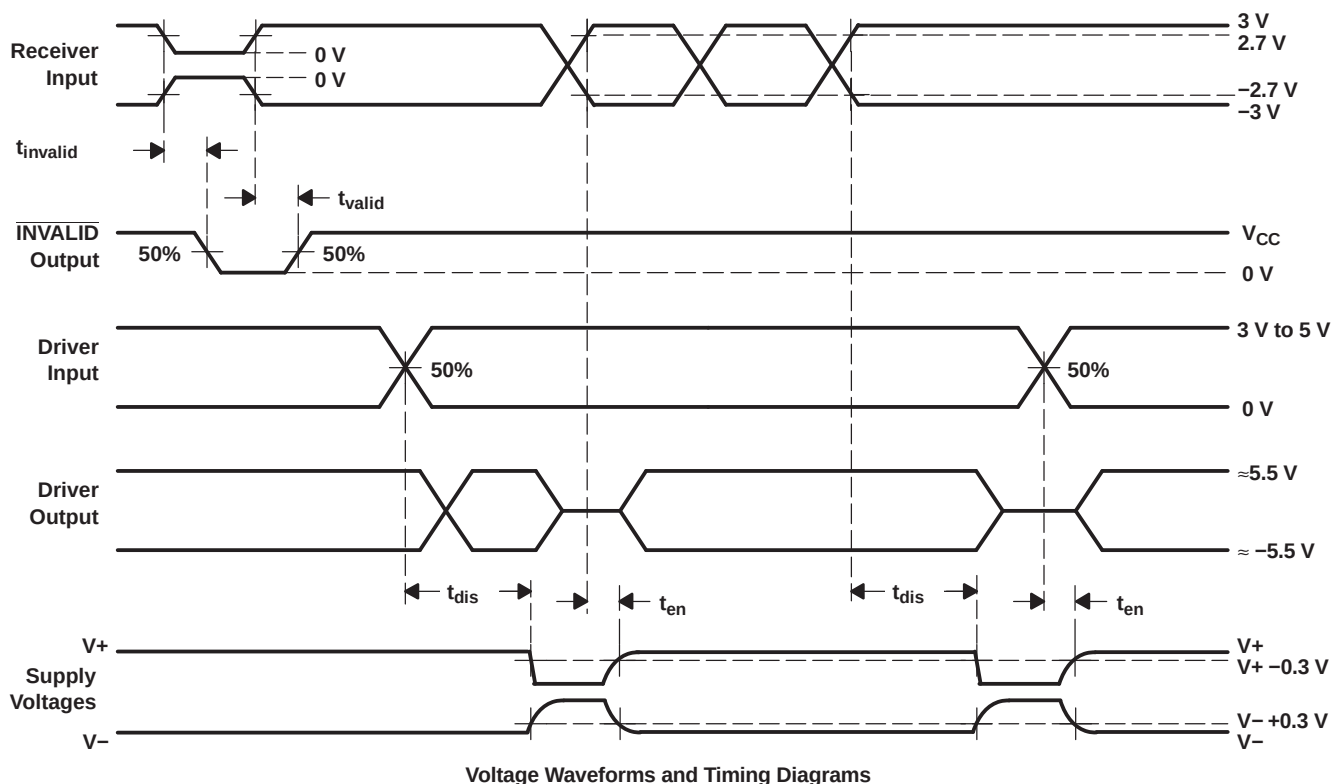


Figure 5.  $\overline{\text{INVALID}}$  Propagation-Delay Times and Supply-Enabling Time

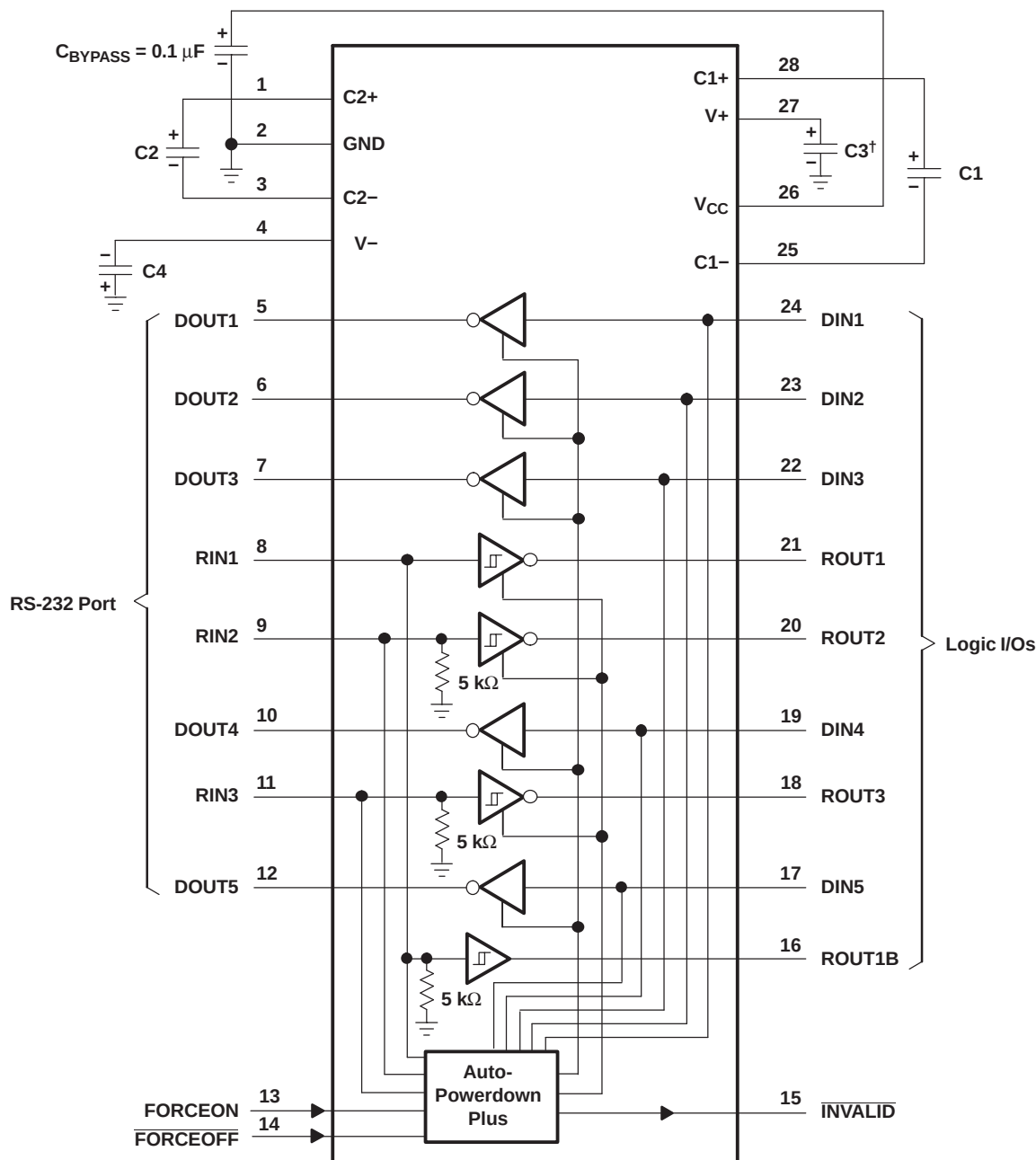
# TRSF3238E

## 3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

### WITH $\pm 15$ -kV ESD (HBM) PROTECTION

SLLS826 – AUGUST 2007

#### APPLICATION INFORMATION



V<sub>CC</sub> vs CAPACITOR VALUES

| V <sub>CC</sub>    | C1            | C2, C3, and C4 |
|--------------------|---------------|----------------|
| 3.3 V $\pm$ 0.15 V | 0.1 $\mu$ F   | 0.1 $\mu$ F    |
| 3.3 V $\pm$ 0.3 V  | 0.22 $\mu$ F  | 0.22 $\mu$ F   |
| 5 V $\pm$ 0.5 V    | 0.047 $\mu$ F | 0.33 $\mu$ F   |
| 3 V to 5.5 V       | 0.22 $\mu$ F  | 1 $\mu$ F      |

<sup>†</sup> C3 can be connected to V<sub>CC</sub> 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 6. Typical Operating Circuit and Capacitor Values**

## 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="#">TRSF3238EIDBR</a> | Active        | Production           | SSOP (DB)   28 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TRSF3238EI          |
| TRSF3238EIDBR.B               | Active        | Production           | SSOP (DB)   28 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TRSF3238EI          |
| <a href="#">TRSF3238EIDWR</a> | Active        | Production           | SOIC (DW)   28 | 1000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TRSF3238EI          |
| TRSF3238EIDWR.A               | Active        | Production           | SOIC (DW)   28 | 1000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TRSF3238EI          |
| TRSF3238EIDWR.B               | Active        | Production           | SOIC (DW)   28 | 1000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TRSF3238EI          |

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

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

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

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

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

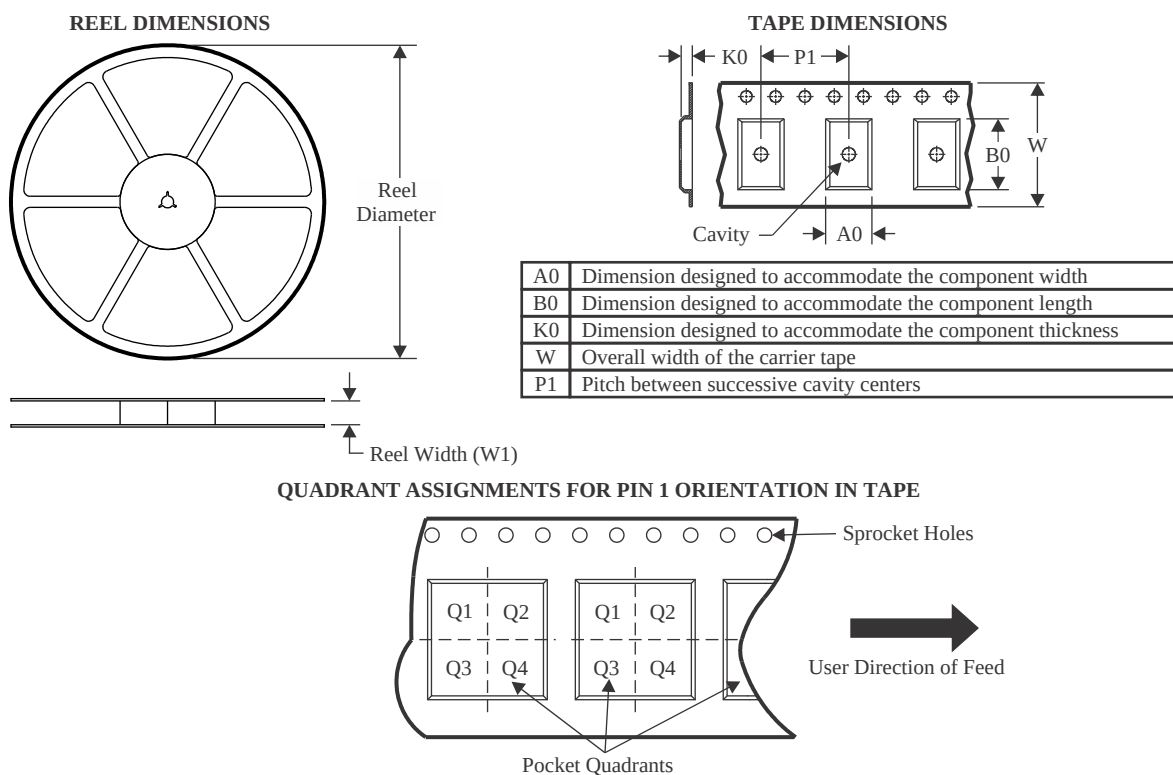
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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

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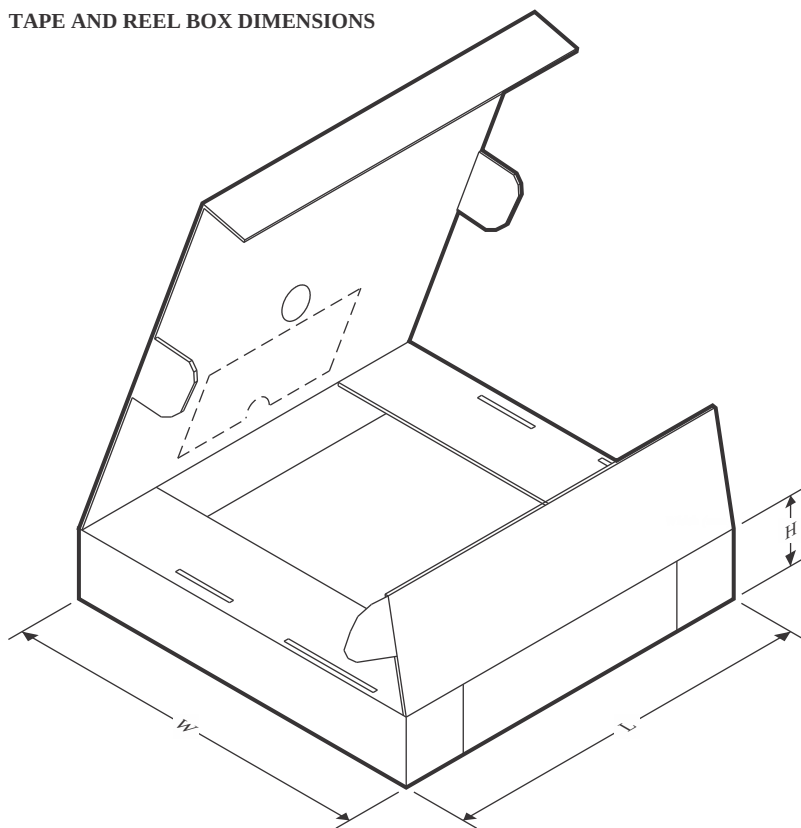
## TAPE AND REEL INFORMATION



\*All dimensions are nominal

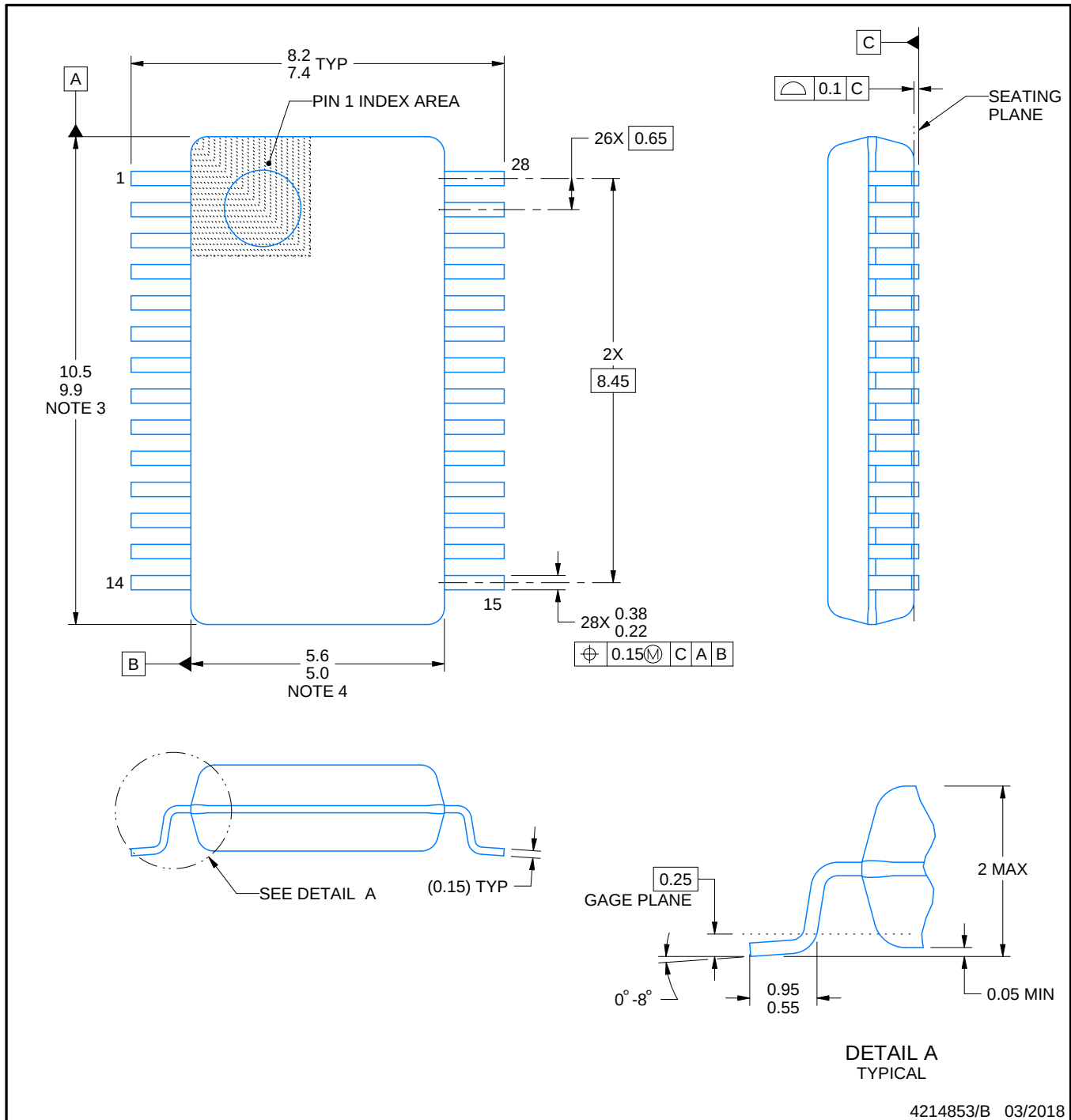
| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TRSF3238EIDBR | SSOP         | DB              | 28   | 2000 | 330.0              | 16.4               | 8.45    | 10.55   | 2.5     | 12.0    | 16.2   | Q1            |
| TRSF3238EIDWR | SOIC         | DW              | 28   | 1000 | 330.0              | 32.4               | 11.35   | 18.67   | 3.1     | 16.0    | 32.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TRSF3238EIDBR | SSOP         | DB              | 28   | 2000 | 356.0       | 356.0      | 35.0        |
| TRSF3238EIDWR | SOIC         | DW              | 28   | 1000 | 350.0       | 350.0      | 66.0        |



## NOTES:

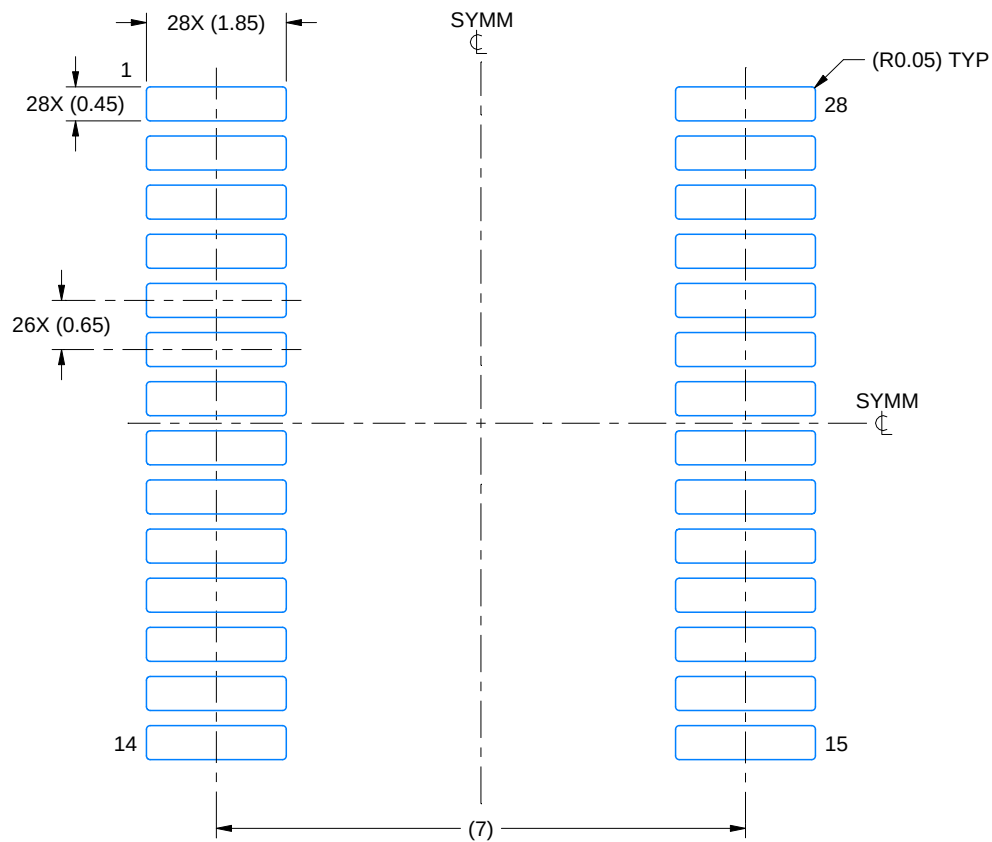
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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-150.

# EXAMPLE BOARD LAYOUT

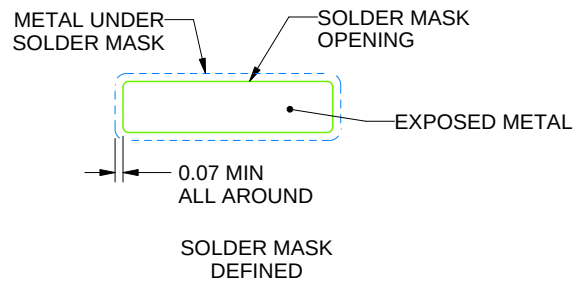
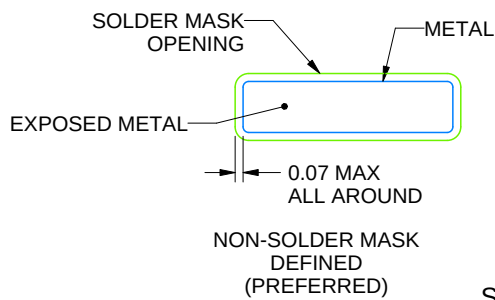
DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4214853/B 03/2018

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

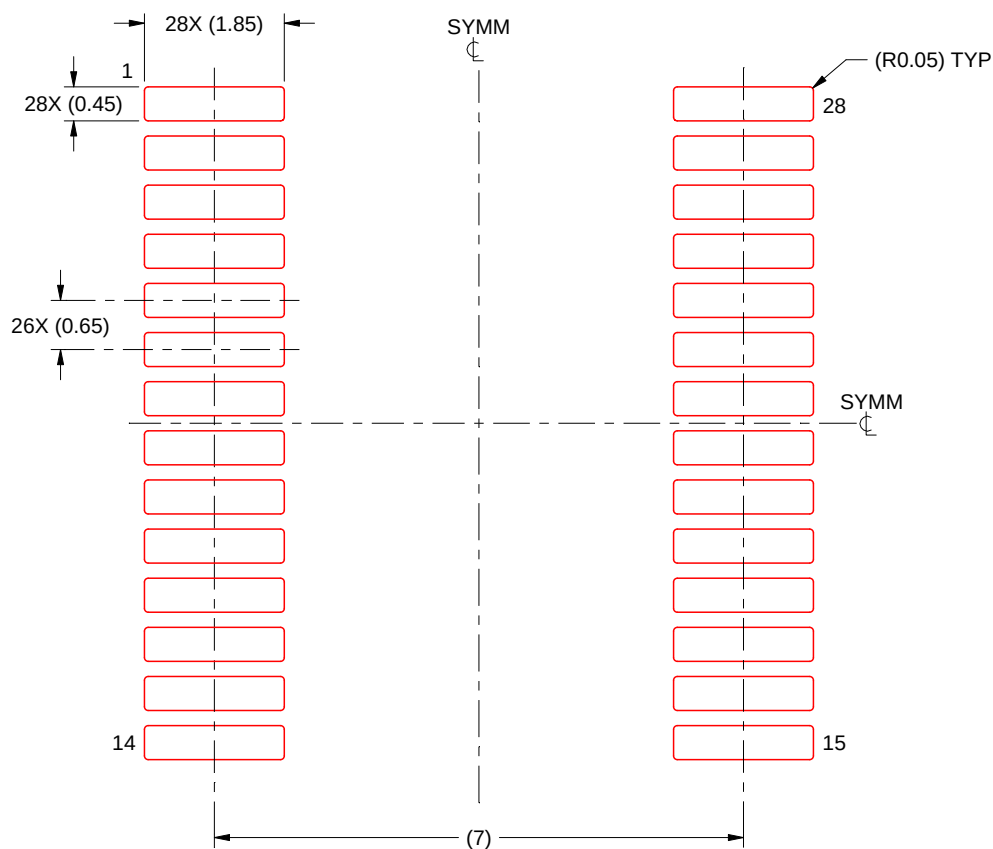
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



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

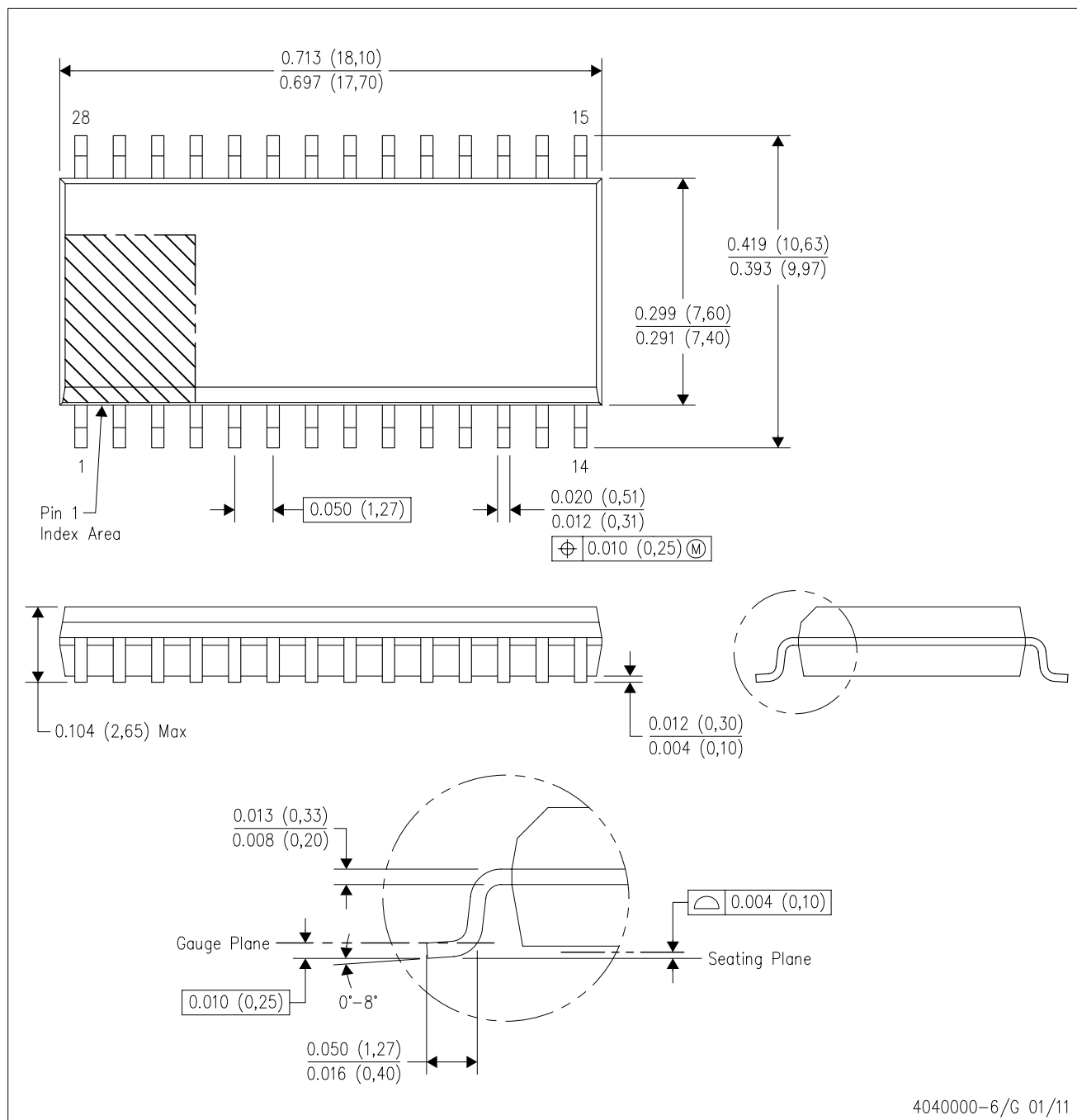
4214853/B 03/2018

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.

DW (R-PDSO-G28)

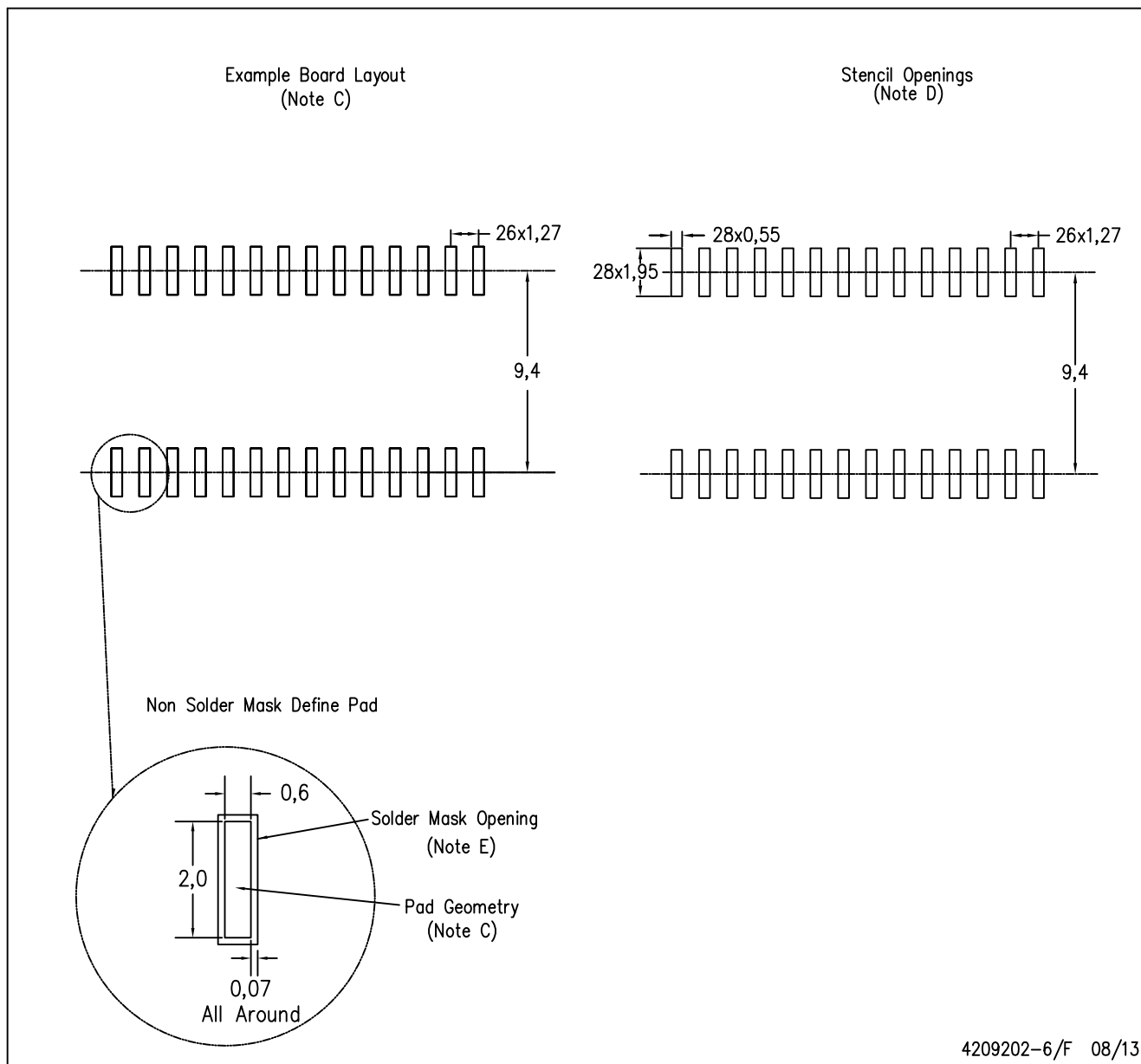
PLASTIC SMALL OUTLINE



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

DW (R-PDSO-G28)

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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