

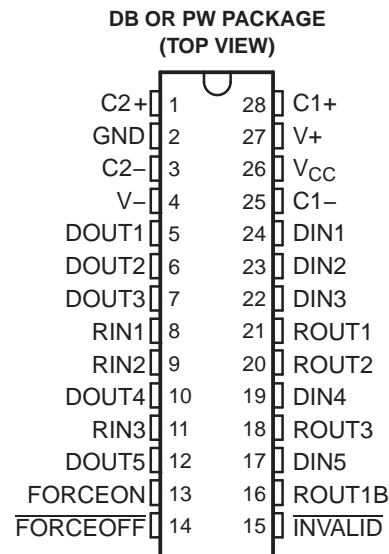


# THE DATASHEET OF TRS3238CDBRG4



## 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 250 kbit/s
- Five Drivers and Three Receivers
- Low Standby Current . . . 1  $\mu$ A Typical
- External Capacitors . . .  $4 \times 0.1 \mu$ F
- Accepts 5-V Logic Input With 3.3-V Supply
- Always-Active Noninverting Receiver Output (ROUT1B)
- Alternative High-Speed Pin-Compatible Device (1 Mbit/s)  
– TRSF3238



## APPLICATIONS

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

## DESCRIPTION/ORDERING INFORMATION

The TRS3238 consists of five line drivers, three line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD (HBM) protection pin to pin (serial-port connection pins, including GND). The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between 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 TRS3238 operates at data signaling rates up to 250 kbit/s and a maximum of 30-V/ $\mu$ s driver output slew rate.

Flexible control options for power management are featured when the serial port and driver inputs are inactive. The auto-powerdown plus feature functions when FORCEON is low and 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  $\mu$ 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 FORCEON and FORCEOFF are high. With auto-powerdown plus enabled, the device activates automatically when a valid signal is applied to any receiver or driver input. 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  $\mu$ s. INVALID is low (invalid data) if all receiver input voltages are between  $-0.3$  V and 0.3 V for more than 30  $\mu$ s. Refer to Figure 5 for receiver input levels.



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.

**TRS3238**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH ±15-kV ESD (HBM) PROTECTION**



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**ORDERING INFORMATION**

| T <sub>A</sub> | PACKAGE <sup>(1)(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|---------------------------|--------------|-----------------------|------------------|
| 0°C to 70°C    | SSOP – DB                 | Tube of 50   | TRS3238CDB            | TRS3238C         |
|                |                           | Reel of 2000 | TRS3238CDBR           |                  |
|                | TSSOP – PW                | Tube of 50   | TRS3238CPW            | RS38C            |
|                |                           | Reel of 2000 | TRS3238CPWR           |                  |
| –40°C to 85°C  | SSOP – DB                 | Tube of 50   | TRS3238IDB            | TRS3238I         |
|                |                           | Reel of 2000 | TRS3238IDBR           |                  |
|                | TSSOP – PW                | Tube of 50   | TRS3238IPW            | TRS38I           |
|                |                           | Reel of 2000 | TRS3238IPWR           |                  |

- (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).

**FUNCTION TABLES**

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

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

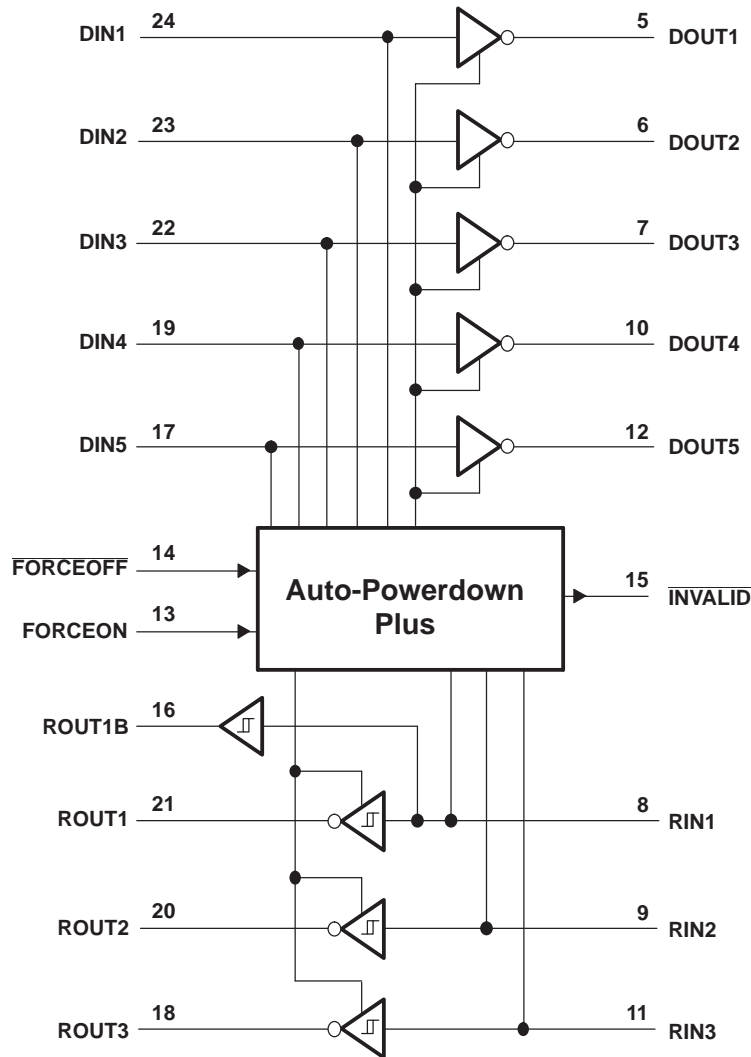
- (1) H = high level, L = low level, X = irrelevant, Z = high impedance

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

| INPUTS |           |          |   | OUTPUTS |      | RECEIVER STATUS  |
|--------|-----------|----------|---|---------|------|--|
| RIN1   | RIN2–RIN3 | FORCEOFF | TIME ELAPSED SINCE LAST RIN OR DIN TRANSITION | ROUT1B  | ROUT |  |
| L      | X         | L        |   | L       | Z    | Powered off while ROUT1B is active                         |
| H      | X         | L        |   | H       | Z    |  |
| L      | L         | H        |   | L       | H    | Normal operation with auto-powerdown plus disabled/enabled |
| L      | H         | H        |   | L       | L    |  |
| H      | L         | H        |   | H       | H    |  |
| H      | H         | H        |   | H       | L    |  |
| Open   | Open      | H        |   | L       | H    |  |

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

**LOGIC DIAGRAM (POSITIVE LOGIC)**



**TRS3238**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH ±15-kV ESD (HBM) PROTECTION**

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**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 (FORCEOFF, FORCEON) |                       | V    |
|                  |   | Receiver                   |                       |      |
| V <sub>O</sub>   | Output voltage range                                | Driver                     |                       | V    |
|                  |   | −13.2                      | 13.2                  |      |
|                  |   | −0.3                       | V <sub>CC</sub> + 0.3 |      |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(3)(4)</sup>         | DB package                 |                       | °C/W |
|                  |   | PW package                 |                       |      |
| 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(max)</sub>, θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J(max)</sub> − T<sub>A</sub>)/θ<sub>JA</sub>. 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 JESD 51-7.

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

See [Figure 6](#)

|  |   |   | MIN | NOM | MAX | UNIT |
|--|---|---|-----|-----|-----|------|
| Supply voltage                                       | $V_{CC} = 3.3\text{ V}$                     |   | 3   | 3.3 | 3.6 | V    |
|  | $V_{CC} = 5\text{ V}$                       |   | 4.5 | 5   | 5.5 |      |
| $V_{IH}$ Driver and control high-level input voltage | DIN, $\overline{\text{FORCEOFF}}$ , FORCEON | $V_{CC} = 3.3\text{ V}$                     | 2   |     | V   |      |
|  |   | $V_{CC} = 5\text{ V}$                       | 2.4 |     |     |      |
| $V_{IL}$ Driver and control low-level input voltage  | DIN, $\overline{\text{FORCEOFF}}$ , FORCEON |   |     |     | 0.8 | V    |
| $V_I$  | Driver and control input voltage            | DIN, $\overline{\text{FORCEOFF}}$ , FORCEON |     | 0   | 5.5 | V    |
|  | Receiver input voltage                      |   |     | -25 | 25  |      |
| $T_A$ Operating free-air temperature                 | TRS3238C                                    |   | 0   | 70  |     | °C   |
|  | TRS3238I                                    |   | -40 | 85  |     |      |

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

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

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

| PARAMETER |  | TEST CONDITIONS                        | MIN  | TYP <sup>(2)</sup> | MAX     | UNIT          |               |
|-----------|--|--|--|--------------------|---------|---------------|---------------|
| $I_I$     | Input leakage current                          | $\overline{\text{FORCEOFF}}$ , FORCEON |  | $\pm 0.01$         | $\pm 1$ | $\mu\text{A}$ |               |
| $I_{CC}$  | Supply current<br>( $T_A = 25^\circ\text{C}$ ) | Auto-powerdown plus disabled           | No load, $\overline{\text{FORCEOFF}}$ and FORCEON at $V_{CC}$                                    |                    | 0.5     | 2             | mA            |
|           |  | Powered off                            | No load, $\overline{\text{FORCEOFF}}$ at GND   |                    | 1       | 10            |               |
|           |  | Auto-powerdown plus enabled            | No load, $\overline{\text{FORCEOFF}}$ at $V_{CC}$ , FORCEON at GND, All RIN are open or grounded |                    | 1       | 10            | $\mu\text{A}$ |

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

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

**TRS3238**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH ±15-kV ESD (HBM) PROTECTION**

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**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 kΩ to GND                  | 5  | 5.4                |      | V    |
| V <sub>OL</sub>  | Low-level output voltage                    | All DOUT at R <sub>L</sub> = 3 kΩ to GND                  | –5   | –5.4               |      | V    |
| I <sub>IH</sub>  | High-level input current                    | V <sub>I</sub> = V <sub>CC</sub>                          |  | ±0.01              | ±1   | μA   |
| I <sub>IL</sub>  | Low-level input current                     | V <sub>I</sub> at GND                                     |  | ±0.01              | ±1   | μA   |
| I <sub>OS</sub>  | Short-circuit output current <sup>(3)</sup> | V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 0 V             |  | ±35                | ±60  | mA   |
|                  |   | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0 V             |  | ±40                | ±100 |      |
| r <sub>o</sub>   | Output resistance                           | V <sub>CC</sub> , V+, and V– = 0 V, V <sub>O</sub> = ±2 V | 300  | 10M                |      | Ω    |
| I <sub>off</sub> | Output leakage current                      | FORCEOFF = GND  | V <sub>O</sub> = ±12 V, V <sub>CC</sub> = 3 V to 3.6 V   |                    | ±25  | μA   |
|                  |   |   | V <sub>O</sub> = ±10 V, V <sub>CC</sub> = 4.5 V to 5.5 V |                    | ±25  |      |

- (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) 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   | C <sub>L</sub> = 1000 pF, R <sub>L</sub> = 3 kΩ,<br>One DOUT switching, See <a href="#">Figure 1</a> | 150 | 250                |     | kbit/s |
| t <sub>sk(p)</sub> | Pulse skew <sup>(3)</sup>                                       | C <sub>L</sub> = 150 pF to 2500 pF, R <sub>L</sub> = 3 kΩ to 7 kΩ,<br>See <a href="#">Figure 2</a>   |     | 100                |     | ns     |
| SR(tr)             | Slew rate, transition region<br>(see <a href="#">Figure 1</a> ) | V <sub>CC</sub> = 3.3 V, C <sub>L</sub> = 150 pF to 1000 pF  | 6   |                    | 30  | V/μs   |
|                    |   | R <sub>L</sub> = 3 kΩ to 7 kΩ, C <sub>L</sub> = 150 pF to 2500 pF                                    | 4   |                    | 30  |        |

- (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.

## 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>OH</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>off</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,<br>See <a href="#">Figure 4</a> | R <sub>L</sub> = 3 kΩ,                              | 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.

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

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**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,<br>$\overline{FORCEOFF} = V_{CC}$  | FORCEON = GND,                 | $V_{CC} - 0.6$ |     | V    |
| $V_{OL}$         | $\overline{INVALID}$ low-level output voltage                               | $I_{OH} = 1.6$ mA,<br>$\overline{FORCEOFF} = V_{CC}$ | FORCEON = GND,                 |                | 0.4 | V    |

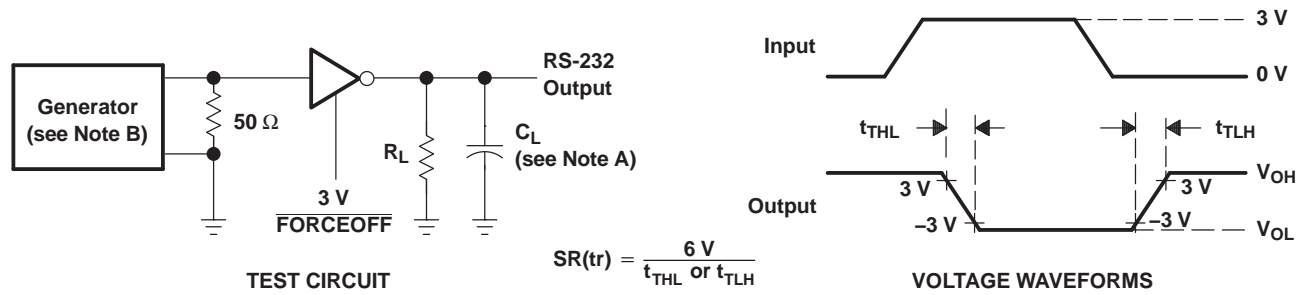
**Switching Characteristics**

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       |

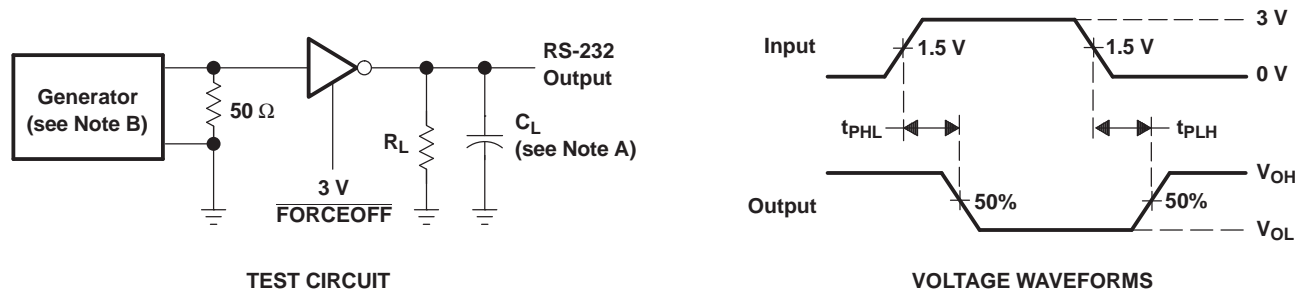
(1) All typical values are at  $V_{CC} = 3.3$  V or  $V_{CC} = 5$  V, and  $T_A = 25^\circ\text{C}$ .

PARAMETER MEASUREMENT INFORMATION



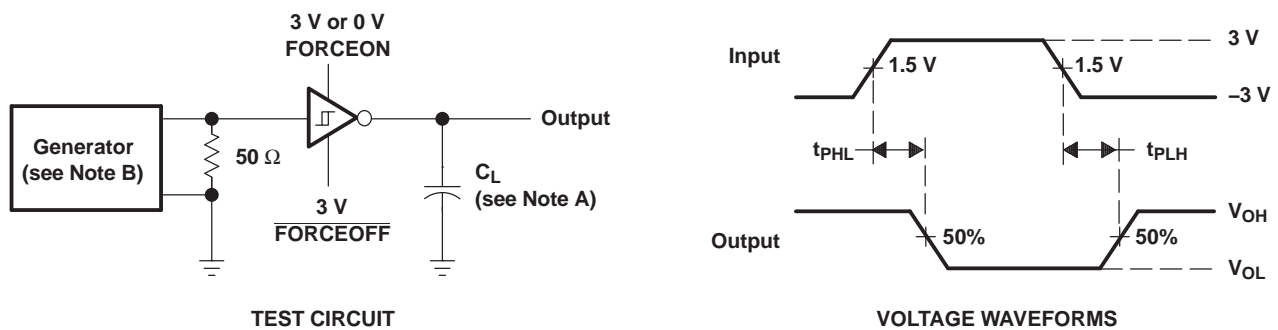
- A.  $C_L$  includes probe and jig capacitance.
- B. The pulse generator has the following characteristics: PRR = 250 kbit/s,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns.

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.

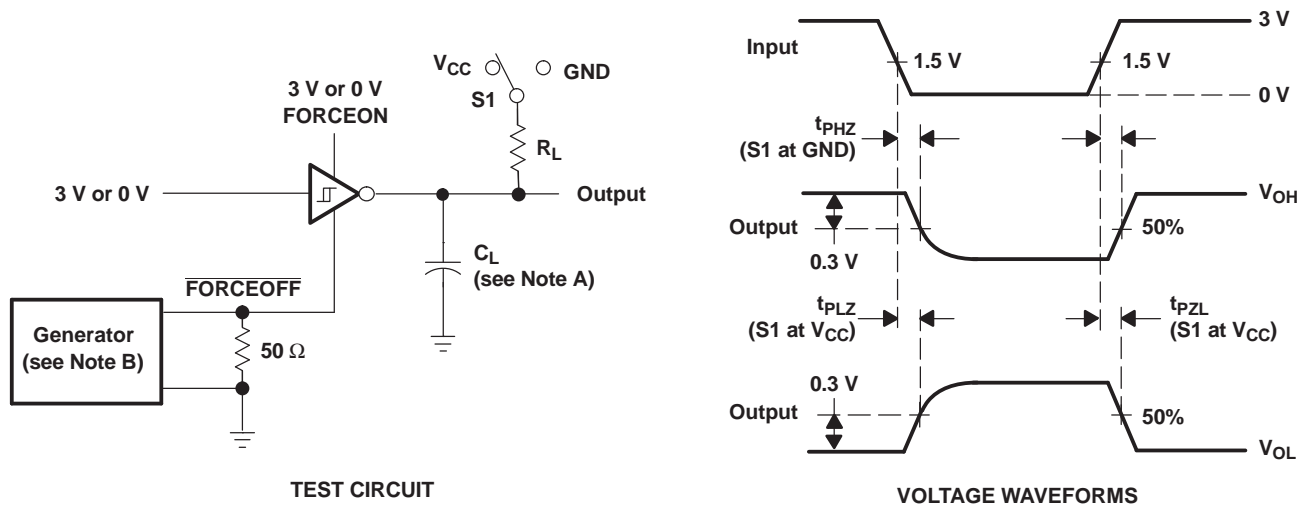
Figure 2. Driver Pulse Skew



- 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

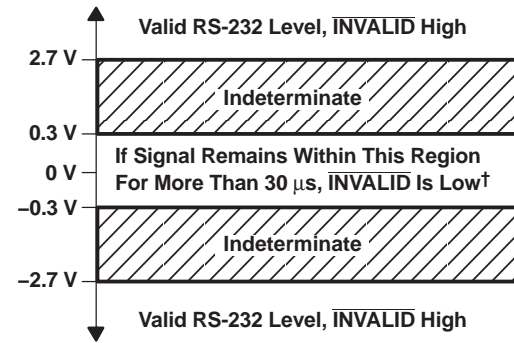
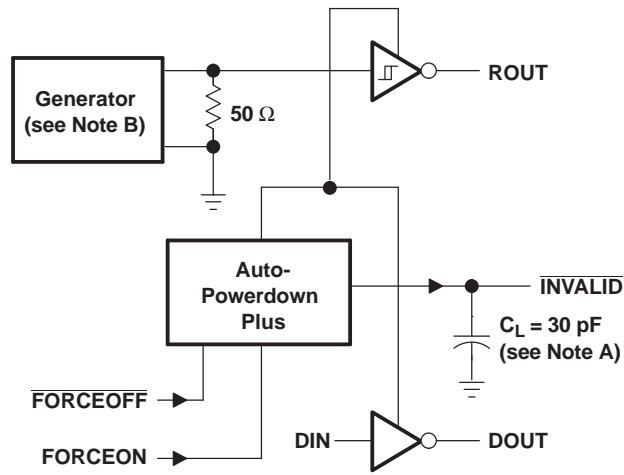
PARAMETER MEASUREMENT INFORMATION (continued)



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



† Auto-powerdown plus disables drivers and reduces supply current to 1  $\mu$ A.

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

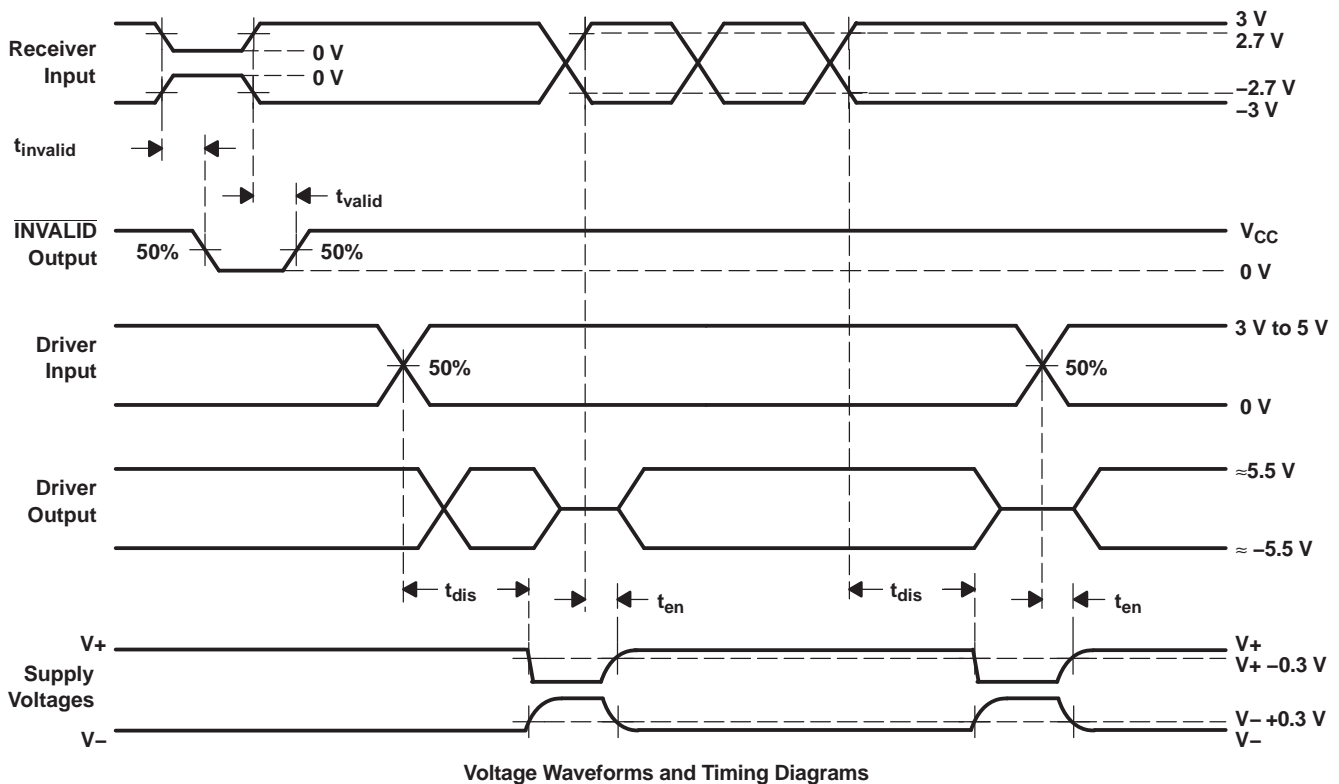
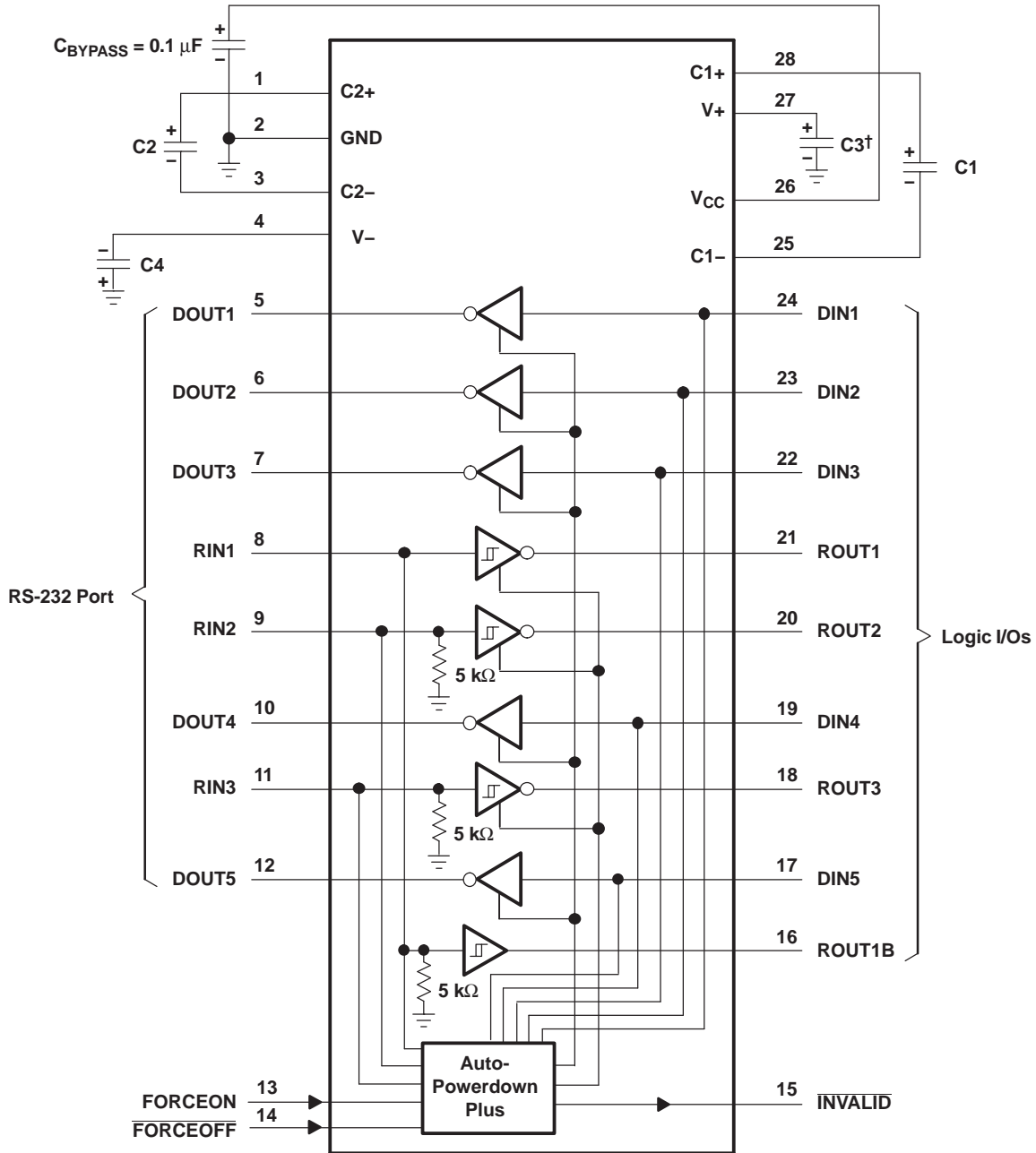


Figure 5.  $\overline{\text{INVALID}}$  Propagation-Delay Times and Supply-Enabling Time

APPLICATION INFORMATION



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

| V <sub>CC</sub> | C1       | C2, C3, and C4 |
|-----------------|----------|----------------|
| 3.3 V ± 0.15 V  | 0.1 μF   | 0.1 μF         |
| 3.3 V ± 0.3 V   | 0.22 μF  | 0.22 μF        |
| 5 V ± 0.5 V     | 0.047 μF | 0.33 μF        |
| 3 V to 5.5 V    | 0.22 μF  | 1 μF           |

† 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 Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login)          |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|--------------------------------------|
| TRS3238CDB       | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238CDBG4     | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238CDBR      | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238CDBRG4    | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238CPW       | ACTIVE                | TSSOP        | PW              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238CPWG4     | ACTIVE                | TSSOP        | PW              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238CPWR      | ACTIVE                | TSSOP        | PW              | 28   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           | <a href="#">Request Free Samples</a> |
| TRS3238CPWRG4    | ACTIVE                | TSSOP        | PW              | 28   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           | <a href="#">Request Free Samples</a> |
| TRS3238IDB       | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238IDBG4     | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238IDBR      | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238IDBRG4    | ACTIVE                | SSOP         | DB              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238IPW       | ACTIVE                | TSSOP        | PW              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238IPWG4     | ACTIVE                | TSSOP        | PW              | 28   |             | TBD                     | Call TI          | Call TI                      | <a href="#">Purchase Samples</a>     |
| TRS3238IPWR      | ACTIVE                | TSSOP        | PW              | 28   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           | <a href="#">Request Free Samples</a> |
| TRS3238IPWRG4    | ACTIVE                | TSSOP        | PW              | 28   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           | <a href="#">Request Free Samples</a> |

<sup>(1)</sup> 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.

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

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

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

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

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

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

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

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TRS3238CPWR | TSSOP        | PW              | 28   | 2000 | 330.0              | 16.4               | 6.9     | 10.2    | 1.8     | 12.0    | 16.0   | Q1            |
| TRS3238CPWR | TSSOP        | PW              | 28   | 2000 | 330.0              | 16.4               | 7.1     | 10.4    | 1.6     | 12.0    | 16.0   | Q1            |
| TRS3238IPWR | TSSOP        | PW              | 28   | 2000 | 330.0              | 16.4               | 6.9     | 10.2    | 1.8     | 12.0    | 16.0   | Q1            |
| TRS3238IPWR | TSSOP        | PW              | 28   | 2000 | 330.0              | 16.4               | 7.1     | 10.4    | 1.6     | 12.0    | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TRS3238CPWR | TSSOP        | PW              | 28   | 2000 | 346.0       | 346.0      | 33.0        |
| TRS3238CPWR | TSSOP        | PW              | 28   | 2000 | 346.0       | 346.0      | 33.0        |
| TRS3238IPWR | TSSOP        | PW              | 28   | 2000 | 346.0       | 346.0      | 33.0        |
| TRS3238IPWR | TSSOP        | PW              | 28   | 2000 | 346.0       | 346.0      | 33.0        |

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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