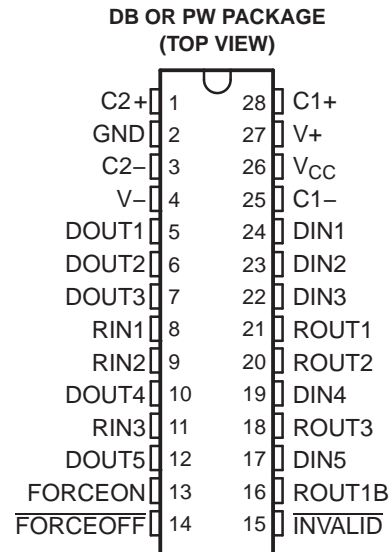


FEATURES

- RS-232 Bus-Pin ESD Protection Exceeds ± 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 μ 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 ± 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/ μ 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 μ 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 μ s. INVALID is low (invalid data) if all receiver input voltages are between -0.3 V and 0.3 V for more than 30 μ 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 _A | PACKAGE ⁽¹⁾⁽²⁾ | | 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.
- (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.

FUNCTION TABLES

Each Driver⁽¹⁾

| INPUTS | | | | OUTPUT DOUT | DRIVER STATUS |
|--------|---------|----------|---|-------------|---|
| DIN | FORCEON | FORCEOFF | TIME ELAPSED SINCE LAST RIN OR DIN TRANSITION | | |
| 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 | |

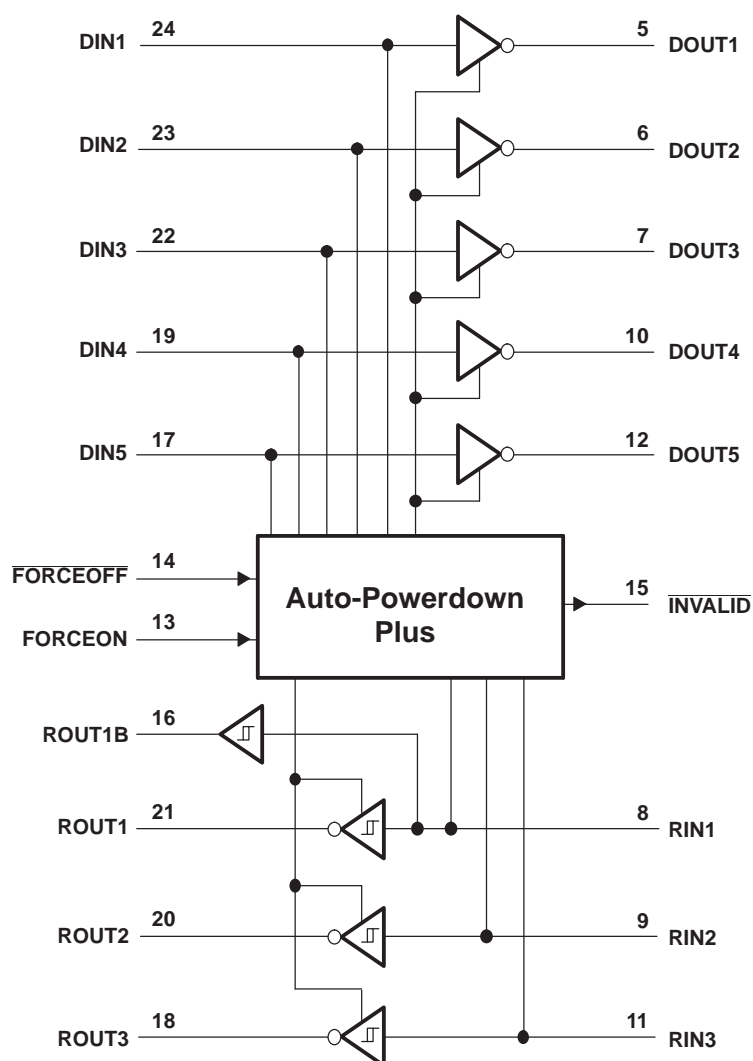
- (1) H = high level, L = low level, X = irrelevant, Z = high impedance

Each Receiver⁽¹⁾

| INPUTS | | | | OUTPUTS | | RECEIVER STATUS |
|--------|-----------|----------|---|---------|------|--|
| RIN1 | RIN2–RIN3 | FORCEOFF | TIME ELAPSED SINCE LAST RIN OR DIN TRANSITION | ROUT1B | ROUT | |
| L | X | L | X | L | Z | Powered off while ROUT1B is active |
| H | X | L | X | H | Z | |
| L | L | H | <30 s | L | H | Normal operation with auto-powerdown plus 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

LOGIC DIAGRAM (POSITIVE LOGIC)



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Absolute Maximum Ratings⁽¹⁾

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

| | | | MIN | MAX | UNIT |
|------------------|---|----------------------------|-------|-----------------------|------|
| V _{CC} | Supply voltage range ⁽²⁾ | | –0.3 | 6 | V |
| V+ | Positive output supply voltage range ⁽²⁾ | | –0.3 | 7 | V |
| V– | Negative output supply voltage range ⁽²⁾ | | 0.3 | –7 | V |
| V+ – V– | Supply voltage difference ⁽²⁾ | | | 13 | V |
| V _I | Input voltage range | Driver (FORCEOFF, FORCEON) | –0.3 | 6 | V |
| | | Receiver | –25 | 25 | |
| V _O | Output voltage range | Driver | –13.2 | 13.2 | V |
| | | Receiver (INVALID) | –0.3 | V _{CC} + 0.3 | |
| θ_{JA} | Package thermal impedance ⁽³⁾⁽⁴⁾ | DB package | | 62 | °C/W |
| | | PW package | | 62 | |
| T _J | Operating virtual junction temperature | | | 150 | °C |
| T _{stg} | Storage temperature range | | –65 | 150 | °C |

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

Recommended Operating Conditions⁽¹⁾

See [Figure 6](#)

| | | | | MIN | NOM | MAX | UNIT |
|-----------------|---|-------------------------|------------------------------------|-------------------------|-----|-----|------|
| Supply voltage | | V _{CC} = 3.3 V | | 3 | 3.3 | 3.6 | V |
| | | V _{CC} = 5 V | | 4.5 | 5 | 5.5 | |
| V _{IH} | Driver and control high-level input voltage | | DIN, FORCEOFF , FORCEON | V _{CC} = 3.3 V | 2 | | V |
| | | | | V _{CC} = 5 V | 2.4 | | |
| V _{IL} | Driver and control low-level input voltage | | DIN, FORCEOFF , FORCEON | | 0.8 | | V |
| V _I | Driver and control input voltage | | DIN, FORCEOFF , FORCEON | | 0 | | V |
| | Receiver input voltage | | | | -25 | | |
| T _A | Operating free-air temperature | | TRS3238C | | 0 | | °C |
| | | | TRS3238I | | -40 | | |

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

Electrical Characteristics⁽¹⁾

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

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

(1) Testing supply conditions are C1–C4 = 0.1 μF at $V_{CC} = 3.3\text{ V} \pm 0.15\text{ V}$; C1–C4 = 0.22 μF at $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$; and C1 = 0.047 μF and C2–C4 = 0.33 μF 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 $T_A = 25^\circ\text{C}$.

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DRIVER SECTION

Electrical Characteristics⁽¹⁾

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

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽²⁾ | MAX | UNIT |
|---|---|-----|--------------------|-----------|----------|
| V _{OH} High-level output voltage | All DOUT at R _L = 3 k Ω to GND | 5 | 5.4 | | V |
| V _{OL} Low-level output voltage | All DOUT at R _L = 3 k Ω to GND | –5 | –5.4 | | V |
| I _{IH} High-level input current | V _I = V _{CC} | | ± 0.01 | ± 1 | μ A |
| I _{IL} Low-level input current | V _I at GND | | ± 0.01 | ± 1 | μ A |
| I _{OS} Short-circuit output current ⁽³⁾ | V _{CC} = 3.6 V, V _O = 0 V | | ± 35 | ± 60 | mA |
| | V _{CC} = 5.5 V, V _O = 0 V | | ± 40 | ± 100 | |
| r _o Output resistance | V _{CC} , V+, and V– = 0 V, V _O = ± 2 V | 300 | 10M | | Ω |
| I _{off} Output leakage current | FORCEOFF = GND, V _O = ± 12 V, V _{CC} = 3 V to 3.6 V | | | ± 25 | μ A |
| | V _O = ± 10 V, V _{CC} = 4.5 V to 5.5 V | | | ± 25 | |

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

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 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⁽¹⁾

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

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽²⁾ | MAX | UNIT |
|--|---|-----|--------------------|-----|------------|
| Maximum data rate | C _L = 1000 pF, R _L = 3 k Ω , One DOUT switching, See Figure 1 | 150 | 250 | | kbit/s |
| t _{sk(p)} Pulse skew ⁽³⁾ | C _L = 150 pF to 2500 pF, R _L = 3 k Ω to 7 k Ω , See Figure 2 | | 100 | | ns |
| SR(tr) Slew rate, transition region (see Figure 1) | V _{CC} = 3.3 V, R _L = 3 k Ω to 7 k Ω , C _L = 150 pF to 1000 pF | 6 | | 30 | V/ μ s |
| | C _L = 150 pF to 2500 pF | 4 | | 30 | |

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

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

(3) Pulse skew is defined as |t_{PLH} – t_{PHL}| of each channel of the same device.

RECEIVER SECTION

Electrical Characteristics⁽¹⁾

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

| PARAMETER | | TEST CONDITIONS | MIN | TYP ⁽²⁾ | MAX | UNIT |
|------------------|---|--------------------------------|-----------------------|-----------------------|-----|------|
| V _{OH} | High-level output voltage | I _{OH} = –1 mA | V _{CC} – 0.6 | V _{CC} – 0.1 | | V |
| V _{OL} | Low-level output voltage | I _{OH} = 1.6 mA | | | 0.4 | V |
| V _{IT+} | Positive-going input threshold voltage | V _{CC} = 3.3 V | | 1.5 | 2.4 | V |
| | | V _{CC} = 5 V | | 1.8 | 2.4 | |
| V _{IT–} | Negative-going input threshold voltage | V _{CC} = 3.3 V | 0.6 | 1.2 | | V |
| | | V _{CC} = 5 V | 0.8 | 1.5 | | |
| V _{hys} | Input hysteresis (V _{IT+} – V _{IT–}) | | | 0.3 | | V |
| I _{off} | Output leakage current (except ROUT1B) | FORCEOFF = 0 V | | ±0.05 | ±10 | μA |
| r _I | Input resistance | V _I = ±3 V to ±25 V | 3 | 5 | 7 | kΩ |

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

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

Switching Characteristics⁽¹⁾

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

| PARAMETER | | TEST CONDITIONS | TYP ⁽²⁾ | UNIT |
|--------------------|---|--|--------------------|------|
| t _{PLH} | Propagation delay time, low- to high-level output | C _L = 150 pF, See Figure 3 | 150 | ns |
| t _{PHL} | Propagation delay time, high- to low-level output | C _L = 150 pF, See Figure 3 | 150 | ns |
| t _{en} | Output enable time | C _L = 150 pF, See Figure 4 , R _L = 3 kΩ, | 200 | ns |
| t _{dis} | Output disable time | C _L = 150 pF, R _L = 3 kΩ, See Figure 4 | 200 | ns |
| t _{sk(p)} | Pulse skew ⁽³⁾ | See Figure 3 | 50 | ns |

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

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

(3) Pulse skew is defined as |t_{PLH} – t_{PHL}| of each channel of the same device.

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

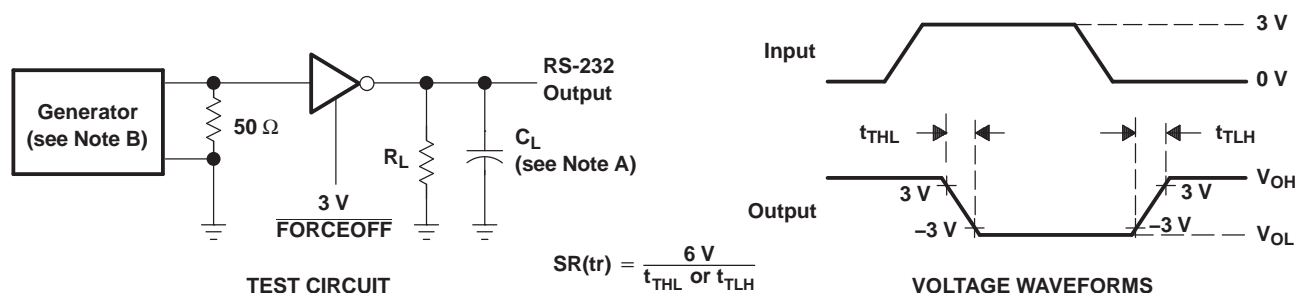
Switching Characteristics

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

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

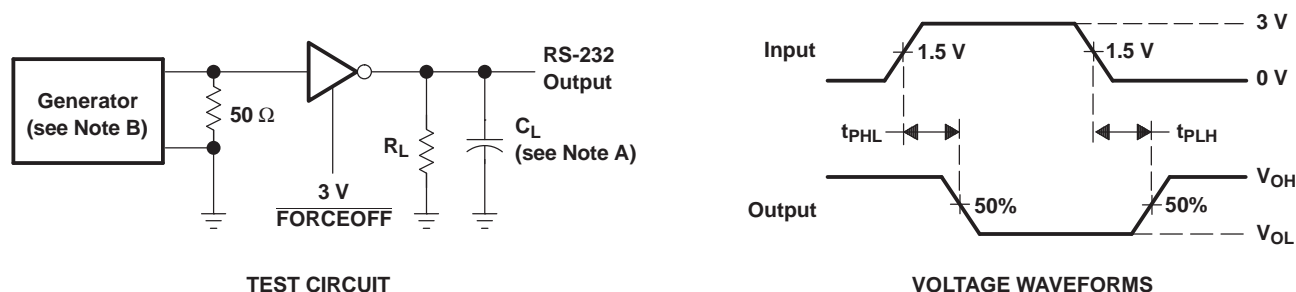
(1) All typical values are at $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION



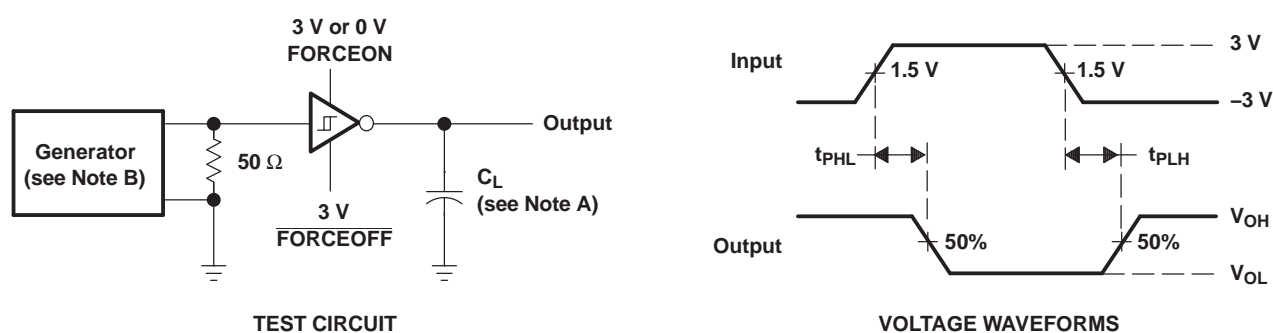
- A. C_L includes probe and jig capacitance.
- B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

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, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

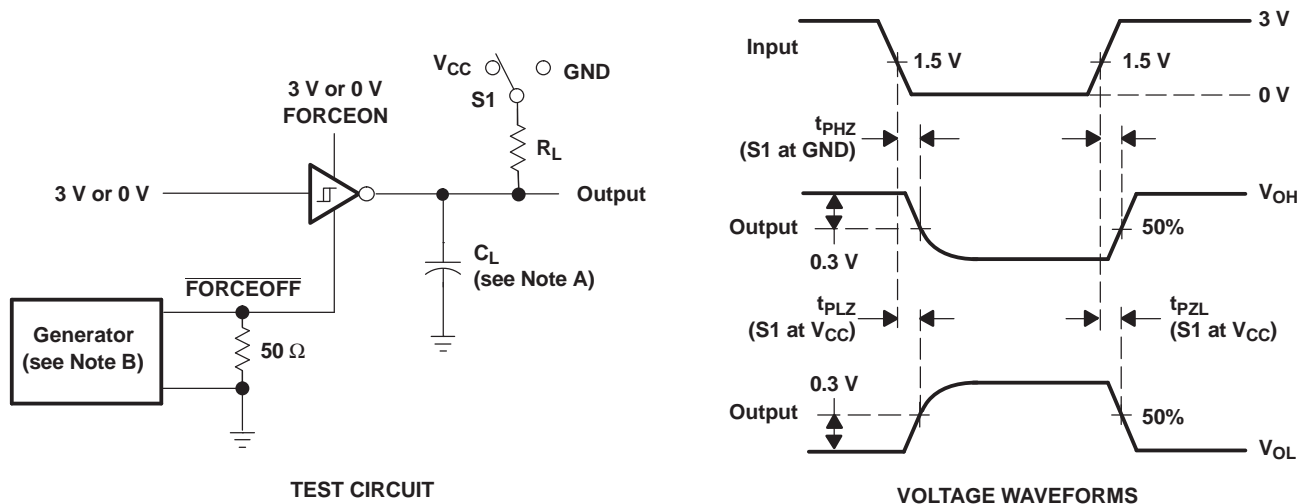
Figure 2. Driver Pulse Skew



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

Figure 3. Receiver Propagation Delay Times

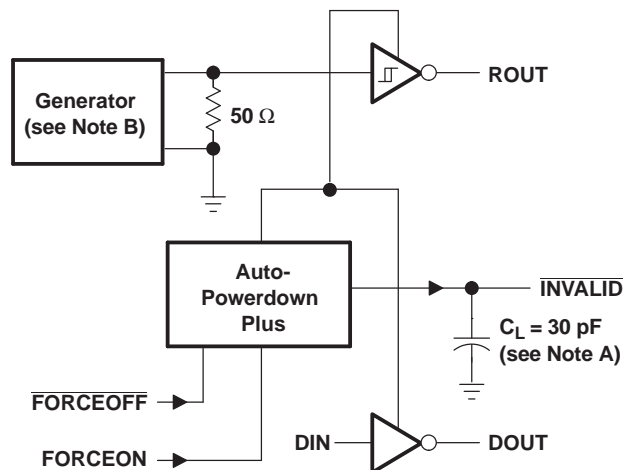
PARAMETER MEASUREMENT INFORMATION (continued)



- 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} .

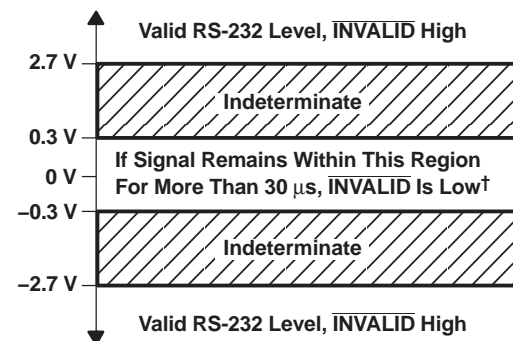
Figure 4. Receiver Enable and Disable Times

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



† Auto-powerdown plus disables drivers and reduces supply current to 1 μ A.

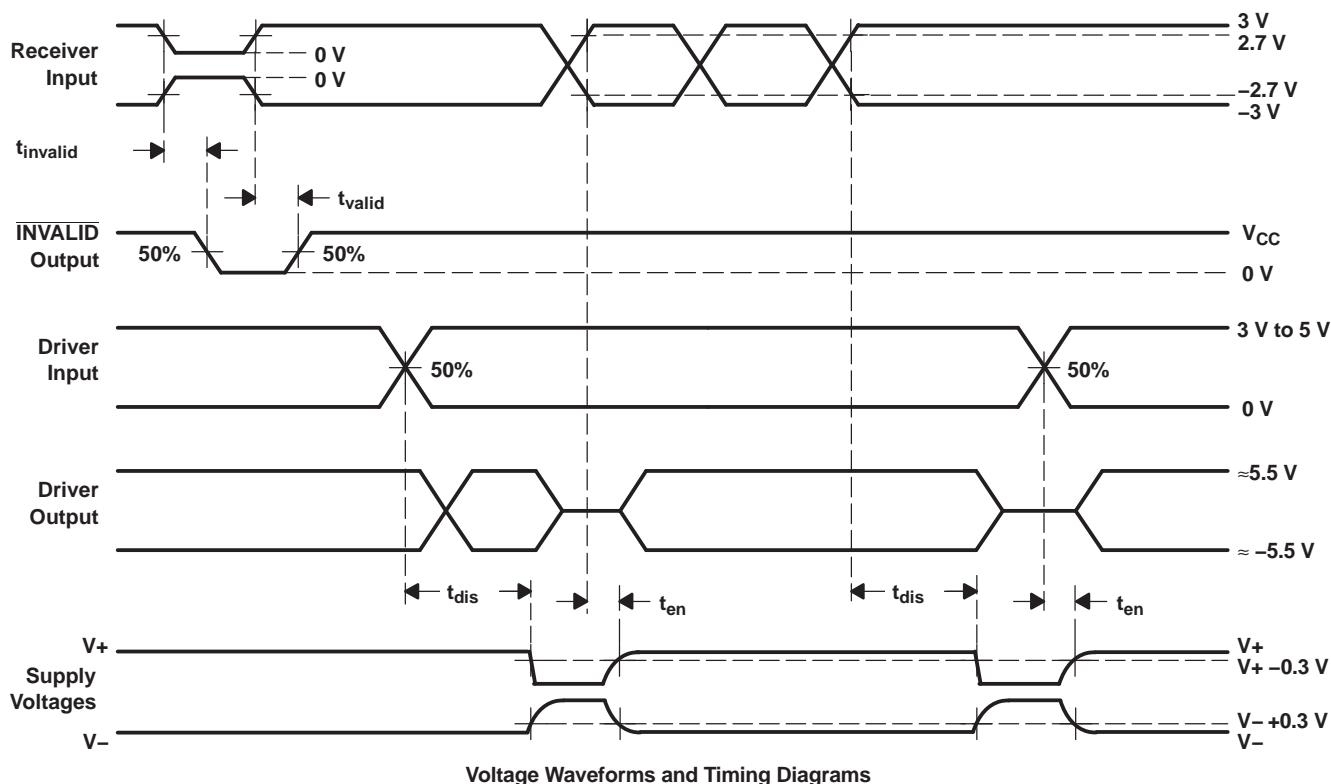
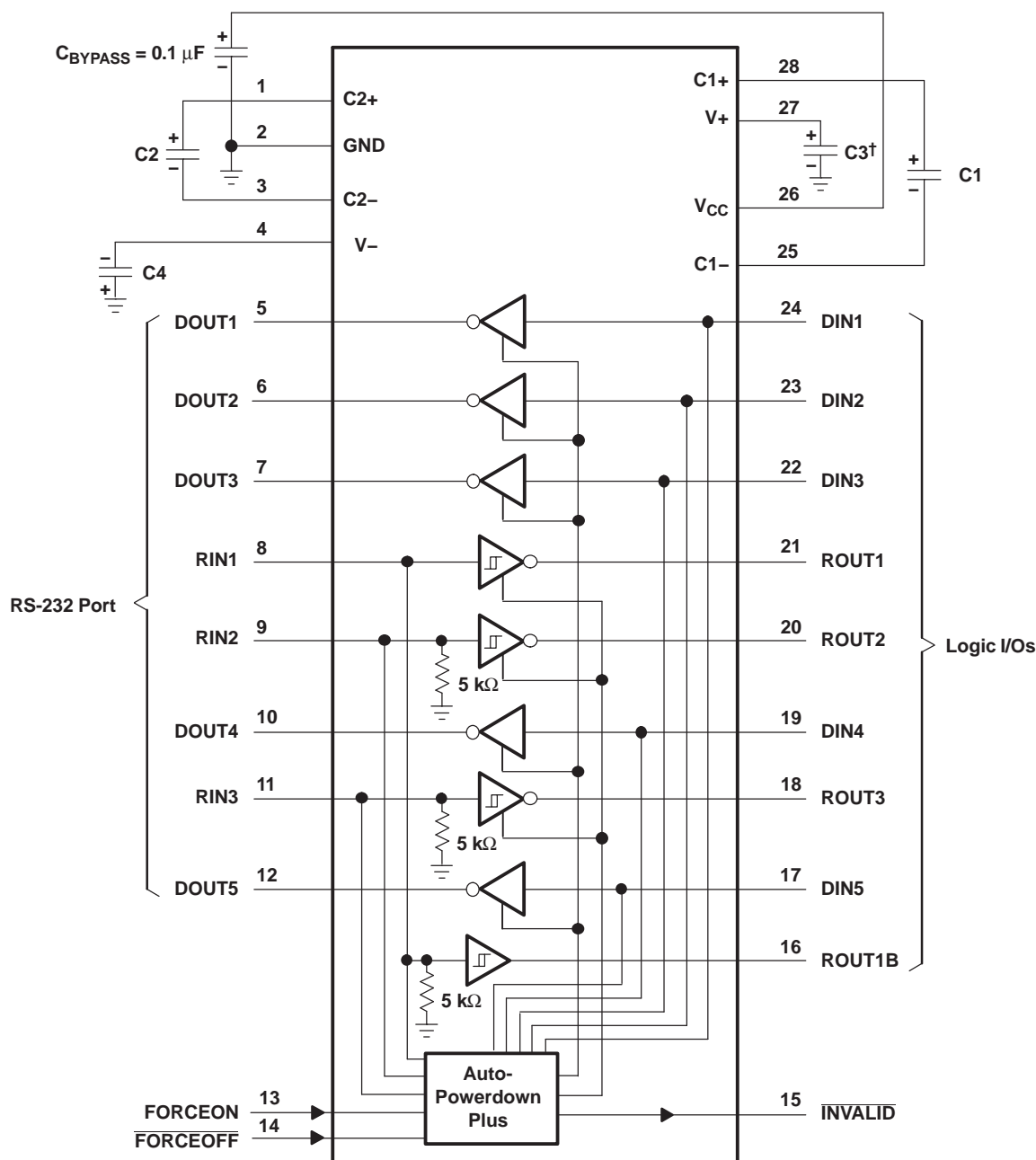


Figure 5. $\overline{\text{INVALID}}$ Propagation-Delay Times and Supply-Enabling Time

APPLICATION INFORMATION



† C3 can be connected to V_{CC} or GND.

NOTES: A. Resistor values shown are nominal.

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

V_{CC} vs CAPACITOR VALUES

| V _{CC} | 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 |

Figure 6. Typical Operating Circuit and Capacitor Values

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TRS3238CPWR | ACTIVE | TSSOP | PW | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | RS38C | Samples |
| TRS3238CPWRG4 | ACTIVE | TSSOP | PW | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | RS38C | Samples |
| TRS3238IPWR | ACTIVE | TSSOP | PW | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | RS38I | Samples |
| TRS3238IPWRG4 | ACTIVE | TSSOP | PW | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | RS38I | Samples |

(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.

OBSOLETE: TI has discontinued the production of the device.

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

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

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

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

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

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

(4) Only one of markings shown within the brackets will appear on the physical 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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TRS3238CPWR | 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 | 6.9 | 10.2 | 1.8 | 12.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS

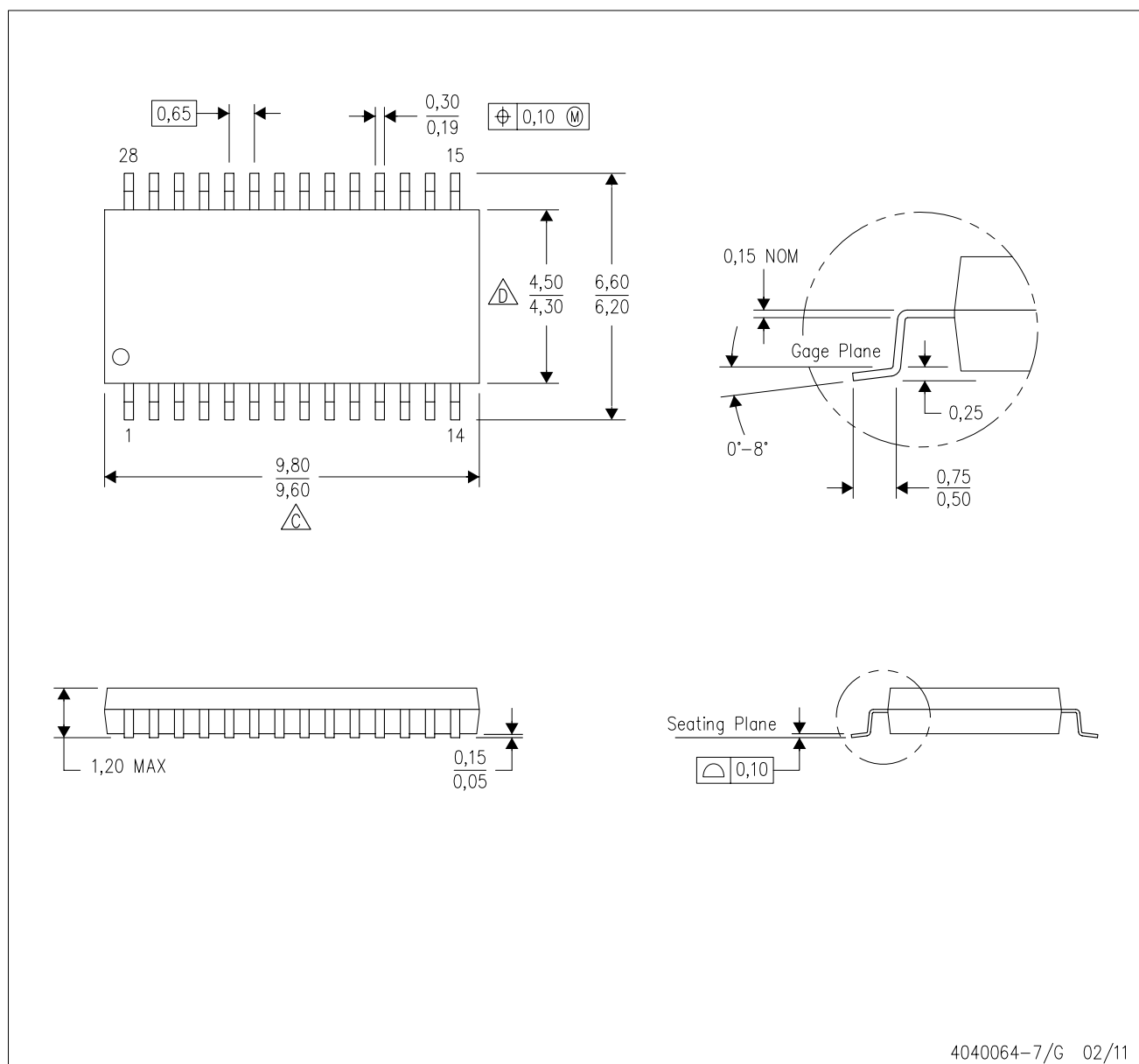


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TRS3238CPWR | TSSOP | PW | 28 | 2000 | 367.0 | 367.0 | 38.0 |
| TRS3238IPWR | TSSOP | PW | 28 | 2000 | 367.0 | 367.0 | 38.0 |

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE



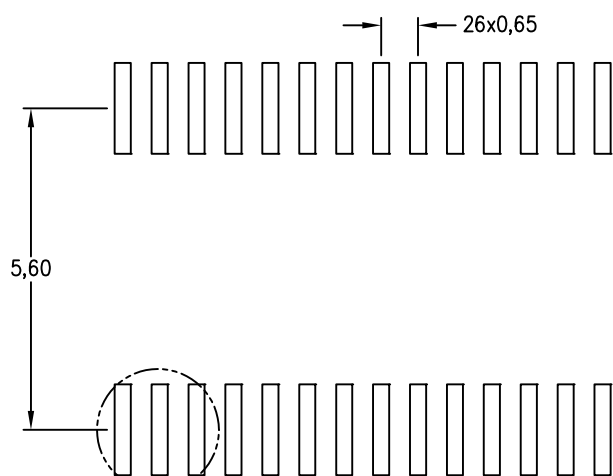
4040064-7/G 02/11

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

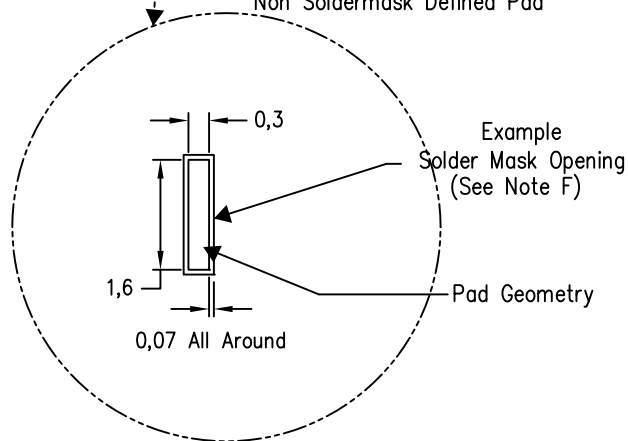
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

Example Board Layout



Example
Non Soldermask Defined Pad



Stencil Openings
Based on a stencil thickness
of .127mm (.005inch).



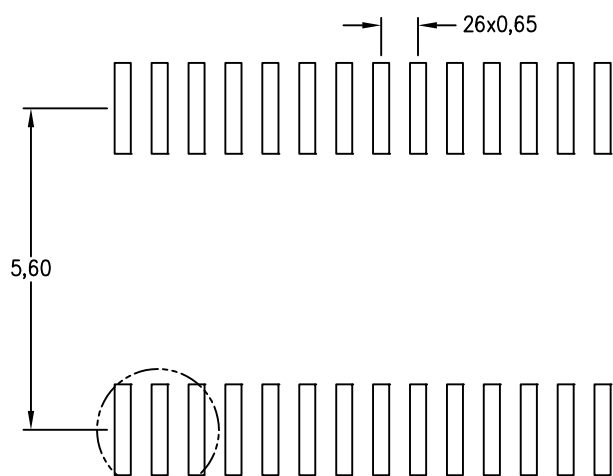
4211284-6/F 12/12

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate 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.

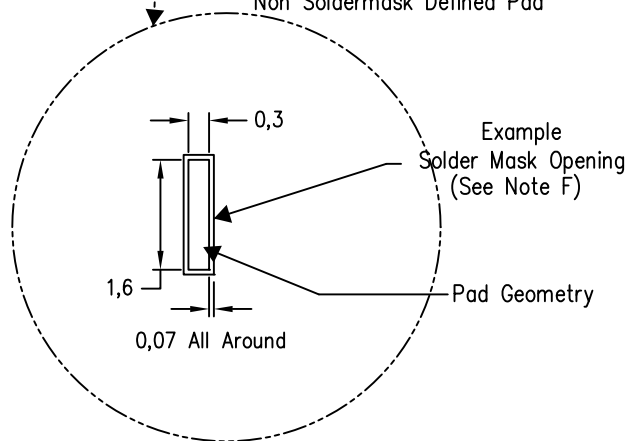
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

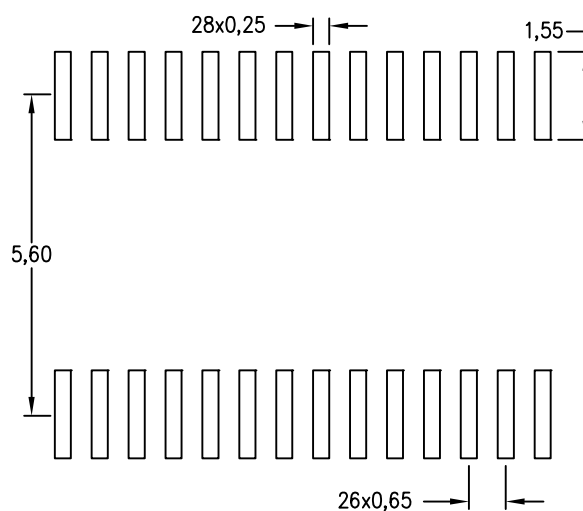
Example Board Layout



Example
Non Soldermask Defined Pad



Stencil Openings
Based on a stencil thickness
of .127mm (.005inch).



4211284-6/F 12/12

- NOTES:
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