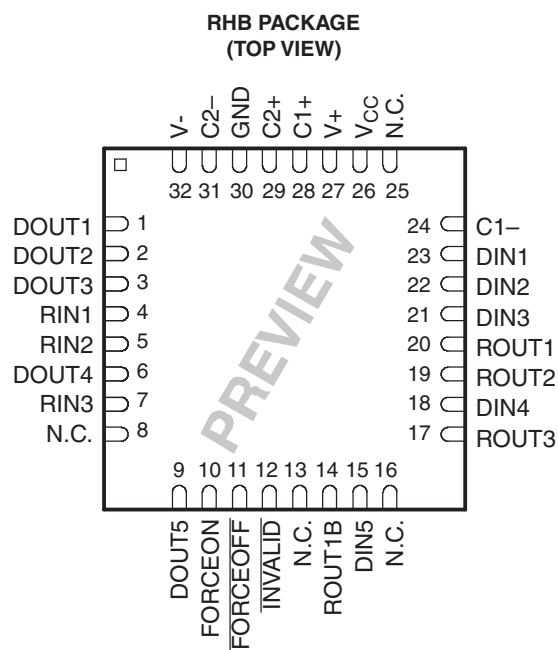
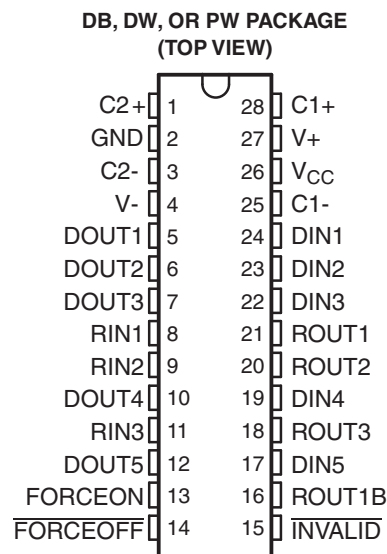


## FEATURES

- 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 400 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
- 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) for TRSF3238
- 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



N.C. - Not internally connected

## DESCRIPTION/ORDERING INFORMATION

The TRS3238E 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. This device operates at data signaling rates up to 250 kbit/s and a maximum of 30-V/ $\mu$ s driver output slew rate.



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.

**TRS3238E**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
**WITH  $\pm 15$ -kV ESD (HBM) PROTECTION**

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**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	SSOP – DB	Tube of 50	TRS3238ECDB	TRS3238EC
		Reel of 2000	TRS3238ECDBR	
	TSSOP – PW	Tube of 50	TRS3238ECPW	RS38EC
		Reel of 2000	TRS3238ECPWR	
	SOIC – DW	Reel of 2000	TRS3238ECDWR	TRS3238EC
–40°C to 85°C	QFN – RHB	Reel of 2000	TRS3238ECRHBR	PREVIEW
	SSOP – DB	Tube of 50	TRS3238EIDB	TRS3238EI
		Reel of 2000	TRS3238EIDBR	
	TSSOP – PW	Tube of 50	TRS3238EIPW	RS38EI
		Reel of 2000	TRS3238EIPWR	
	SOIC – DW	Reel of 2000	TRS3238ICDWR	TRS3238EI
	QFN – RHB	Reel of 2000	TRS3238EIRHBR	PREVIEW

- (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				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 plus disabled
H	H	H	X	L	
L	L	H	<30 s	H	Normal operation with auto-powerdown plus 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>

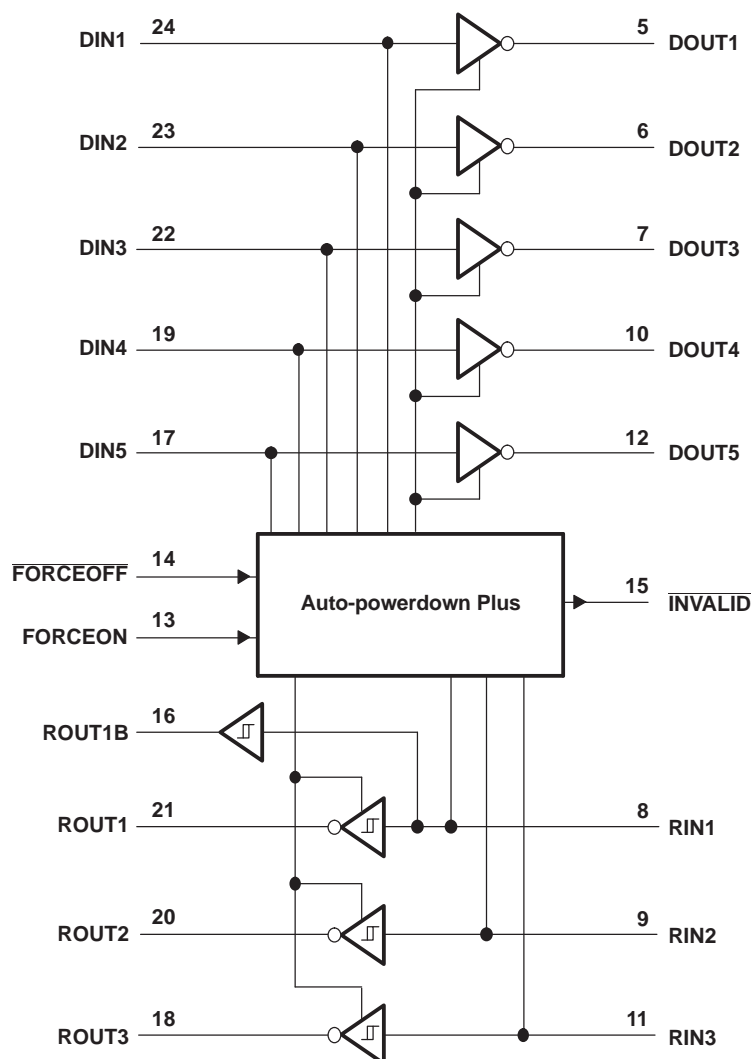
INPUTS				OUTPUTS		RECEIVER STATUS
RIN1	RIN2–RIN3	FORCEOFF	TIME ELAPSED SINCE LAST RIN OR DIN TRANSITION	ROUT1B	ROUT2 AND ROUT3	
L	X	L	X	L	Z	Powered off while ROUT1B is active
H	X	L	X	H	Z	
L	L	H	<30 s	L	H	Normal operation with auto-powerdown plus disabled/enabled
L	H	H	<30 s	L	L	
H	L	H	<30 s	H	H	
H	H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

**TRS3238E**  
**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER**  
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**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 ( <del>FORCEOFF</del> , FORCEON)	−0.3	6	V
		Receiver	−25	25	
V <sub>O</sub>	Output voltage range	Driver	−13.2	13.2	V
		Receiver ( <del>INVALID</del> )	−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		PREVIEW	
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), 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</sub>(max) – 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 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, <del>FORCEOFF</del> , FORCEON	V <sub>CC</sub> = 3.3 V	2	V
			V <sub>CC</sub> = 5 V	2.4	
V <sub>IL</sub>	Driver and control low-level input voltage	DIN, <del>FORCEOFF</del> , FORCEON		0	V
V <sub>I</sub>	Receiver input voltage		–25	25	V
T <sub>A</sub>	Operating free-air temperature	TRS3238EC		0	°C
		TRS3238EI		–40	

- (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.

## 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	<del>FORCEOFF</del> , FORCEON		±0.01	±1	μA
I <sub>CC</sub>	Supply current (T <sub>A</sub> = 25°C)	Auto-powerdown plus disabled	No load, <del>FORCEOFF</del> and FORCEON at V <sub>CC</sub>	0.5	2	mA
		Powered off	No load, <del>FORCEOFF</del> at GND	1	10	
		Auto-powerdown plus enabled	No load, <del>FORCEOFF</del> at V <sub>CC</sub> , FORCEON at GND, All RIN are open or grounded	1	10	μA

- (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.

**TRS3238E**  
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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 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>CC</sub> = 3.6 V, V <sub>O</sub> = 0 V		$\pm 35$	$\pm 60$	mA
	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0 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	FORCEOFF = GND	V <sub>O</sub> = $\pm 12$ V, V <sub>CC</sub> = 3 V to 3.6 V		$\pm 25$	$\mu$ A
		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	C <sub>L</sub> = 1000 pF, One DOUT switching, R <sub>L</sub> = 3 k $\Omega$ , See <a href="#">Figure 1</a>	250	400		kbit/s
t <sub>sk(p)</sub> Pulse skew <sup>(3)</sup>	C <sub>L</sub> = 150 pF to 2500 pF, See <a href="#">Figure 2</a> , R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$		100		ns
SR(tr) Slew rate, transition region (see <a href="#">Figure 1</a> )	V <sub>CC</sub> = 3.3 V, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$	C <sub>L</sub> = 150 pF to 1000 pF	6	30	V/ $\mu$ s
		C <sub>L</sub> = 150 pF to 2500 pF	4	30	

(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	

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

### Switching Characteristics

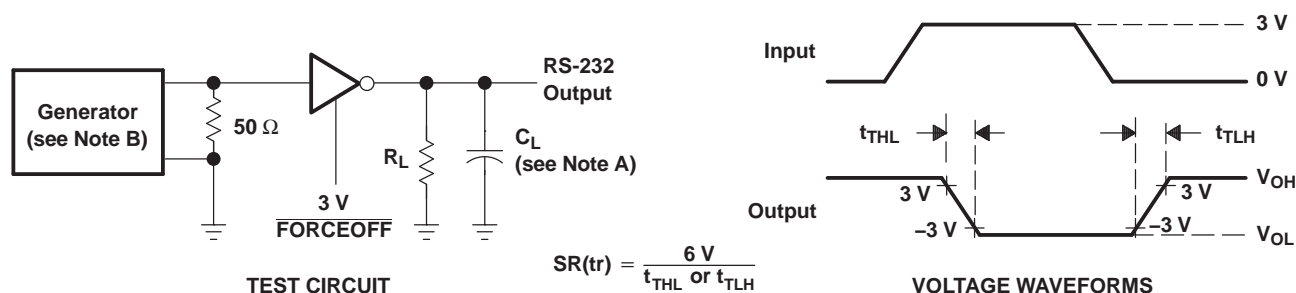
over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [Figure 5](#))

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  $T_A = 25^\circ\text{C}$ .

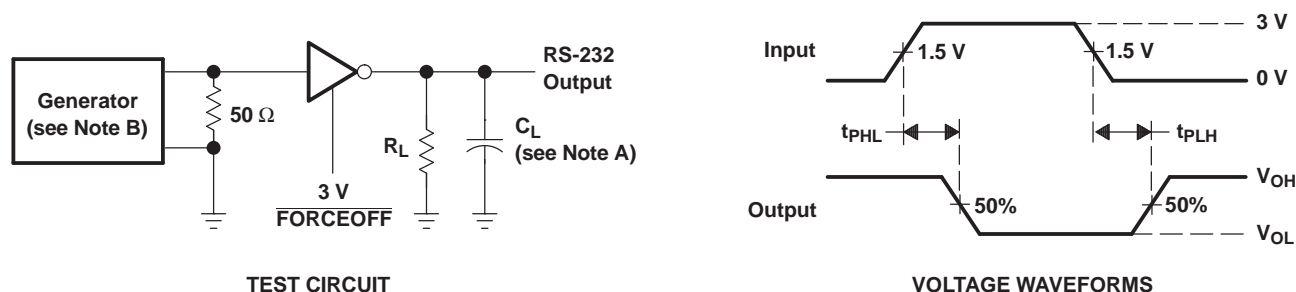


## PARAMETER MEASUREMENT INFORMATION



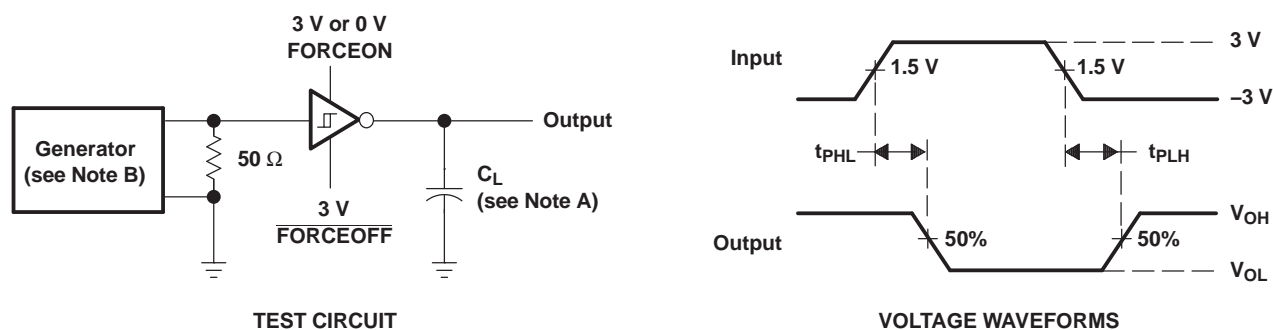
- A.  $C_L$  includes probe and jig capacitance.
- B. The pulse generator has the following characteristics: PRR = 250 kbit/s,  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .

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

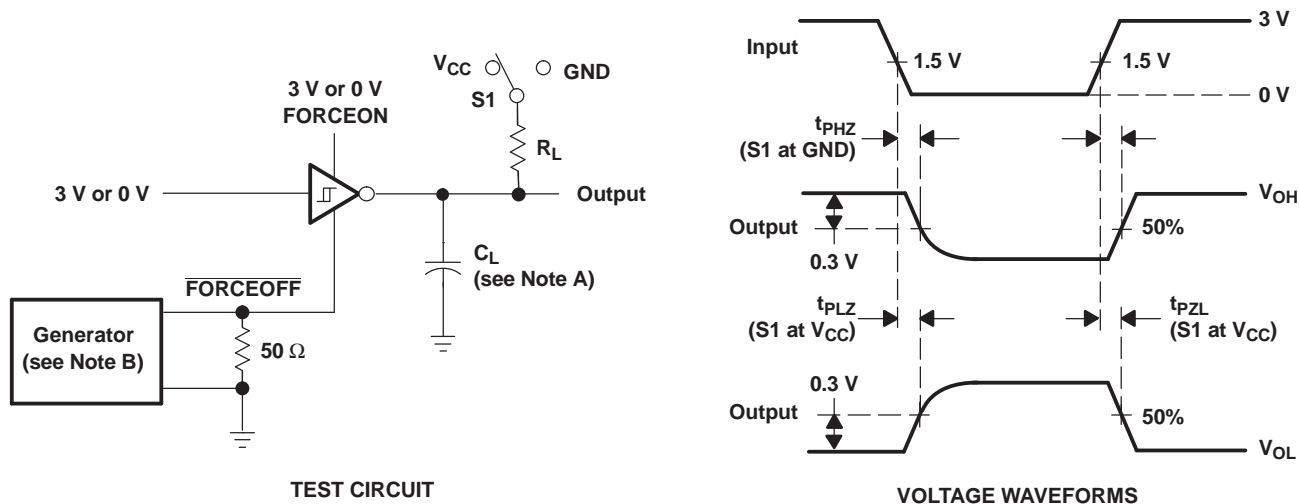
Figure 2. Driver Pulse Skew



- 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

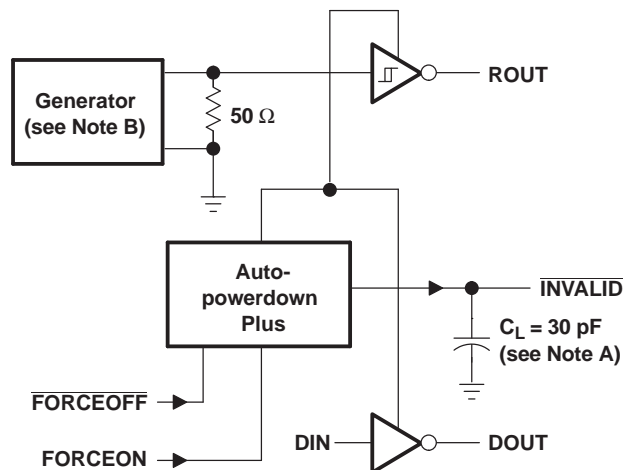
## PARAMETER MEASUREMENT INFORMATION (continued)



- 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  $t_{en}$ .

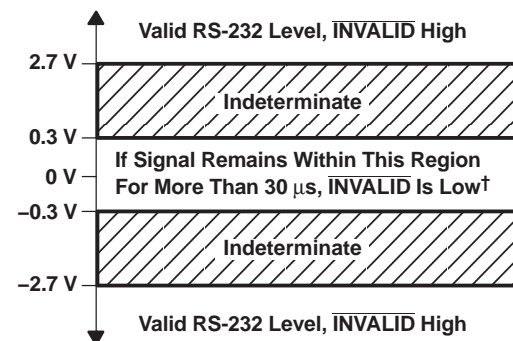
**Figure 4. Receiver Enable and Disable Times**

# PARAMETER MEASUREMENT INFORMATION (continued)

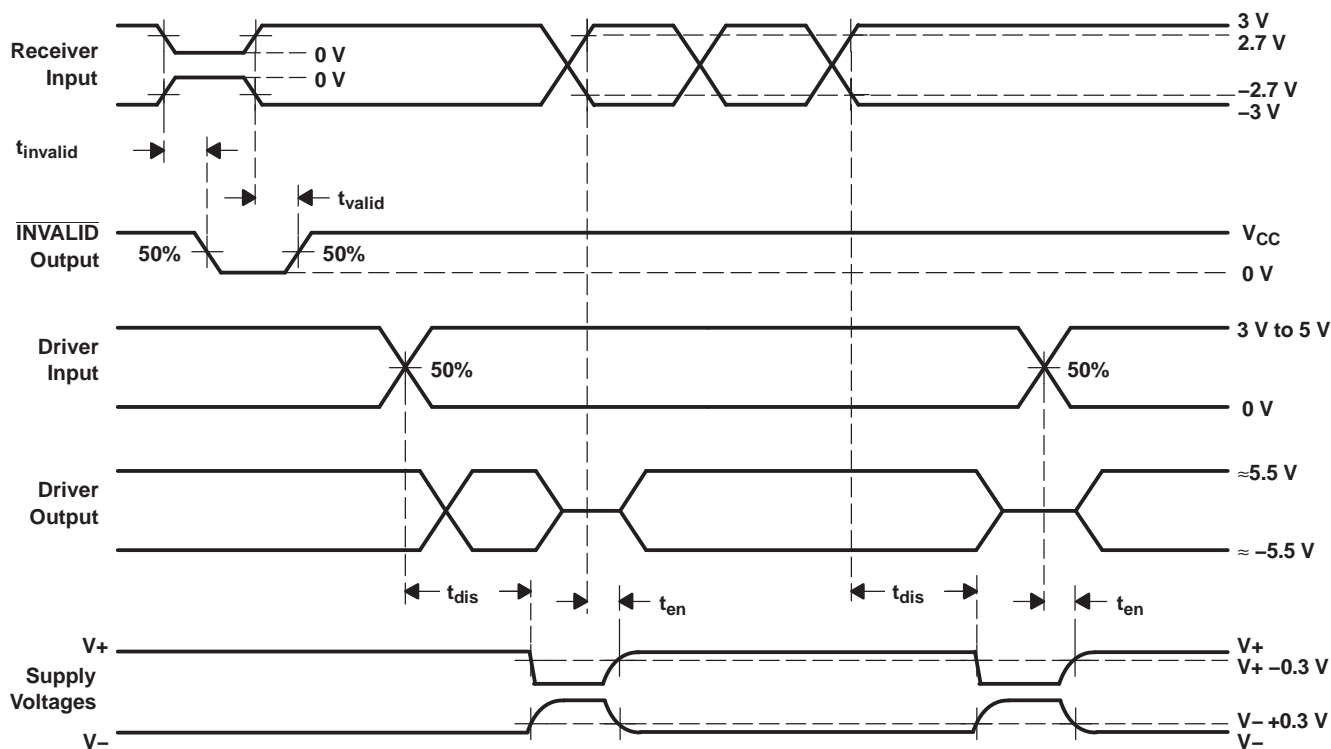


TEST CIRCUIT

- 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.



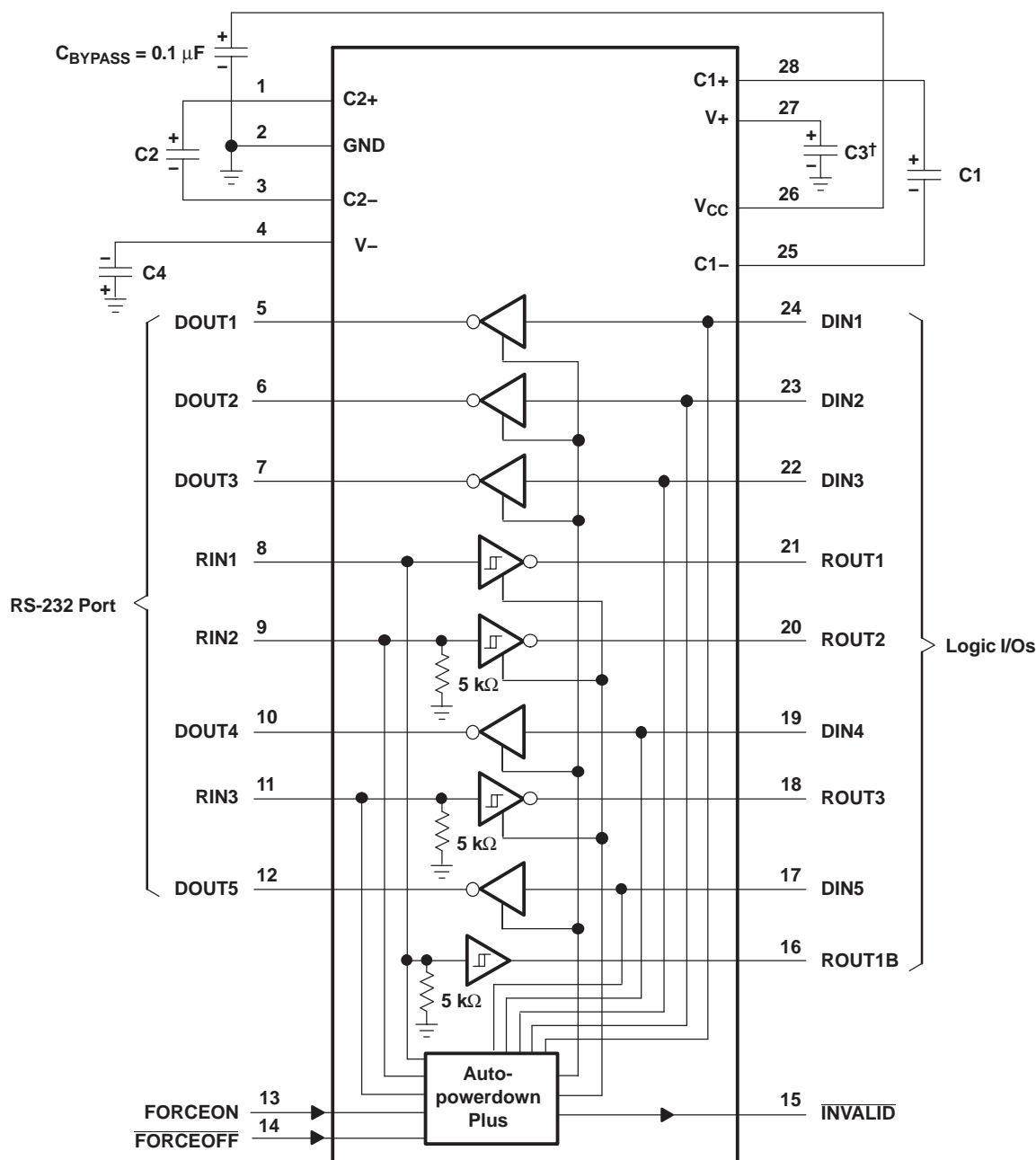
† Auto-powerdown plus disables drivers and reduces supply current to 1  $\mu$ A.



Voltage Waveforms and Timing Diagrams

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 $\pm$ 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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TRS3238ECDB	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRS3238EC	<a href="#">Samples</a>
TRS3238ECDBG4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRS3238EC	<a href="#">Samples</a>
TRS3238ECDBR	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRS3238EC	<a href="#">Samples</a>
TRS3238ECDBRG4	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRS3238EC	<a href="#">Samples</a>
TRS3238ECDWR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRS3238EC	<a href="#">Samples</a>
TRS3238ECDWRG4	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRS3238EC	<a href="#">Samples</a>
TRS3238ECPWR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	RS38EC	<a href="#">Samples</a>
TRS3238ECPWRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	RS38EC	<a href="#">Samples</a>
TRS3238EIDB	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDBG4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDBR	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDBRG4	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDWG4	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDWR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIDWRG4	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRS3238EI	<a href="#">Samples</a>
TRS3238EIPW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RS38EI	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TRS3238EIPWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RS38EI	<a href="#">Samples</a>
TRS3238EIPWR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RS38EI	<a href="#">Samples</a>
TRS3238EIPWRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RS38EI	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**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.

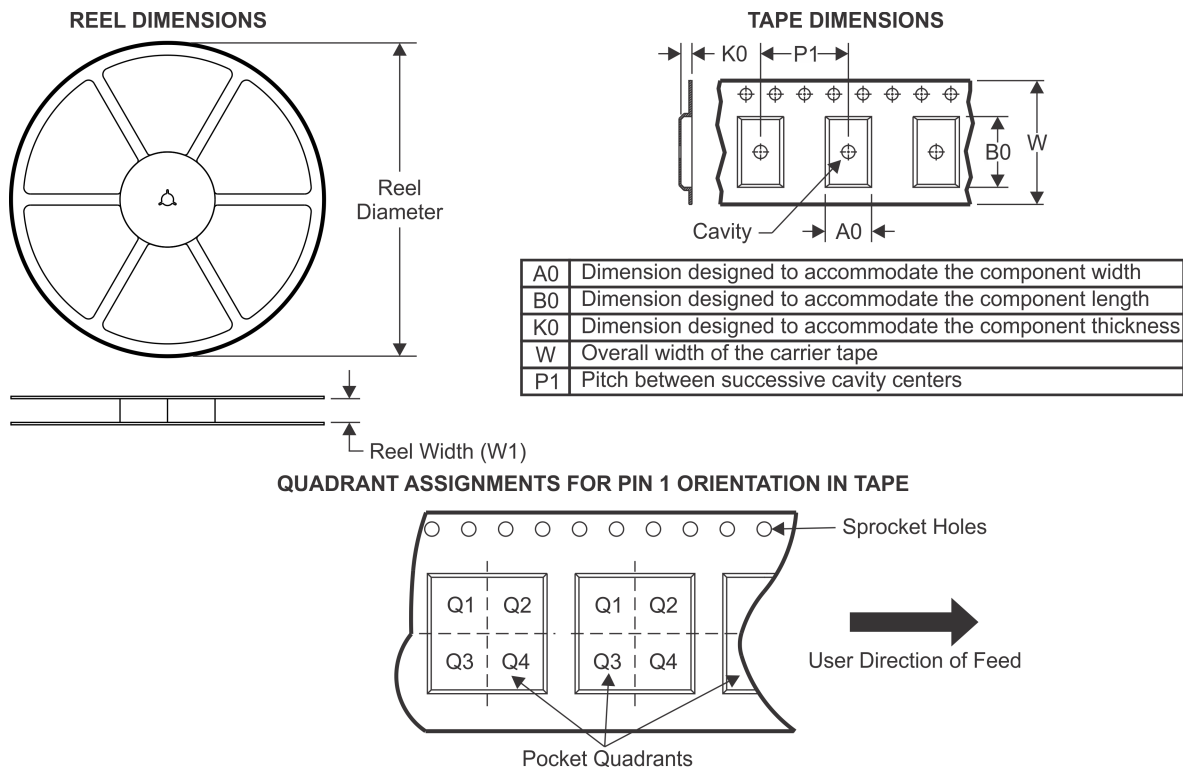
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

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

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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
TRS3238ECDBR	SSOP	DB	28	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
TRS3238ECDWR	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
TRS3238ECPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
TRS3238EIDBR	SSOP	DB	28	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
TRS3238EIDWR	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
TRS3238EIPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1



## TAPE AND REEL BOX DIMENSIONS

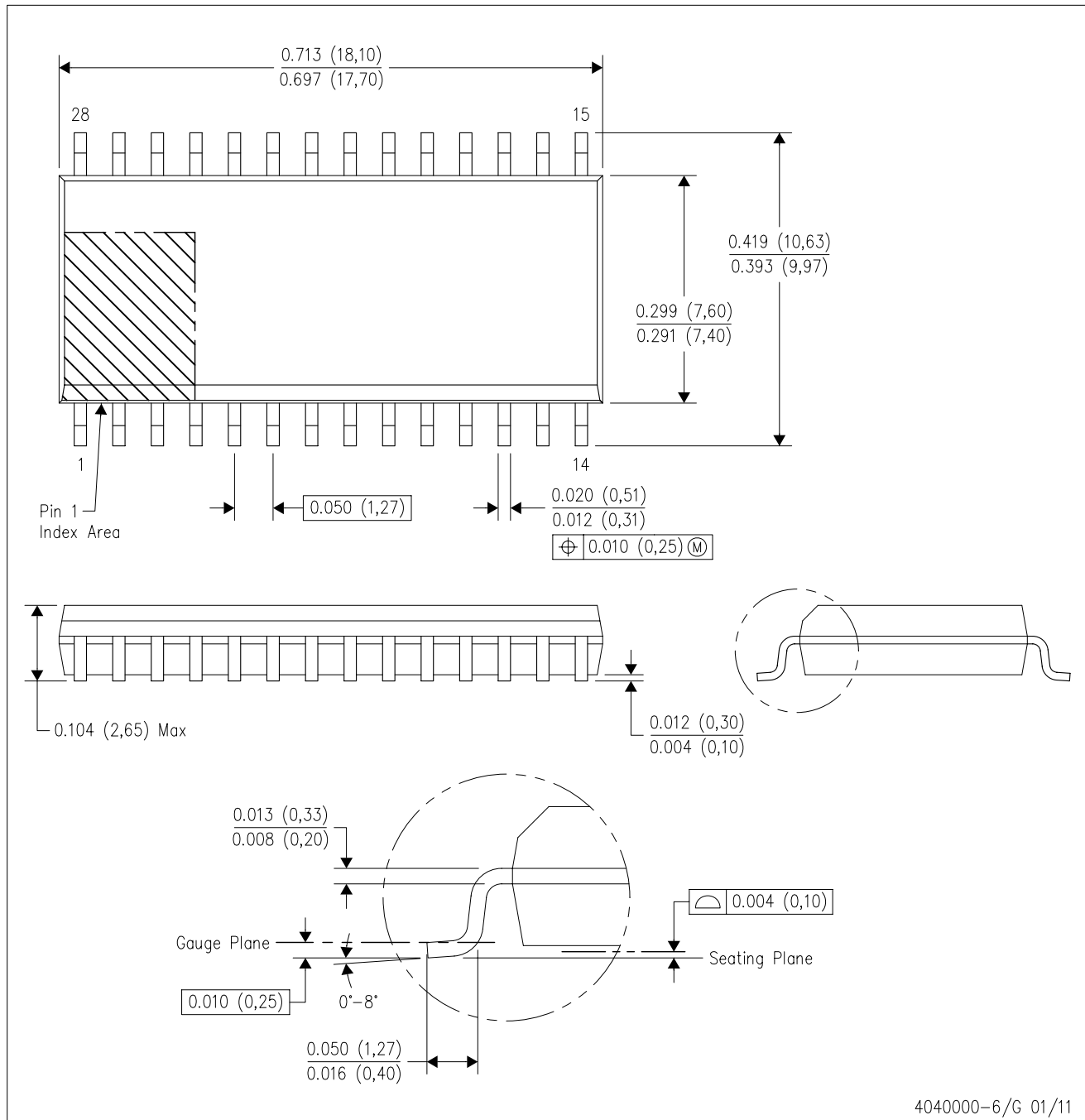


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TRS3238ECDBR	SSOP	DB	28	2000	367.0	367.0	38.0
TRS3238ECDWR	SOIC	DW	28	1000	367.0	367.0	55.0
TRS3238ECPWR	TSSOP	PW	28	2000	367.0	367.0	38.0
TRS3238EIDBR	SSOP	DB	28	2000	367.0	367.0	38.0
TRS3238EIDWR	SOIC	DW	28	1000	367.0	367.0	55.0
TRS3238EIPWR	TSSOP	PW	28	2000	367.0	367.0	38.0

DW (R-PDSO-G28)

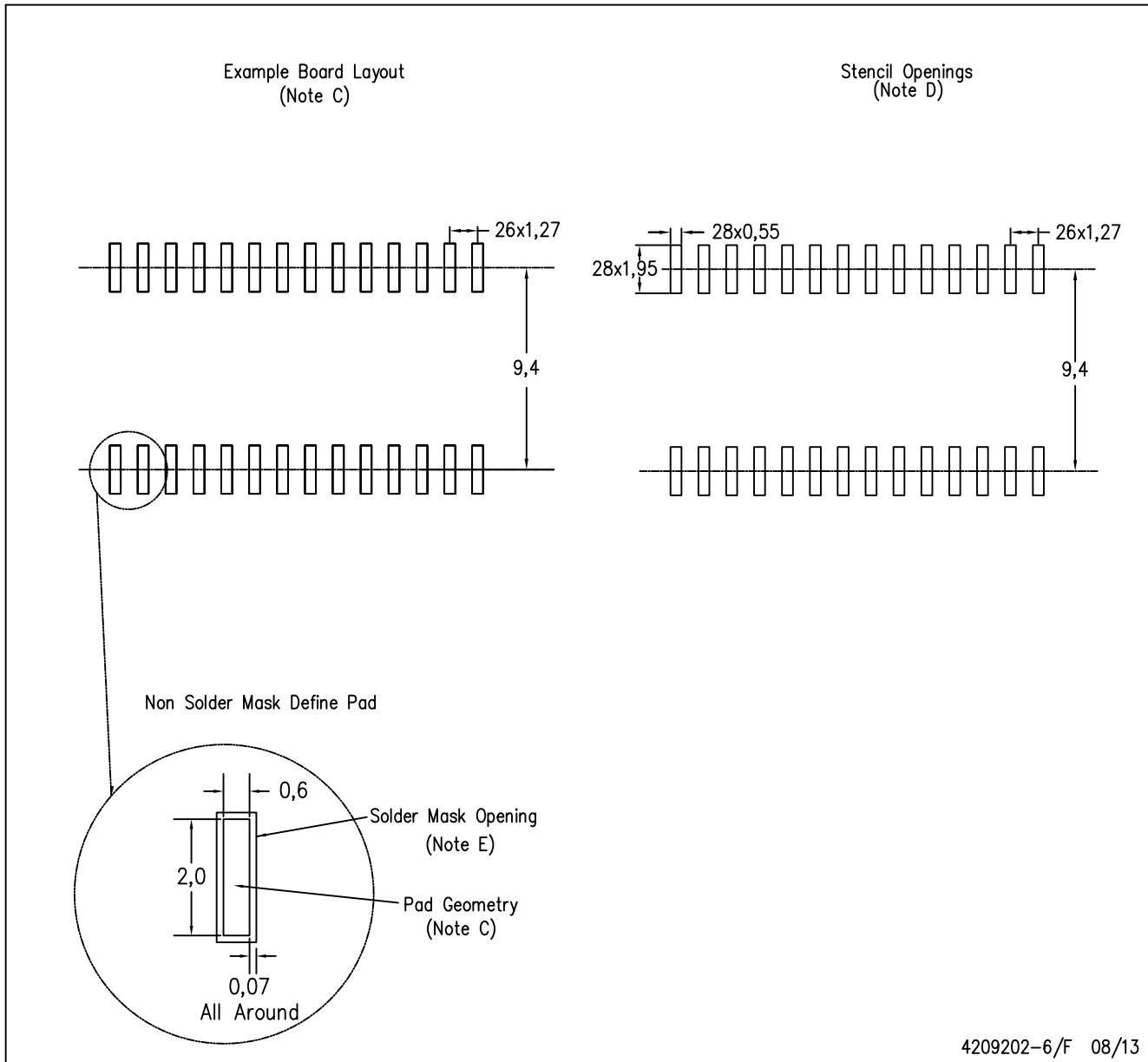
PLASTIC SMALL OUTLINE



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

DW (R-PDSO-G28)

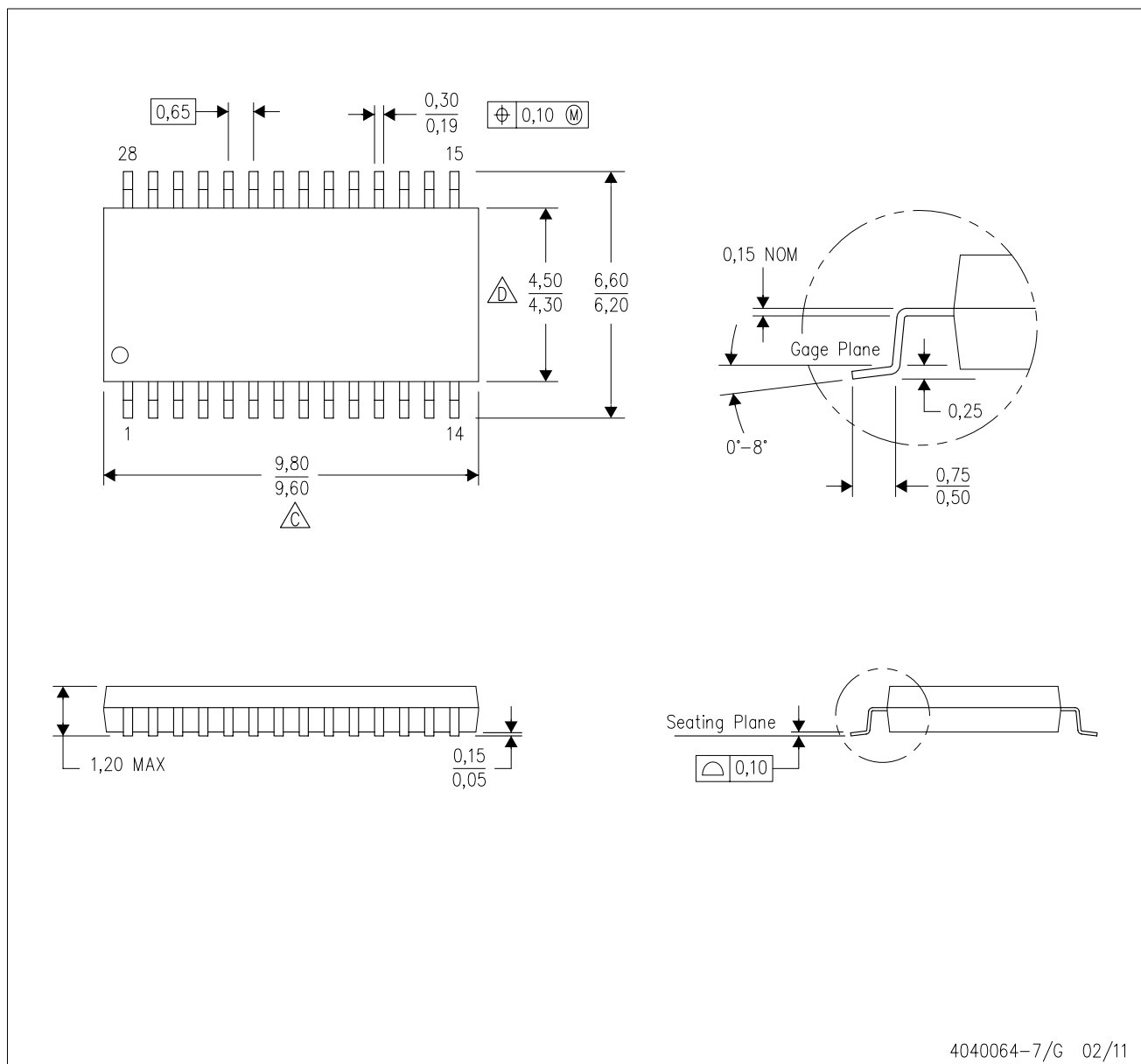
PLASTIC SMALL OUTLINE



- 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.

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

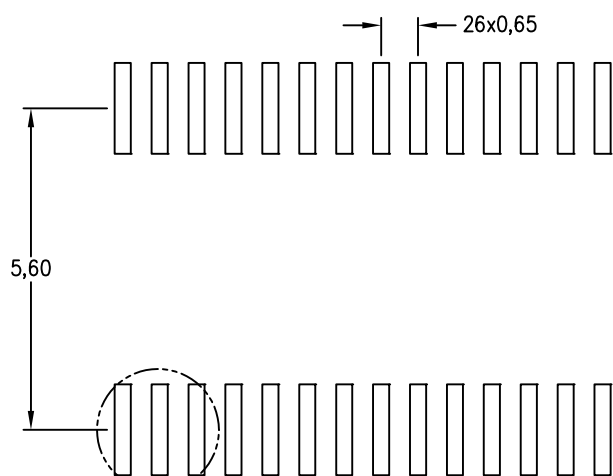


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 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

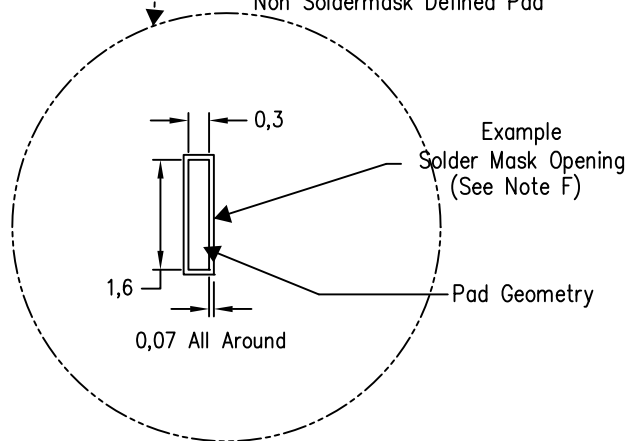
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

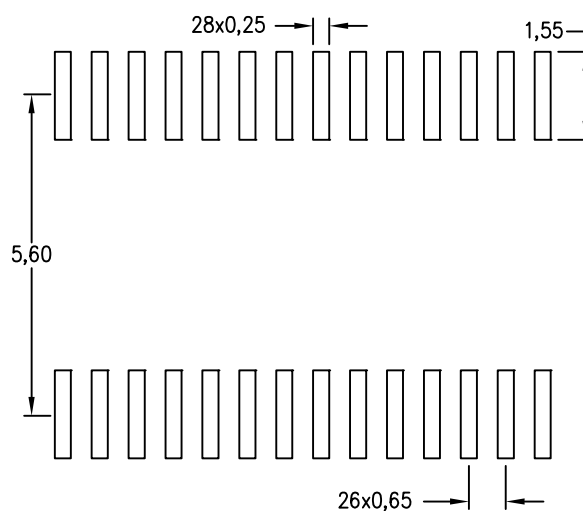
Example Board Layout



Example  
Non Soldermask Defined Pad



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



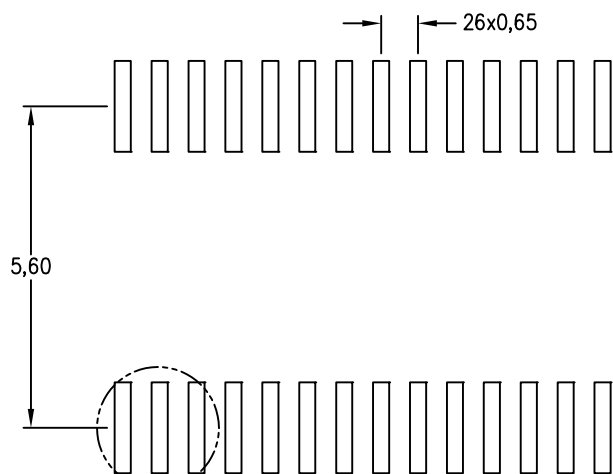
4211284-6/F 12/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate design.
  - 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.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

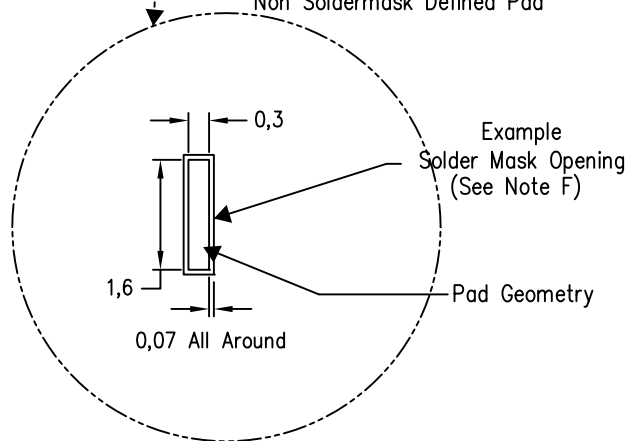
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

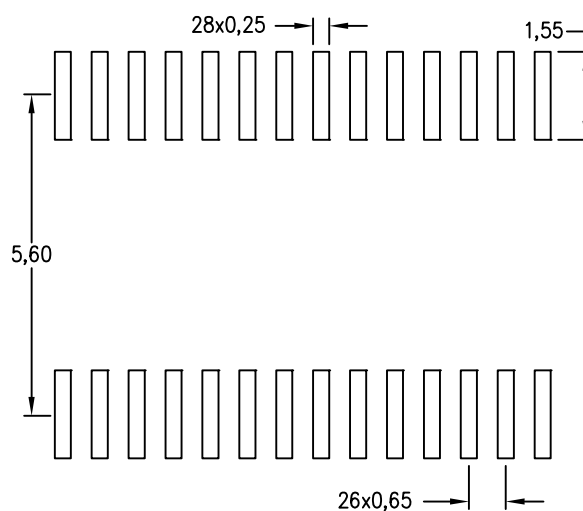
Example Board Layout



Example  
Non Soldermask Defined Pad



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



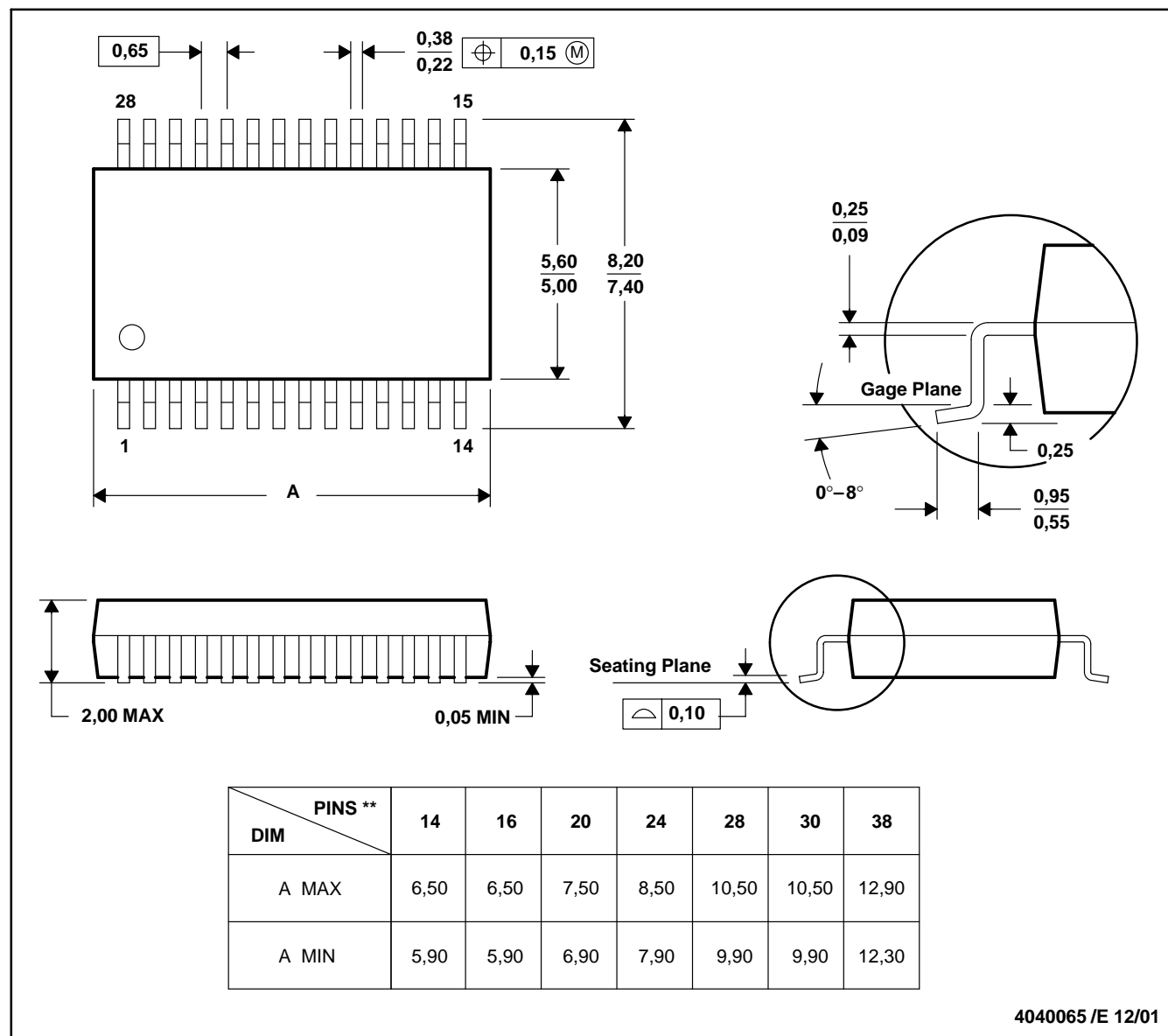
4211284-6/F 12/12

- NOTES:
- 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.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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-150

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