

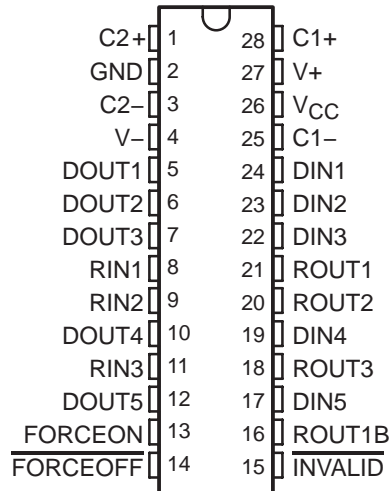
MAX3238-Q1

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

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- Qualified for Automotive Applications
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Meets or Exceeds 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)
- RS-232 Bus-Pin ESD Protection Exceeds ± 15 kV Using Human-Body Model (HBM)

DB OR PW PACKAGE
(TOP VIEW)



description/ordering information

The MAX3238 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. These devices operate at data signaling rates up to 250 kbit/s and a maximum of 30-V/ μ s driver output slew rate.

ORDERING INFORMATION†

T _A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP (DB)	Tape and reel	MAX3238IDBRQ1	MAX3238Q
	TSSOP (PW)	Tape and reel	MAX3238IPWRQ1	MB3238Q

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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MAX3238-Q1**3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER****WITH ± 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 **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 automatically activates once 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.

Function Tables**EACH DRIVER**

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	

H = high level, L = low level, X = irrelevant, Z = high impedance

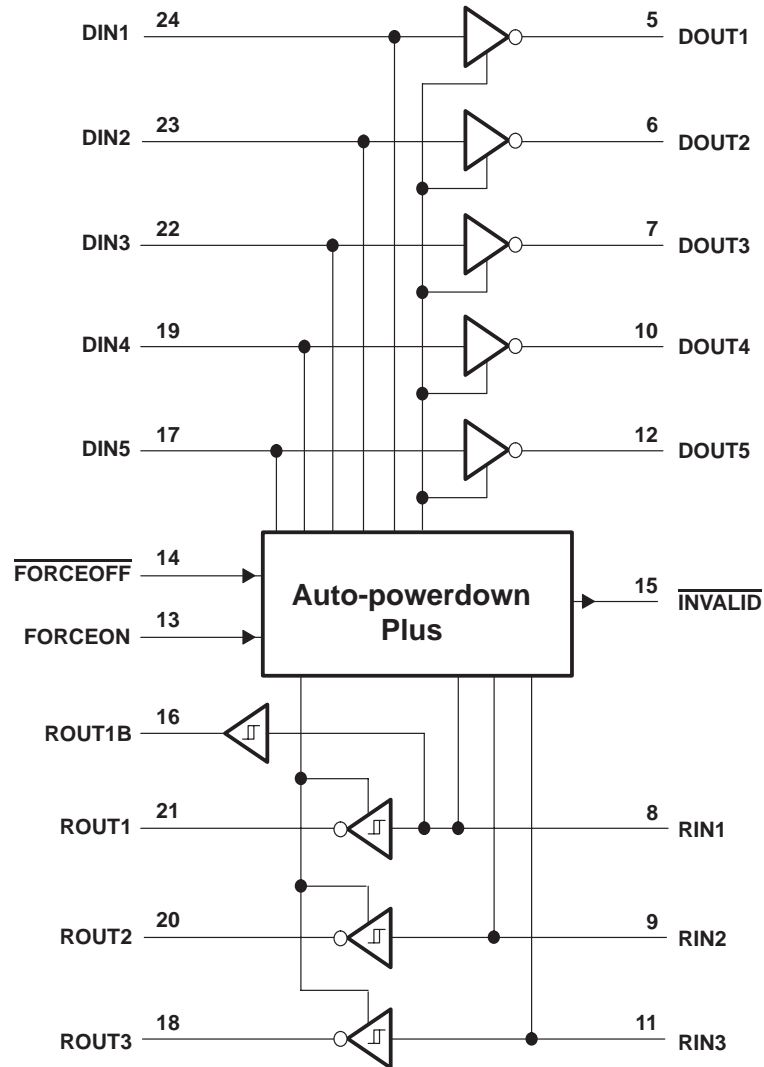
EACH RECEIVER

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	

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

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logic diagram (positive logic)



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC} (see Note 1)	–0.3 V to 6 V
Positive output supply voltage range, V_+ (see Note 1)	–0.3 V to 7 V
Negative output supply voltage range, V_- (see Note 1)	0.3 V to –7 V
Supply voltage difference, $V_+ - V_-$ (see Note 1)	13 V
Input voltage range, V_I : Driver ($\overline{\text{FORCEOFF}}$, FORCEON)	–0.3 V to 6 V
Receiver	–25 V to 25 V
Output voltage range, V_O : Driver	–13.2 V to 13.2 V
Receiver (INVALID)	–0.3 V to $V_{CC} + 0.3$ V
Package thermal impedance, θ_{JA} (see Notes 2 and 3): DB package	62°C/W
PW package	62°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{stg}	–65°C to 150°C

[†] 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.

NOTES: 1. All voltages are with respect to network GND.

2. Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4 and 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, $\overline{\text{FORCEOFF}}$, FORCEON	V _{CC} = 3.3 V	2			V	
			V _{CC} = 5 V	2.4				
V _{IL}	Driver and control low-level input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON		0.8			V	
V _I	Driver and control input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON		0			5.5	V
V _I	Receiver input voltage			−25			25	V
T _A	Operating free-air temperature		MAX3238I	−40			85	°C

NOTE 4: Testing supply conditions are C1–C4 = 0.1 μ F at $V_{CC} = 3.3$ V ± 0.15 V; C1–C4 = 0.22 μ F at $V_{CC} = 3.3$ V ± 0.3 V; and C1 = 0.047 μ F and C2–C4 = 0.33 μ F at $V_{CC} = 5$ V ± 0.5 V.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER		TEST CONDITIONS	MIN	TYP [‡]	MAX	UNIT
I_I	Input leakage current	$\overline{\text{FORCEOFF}}$, FORCEON		± 0.01	± 1	μ A
I_{CC}	Supply current ($T_A = 25^\circ\text{C}$)	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	μ A
		Auto-powerdown plus enabled	No load, $\overline{\text{FORCEOFF}}$ at V_{CC} , FORCEON at GND, All RIN are open or grounded	1	10	

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

NOTE 4: Testing supply conditions are C1–C4 = 0.1 μ F at $V_{CC} = 3.3$ V ± 0.15 V; C1–C4 = 0.22 μ F at $V_{CC} = 3.3$ V ± 0.3 V; and C1 = 0.047 μ F and C2–C4 = 0.33 μ F at $V_{CC} = 5$ V ± 0.5 V.

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DRIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	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‡	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} = 0 to 5.5 V			± 25	μ A

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

‡ 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.

NOTE 4: 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.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Maximum data rate	C _L = 1000 pF, One DOUT switching, R _L = 3 k Ω , See Figure 1	150	250		kbit/s
t _{sk(p)} Pulse skew§	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	

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

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

NOTE 4: 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.

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RECEIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{OH} High-level output voltage	$I_{OH} = -1$ mA	$V_{CC} - 0.6$ V	$V_{CC} - 0.1$ V		V
V_{OL} Low-level output voltage	$I_{OL} = 1.6$ 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)	$\overline{FORCEOFF} = 0$ V		± 0.05	± 10	μ A
r_i Input resistance	$V_I = \pm 3$ V to ± 25 V	3	5	7	k Ω

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

NOTE 4: Testing supply conditions are C1–C4 = 0.1 μ F at $V_{CC} = 3.3$ V ± 0.15 V; C1–C4 = 0.22 μ F at $V_{CC} = 3.3$ V ± 0.3 V; and C1 = 0.047 μ F and C2–C4 = 0.33 μ F at $V_{CC} = 5$ V ± 0.5 V.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	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			150		ns
t_{en} Output enable time	$C_L = 150$ pF, $R_L = 3$ k Ω , See Figure 4		200		ns
t_{dis} Output disable time			200		ns
$t_{sk(p)}$ Pulse skew‡	See Figure 3		50		ns

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

‡ Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.

NOTE 4: Testing supply conditions are C1–C4 = 0.1 μ F at $V_{CC} = 3.3$ V ± 0.15 V; C1–C4 = 0.22 μ F at $V_{CC} = 3.3$ V ± 0.3 V; and C1 = 0.047 μ F and C2–C4 = 0.33 μ F at $V_{CC} = 5$ V ± 0.5 V.

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

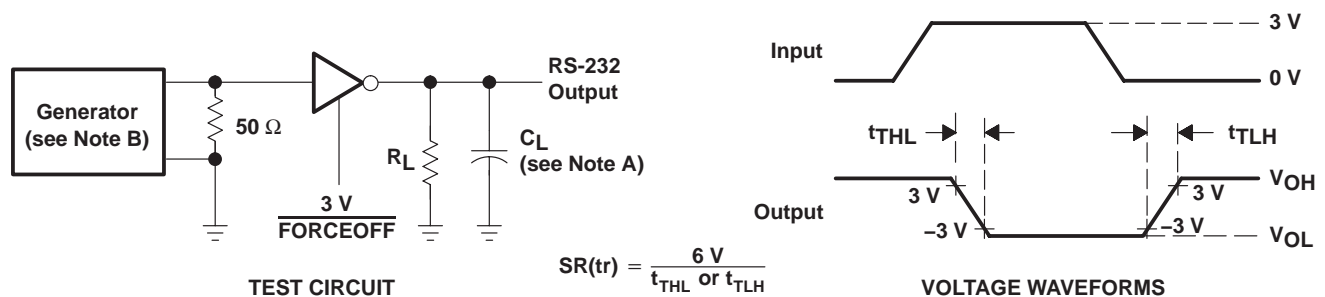
† All typical values are at $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

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

PARAMETER	MIN	TYP†	MAX	UNIT
t_{valid}		0.1		μs
t_{invalid}		50		μs
t_{en}		25		μs
t_{dis}	15	30	60	s

† 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



NOTES: A. C_L includes probe and jig capacitance.

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

Figure 1. Driver Slew Rate

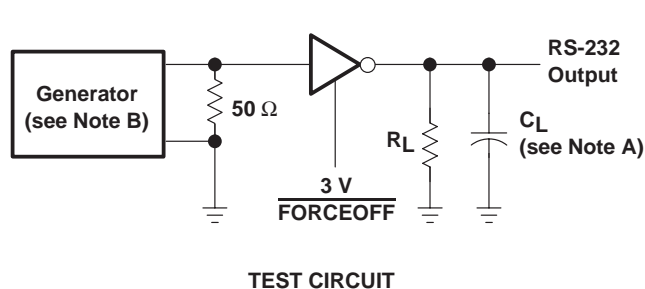
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3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

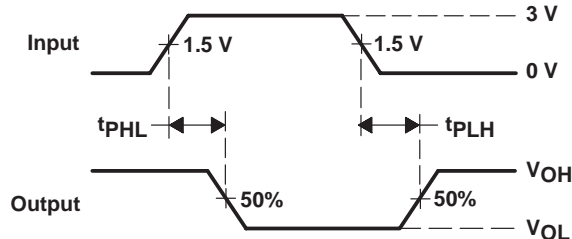
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PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

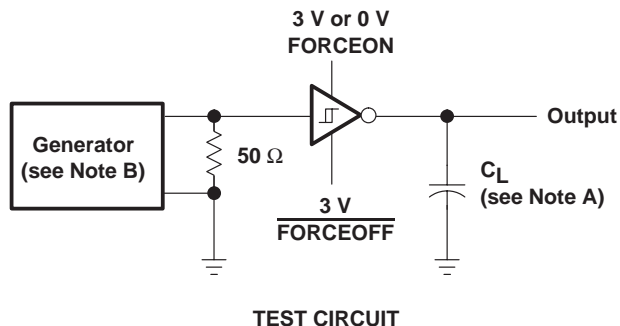


VOLTAGE WAVEFORMS

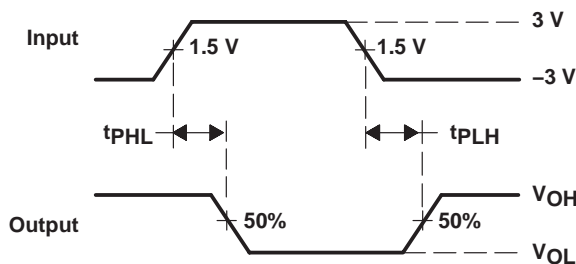
NOTES: A. C_L includes probe and jig capacitance.

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

Figure 2. Driver Pulse Skew



TEST CIRCUIT

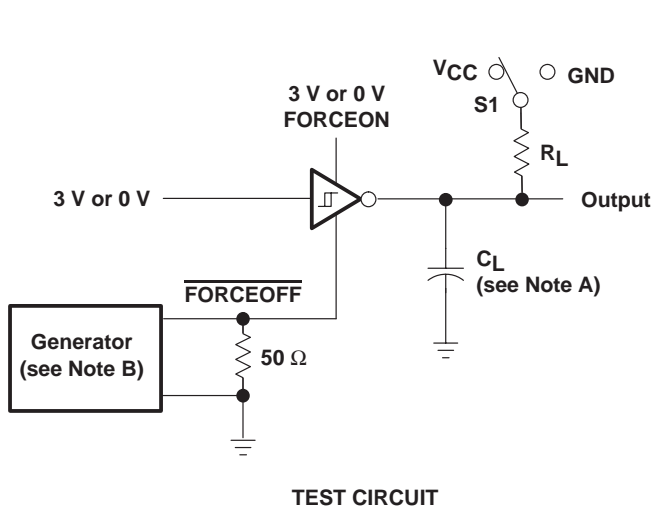


VOLTAGE WAVEFORMS

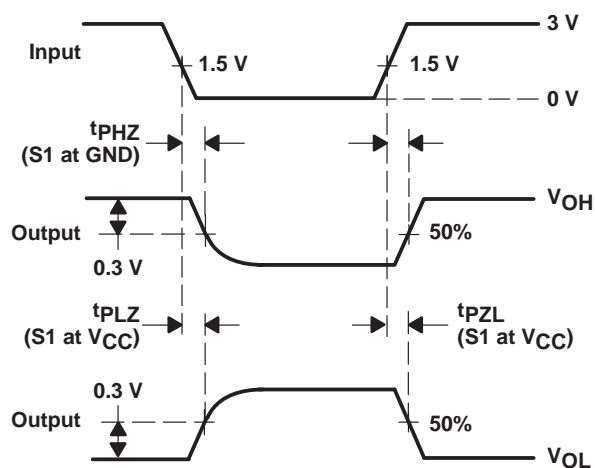
NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 3. Receiver Propagation Delay Times



TEST CIRCUIT



VOLTAGE WAVEFORMS

NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ 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} .

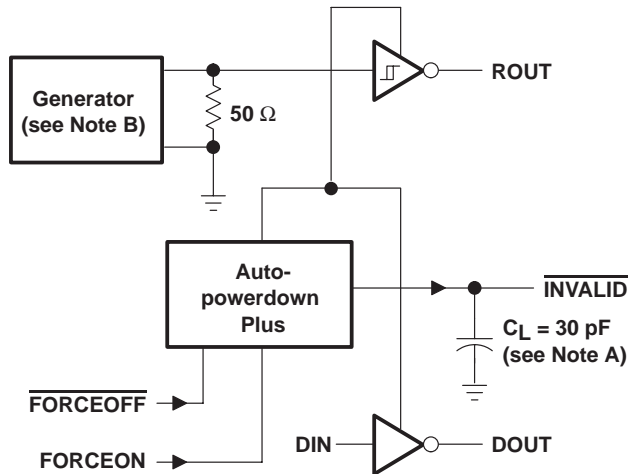
Figure 4. Receiver Enable and Disable Times

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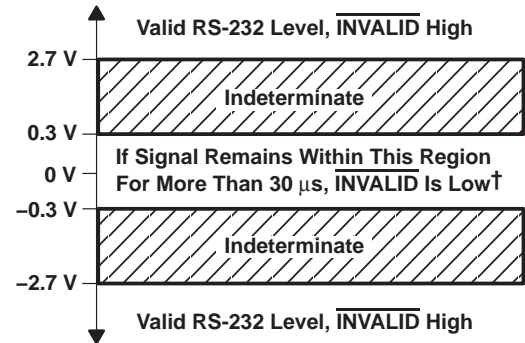
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PARAMETER MEASUREMENT INFORMATION



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.

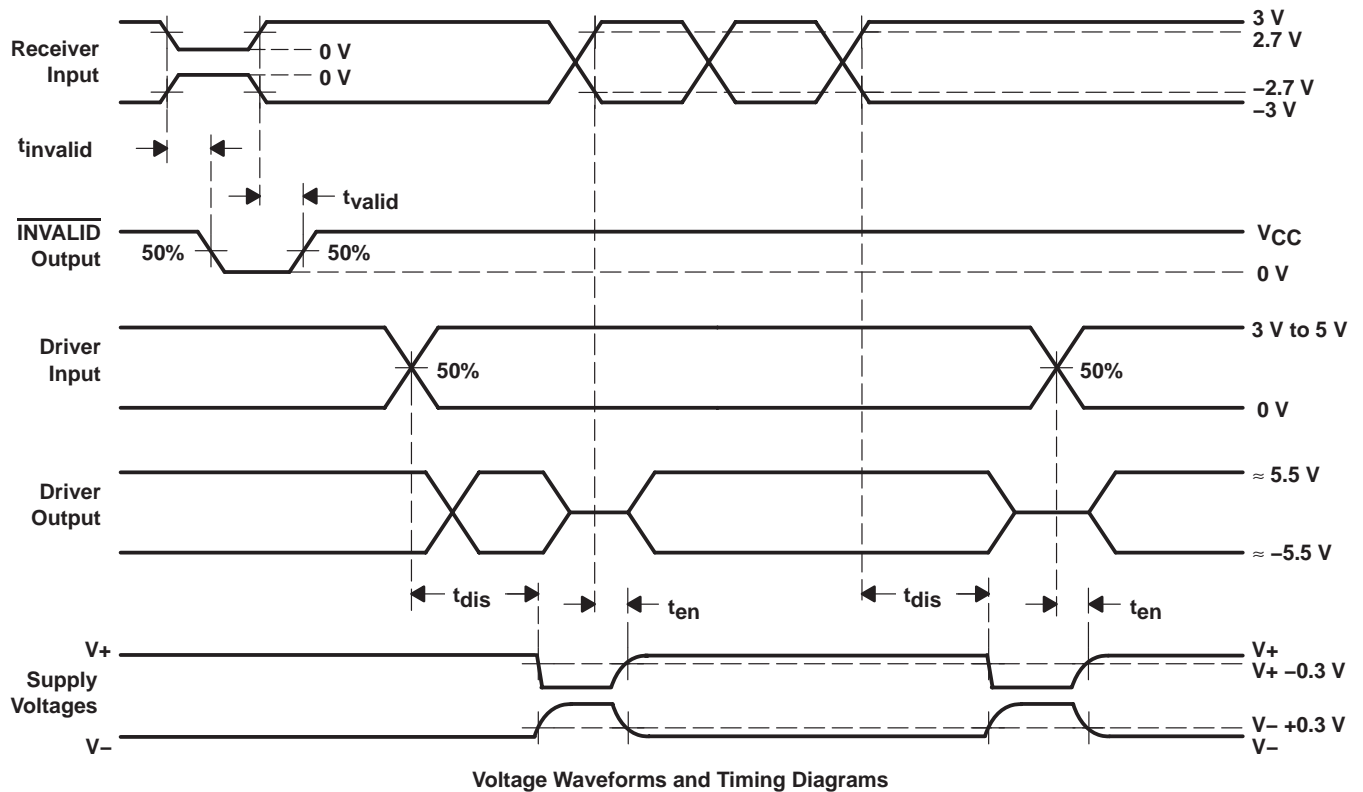


Figure 5. $\overline{\text{INVALID}}$ Propagation-Delay Times and Supply-Enabling Time

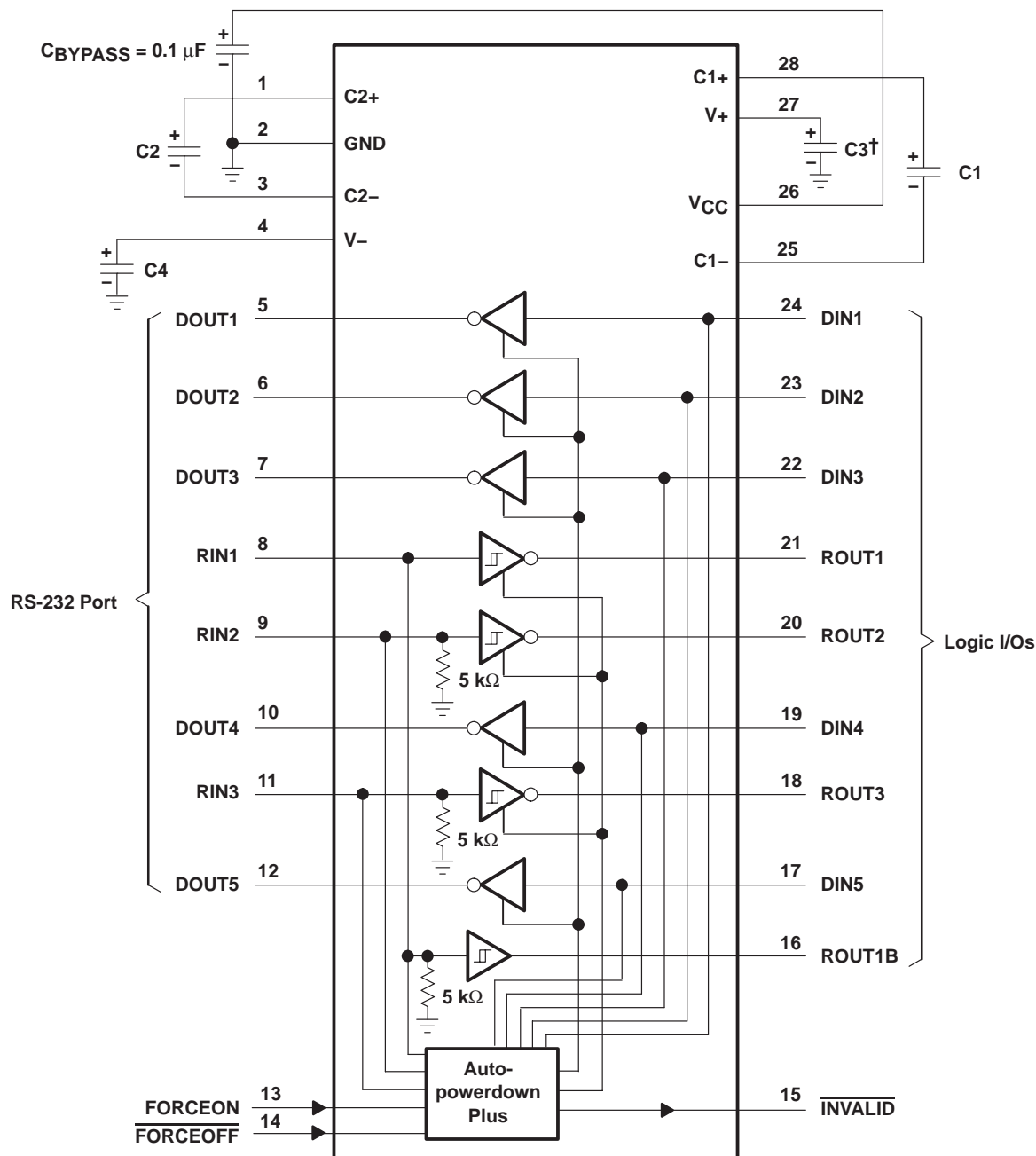
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APPLICATION INFORMATION



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

NOTE A: Resistor values shown are nominal.

V_{CC} vs CAPACITOR VALUES

V_{CC}	C1	C2, C3, and C4
3.3 V \pm 0.15 V	0.1 μ F	0.1 μ F
3.3 V \pm 0.3 V	0.22 μ F	0.22 μ F
5 V \pm 0.5 V	0.047 μ F	0.33 μ F
3 V to 5.5 V	0.22 μ F	1 μ F

Figure 6. Typical Operating Circuit and Capacitor Values



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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
MAX3238IDBG4Q1	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3238Q	Samples
MAX3238IDBRG4Q1	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3238Q	Samples
MAX3238IPWG4Q1	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3238Q	Samples
MAX3238IPWQ1	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3238Q	Samples
MAX3238IPWRG4Q1	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3238Q	Samples
MAX3238IPWRQ1	OBSOLETE	TSSOP	PW	28		TBD	Call TI	Call TI	-40 to 85	MB3238Q	

(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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OTHER QUALIFIED VERSIONS OF MAX3238-Q1 :

- Catalog: [MAX3238](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

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
MAX3238IDBRG4Q1	SSOP	DB	28	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS

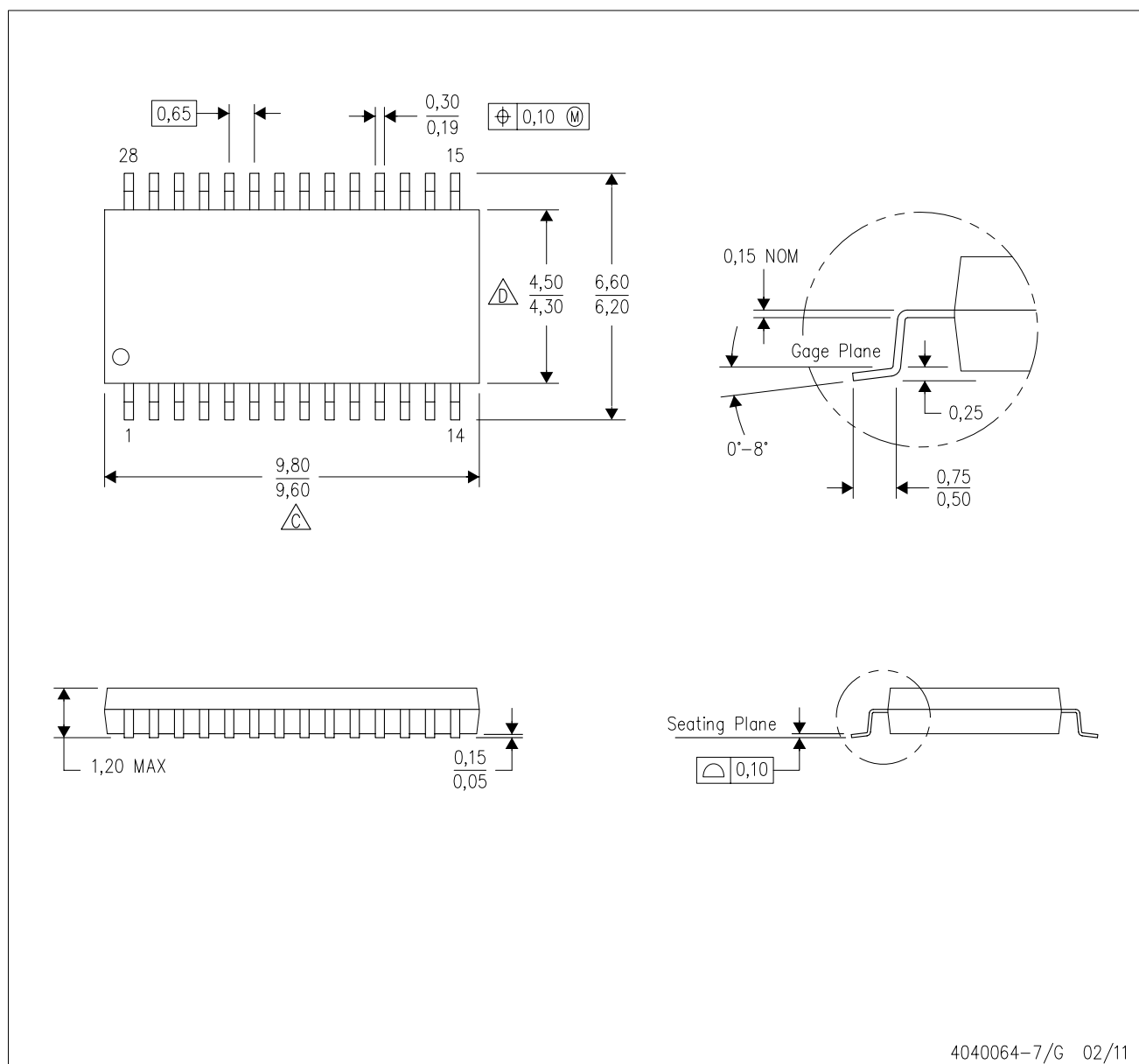


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3238IDBRG4Q1	SSOP	DB	28	2000	367.0	367.0	38.0

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

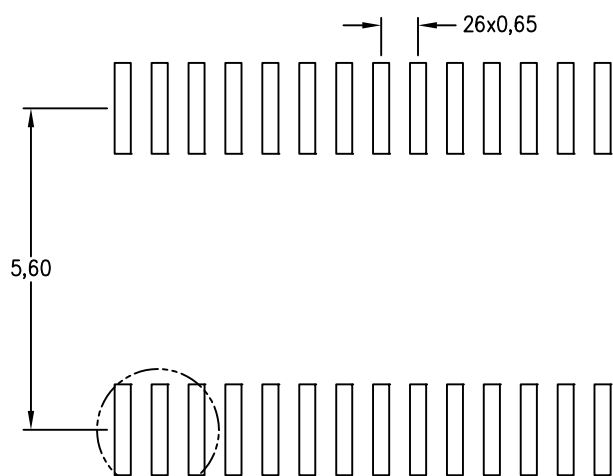


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each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

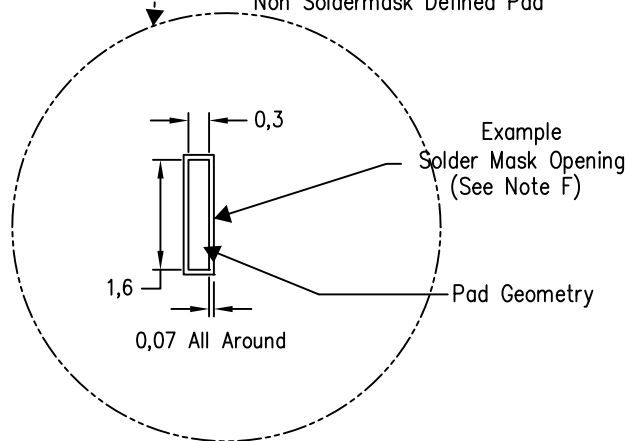
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

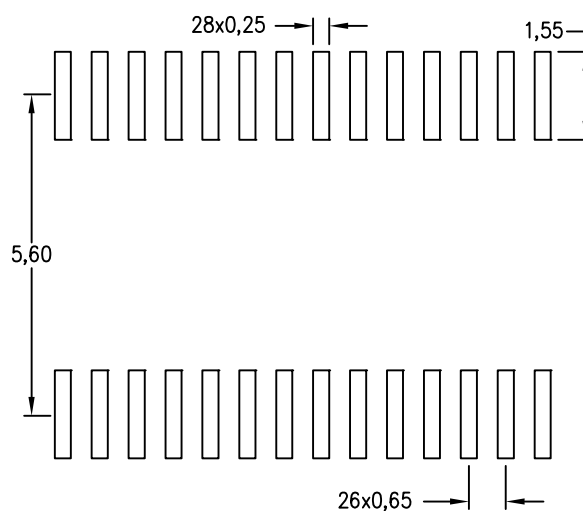
Example Board Layout



Example
Non Soldermask Defined Pad



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



4211284-6/F 12/12

- NOTES:
- 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:
- 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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