MAX3222 3-V to 5.5-V Multichannel RS-232 Line Driver and Receiver With ±15-kV ESD Protection

1 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 kbps
- Two Drivers and Two Receivers
- Low Standby Current: 1 µA Typical
- External Capacitors: 4 × 0.1 µF
- Accepts 5-V Logic Input With 3.3-V Supply
- Alternative High-Speed Pin-Compatible Device (1 Mbps)
  - SNx5C3222

2 Applications

- Battery-Powered Systems
- PDAs
- Notebooks
- Laptops
- Palmtop PCs
- Hand-held Equipment

3 Description

The MAX3222 consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±15-kV ESD 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 an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. The device operates at data signaling rates up to 250 kbit/s and a maximum of 30-V/µs driver output slew rate.

The MAX3222 can be placed in the power-down mode by setting $\overline{\text{PWRDOWN}}$ low, which draws only 1 µA from the power supply. When the device is powered down, the receivers remain active while the drivers are placed in the high-impedance state. Receiver outputs also can be placed in the high-impedance state by setting $\overline{\text{EN}}$ high.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
MAX3222CDW, MAX322IDW	SOIC (20)	12.80 mm × 7.50 mm
MAX3222CDB, MAX322IDB	SSOP (20)	7.20 mm × 5.30 mm
MAX3222CPW, MAX322IPW	TSSOP (20)	6.50 mm × 4.40 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Block Diagram

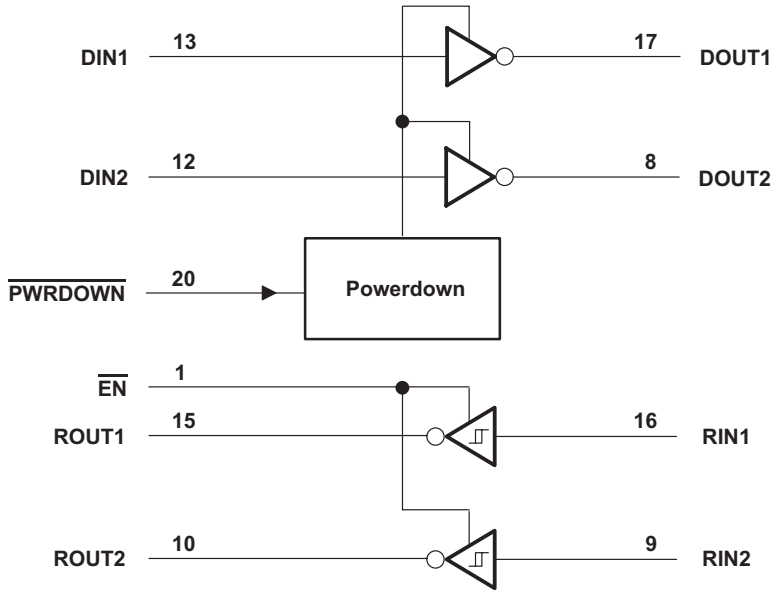


Table of Contents

4 Revision History

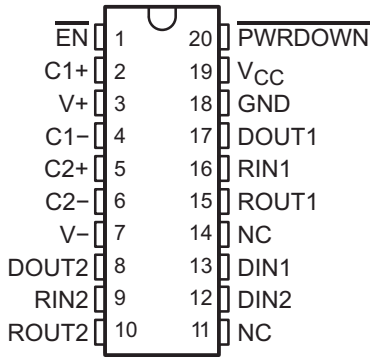
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision G (March 2004) to Revision H **Page**

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section. ... 1
- Deleted *ODERING INFORMATION* table; see POA at the end of the datasheet. ... 3
- Changed $R_{\theta JA}$ for DB, DW and PW package from: 70 °C/W to 84.4°C/W (DB), 58 °C/W to 70.2 °C/W (DW) and 83 °C/W to 94.3 °C/W (PW) in the *Thermal Information* table. ... 5

5 Pin Configuration and Functions

DB, DW, or PW Package
20-Pin SOIC, SSOP, TSSOP
Top View



NC − No internal connection

Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
C1+	2	—	Charge pump capacitor pin
C1-	4	—	Charge pump capacitor pin
C2+	5	—	Charge pump capacitor pin
C2-	6	—	Charge pump capacitor pin
DIN1	13	I	Driver logic input
DIN2	12	I	Driver logic input
DOUT1	17	O	RS-232 driver output
DOUT2	8	O	RS-232 driver output
$\overline{EN}$	1	I	Receiver enable, active low
GND	18	—	Ground
NC	11,14	—	No internal connection
$\overline{PWRDOWN}$	20	I	Driver disable, active low
RIN1	16	I	RS-232 receiver input
RIN2	9	I	RS-232 receiver input
ROUT1	15	O	Receiver logic output
ROUT2	10	O	Receiver logic output
V_{CC}	19	—	Power Supply
V+	3	—	Charge pump capacitor pin
V-	7	—	Charge pump capacitor pin

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Supply voltage, V_{CC}(2)		–0.3	6	V
Positive output supply voltage, V+(2)		–0.3	7	V
Negative output supply voltage, V–(2)		0.3	-7	V
Supply voltage difference, V+ – V–			13	V
Input voltage, V_I	Drivers, $\overline{EN}$, $\overline{PWRDOWN}$	–0.3	6	V
	Receiver	–25	25	
Output voltage, V_O	Drivers	–13.2	13.2	V
	Receivers	–0.3	V_{CC} + 0.3	
Operating virtual junction temperature, T_J			150	°C
Storage temperature, T_{stg}		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to network GND.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 RIN, DOUT, and GND pins (1)	Pins 8, 9, 16, 17 and 18	±15000	V
			All other pins	±3000	
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	All pins	±1500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)(1). See Figure 8.

				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	
VIH	Driver and control high-level input voltage	DIR, $\overline{EN}$, $\overline{PWRDOWN}$	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 V	2.4			
VIL	Driver and control low-level input voltage	DIR, $\overline{EN}$, $\overline{PWRDOWN}$				0.8	V
VI	Driver and control input voltage	DIR, $\overline{EN}$, $\overline{PWRDOWN}$		0		5.5	V
VI	Receiver input voltage			–25		25	V
TA	Operating free-air temperature	MAX3222C		0		70	°C
		MAX3222I		–40		85	

(1) Test conditions are C1−C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2−C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.

6.4 Thermal Information

THERMAL METRIC[1][2][3]		MAX3222			UNIT
		DB (SSOP)	DW (SOIC)	PW (TSSOP)	
		20 PINS	20 PINS	20 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	84.4	70.2	94.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	44.1	36.2	29.9	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	40	37.9	45.1	°C/W
ψ_{JT}	Junction-to-top characterization parameter	11	11.1	1.4	°C/W
ψ_{JB}	Junction-to-board characterization parameter	39.5	37.5	44.6	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.
(2) 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 $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. 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.

6.5 Electrical Characteristics: Device

over operating free-air temperature range (unless otherwise noted)[1]. See Figure 8.

PARAMETER		TEST CONDITIONS	MIN	TYP[2]	MAX	UNIT
II	Input leakage current ($\overline{EN}$, $\overline{PWRDOWN}$)			±0.01	±1	µA
I_{CC}	Supply current	No load, $\overline{PWRDOWN}$ at V_{CC}		0.3	1	mA
	Supply current (powered off)	No load, $\overline{PWRDOWN}$ at GND		1	10	µA

(1) Test conditions are C1−C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, 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.

6.6 Electrical Characteristics: Driver

over operating free-air temperature range (unless otherwise noted)[1]. See Figure 8.

PARAMETER		TEST CONDITIONS	MIN	TYP[2]	MAX	UNIT
V_{OH}	High-level output voltage	DOUT at R_L = 3 kΩ to GND, DIN = GND	5	5.4		V
V_{OL}	Low-level output voltage	DOUT at R_L = 3 kΩ to GND, DIN = V_{CC}	–5	–5.4		V
I_{IH}	High-level input current	$V_I = V_{CC}$		±0.01	±1	µA
I_{IL}	Low-level input current	V_I at GND		±0.01	±1	µA
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				
r_o	Output resistance	V_{CC}, V+, and V– = 0 V, V_O = ±2 V	300	10M		Ω
I_{off}	Output leakage current	$\overline{PWRDOWN}$ = GND, V_O = ±12 V, V_{CC} = 3 V to 3.6 V			±25	µA
		$\overline{PWRDOWN}$ = GND, V_O = ±10 V, V_{CC} = 4.5 V to 5.5 V			±25	

(1) Test conditions are C1−C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, 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.

6.7 Electrical Characteristics: Receiver

over operating free-air temperature range (unless otherwise noted)(1). See Figure 8.

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_{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	$\overline{EN}$ = V_{CC}		±0.05	±10	µA
r_i	Input resistance	V_I = ±3 V to ±25 V	3	5	7	kΩ

(1) Test conditions are C1−C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, 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.

6.8 Switching Characteristics: Driver

over operating free-air temperature range (unless otherwise noted)(1). See Figure 8.

PARAMETER		TEST CONDITIONS		MIN	TYP(2)	MAX	UNIT
	Maximum data rate	C_L = 1000 pF, R_L = 3 kΩ, One DOUT switching, see Figure 3		150	250		kbps
$t_{sk(p)}$	Pulse skew(3)	C_L = 150 pF to 2500 pF, R_L = 3 kΩ to 7 kΩ, see Figure 4			300		ns
SR(tr)	Slew rate, transition region (see Figure 3)	R_L = 3 kΩ to 7 kΩ, V_{CC} = 3.3 V	C_L = 150 pF to 1000 pF	6		30	V/µs
			C_L = 150 pF to 2500 pF	4		30	

(1) Test conditions are C1−C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, 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 |tPLH − tPHL| of each channel of the same device.

6.9 Switching Characteristics: Receiver

over operating free-air temperature range (unless otherwise noted)(1). See Figure 8.

PARAMETER		TEST CONDITIONS	MIN	TYP(2)	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	C_L = 150 pF, see Figure 5		300		ns
t_{PHL}	Propagation delay time, high- to low-level output	C_L = 150 pF, see Figure 5		300		ns
t_{en}	Output enable time	C_L = 150 pF, R_L = 3 kΩ, see Figure 6		200		ns
t_{dis}	Output disable time	C_L = 150 pF, R_L = 3 kΩ, see Figure 6		200		ns
$t_{sk(p)}$	Pulse skew(3)	See Figure 5		300		ns

(1) Test conditions are C1−C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, 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 |tPLH − tPHL| of each channel of the same device.

6.10 Typical Characteristics

T_A = 25° C; V_{CC} = 3.3V

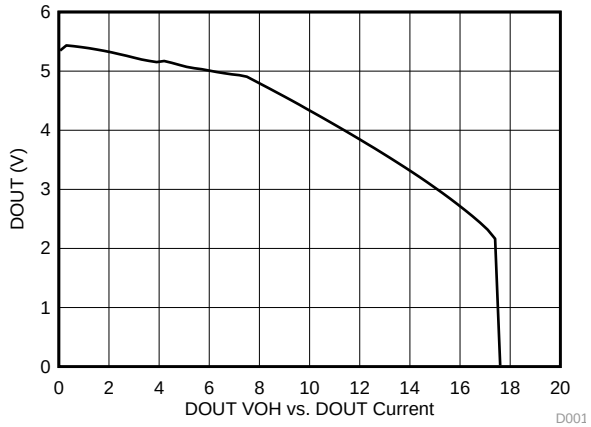


Figure 1. Driver VOH vs Load Current

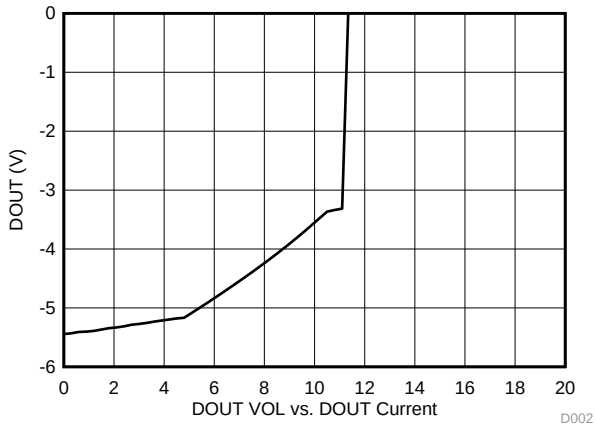
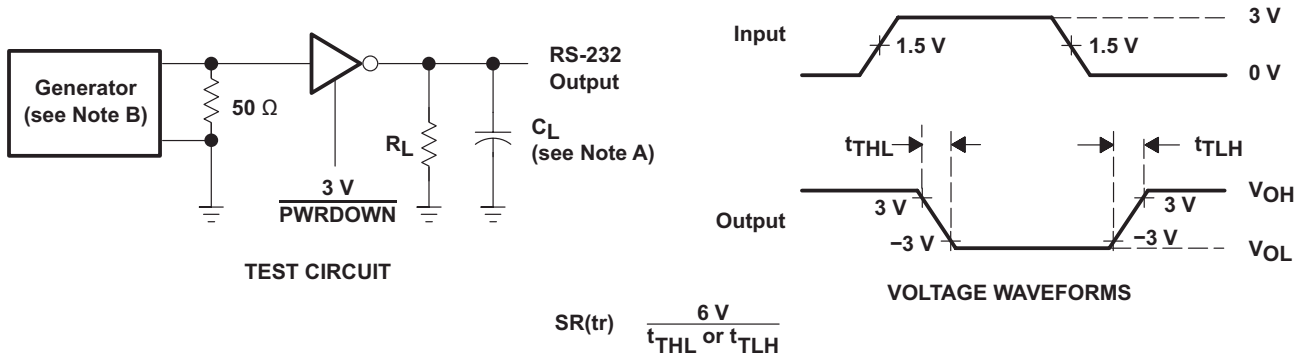


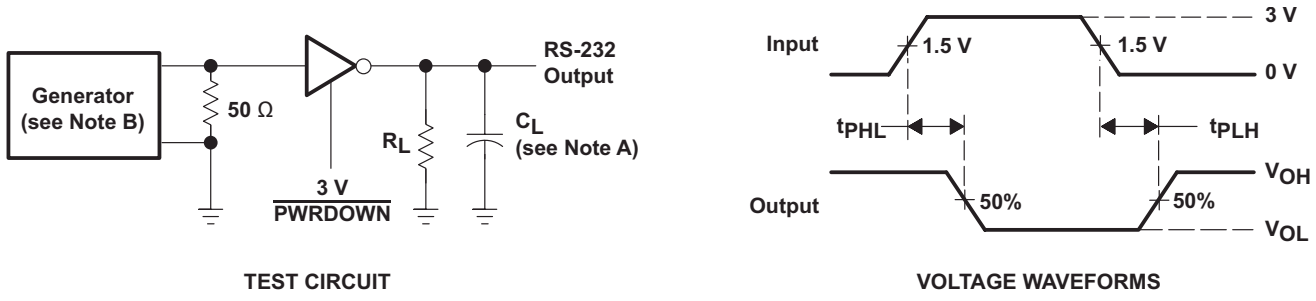
Figure 2. Driver VOL vs Load Current

7 Parameter Measurement Information



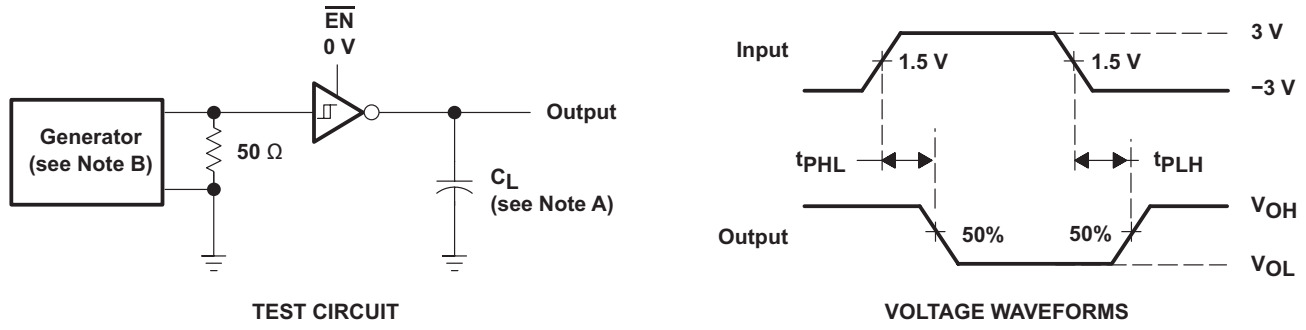
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 250 kbit/s, Z_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

Figure 3. Driver Slew Rate



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

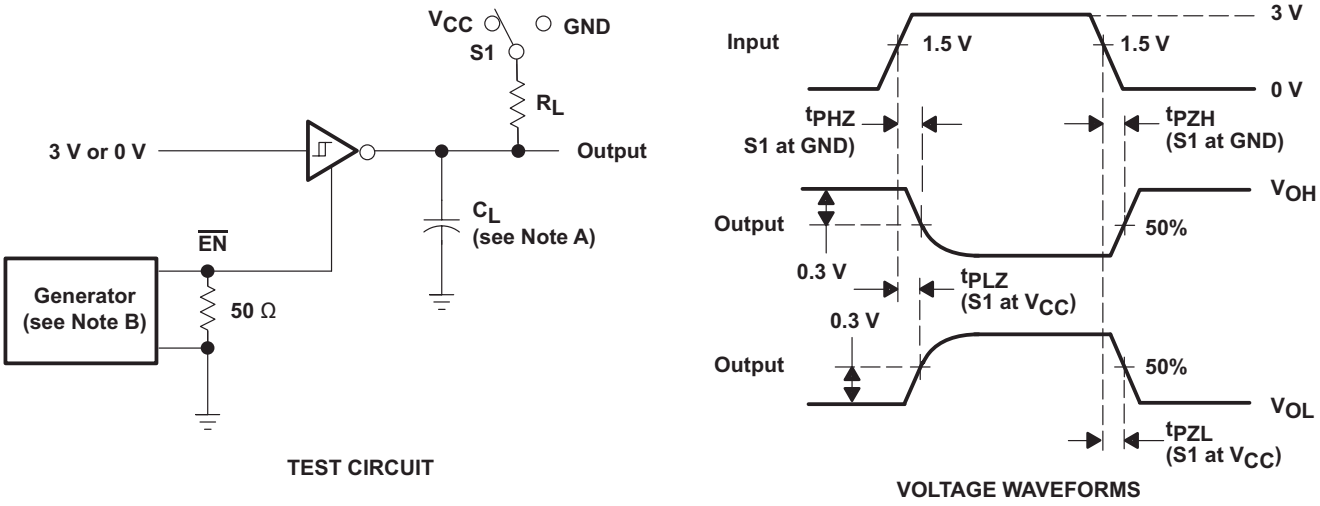
Figure 4. Driver Pulse Skew



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: Z_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

Figure 5. Receiver Propagation Delay Times

Parameter Measurement Information (continued)



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

Figure 6. Receiver Enable and Disable Times

8 Detailed Description

8.1 Overview

The MAX3222 consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±15-kV ESD 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 an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. The device operates at data signaling rates up to 250 kbit/s and a maximum of 30-V/μs driver output slew rate.

The MAX3222 can be placed in the power-down mode by setting $\overline{\text{PWRDOWN}}$ low, which draws only 1 μA from the power supply. When the device is powered down, the receivers remain active while the drivers are placed in the high-impedance state. Also, during power down, the onboard charge pump is disabled; V+ is lowered to V_{CC}, and V− is raised toward GND. Receiver outputs also can be placed in the high-impedance state by setting EN high.

8.2 Functional Block Diagram

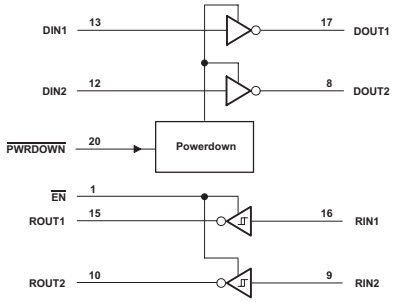


Figure 7. Logic Diagram (Positive Logic)

8.3 Feature Description

8.3.1 Power

The power block increases, inverts, and regulates voltage at V+ and V- pins using a charge pump that requires four external capacitors.

8.3.2 RS232 Driver

Two drivers interface standard logic level to RS232 levels. $\overline{\text{PWRDOWN}}$ input low turns driver off and $\overline{\text{PWRDOWN}}$ input high turns driver on. Both DIN inputs and $\overline{\text{PWRDOWN}}$ input must be valid high or low. Do not float logic input pins.

8.3.3 RS232 Receiver

Two receivers interface RS232 levels to standard logic levels. An open input will result in a high output on ROUT. Each RIN input includes an internal standard RS232 load. $\overline{\text{EN}}$ input low turns on both ROUT pins. $\overline{\text{EN}}$ input high puts both ROUT pins into high impedance state, output off. $\overline{\text{EN}}$ input must be valid high or low. Do not float logic input pins.

8.4 Device Functional Modes

Driver and receiver outputs are controlled by the functional truth tables.

Table 1. Functional Table - Each Driver(1)

INPUTS		OUTPUT DOUT
DIN	$\overline{\text{PWRDOWN}}$	
X	L	Z
L	H	H
H	H	L

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

Table 2. Functional Table - Each Receiver(1)

INPUTS		OUTPUT ROUT
RIN	$\overline{\text{EN}}$	
L	L	H
H	L	L
X	H	Z
Open	L	H

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

9 Application and Implementation

NOTE

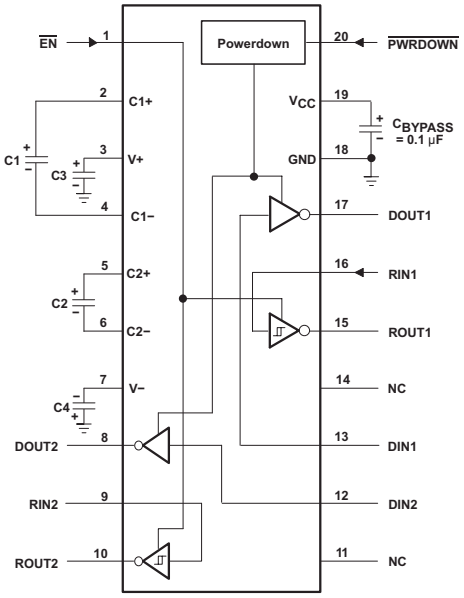
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The MAX3222 interfaces a universal asynchronous receiver / transmitter (UART) to RS-232 port voltage levels. External capacitors are used to generate RS-232 compliant voltages. For proper operation, add capacitors as shown in Figure 8.

9.2 Typical Application

ROUT and DIN connect to UART or general purpose logic lines. RIN and DOUT lines connect to a RS232 connector or cable.



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

Resistor values shown are nominal.

NC − No internal connection

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

Figure 8. Recommended Application Schematic

9.2.1 Design Requirements

- Recommended V_{CC} is 3.3 V or 5 V. 3 V to 5.5 V is also possible
- Maximum recommended bit rate is 250 kbit/s.

Table 3. V_{CC} vs Capacitor Values

VCC	C1	C2, C3, and C4
3.3 V ± 0.3 V	0.1 µF	0.1 µF
5 V ± 0.5 V	0.047 µF	0.33 µF
3 V ± 5.5 V	0.1 µF	0.47 µF

9.2.2 Detailed Design Procedure

- All DIN, $\overline{\text{PWRDOWN}}$ and $\overline{\text{EN}}$ inputs must be connected to valid low or high logic levels.
- Select capacitor values based on VCC level for best performance.

9.2.3 Application Curves

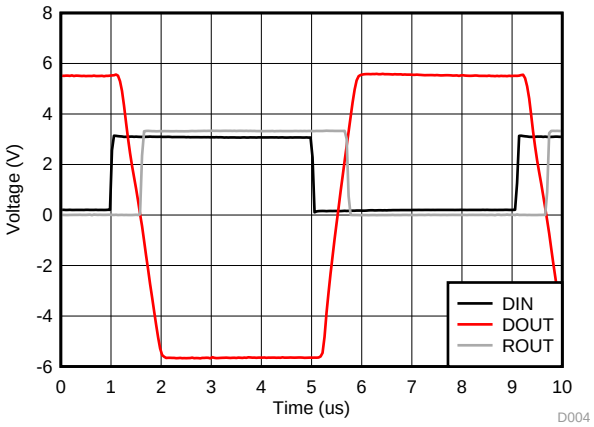


Figure 9. Loopback Waveforms
V_{CC} = 3.3 V, Data Rate 250 kbit/s

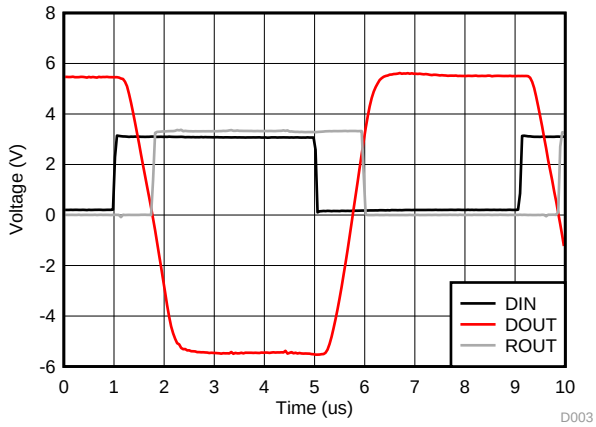


Figure 10. Loopback Waveforms with 1-nF load
V_{CC} = 3.3 V, Data Rate 250 kbit/s

10 Power Supply Recommendations

V_{CC} should be between 3 V and 5.5 V. Charge pump capacitors should be chosen using table in Table 3.

11 Layout

11.1 Layout Guidelines

Keep the external capacitor traces short. This is more important on C1 and C2 nodes that have the fastest rise and fall times. Make the impedance from MAX3222 ground pin and circuit board's ground plane as low as possible for best ESD performance. Use wide metal and multiple vias on both sides of ground pin

11.2 Layout Example

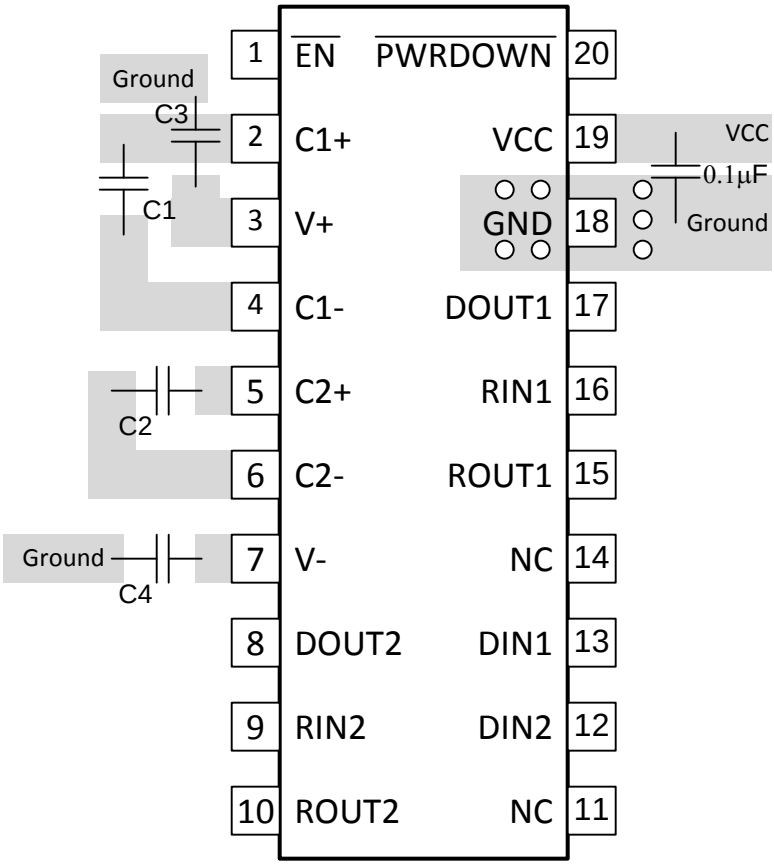


Figure 11. MAX3222 Layout

12 Device and Documentation Support

12.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

12.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.3 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.4 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

12.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
MAX3222CDB	Obsolete	Production	SSOP (DB) | 20	-	-	Call TI	Call TI	0 to 70	MA3222C
MAX3222CDBR	Obsolete	Production	SSOP (DB) | 20	-	-	Call TI	Call TI	0 to 70	MA3222C
MAX3222CDW	Obsolete	Production	SOIC (DW) | 20	-	-	Call TI	Call TI	0 to 70	MAX3222C
MAX3222CDWR	Obsolete	Production	SOIC (DW) | 20	-	-	Call TI	Call TI	0 to 70	MAX3222C
MAX3222CPWR	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3222C
MAX3222CPWR.A	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3222C
MAX3222IDB	Obsolete	Production	SSOP (DB) | 20	-	-	Call TI	Call TI	-40 to 85	MB3222I
MAX3222IDW	Obsolete	Production	SOIC (DW) | 20	-	-	Call TI	Call TI	-40 to 85	MAX3222I
MAX3222IDWR	Obsolete	Production	SOIC (DW) | 20	-	-	Call TI	Call TI	-40 to 85	MAX3222I
MAX3222IPWR	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3222I
MAX3222IPWR.A	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3222I

(1) **Status:** For more details on status, see our product life cycle.

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

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

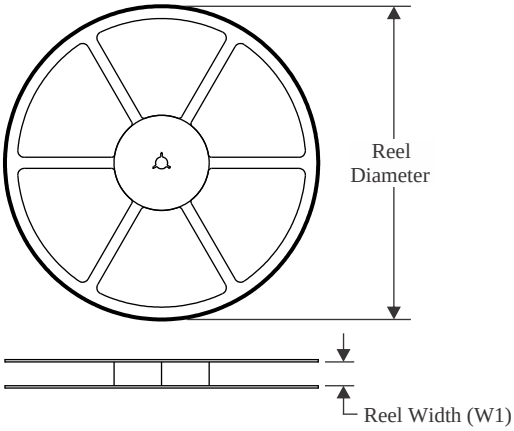
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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

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

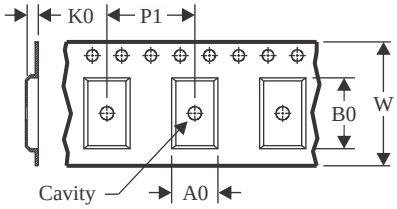
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

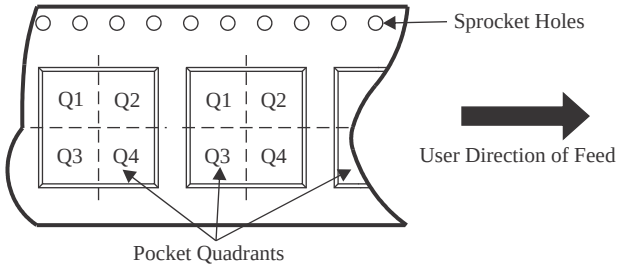


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

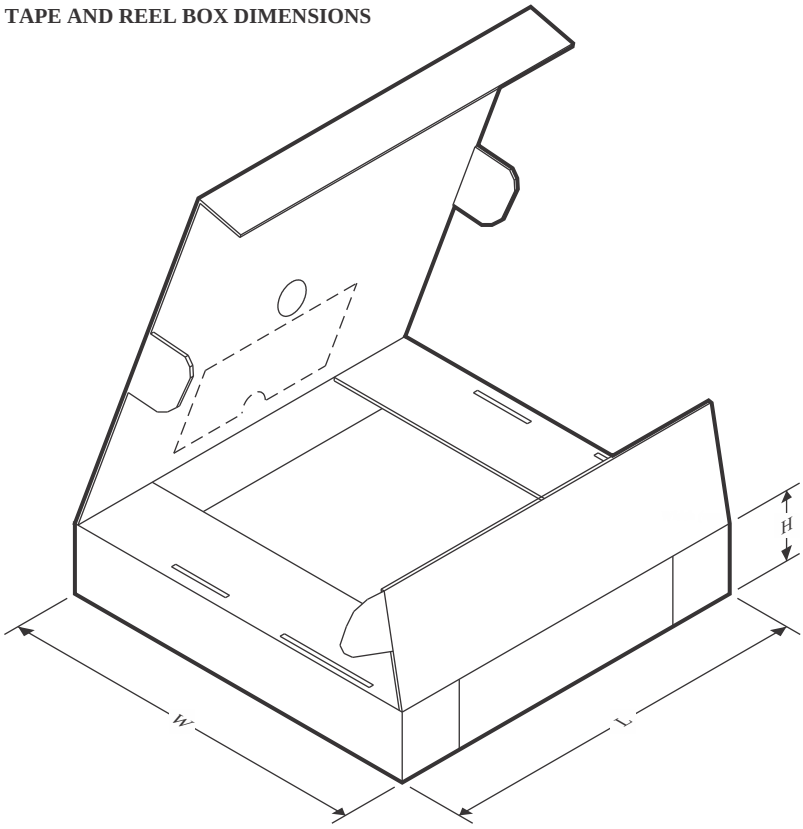
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
MAX3222CPWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1
MAX3222IPWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

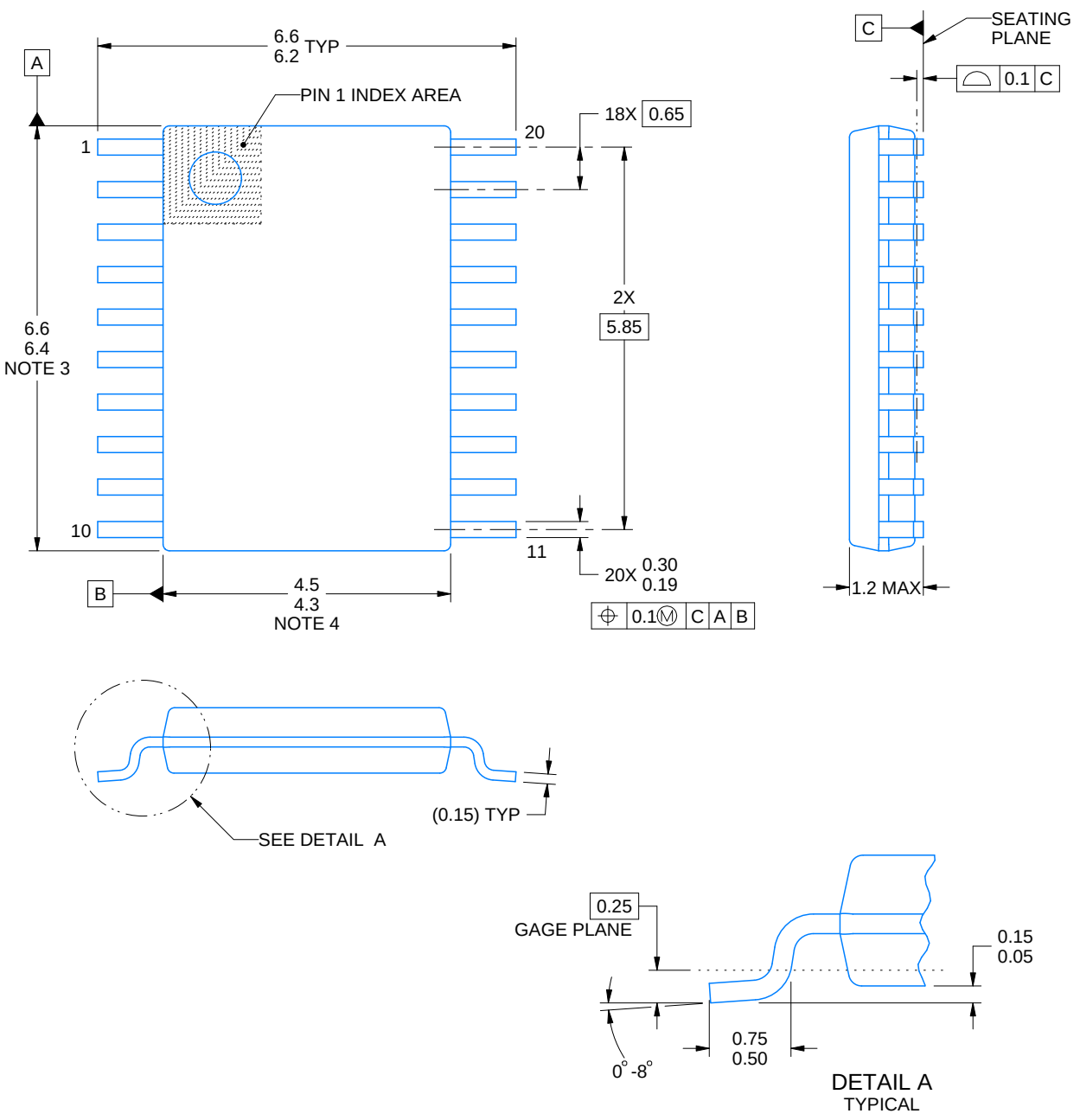
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3222CPWR	TSSOP	PW	20	2000	353.0	353.0	32.0
MAX3222IPWR	TSSOP	PW	20	2000	353.0	353.0	32.0

PACKAGE OUTLINE

PW0020A

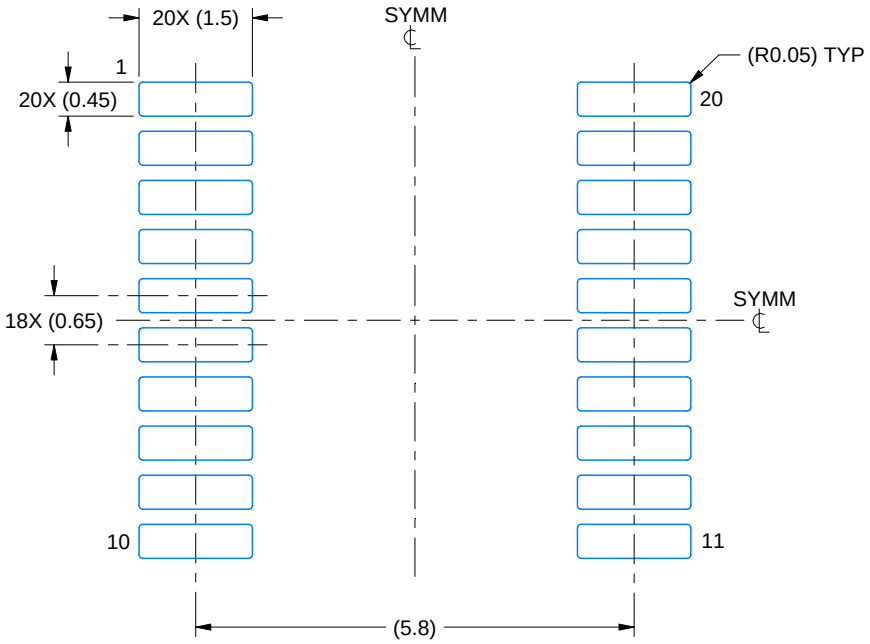
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.



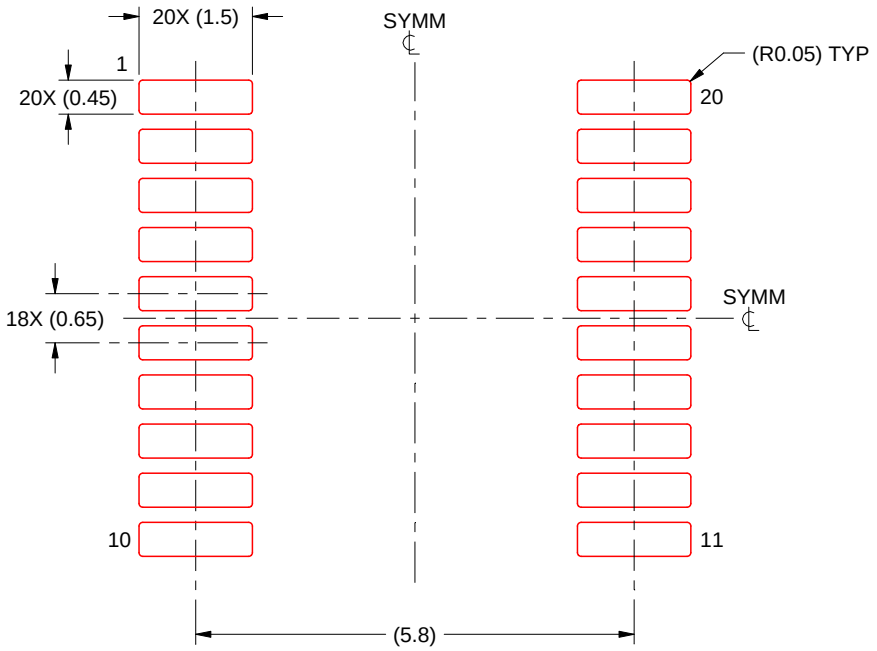
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

SOLDER MASK DETAILS

4220206/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



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

4220206/A 02/2017

NOTES: (continued)

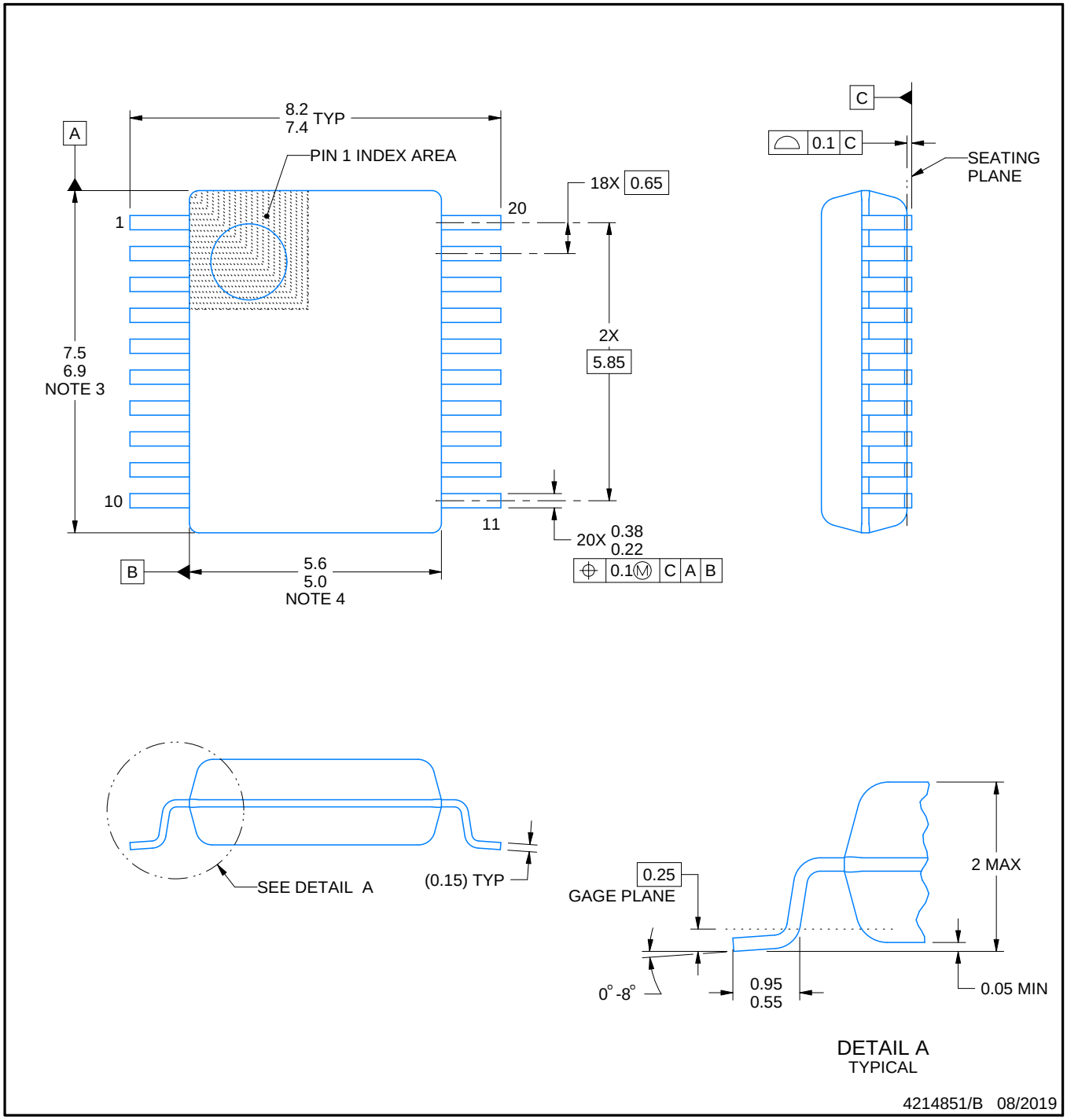
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

DB0020A

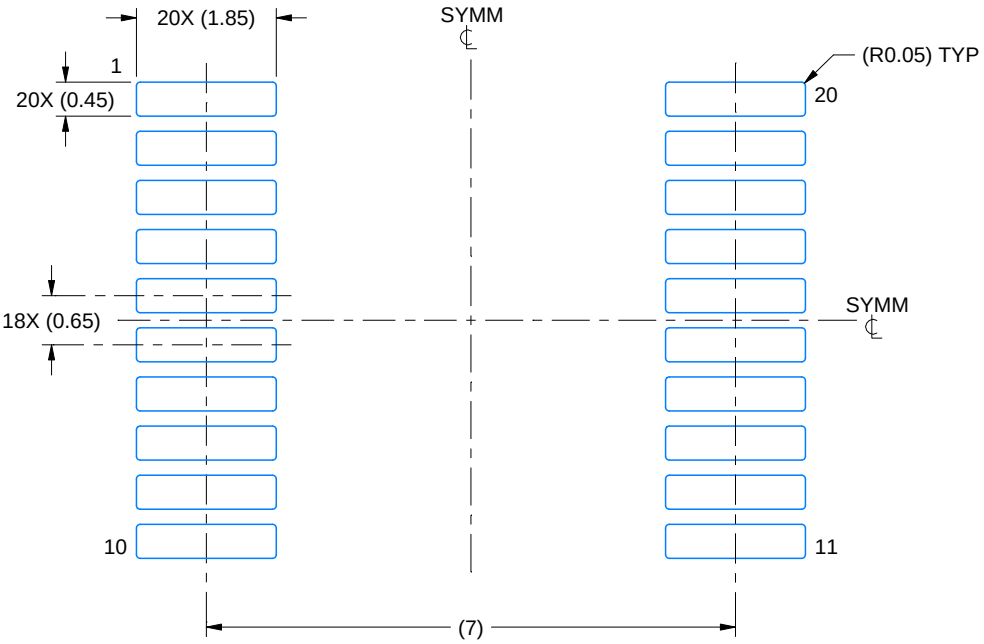
SSOP - 2 mm max height

SMALL OUTLINE PACKAGE

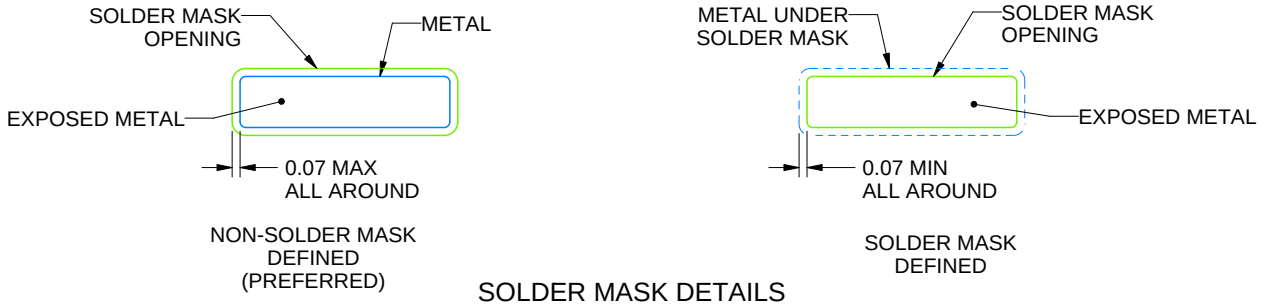


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-150.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4214851/B 08/2019

NOTES: (continued)

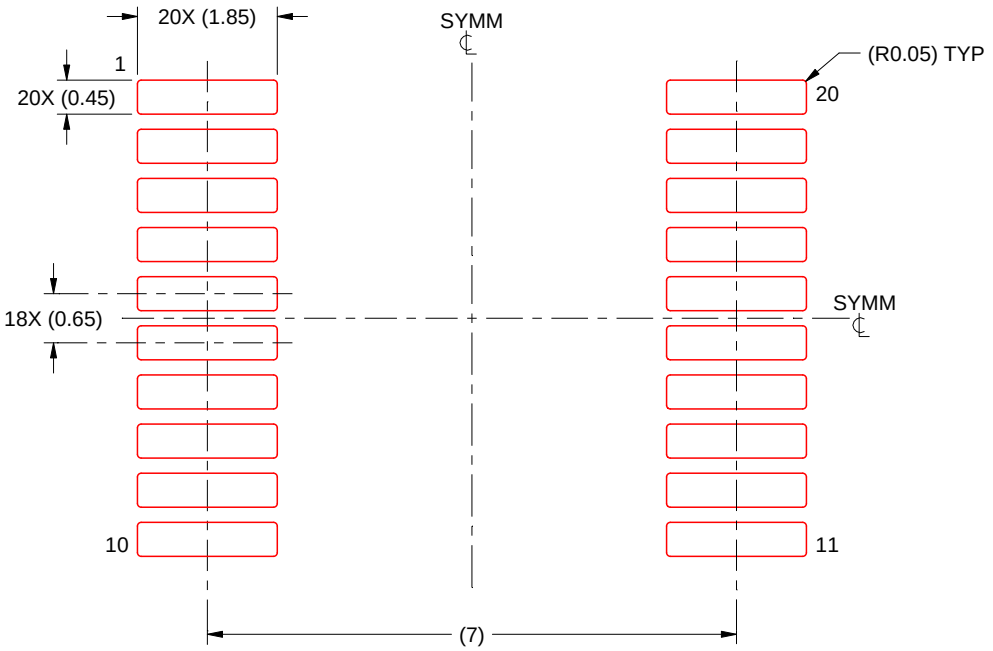
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DB0020A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE

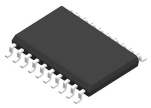


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4214851/B 08/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

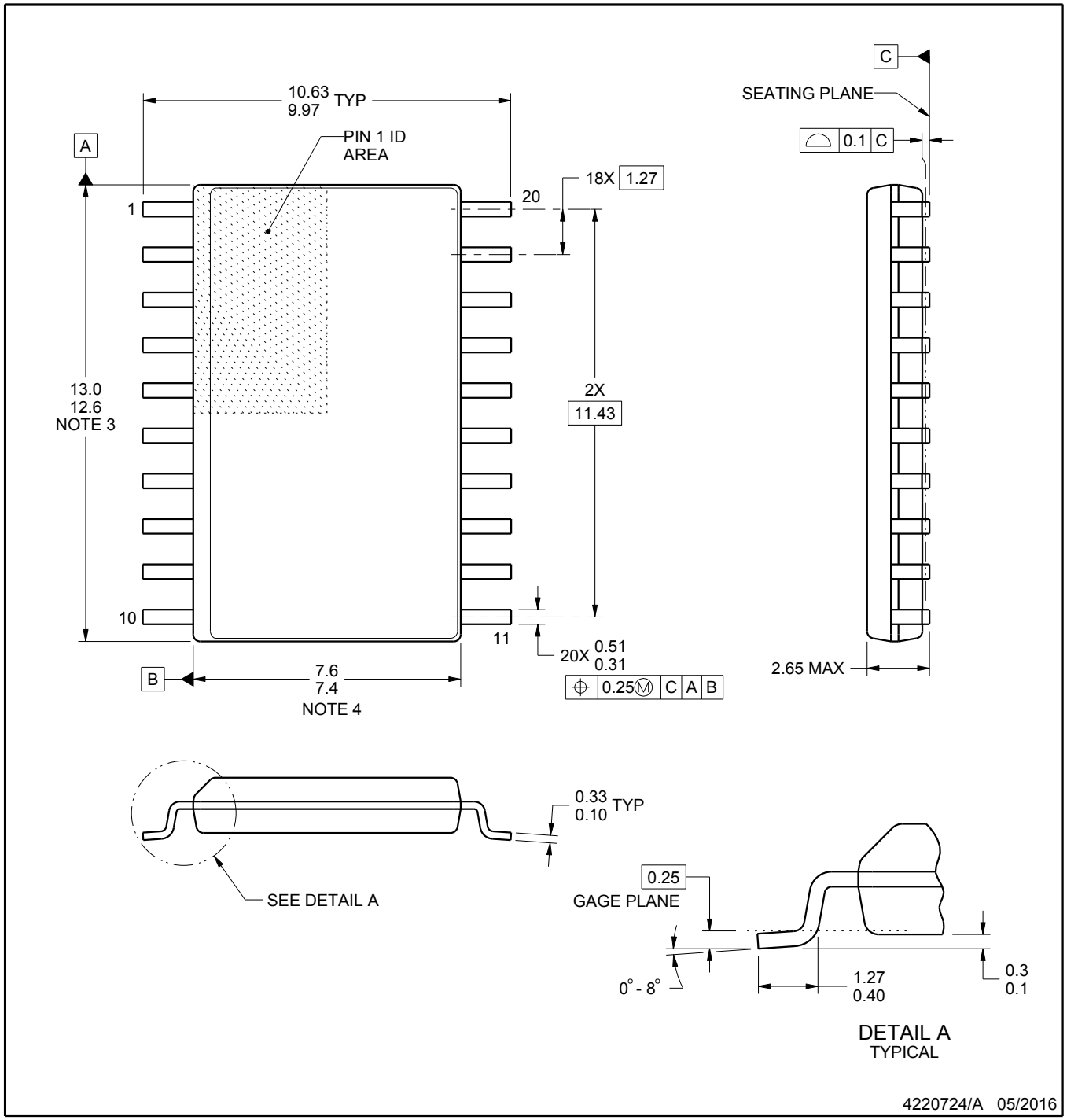


PACKAGE OUTLINE

DW0020A

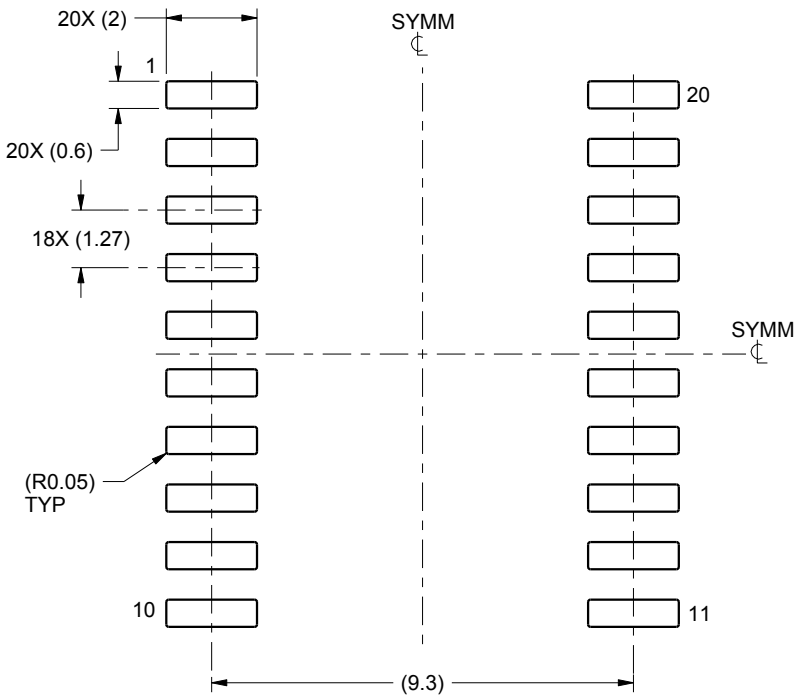
SOIC - 2.65 mm max height

SOIC

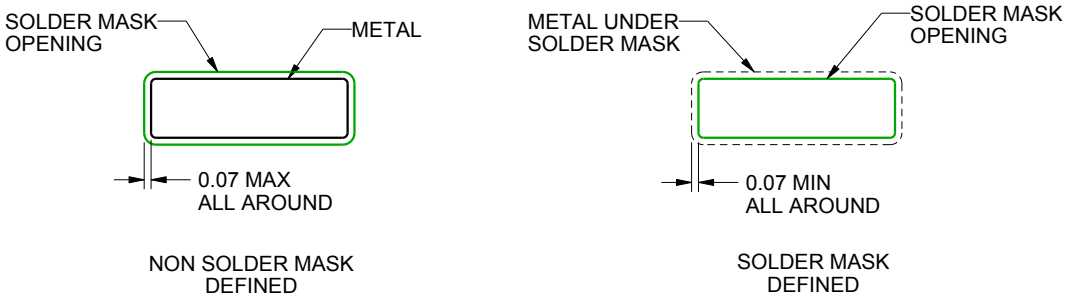


NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.



LAND PATTERN EXAMPLE
SCALE:6X

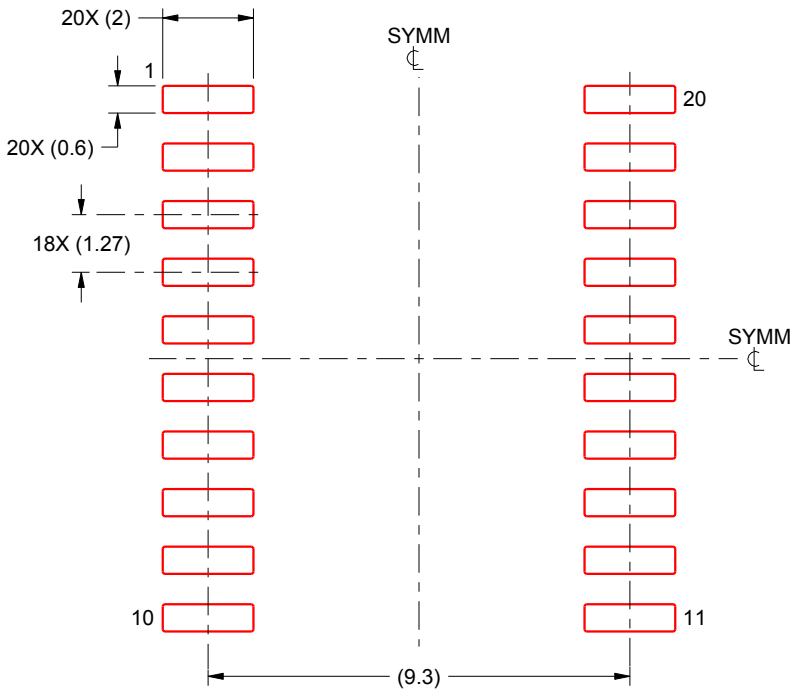


SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265