

# MAX3232 3-V to 5.5-V Multichannel RS-232 Line Driver and Receiver

## With $\pm 15$ -kV ESD Protection

### 1 Features

- RS-232 Bus-terminal esd protection exceeds  $\pm 15$  kV using human-body model (HBM)
- Meets or exceeds the requirements of TIA/EIA-232-F and ITU V.28 standards
- Operates with 3-V to 5.5-V  $V_{CC}$  supply
- Operates up to 250 kbit/s
- Two drivers and two receivers
- Low supply current: 300  $\mu$ A Typical
- External capacitors:  $4 \times 0.1 \mu$ F
- Accepts 5-V logic input with 3.3-V supply
- Alternative high-speed terminal-compatible devices (1 Mbit/s)
  - SN65C3232 ( $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ )
  - SN75C3232 ( $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ )

### 2 Applications

- [Industrial PCs](#)
- [Wired networking](#)
- [Data center and enterprise networking](#)
- [Battery-powered systems](#)
- [PDAs](#)
- [Notebooks](#)
- [Laptops](#)
- [Palmtop PCs](#)
- [Hand-held equipment](#)

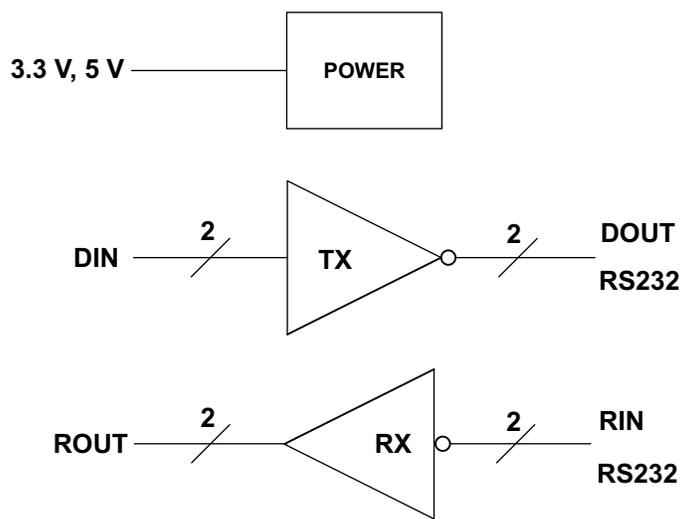
### 3 Description

The MAX3232 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD protection terminal to terminal (serial-port connection terminals, 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 devices operate at data signaling rates up to 250 kbit/s and a maximum of 30-V/ $\mu$ s driver output slew rate.

#### Device Information

PART NUMBER	PACKAGE <sup>(1)</sup>	BODY SIZE
MAX3232	SOIC (D) (16)	9.90 mm $\times$ 3.91 mm
	SSOP (DB) (16)	6.20 mm $\times$ 5.30 mm
	SOIC (DW) (16)	10.30 mm $\times$ 7.50 mm
	TSSOP (PW) (16)	5.00 mm $\times$ 4.40 mm

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



Simplified Schematic



## Table of Contents

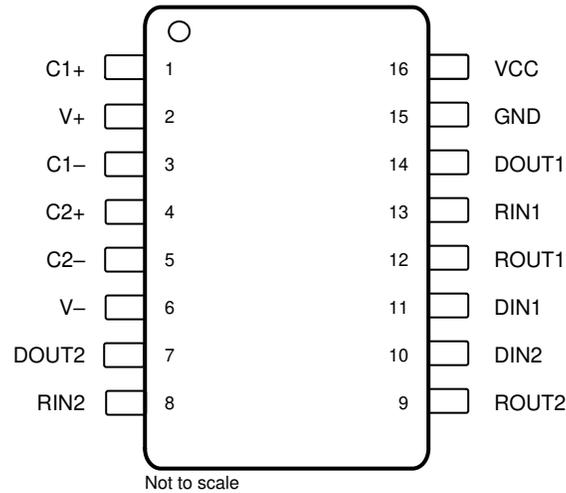
<b>1 Features</b> .....	1	8.2 Functional Block Diagram.....	9
<b>2 Applications</b> .....	1	8.3 Feature Description.....	9
<b>3 Description</b> .....	1	8.4 Device Functional Modes.....	10
<b>4 Revision History</b> .....	2	<b>9 Application and Implementation</b> .....	11
<b>5 Pin Configuration and Functions</b> .....	3	9.1 Application Information.....	11
<b>6 Specifications</b> .....	4	9.2 Standard Application.....	11
6.1 Absolute Maximum Ratings.....	4	<b>10 Power Supply Recommendations</b> .....	12
6.2 ESD Ratings.....	4	<b>11 Layout</b> .....	13
6.3 Recommended Operating Conditions.....	4	11.1 Layout Guidelines.....	13
6.4 Thermal Information.....	5	11.2 Layout Example.....	13
6.5 Electrical Characteristics — Device.....	5	<b>12 Device and Documentation Support</b> .....	14
6.6 Electrical Characteristics — Driver.....	5	12.1 Receiving Notification of Documentation Updates.....	14
6.7 Electrical Characteristics — Receiver.....	6	12.2 Support Resources.....	14
6.8 Switching Characteristics.....	6	12.3 Trademarks.....	14
6.9 Typical Characteristics.....	7	12.4 Electrostatic Discharge Caution.....	14
<b>7 Parameter Measurement Information</b> .....	8	12.5 Glossary.....	14
<b>8 Detailed Description</b> .....	9	<b>13 Mechanical, Packaging, and Orderable Information</b> .....	14
8.1 Overview.....	9		

## 4 Revision History

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

<b>Changes from Revision N (June 2017) to Revision O (June 2021)</b>	<b>Page</b>
• Added <i>Applications</i> : Industrial PCs, Wired networking, and Data center and enterprise computing.....	1
• Changed the thermal parameter values for D, DB and PW packages in the <i>Thermal Information</i> table.....	5
<hr/>	
<b>Changes from Revision M (April 2017) to Revision N (June 2017)</b>	<b>Page</b>
• Changed the <i>Thermal Information</i> table .....	5
<hr/>	
<b>Changes from Revision L (March 2017) to Revision M (April 2017)</b>	<b>Page</b>
• Changed From: "±" To: "to" in the $V_{CC}$ column of <a href="#">Table 9-1</a> .....	12
<hr/>	
<b>Changes from Revision K (January 2015) to Revision L (March 2017)</b>	<b>Page</b>
• Changed pin 16 ( $V_{CC}$ ) in <a href="#">Typical Operating Circuit and Capacitor Values</a> .....	11
<hr/>	
<b>Changes from Revision J (January 2014) to Revision K (January 2015)</b>	<b>Page</b>
• Added <i>Applications</i> , <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Typical Characteristics</i> , <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section.....	1
<hr/>	
<b>Changes from Revision I (January 2004) to Revision J (January 2014)</b>	<b>Page</b>
• Updated document to new TI data sheet format - no specification changes.....	1
• Deleted <i>Ordering Information</i> table.....	1

## 5 Pin Configuration and Functions



**Figure 5-1. D, DB, DW, or PW Package, 16-Pin SOIC, SSOP, or TSSOP, Top View**

**Table 5-1. Pin Functions**

PIN		TYPE	DESCRIPTION
NAME	NO.		
C1+	1	—	Positive lead of C1 capacitor
V+	2	O	Positive charge pump output for storage capacitor only
C1–	3	—	Negative lead of C1 capacitor
C2+	4	—	Positive lead of C2 capacitor
C2–	5	—	Negative lead of C2 capacitor
V–	6	O	Negative charge pump output for storage capacitor only
DOUT2	7	O	RS232 line data output (to remote RS232 system)
DOUT1	14	O	RS232 line data output (to remote RS232 system)
RIN2	8	I	RS232 line data input (from remote RS232 system)
RIN1	13	I	RS232 line data input (from remote RS232 system)
ROUT2	9	O	Logic data output (to UART)
ROUT1	12	O	Logic data output (to UART)
DIN2	10	I	Logic data input (from UART)
DIN1	11	I	Logic data input (from UART)
GND	15	—	Ground
V <sub>CC</sub>	16	—	Supply Voltage, Connect to external 3 V to 5.5 V power supply

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		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>	-7	0.3	V	
V+ - V-	Supply voltage difference <sup>(2)</sup>		13	V	
V <sub>I</sub>	Input voltage range	Drivers	-0.3	6	V
		Receivers	-25	25	
V <sub>O</sub>	Output voltage range	Drivers	-13.2	13.2	V
		Receivers	-0.3	V <sub>CC</sub> + 0.3	
T <sub>J</sub>	Operating virtual junction temperature		150	°C	
T <sub>stg</sub>	Storage temperature range	-65	150	°C	

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) All voltages are with respect to network GND.

### 6.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 RIN, DOUT, and GND pins <sup>(1)</sup>	15000	V
		Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 All other pins <sup>(1)</sup>	3000	
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup>	1000	

- (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

(see [Typical Operating Circuit and Capacitor Values](#))<sup>(1)</sup>

		MIN	NOM	MAX	UNIT	
V <sub>CC</sub>	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 high-level input voltage	DIN	V <sub>CC</sub> = 3.3 V	2		V
			V <sub>CC</sub> = 5 V	2.4		
V <sub>IL</sub>	Driver low-level input voltage	DIN			0.8	V
V <sub>I</sub>	Driver input voltage	DIN	0		5.5	V
	Receiver input voltage	RIN	-25		25	
T <sub>A</sub>	Operating free-air temperature	MAX3232C	0		70	°C
		MAX3232I	-40		85	

- (1) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

## 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>	MAX3232				UNIT
	SOIC (D)	SSOP (DB)	SOIC (DW)	TSSOP (PW)	
	16 PINS				
R <sub>θJA</sub> Junction-to-ambient thermal resistance	85.9	103.1	66.6	108.2	°C/W
R <sub>θJC(top)</sub> Junction-to-case (top) thermal resistance	43.1	49.2	32.4	39.0	°C/W
R <sub>θJB</sub> Junction-to-board thermal resistance	44.5	54.8	31.9	54.4	°C/W
ψ <sub>JT</sub> Junction-to-top characterization parameter	10.1	12	8.4	3.3	°C/W
ψ <sub>JB</sub> Junction-to-board characterization parameter	44.1	54.1	31.5	53.8	°C/W
R <sub>θJC(bot)</sub> Junction-to-case (bottom) thermal resistance	n/a	n/a	n/a	n/a	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 6.5 Electrical Characteristics — Device

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)<sup>(2)</sup> (see [Typical Operating Circuit and Capacitor Values](#))

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
I <sub>CC</sub> Supply current	No load, V <sub>CC</sub> = 3.3 V to 5 V		0.3	1	mA

(1) 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.

(2) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

## 6.6 Electrical Characteristics — Driver

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)<sup>(3)</sup> (see [Typical Operating Circuit and Capacitor Values](#))

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>OH</sub> High-level output voltage	D <sub>OUT</sub> at R <sub>L</sub> = 3 kΩ to GND, D <sub>IN</sub> = GND	5	5.4		V
V <sub>OL</sub> Low-level output voltage	D <sub>OUT</sub> at R <sub>L</sub> = 3 kΩ to GND, D <sub>IN</sub> = V <sub>CC</sub>	–5	–5.4		V
I <sub>IH</sub> High-level input current	V <sub>I</sub> = V <sub>CC</sub>		±0.01	±1	μA
I <sub>IL</sub> Low-level input current	V <sub>I</sub> at GND		±0.01	±1	μA
I <sub>OS</sub> <sup>(2)</sup> Short-circuit output current	V <sub>CC</sub> = 3.6 V V <sub>O</sub> = 0 V		±35	±60	mA
	V <sub>CC</sub> = 5.5 V V <sub>O</sub> = 0 V				
r <sub>O</sub> Output resistance	V <sub>CC</sub> , V+, and V– = 0 V V <sub>O</sub> = ±2 V	300	10M		Ω

(1) 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.

(2) 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.

(3) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5

## 6.7 Electrical Characteristics — Receiver

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)<sup>(2)</sup> (see [Typical Operating Circuit and Capacitor Values](#))

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</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
r <sub>I</sub>	Input resistance	V <sub>I</sub> = ±3 V to ±25 V	3	5	7	kΩ

(1) 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.

(2) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

## 6.8 Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)<sup>(3)</sup> (see [Typical Operating Circuit and Capacitor Values](#))

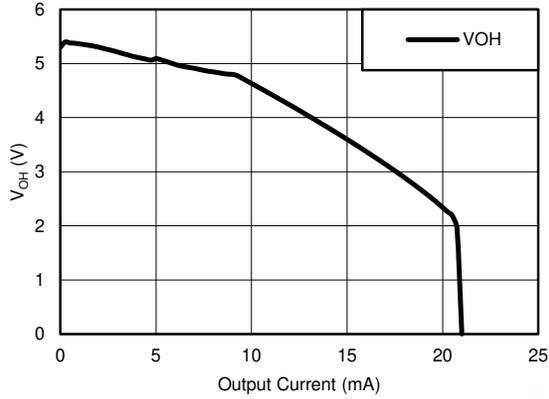
PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(1)</sup>	MAX	UNIT
	Maximum data rate	R <sub>L</sub> = 3 kΩ, One D <sub>OUT</sub> switching, C <sub>L</sub> = 1000 pF See <a href="#">Figure 7-1</a>	150	250		kbit/s
t <sub>sk(p)</sub>	Driver Pulse skew <sup>(2)</sup>	R <sub>L</sub> = 3 kΩ to 7 kΩ, C <sub>L</sub> = 150 to 2500 pF See <a href="#">Figure 7-2</a>		300		ns
SR(tr)	Slew rate, transition region (see <a href="#">Figure 7-1</a> )	R <sub>L</sub> = 3 kΩ to 7 kΩ, V <sub>CC</sub> = 5 V	C <sub>L</sub> = 150 to 1000 pF	6	30	V/μs
			C <sub>L</sub> = 150 to 2500 pF	4	30	
t <sub>PLH</sub> Ⓢ	Propagation delay time, low- to high-level output	C <sub>L</sub> = 150 pF		300		ns
t <sub>PHL</sub> Ⓢ	Propagation delay time, high- to low-level output			300		
t <sub>sk(p)</sub>	Receiver Pulse skew <sup>(3)</sup>				300	

(1) 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.

(2) Pulse skew is defined as |t<sub>PLH</sub> - t<sub>PHL</sub>| of each channel of the same device.

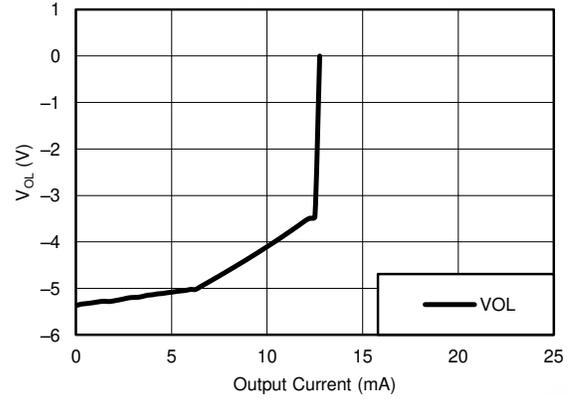
(3) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

## 6.9 Typical Characteristics



$V_{CC} = 3.3\text{ V}$

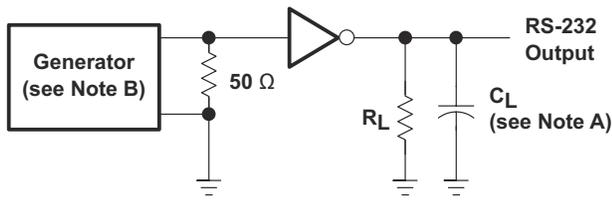
**Figure 6-1. DOUT  $V_{OH}$  vs Load Current, Both Drivers Loaded**



$V_{CC} = 3.3\text{ V}$

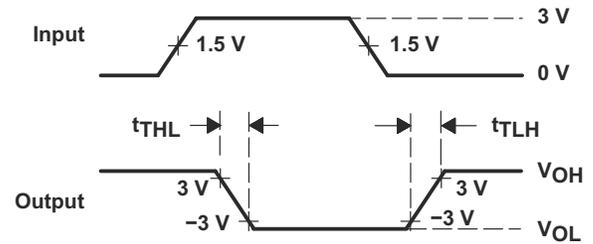
**Figure 6-2. DOUT  $V_{OL}$  vs Load Current, Both Drivers Loaded**

## 7 Parameter Measurement Information



TEST CIRCUIT

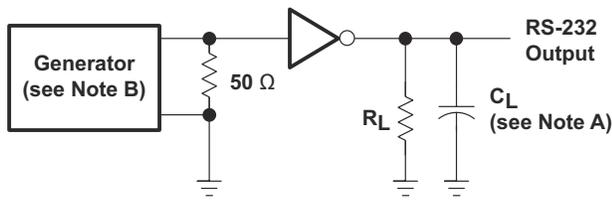
$$SR(tr) = \frac{6\text{ V}}{t_{THL} \text{ or } t_{TLH}}$$



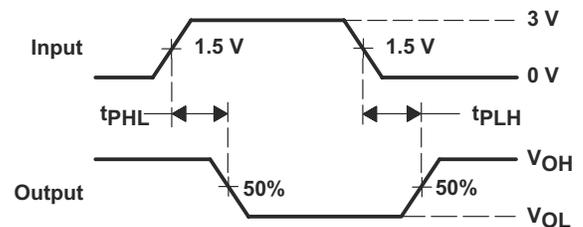
VOLTAGE WAVEFORMS

- 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 7-1. Driver Slew Rate**



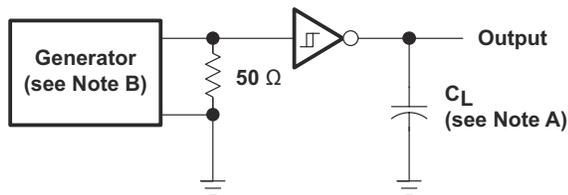
TEST CIRCUIT



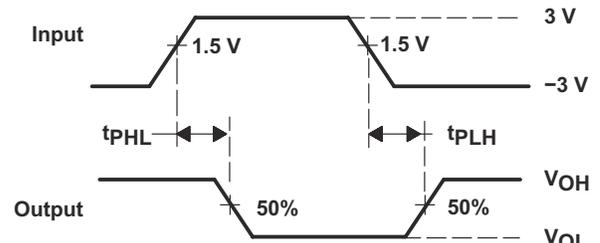
VOLTAGE WAVEFORMS

- 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 7-2. Driver Pulse Skew**



TEST CIRCUIT



VOLTAGE WAVEFORMS

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

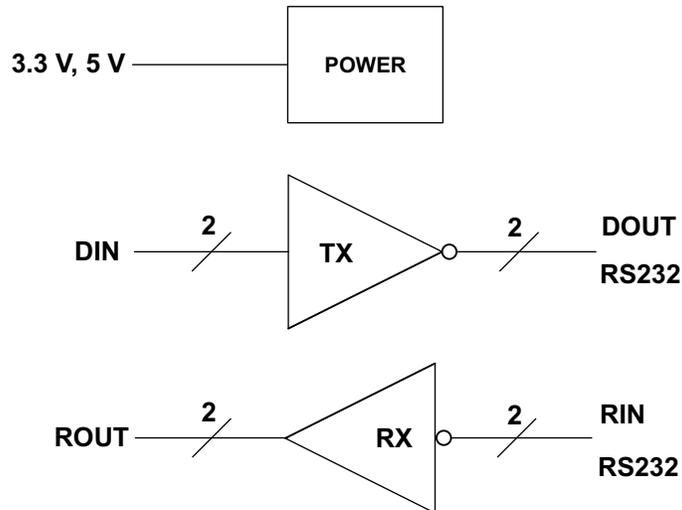
**Figure 7-3. Receiver Propagation Delay Times**

## 8 Detailed Description

### 8.1 Overview

The MAX3232 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD protection terminal to terminal (serial-port connection terminals, 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/ $\mu$ s driver output slew rate. Outputs are protected against shorts to ground.

### 8.2 Functional Block Diagram



### 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. Both DIN inputs must be valid high or low.

#### 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.

## 8.4 Device Functional Modes

**Table 8-1. Each Driver<sup>(1)</sup>**

INPUT DIN	OUTPUT DOUT
L	H
H	L

(1) H = high level, L = low level

**Table 8-2. Each  
Receiver<sup>(1)</sup>**

INPUT RIN	OUTPUT ROUT
L	H
H	L
Open	H

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

### 8.4.1 V<sub>CC</sub> powered by 3 V to 5.5 V

The device will be in normal operation.

### 8.4.2 V<sub>CC</sub> unpowered, V<sub>CC</sub> = 0 V

When MAX3232 is unpowered, it can be safely connected to an active remote RS232 device.

## 9 Application and Implementation

### Note

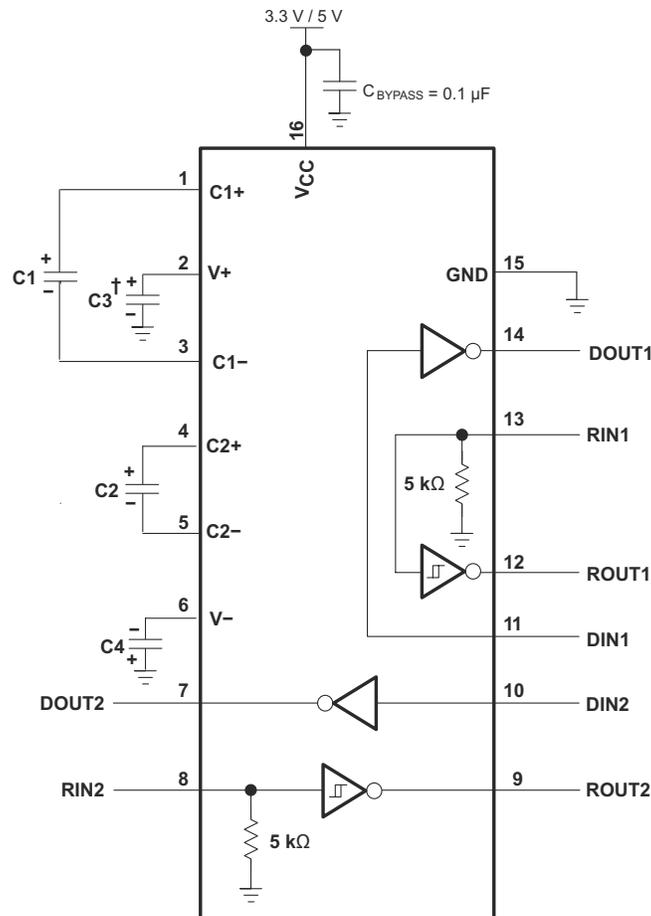
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation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

### 9.1 Application Information

For proper operation, add capacitors as shown in [Typical Operating Circuit and Capacitor Values](#).

### 9.2 Standard 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.

- 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 9-1. Typical Operating Circuit and Capacitor Values**

### 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.

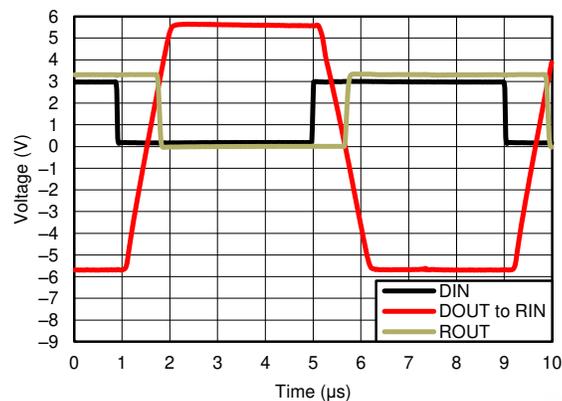
**Table 9-1.  $V_{CC}$  vs Capacitor Values**

$V_{CC}$	C1	C2, C3, C4
3.3 V $\pm$ 0.3 V	0.1 $\mu$ F	0.1 $\mu$ F
5 V $\pm$ 0.5 V	0.047 $\mu$ F	0.33 $\mu$ F
3 V to 5.5 V	0.1 $\mu$ F	0.47 $\mu$ F

### 9.2.2 Detailed Design Procedure

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

### 9.2.3 Application Curves



$V_{CC} = 3.3 \text{ V}$

**Figure 9-2. 250 kbit/s Driver to Receiver Loopback Timing Waveform**

## 10 Power Supply Recommendations

$V_{CC}$  should be between 3 V and 5.5 V. Charge pump capacitors should be chosen using table in [Typical Operating Circuit and Capacitor Values](#).

## 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.

### 11.2 Layout Example

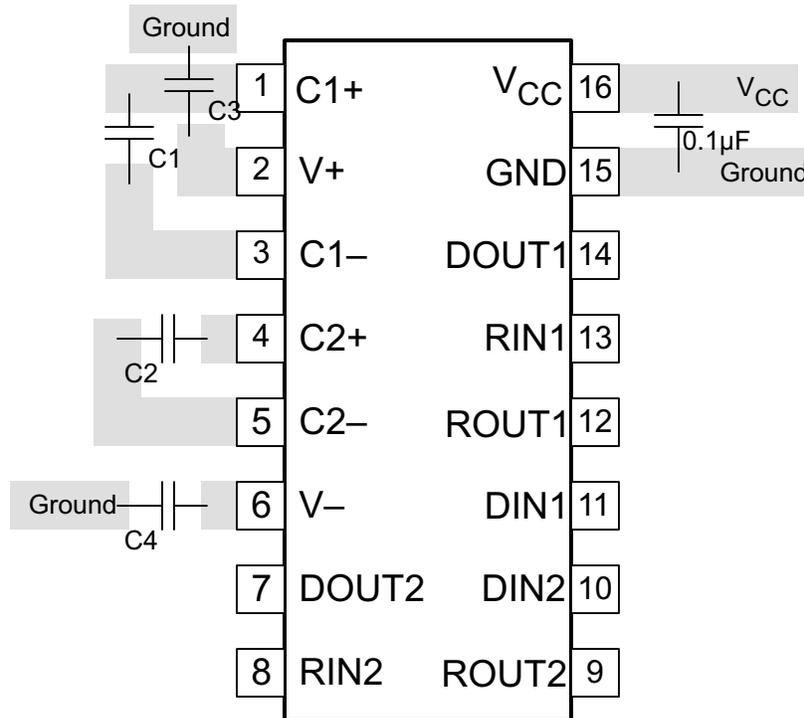


Figure 11-1. Layout Diagram

## 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](http://ti.com). Click on *Subscribe to updates* 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 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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](#).

### 12.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 12.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 12.5 Glossary

[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)
MAX3232CD	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	0 to 70	MAX3232C
<a href="#">MAX3232CDB</a>	Obsolete	Production	SSOP (DB)   16	-	-	Call TI	Call TI	0 to 70	MA3232C
<a href="#">MAX3232CDBR</a>	Active	Production	SSOP (DB)   16	2000   LARGE T&R	Yes	NIPDAU   NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C
MAX3232CDBR.A	Active	Production	SSOP (DB)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MA3232C
<a href="#">MAX3232CDR</a>	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C
MAX3232CDR.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232C
MAX3232CDR1G4	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232C
MAX3232CDR1G4.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232C
<a href="#">MAX3232CDW</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	0 to 70	MAX3232C
<a href="#">MAX3232CDWR</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	0 to 70	MAX3232C
MAX3232CPW	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	0 to 70	MA3232C
<a href="#">MAX3232CPWR</a>	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	0 to 70	MA3232C
MAX3232CPWR.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MA3232C
MAX3232CPWRE4	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C
<a href="#">MAX3232CPWRG4</a>	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C
MAX3232CPWRG4.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MA3232C
MAX3232ID	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	-40 to 85	MAX3232I
<a href="#">MAX3232IDBR</a>	Active	Production	SSOP (DB)   16	2000   LARGE T&R	Yes	NIPDAU   NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I
MAX3232IDBR.A	Active	Production	SSOP (DB)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I
MAX3232IDBRE4	Active	Production	SSOP (DB)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I
MAX3232IDRG4	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	-40 to 85	MAX3232I
<a href="#">MAX3232IDW</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	-40 to 85	MAX3232I
<a href="#">MAX3232IDWR</a>	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 85	MAX3232I
MAX3232IDWR.B	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I
<a href="#">MAX3232IPWR</a>	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 85	MB3232I
MAX3232IPWR.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I
MAX3232IPWRE4	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I
<a href="#">MAX3232IPWRG4</a>	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I
MAX3232IPWRG4.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I

- (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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

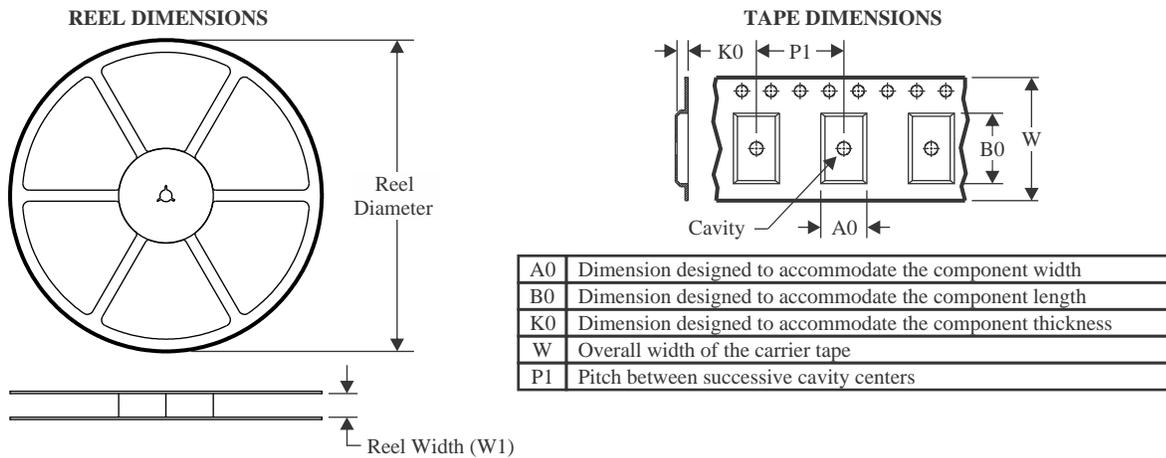
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF MAX3232 :**

- Enhanced Product : [MAX3232-EP](#)

NOTE: Qualified Version Definitions:

- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**TAPE AND REEL INFORMATION**

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


\*All dimensions are nominal

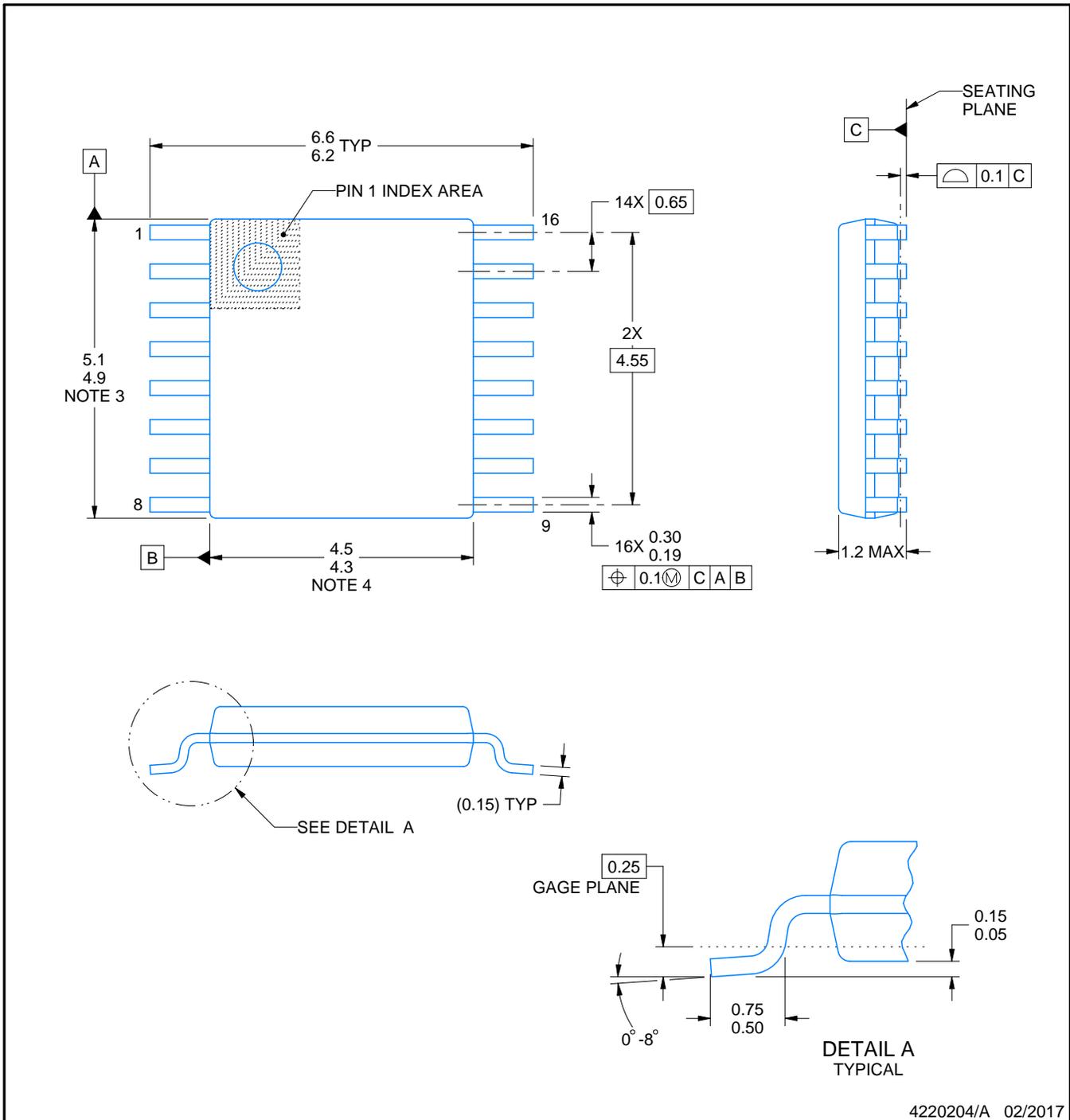
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
MAX3232CDBR	SSOP	DB	16	2000	330.0	16.4	8.35	6.6	2.4	12.0	16.0	Q1
MAX3232CDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX3232CDR1G4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX3232CPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX3232CPWRG4	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX3232IDBR	SSOP	DB	16	2000	330.0	16.4	8.35	6.6	2.4	12.0	16.0	Q1
MAX3232IDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
MAX3232IPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX3232IPWRG4	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3232CDBR	SSOP	DB	16	2000	356.0	356.0	35.0
MAX3232CDR	SOIC	D	16	2500	340.5	336.1	32.0
MAX3232CDR1G4	SOIC	D	16	2500	356.0	356.0	35.0
MAX3232CPWR	TSSOP	PW	16	2000	356.0	356.0	35.0
MAX3232CPWRG4	TSSOP	PW	16	2000	356.0	356.0	35.0
MAX3232IDBR	SSOP	DB	16	2000	356.0	356.0	35.0
MAX3232IDWR	SOIC	DW	16	2000	350.0	350.0	43.0
MAX3232IPWR	TSSOP	PW	16	2000	356.0	356.0	35.0
MAX3232IPWRG4	TSSOP	PW	16	2000	356.0	356.0	35.0





4220204/A 02/2017

NOTES:

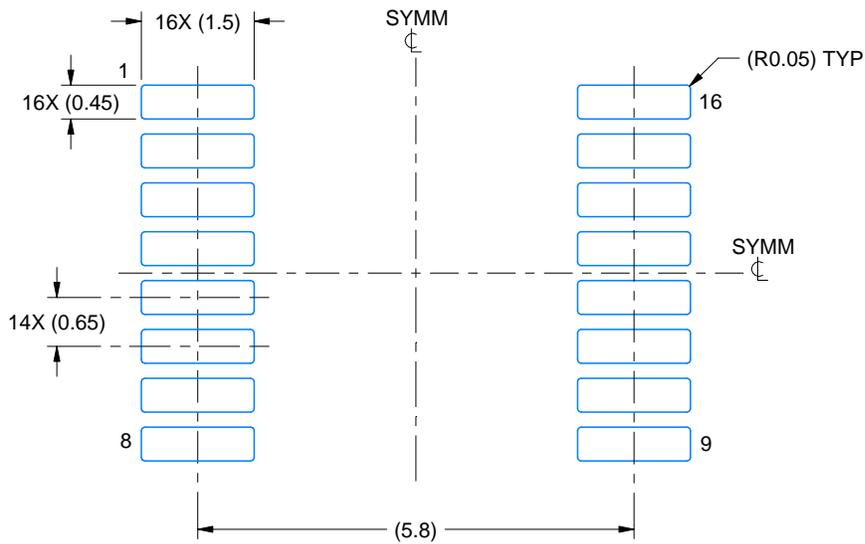
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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.

# EXAMPLE BOARD LAYOUT

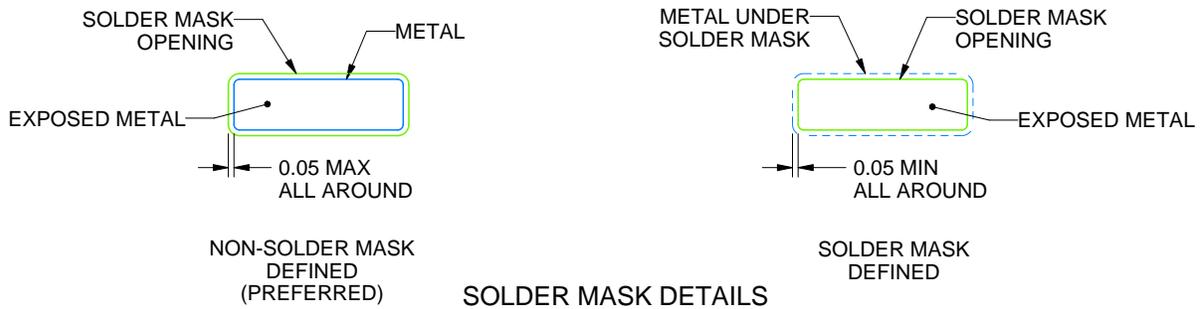
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

NOTES: (continued)

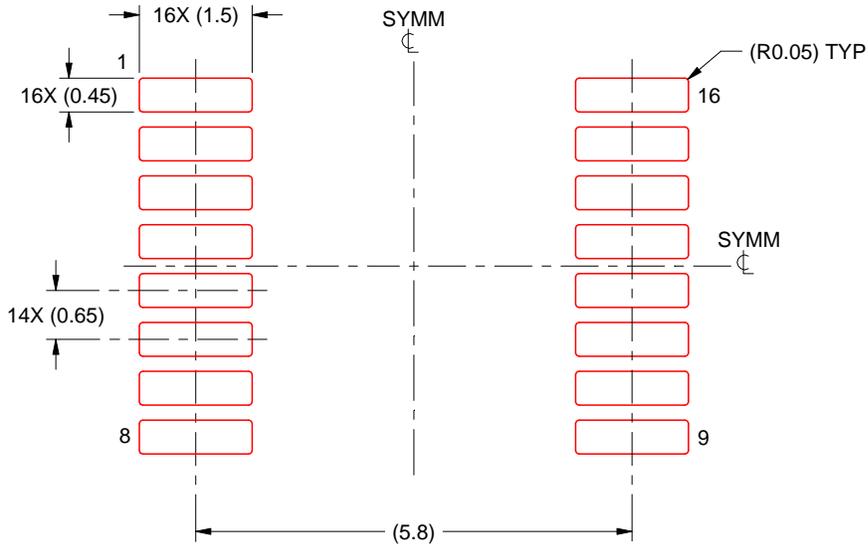
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220204/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.

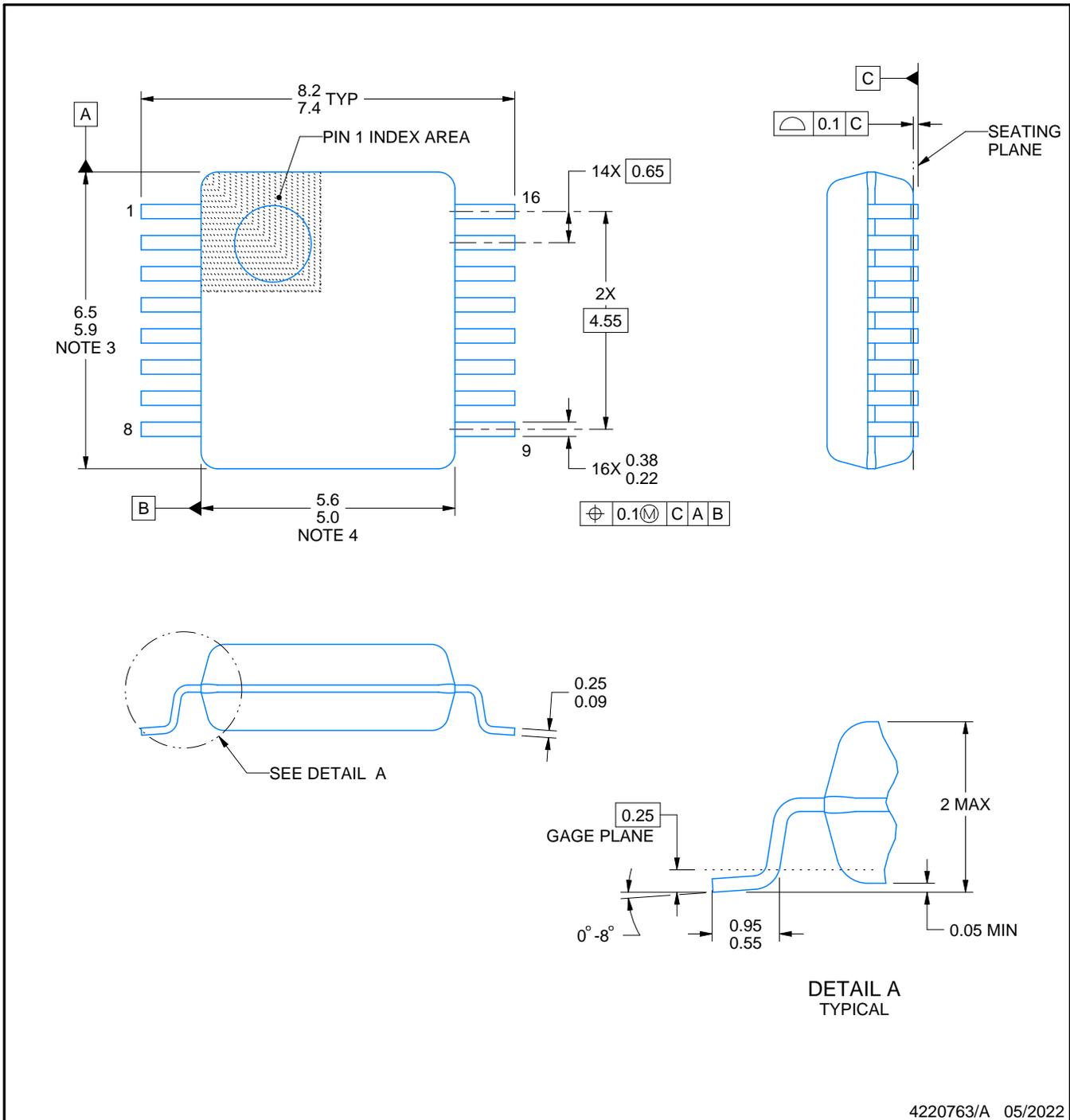
# DB0016A



# PACKAGE OUTLINE

## SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



4220763/A 05/2022

**NOTES:**

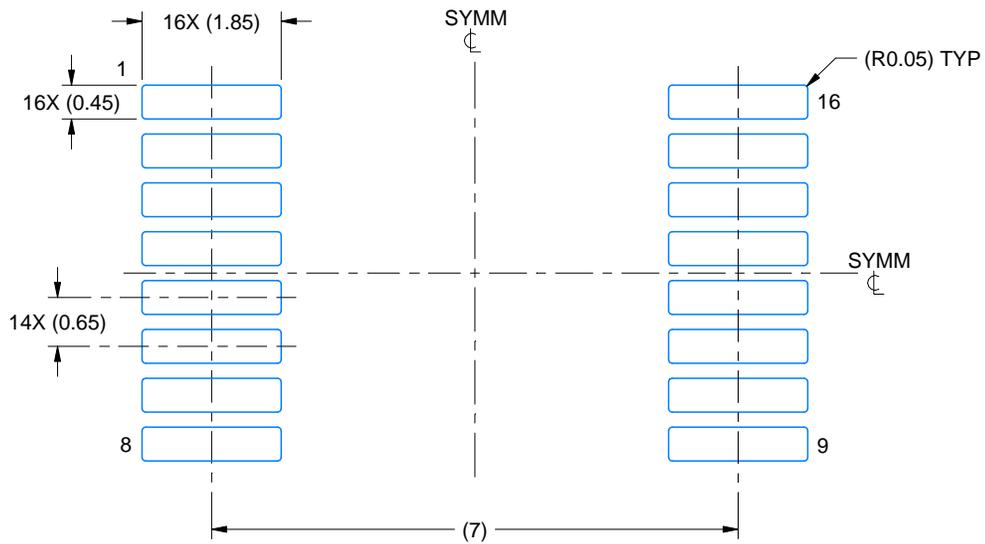
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

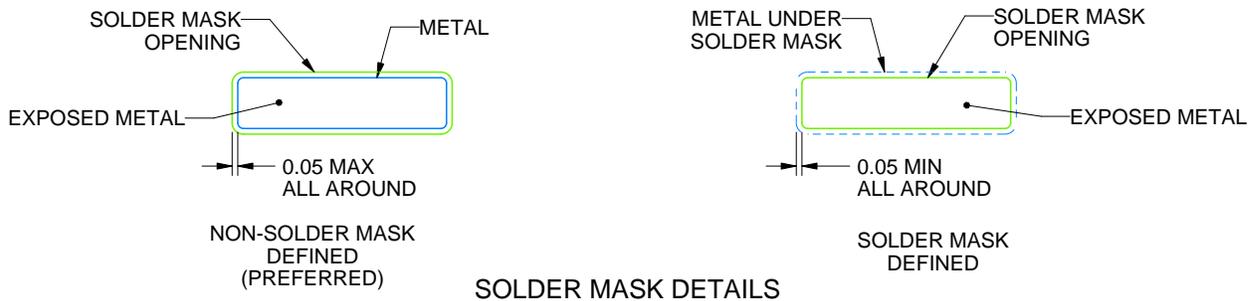
DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220763/A 05/2022

NOTES: (continued)

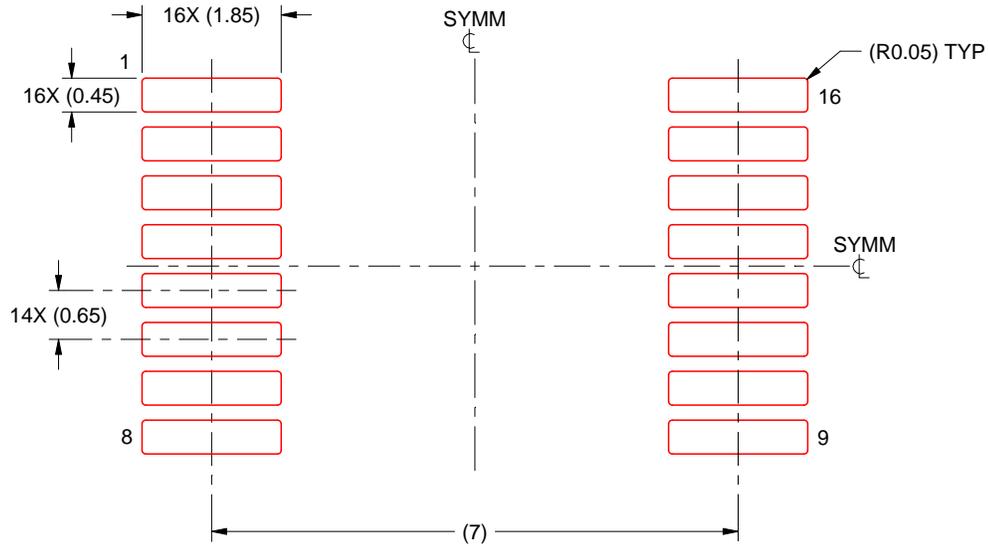
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



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

4220763/A 05/2022

NOTES: (continued)

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

## GENERIC PACKAGE VIEW

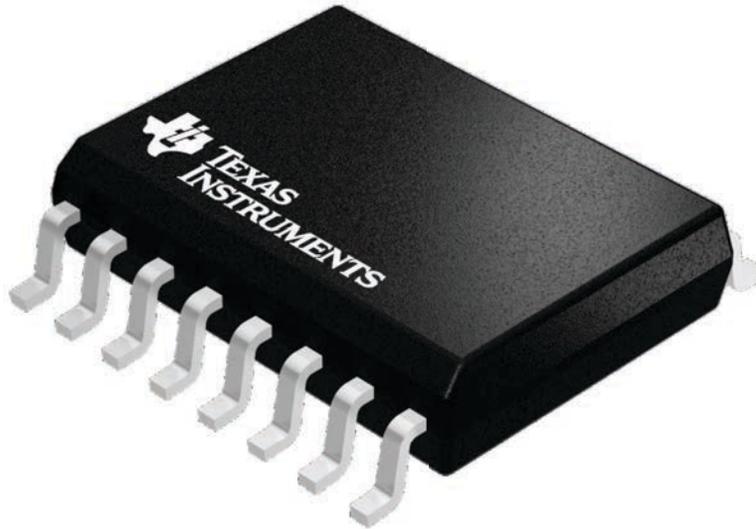
**DW 16**

**SOIC - 2.65 mm max height**

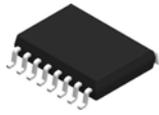
7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



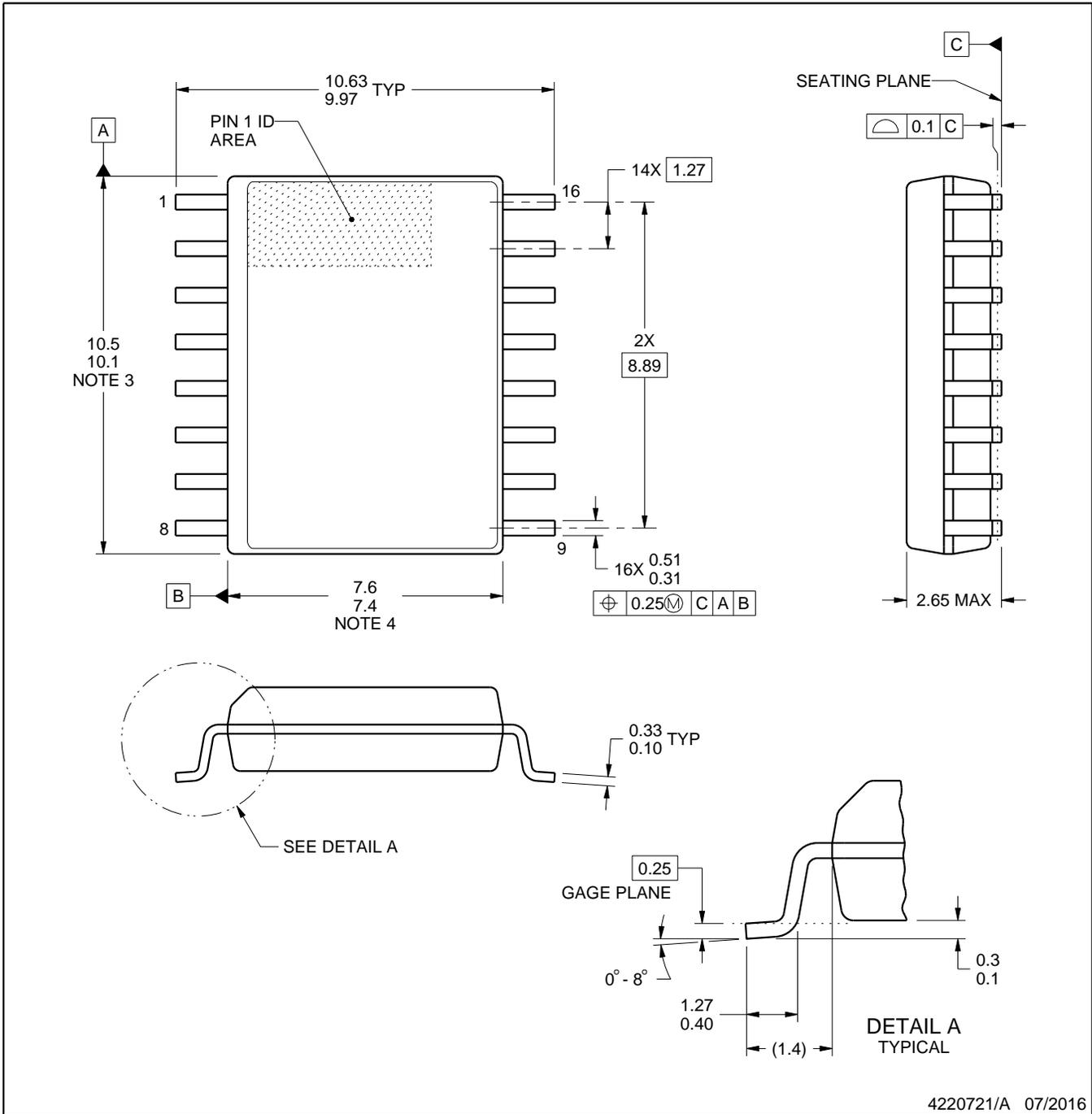
4224780/A



# DW0016A

# PACKAGE OUTLINE SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

## NOTES:

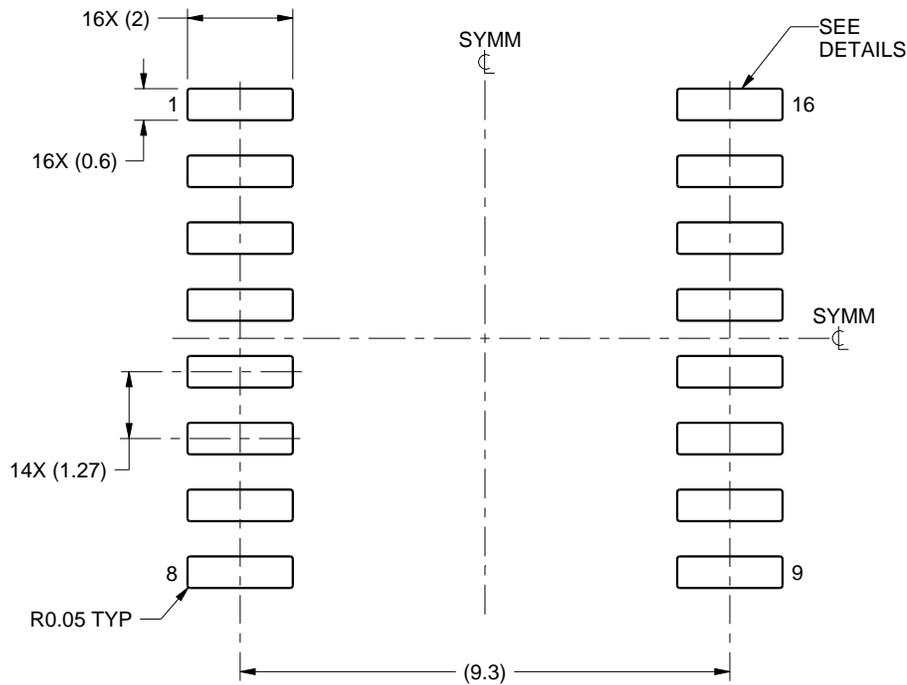
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

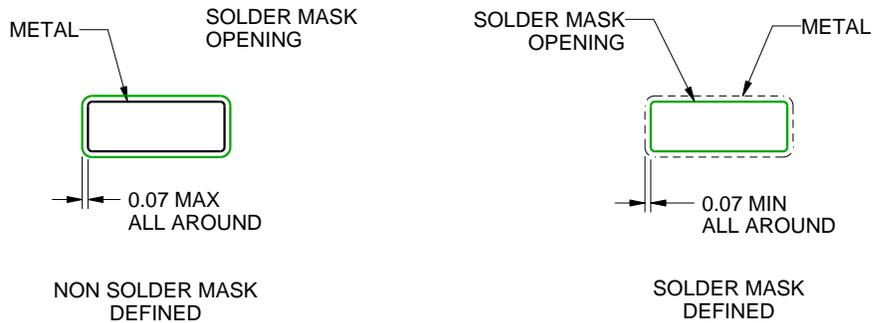
DW0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:7X



SOLDER MASK DETAILS

4220721/A 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

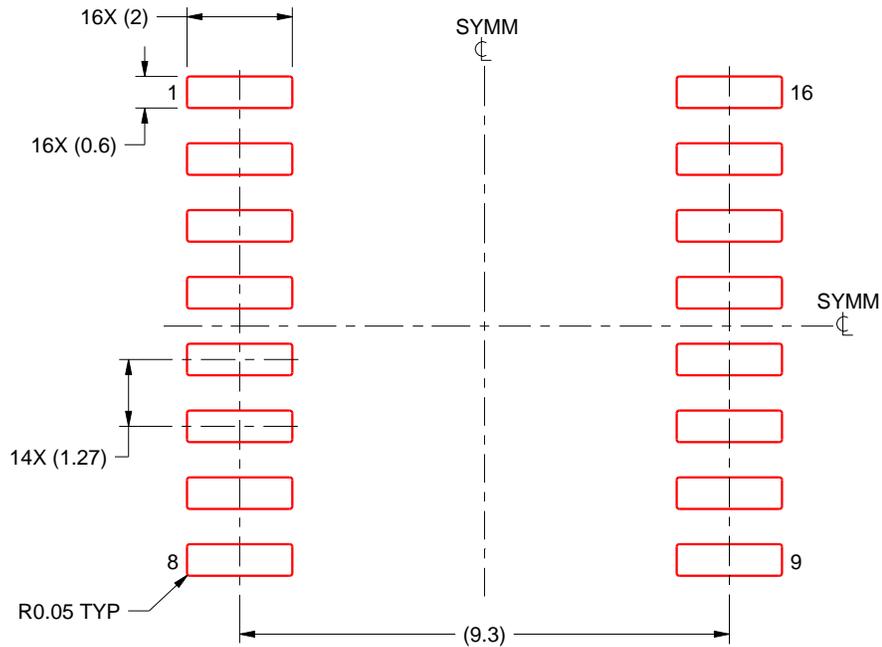
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0016A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220721/A 07/2016

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](https://www.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  
Copyright © 2025, Texas Instruments Incorporated