MAX3232 3-V to 5.5-V Multichannel RS-232 Line Driver and Receiver With ±15-kV ESD Protection

1 Features

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

2 Applications

- Industrial PCs
- Wired networking
- Data center and enterprise networking
- Battery-powered systems
- PDAs
- Notebooks
- Laptops
- Palmtop PCs
- Hand-held equipment

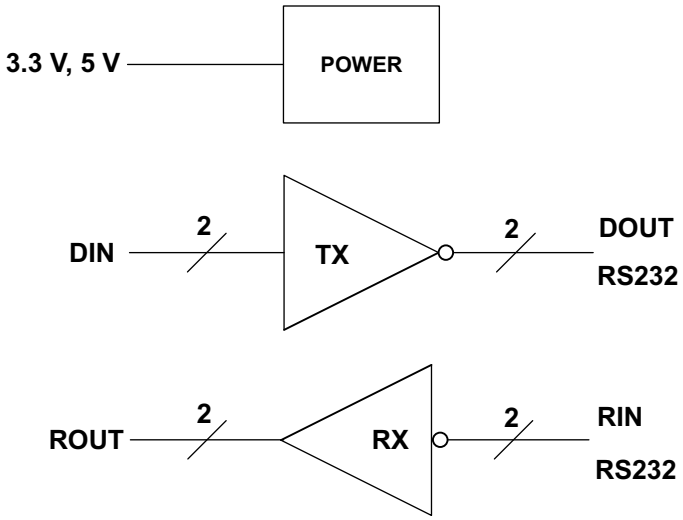
3 Description

The MAX3232 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±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/µs driver output slew rate.

Device Information

PART NUMBER	PACKAGE(1)	BODY SIZE
MAX3232	SOIC (D) (16)	9.90 mm × 3.91 mm
	SSOP (DB) (16)	6.20 mm × 5.30 mm
	SOIC (DW) (16)	10.30 mm × 7.50 mm
	TSSOP (PW) (16)	5.00 mm × 4.40 mm

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



Simplified Schematic

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4 Revision History

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

Changes from Revision N (June 2017) to Revision O (June 2021) — **Page**

- Added *Applications*: Industrial PCs, Wired networking, and Data center and enterprise computing....1
- Changed the thermal parameter values for D, DB and PW packages in the *Thermal Information* table....5

Changes from Revision M (April 2017) to Revision N (June 2017) — **Page**

- Changed the *Thermal Information* table....5

Changes from Revision L (March 2017) to Revision M (April 2017) — **Page**

- Changed From: "±" To: "to" in the V_{CC} column of Table 9-1....12

Changes from Revision K (January 2015) to Revision L (March 2017) — **Page**

- Changed pin 16 (V_{CC}) in Typical Operating Circuit and Capacitor Values....11

Changes from Revision J (January 2014) to Revision K (January 2015) — **Page**

- Added *Applications*, *Device Information* table, *Pin Functions* table, *ESD Ratings* table, *Thermal Information* table, *Typical Characteristics*, *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

Changes from Revision I (January 2004) to Revision J (January 2014) — **Page**

- Updated document to new TI data sheet format - no specification changes....1
- Deleted *Ordering Information* table....1

5 Pin Configuration and Functions

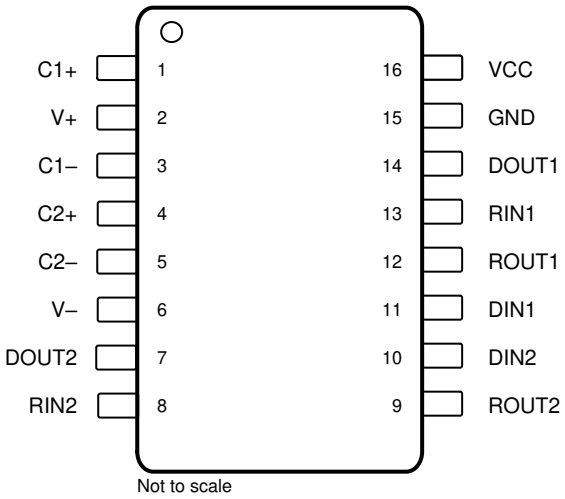


Figure 5-1. D, DB, DW, or PW Package, 16-Pin SOIC, SSOP, or TSSOP, Top View

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_{CC}	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)(1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage(2)		–0.3	6	V
V+	Positive output supply voltage range(2)		–0.3	7	V
V–	Negative output supply voltage range(2)		–7	0.3	V
V+ – V–	Supply voltage difference(2)			13	V
V_I	Input voltage range	Drivers	–0.3	6	V
		Receivers	–25	25	
V_O	Output voltage range	Drivers	–13.2	13.2	V
		Receivers	–0.3	V_{CC} + 0.3	
T_J	Operating virtual junction temperature			150	°C
T_{stg}	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
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 RIN , DOUT, and GND pins (1)	15000	V
		Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 All other pins(1)	3000	
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	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)(1)

				MIN	NOM	MAX	UNIT
V_{CC}	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 high-level input voltage	DIN	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 V	2.4			
V_{IL}	Driver low-level input voltage	DIN				0.8	V
V_I	Driver input voltage	DIN		0		5.5	V
	Receiver input voltage	RIN		–25		25	
T_A	Operating free-air temperature		MAX3232C	0		70	°C
			MAX3232I	–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]		MAX3232				UNIT
		SOIC (D)	SSOP (DB)	SOIC (DW)	TSSOP (PW)	
		16 PINS				
$R_{\theta JA}$	Junction-to-ambient thermal resistance	85.9	103.1	66.6	108.2	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	43.1	49.2	32.4	39.0	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	44.5	54.8	31.9	54.4	°C/W
ψ_{JT}	Junction-to-top characterization parameter	10.1	12	8.4	3.3	°C/W
ψ_{JB}	Junction-to-board characterization parameter	44.1	54.1	31.5	53.8	°C/W
$R_{\theta JC(bot)}$	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)[2] (see Typical Operating Circuit and Capacitor Values)

PARAMETER		TEST CONDITIONS		MIN	TYP[1]	MAX	UNIT
I_{CC}	Supply current	No load,	V_{CC} = 3.3 V to 5 V		0.3	1	mA

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

6.6 Electrical Characteristics — Driver

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

PARAMETER		TEST CONDITIONS		MIN	TYP[1]	MAX	UNIT
V_{OH}	High-level output voltage	D_{OUT} at R_L = 3 kΩ to GND,	D_{IN} = GND	5	5.4		V
V_{OL}	Low-level output voltage	D_{OUT} at R_L = 3 kΩ to GND,	D_{IN} = 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} [2]	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

(1) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 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_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at V_{CC} = 5 V ± 0.5

6.7 Electrical Characteristics — Receiver

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)(2) (see Typical Operating Circuit and Capacitor Values)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	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
r_I	Input resistance	V_I = ±3 V to ±25 V	3	5	7	kΩ

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

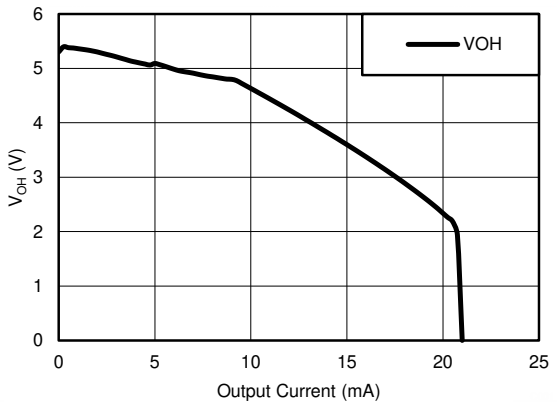
6.8 Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)(3) (see Typical Operating Circuit and Capacitor Values)

PARAMETER		TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
	Maximum data rate	R_L = 3 kΩ, One D_{OUT} switching,	C_L = 1000 pF See Figure 7-1	150	250		kbit/s
$t_{sk(p)}$	Driver Pulse skew(2)	R_L = 3 kΩ to 7 kΩ,	C_L = 150 to 2500 pF See Figure 7-2		300		ns
SR(tr)	Slew rate, transition region (see Figure 7-1)	R_L = 3 kΩ to 7 kΩ, V_{CC} = 5 V	C_L = 150 to 1000 pF	6		30	V/µs
			C_L = 150 to 2500 pF	4		30	
$t_{PLH®)}$	Propagation delay time, low- to high-level output	C_L = 150 pF			300		ns
$t_{PHL®)}$	Propagation delay time, high- to low-level output				300		
$t_{sk(p)}$	Receiver Pulse skew(3)				300		

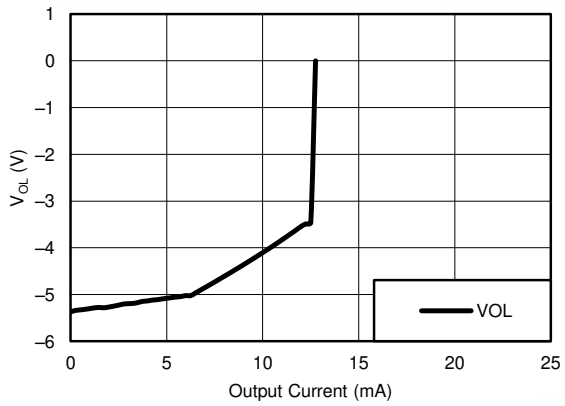
(1) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.
(2) Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.
(3) Test conditions are C1–C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at V_{CC} = 5 V ± 0.5 V.

6.9 Typical Characteristics



V_{CC} = 3.3 V

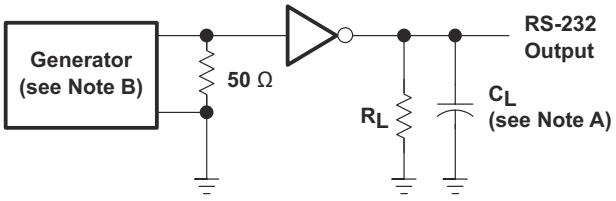
Figure 6-1. DOUT V_{OH} vs Load Current, Both Drivers Loaded



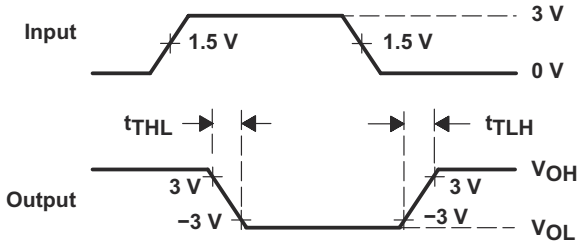
V_{CC} = 3.3 V

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

7 Parameter Measurement Information



TEST CIRCUIT



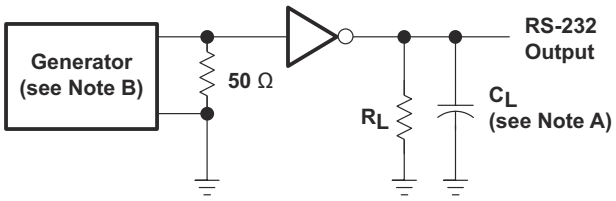
VOLTAGE WAVEFORMS

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

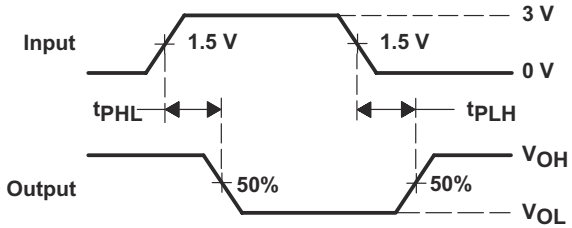
A. C_L includes probe and jig capacitance.

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 7-1. Driver Slew Rate



TEST CIRCUIT

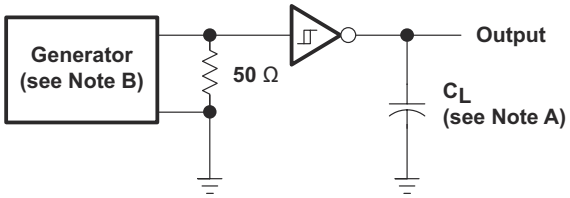


VOLTAGE WAVEFORMS

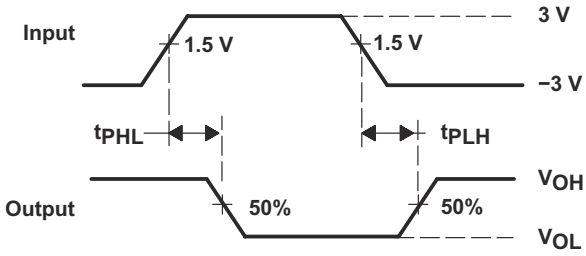
A. C_L includes probe and jig capacitance.

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

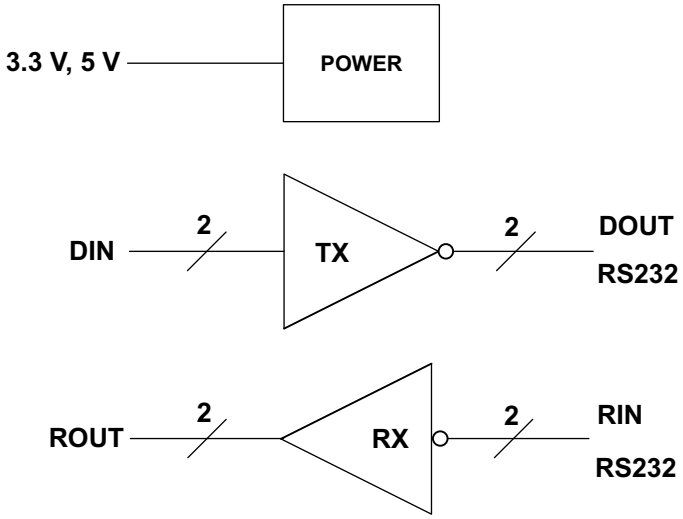
Figure 7-3. Receiver Propagation Delay Times

8 Detailed Description

8.1 Overview

The MAX3232 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±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/µs 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(1)

INPUT DIN	OUTPUT DOUT
L	H
H	L

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

Table 8-2. Each Receiver(1)

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_{CC} powered by 3 V to 5.5 V

The device will be in normal operation.

8.4.2 V_{CC} unpowered, V_{CC} = 0 V

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

9 Application and Implementation

Note

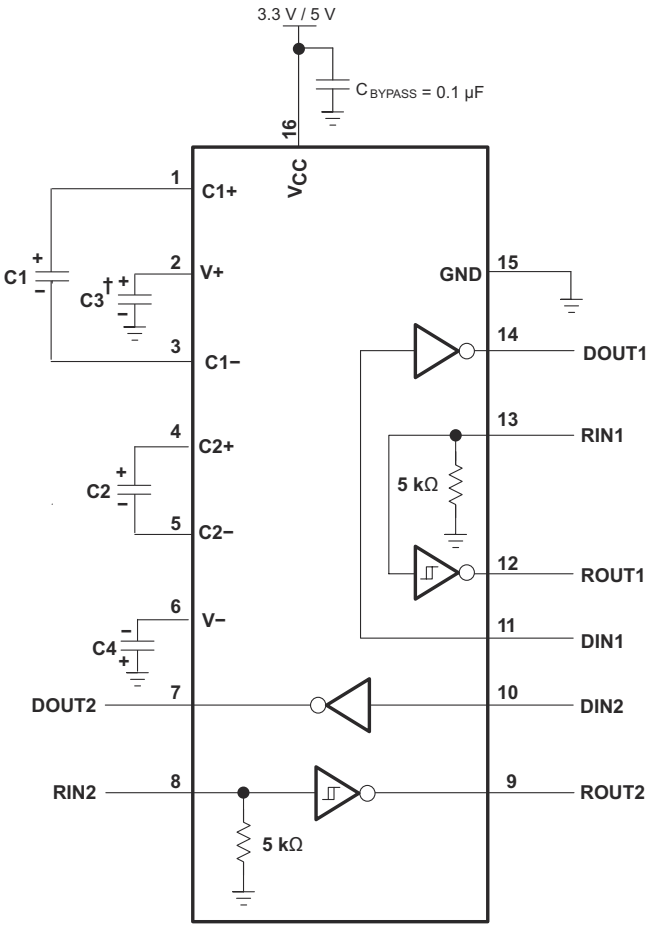
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation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

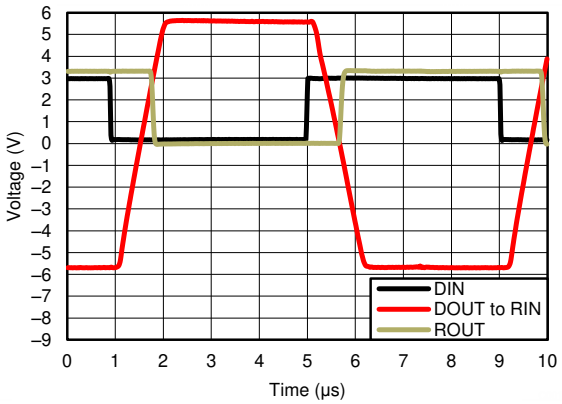
Table 9-1. V_{CC} vs Capacitor Values

V_{CC}	C1	C2, C3, C4
3.3 V ± 0.3 V	0.1 µF	0.1 µF
5 V ± 0.5 V	0.047 µF	0.33 µF
3 V to 5.5 V	0.1 µF	0.47 µF

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 VCC level for best performance.

9.2.3 Application Curves



V_{CC} = 3.3 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

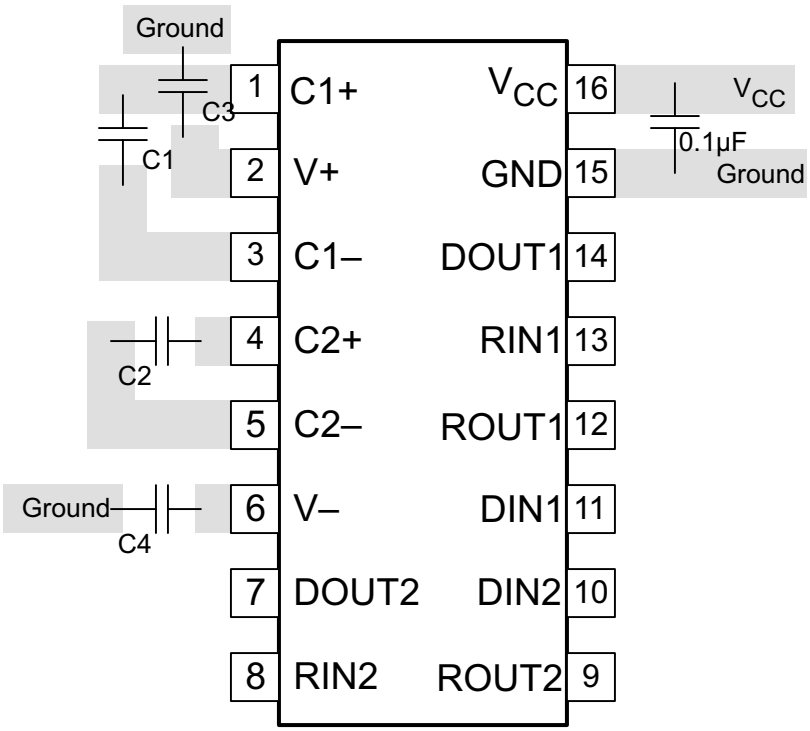


Figure 11-1. Layout Diagram

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. 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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
MAX3232CD	NRND	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	
MAX3232CDB	NRND	SSOP	DB	16	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	
MAX3232CDBE4	NRND	SSOP	DB	16	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	
MAX3232CDBG4	NRND	SSOP	DB	16	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	
MAX3232CDBR	ACTIVE	SSOP	DB	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	Samples
MAX3232CDBRE4	ACTIVE	SSOP	DB	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	Samples
MAX3232CDE4	NRND	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	
MAX3232CDG4	NRND	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	
MAX3232CDR	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDRE4	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDRG4	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDW	ACTIVE	SOIC	DW	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDWG4	ACTIVE	SOIC	DW	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDWR	ACTIVE	SOIC	DW	16	2000	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDWRE4	ACTIVE	SOIC	DW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CDWRG4	ACTIVE	SOIC	DW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3232C	Samples
MAX3232CPW	NRND	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	
MAX3232CPWE4	NRND	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	
MAX3232CPWG4	NRND	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	
MAX3232CPWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	MA3232C	Samples
MAX3232CPWRE4	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	Samples
MAX3232CPWRG4	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MA3232C	Samples
MAX3232ID	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
MAX3232IDB	NRND	SSOP	DB	16	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	
MAX3232IDBE4	NRND	SSOP	DB	16	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	
MAX3232IDBR	ACTIVE	SSOP	DB	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	Samples
MAX3232IDBRE4	ACTIVE	SSOP	DB	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	Samples
MAX3232IDE4	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDG4	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDR	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDRE4	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDRG4	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDW	ACTIVE	SOIC	DW	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDWR	ACTIVE	SOIC	DW	16	2000	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDWRE4	ACTIVE	SOIC	DW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IDWRG4	ACTIVE	SOIC	DW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3232I	Samples
MAX3232IPW	NRND	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	
MAX3232IPWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	MB3232I	Samples
MAX3232IPWRE4	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	Samples
MAX3232IPWRG4	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB3232I	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

(6) Lead finish/Ball material - Orderable Devices 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.

OTHER QUALIFIED VERSIONS OF MAX3232 :

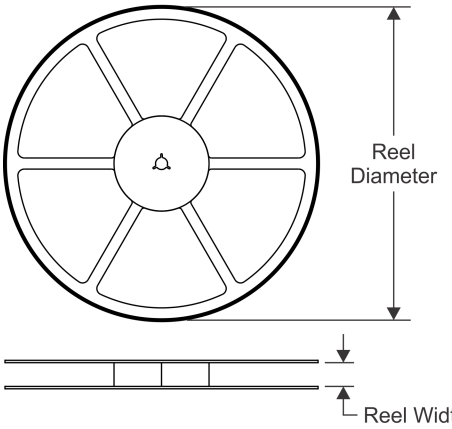
- Enhanced Product : MAX3232-EP

NOTE: Qualified Version Definitions:

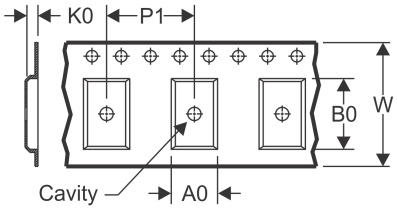
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

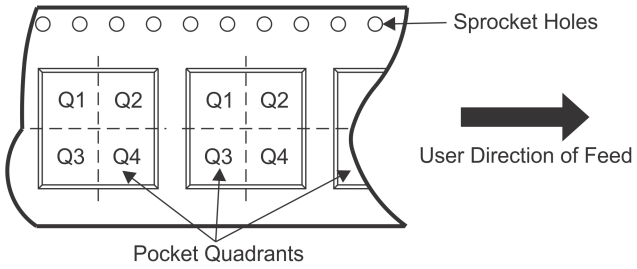


TAPE DIMENSIONS



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

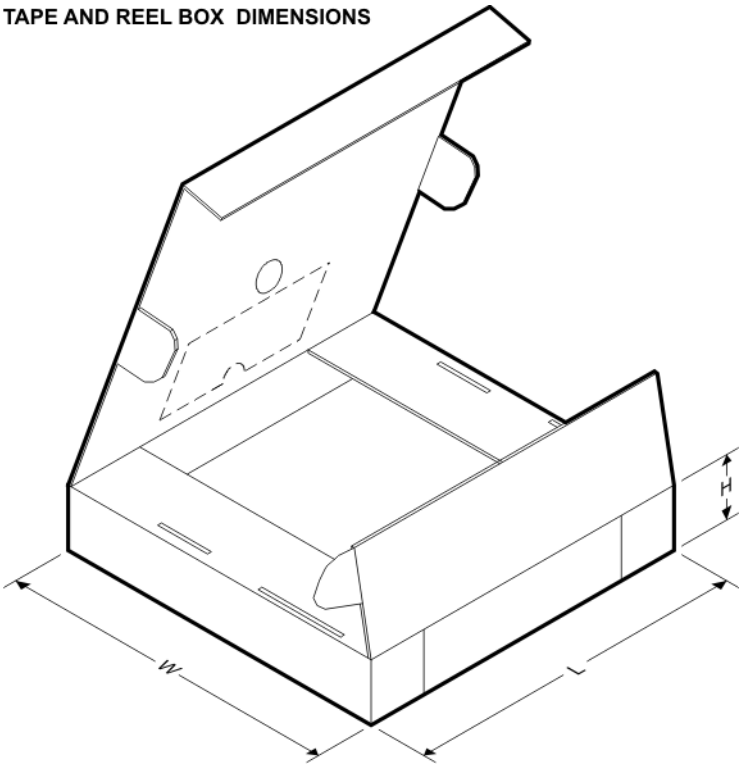


*All dimensions are nominal

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
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
MAX3232CDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX3232CDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
MAX3232CDWRG4	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
MAX3232CPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX3232CPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	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
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
MAX3232IDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX3232IDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX3232IDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
MAX3232IDWRG4	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
MAX3232IPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX3232IPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

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
MAX3232IPWRG4	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

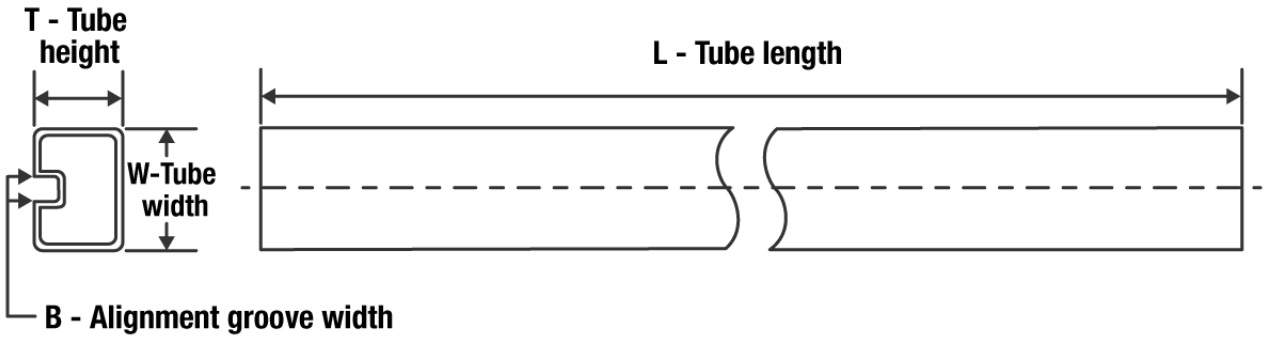


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3232CDBR	SSOP	DB	16	2000	853.0	449.0	35.0
MAX3232CDR	SOIC	D	16	2500	340.5	336.1	32.0
MAX3232CDRG4	SOIC	D	16	2500	340.5	336.1	32.0
MAX3232CDWR	SOIC	DW	16	2000	350.0	350.0	43.0
MAX3232CDWRG4	SOIC	DW	16	2000	350.0	350.0	43.0
MAX3232CPWR	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232CPWR	TSSOP	PW	16	2000	364.0	364.0	27.0
MAX3232CPWR	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232CPWRG4	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232CPWRG4	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232IDBR	SSOP	DB	16	2000	853.0	449.0	35.0
MAX3232IDR	SOIC	D	16	2500	340.5	336.1	32.0
MAX3232IDRG4	SOIC	D	16	2500	340.5	336.1	32.0
MAX3232IDWR	SOIC	DW	16	2000	350.0	350.0	43.0
MAX3232IDWRG4	SOIC	DW	16	2000	350.0	350.0	43.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3232IPWR	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232IPWR	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232IPWR	TSSOP	PW	16	2000	364.0	364.0	27.0
MAX3232IPWRG4	TSSOP	PW	16	2000	853.0	449.0	35.0
MAX3232IPWRG4	TSSOP	PW	16	2000	853.0	449.0	35.0

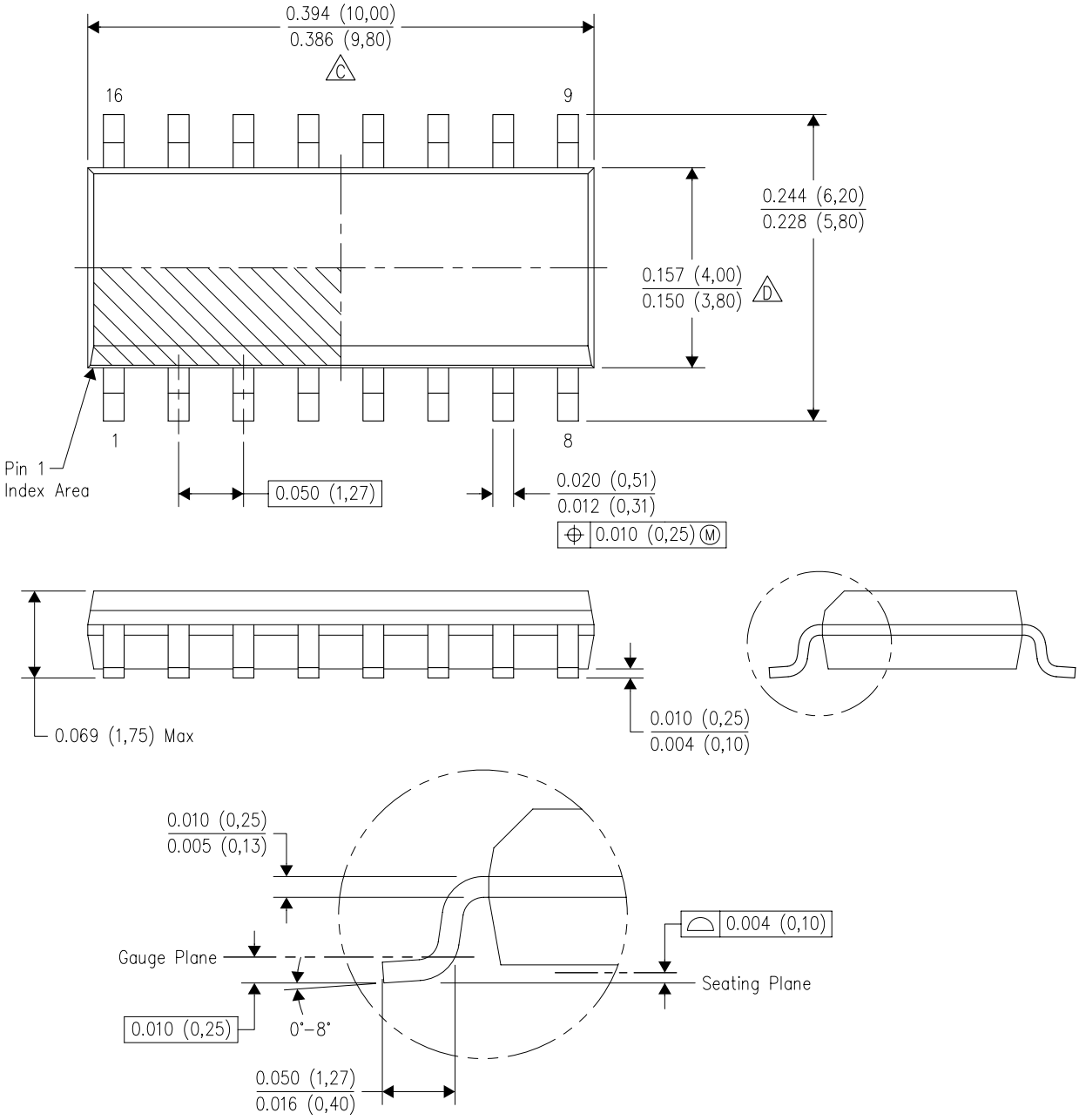
TUBE



*All dimensions are nominal

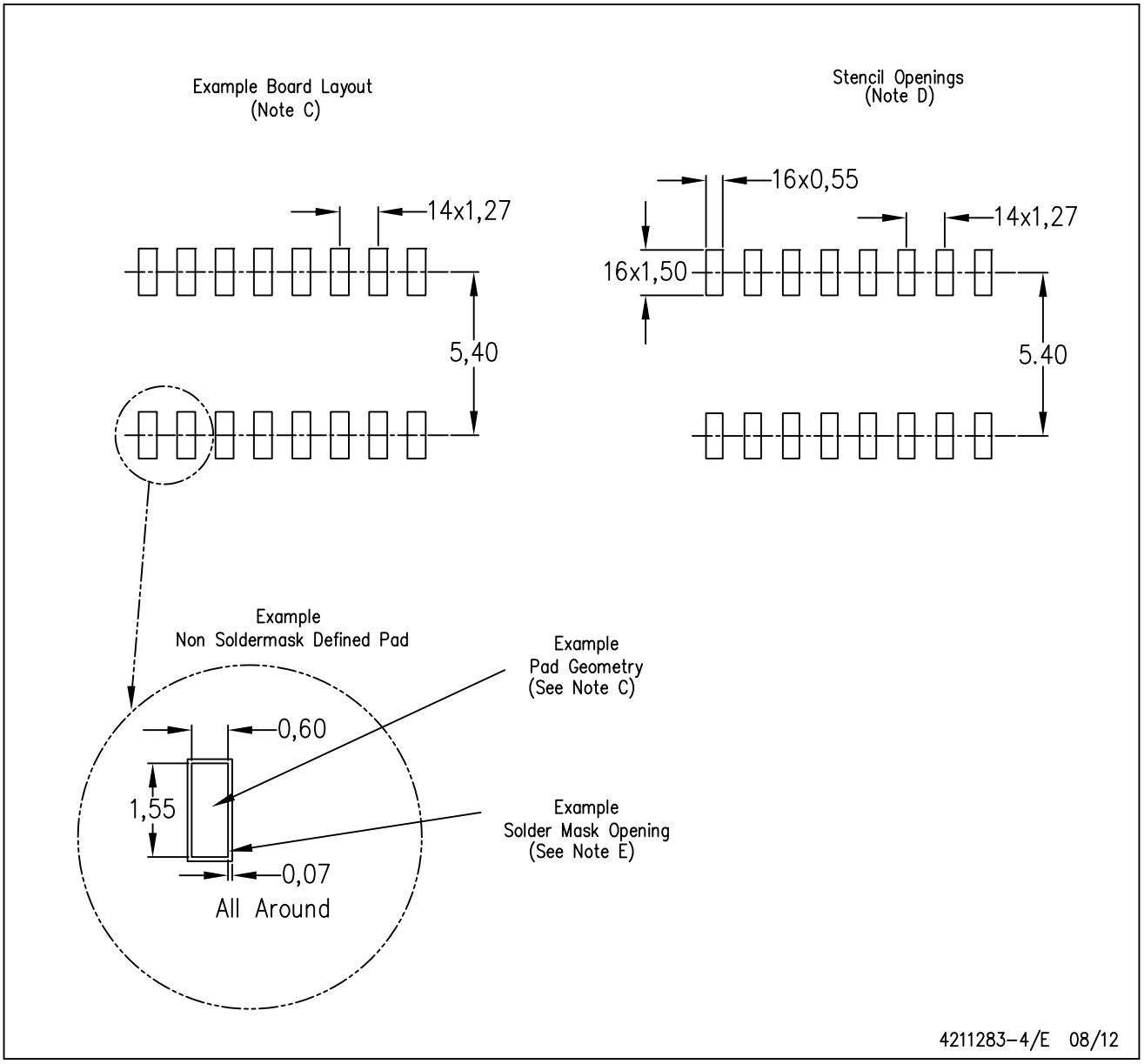
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
MAX3232CD	D	SOIC	16	40	507	8	3940	4.32
MAX3232CDB	DB	SSOP	16	80	530	10.5	4000	4.1
MAX3232CDBE4	DB	SSOP	16	80	530	10.5	4000	4.1
MAX3232CDBG4	DB	SSOP	16	80	530	10.5	4000	4.1
MAX3232CDE4	D	SOIC	16	40	507	8	3940	4.32
MAX3232CDG4	D	SOIC	16	40	507	8	3940	4.32
MAX3232CDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
MAX3232CDWG4	DW	SOIC	16	40	506.98	12.7	4826	6.6
MAX3232CPW	PW	TSSOP	16	90	530	10.2	3600	3.5
MAX3232CPWE4	PW	TSSOP	16	90	530	10.2	3600	3.5
MAX3232CPWG4	PW	TSSOP	16	90	530	10.2	3600	3.5
MAX3232ID	D	SOIC	16	40	507	8	3940	4.32
MAX3232IDB	DB	SSOP	16	80	530	10.5	4000	4.1
MAX3232IDBE4	DB	SSOP	16	80	530	10.5	4000	4.1
MAX3232IDE4	D	SOIC	16	40	507	8	3940	4.32
MAX3232IDG4	D	SOIC	16	40	507	8	3940	4.32
MAX3232IDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
MAX3232IPW	PW	TSSOP	16	90	530	10.2	3600	3.5

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
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 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



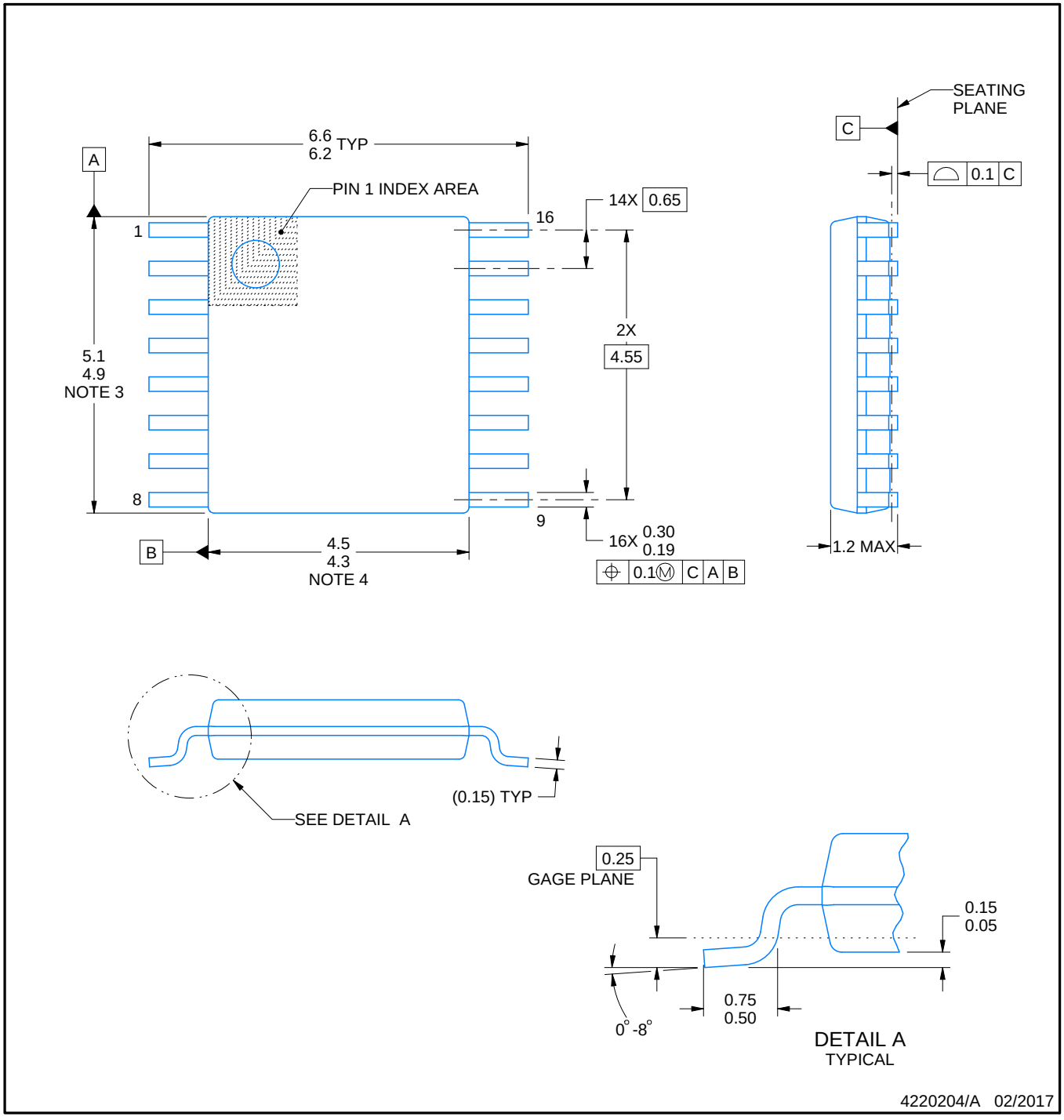
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact 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.

PACKAGE OUTLINE

PW0016A

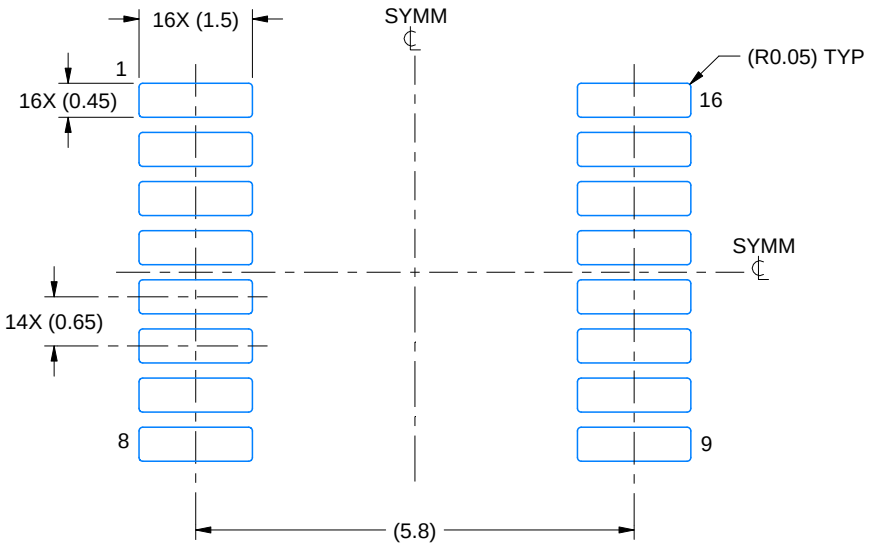
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

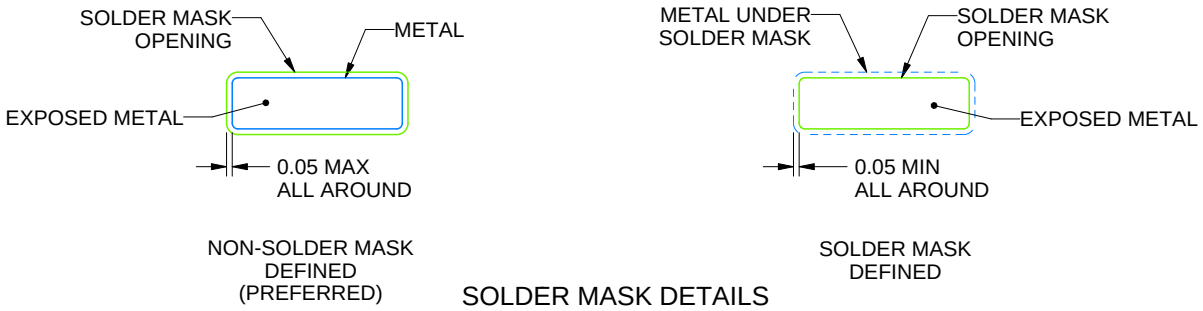


NOTES:

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

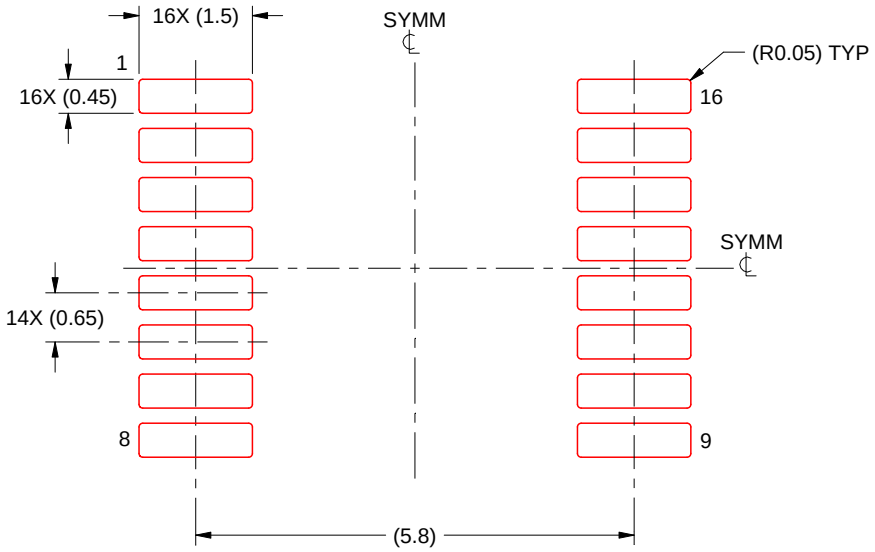


SOLDER MASK DETAILS

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.



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.

GENERIC PACKAGE VIEW

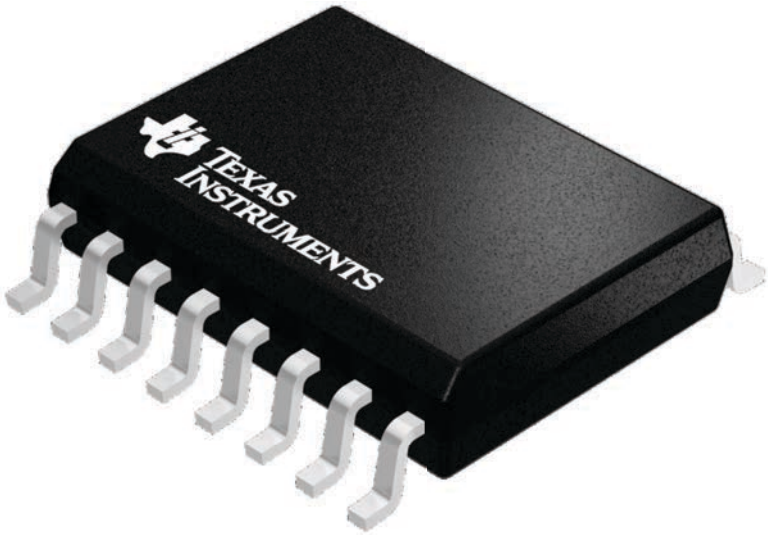
DW 16

SOIC - 2.65 mm max height

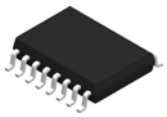
7.5 x 10.3, 1.27 mm pitch

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

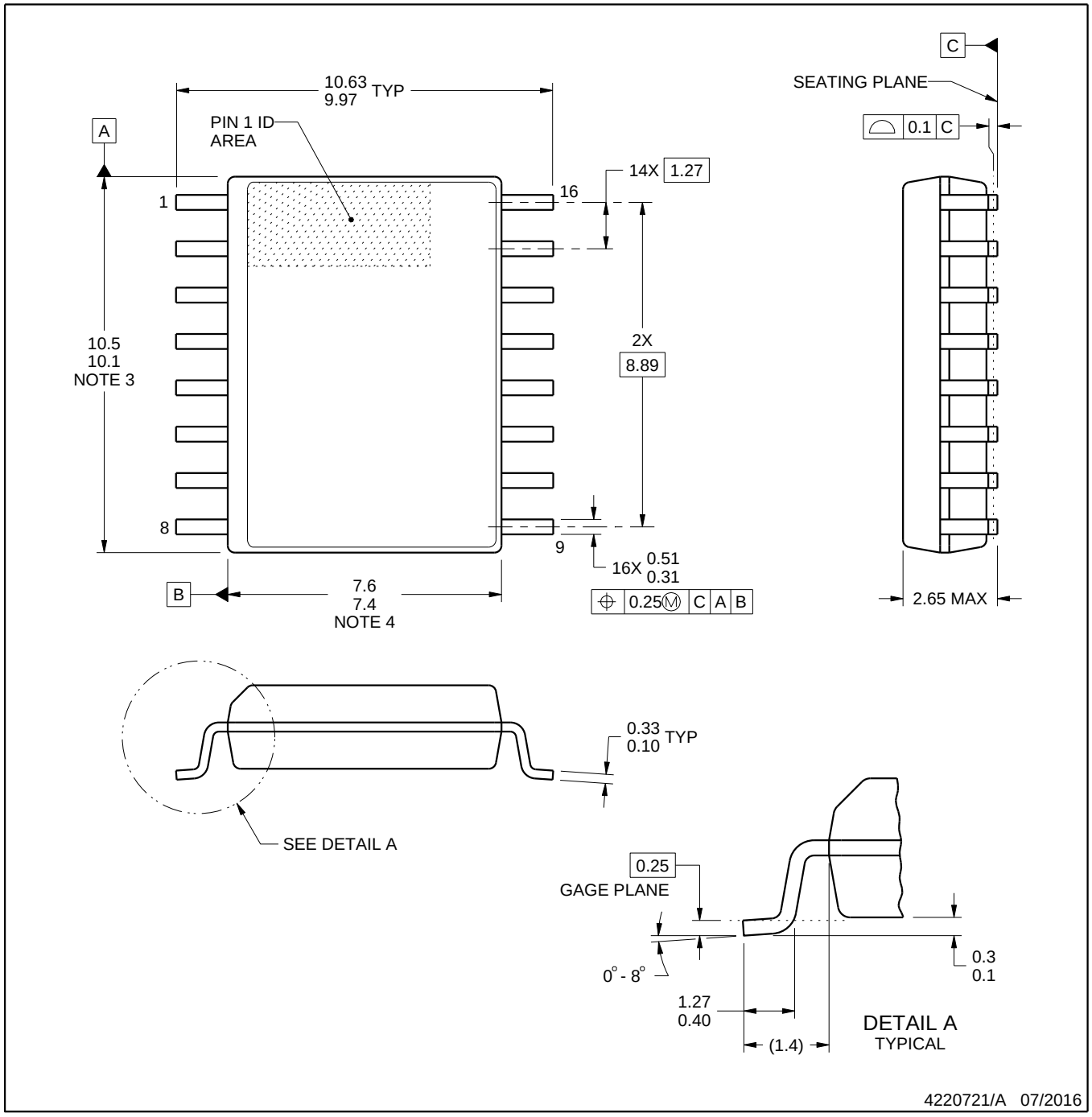


PACKAGE OUTLINE

DW0016A

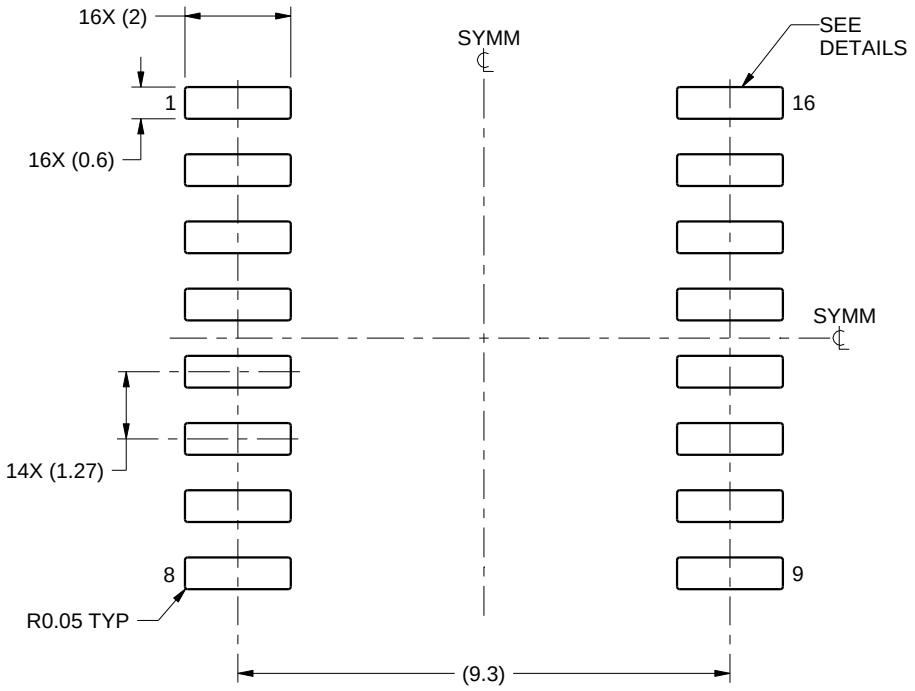
SOIC - 2.65 mm max height

SOIC

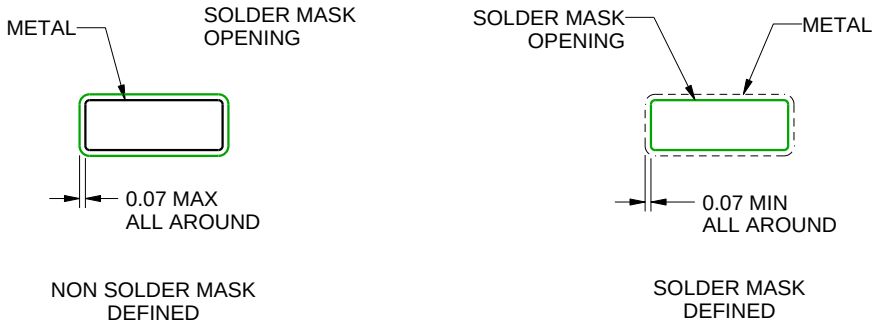


NOTES:

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 0.25 mm, per side.
5. Reference JEDEC registration MS-013.



LAND PATTERN EXAMPLE
SCALE:7X

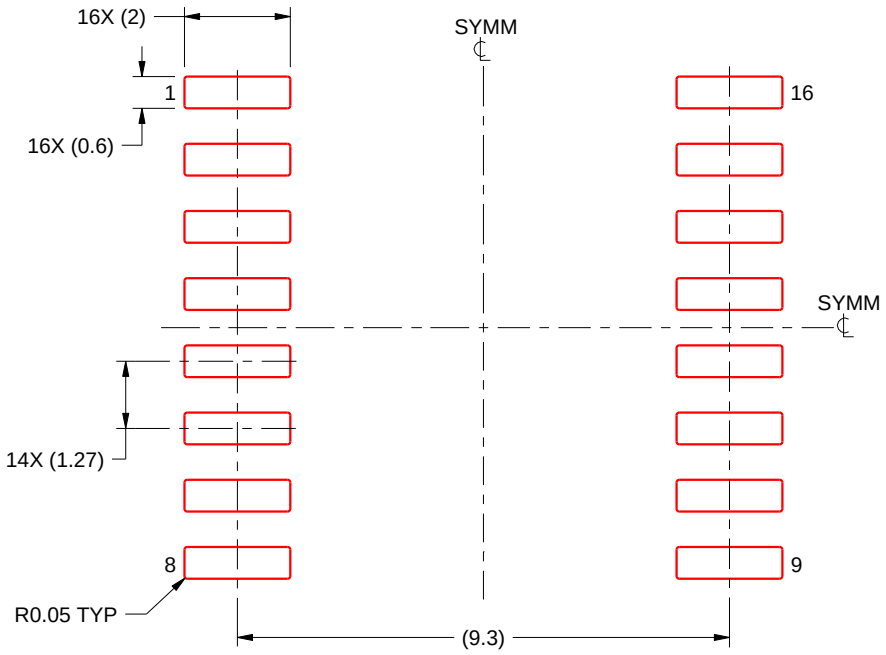


SOLDER MASK DETAILS

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.



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

4220721/A 07/2016

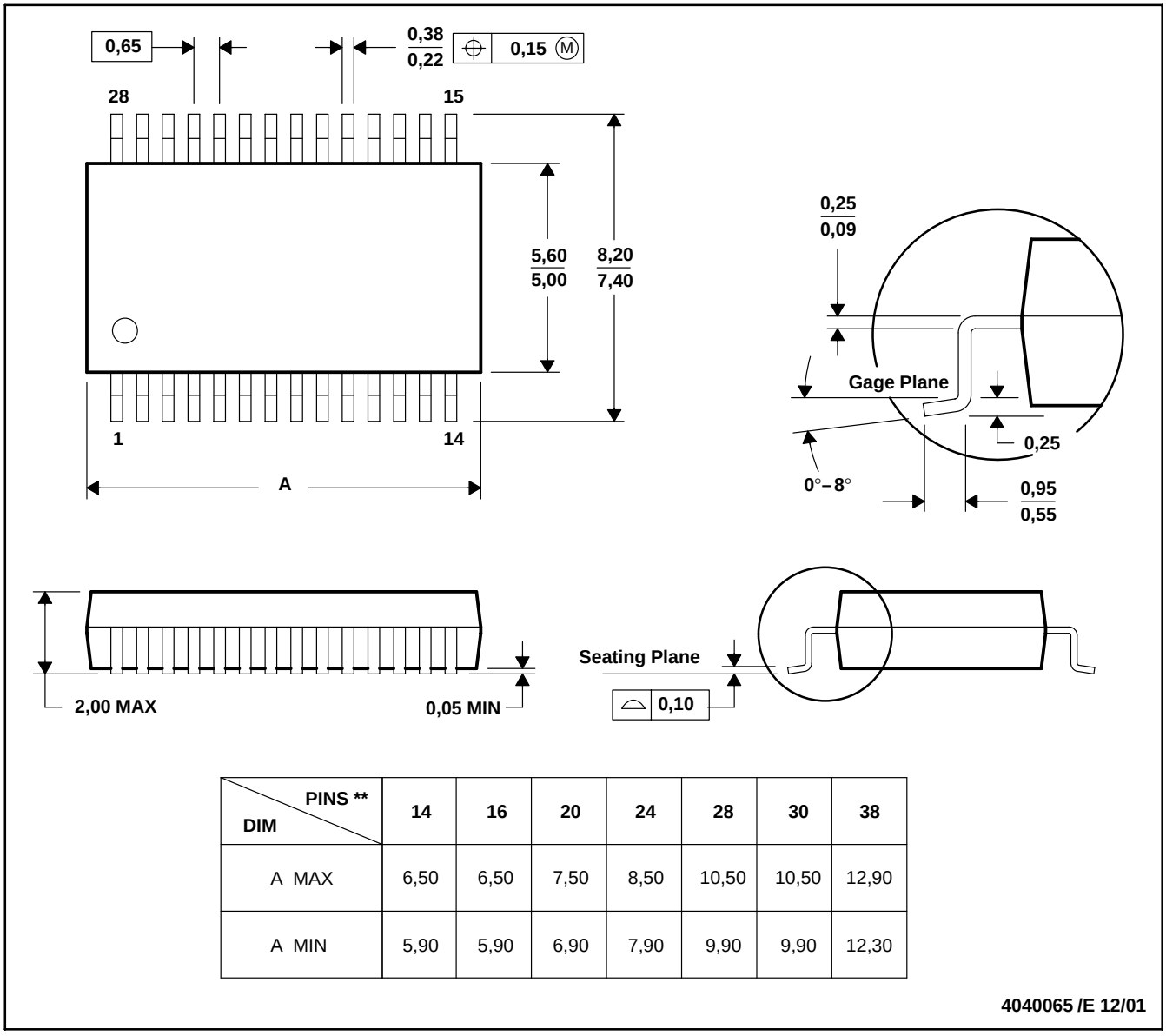
NOTES: (continued)

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.

MSSO002E – JANUARY 1995 – REVISED DECEMBER 2001

DB (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN



DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

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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