

# MAX232E デュアル RS-232 ドライバ/レシーバ、IEC61000-4-2 保護機能搭載

## 1 特長

- TIA/RS-232-F および ITU 勧告 V.28 適合またはそれを上回る性能
- RS-232 バスピン用 ESD 保護機能
  - ±15kV 人体モデル (HBM)
  - ±8kV IEC61000-4-2、接触放電
  - ±15kV IEC61000-4-2、気中放電
- 1µF チャージポンプコンデンサを使用して 5V 単一電源で動作
- 最大 250kbit/s で動作
- 2つのドライバと2つのレシーバ
- 低い消費電流: 8mA (代表値)

## 2 アプリケーション

- TIA/RS-232-F
- [バッテリー駆動システム](#)
- 端末
- モデム
- コンピュータ

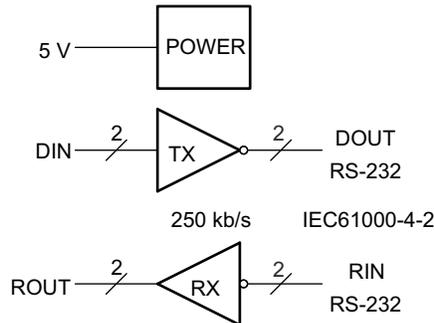
## 3 概要

MAX232E は、5V 単一電源から RS-232-F 準拠の電圧レベルを供給する容量性電圧発生器を内蔵したデュアルドライバ/レシーバです。各レシーバは、RS-232 の入力を 5V の TTL/CMOS レベルに変換します。このレシーバは、標準スレッショルドが 1.3V、標準ヒステリシスが 0.5V で、±30V の入力を受け入れます。各ドライバは、TTL/CMOS 入力レベルを TIA/RS-232-F レベルに変換します。

### パッケージ情報

部品番号	パッケージ (1)	パッケージサイズ(2)
MAX232	SOIC (16)	9.9mm × 6mm
	SOIC (16)	10.4mm × 10.3mm
	PDIP (16)	19.3mm × 9mm
	SOP (16)	10.2mm × 7.8 mm

- (1) 詳細については、[セクション 10](#) を参照してください。
- (2) パッケージサイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。



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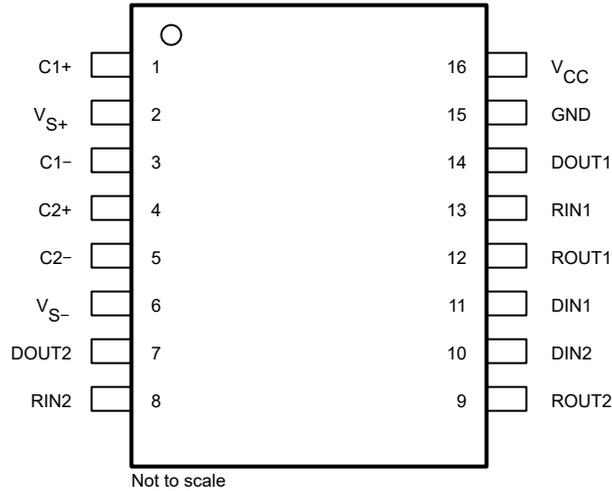
### 論理図 (正論理)



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## 4 Pin Configuration and Functions




**4-1. D (SOIC), DW (SOIC), N (PDIP), or PW (TSSOP) 16-Pin Package (Top View)**

**表 4-1. Pin Functions**

PIN		TYPE	DESCRIPTION
NO.	NAME		
1	C1+	—	Positive lead of C1 capacitor
2	VS+	O	Positive charge pump output for storage capacitor only
3	C1-	—	Negative lead of C1 capacitor
4	C2+	—	Positive lead of C2 capacitor
5	C2-	—	Negative lead of C2 capacitor
6	VS-	O	Negative charge pump output for storage capacitor only
7	DOUT2	O	RS-232 line data output (to remote RS-232 system)
8	RIN2	I	RS-232 line data input (from remote RS-232 system)
9	ROUT2	O	Logic data output (to UART)
10	DIN2	I	Logic data input (from UART)
11	DIN1	I	Logic data input (from UART)
12	ROUT1	O	Logic data output (to UART)
13	RIN1	I	RS-232 line data input (from remote RS-232 system)
14	DOUT1	O	RS-232 line data output (to remote RS-232 system)
15	GND	—	Ground
16	VCC	—	Supply voltage, connect to external 5V power supply

## 5 Specifications

### 5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Input supply voltage <sup>(2)</sup>	-0.3	6	V
V <sub>S+</sub>	Positive output supply voltage	V <sub>CC</sub> - 0.3	15	V
V <sub>S-</sub>	Negative output supply voltage	-0.3	-15	V
V <sub>I</sub>	Input voltage	Driver	V <sub>CC</sub> + 0.3	V
		Receiver	±30	
V <sub>O</sub>	Output voltage	DOUT	V <sub>S-</sub> - 0.3 V <sub>S+</sub> + 0.3	V
		ROUT	-0.3 V <sub>CC</sub> + 0.3	
	Short-circuit duration	DOUT		Unlimited
T <sub>J</sub>	Operating virtual junction temperature		150	°C
T <sub>stg</sub>	Storage temperature	-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.

### 5.2 ESD Ratings

			VALUE	UNIT		
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	Pins 7, 8, 13, and 14	±15000	V	
			Other pins	±3000		
		Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>		All pins		±1500
		IEC61000-4-2, air-gap discharge		Pins 7, 8, 13, and 14		±15000
		IEC61000-4-2, contact discharge				±8000

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

### 5.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	V
V <sub>IH</sub>	High-level input voltage (DIN1, DIN2)	2			V
V <sub>IL</sub>	Low-level input voltage (DIN1, DIN2)			0.8	V
	Receiver input voltage (RIN1, RIN2)	±3		±30	V
T <sub>A</sub>	Operating free-air temperature	MAX232EC	0	70	°C
		MAX232EI	-40	85	

## 5.4 Thermal Information

THERMAL METRIC <sup>(1) (2) (3)</sup>		D (SOIC)	DW (SOIC)	N (PDIP)	PW (TSSOP)	UNIT
		16 PINS	16 PINS	16 PINS	16 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	84.6	73.4	60.6	107.5	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	43.5	35.1	48.1	38.4	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	43.2	38.3	40.6	53.7	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	10.4	9.4	27.5	3.2	°C/W
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	42.8	37.7	40.3	53.1	°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<sub>J(max)</sub>, R<sub>θJA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J(max)</sub> – T<sub>A</sub>)/R<sub>θJA</sub>. Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

## 5.5 Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see [7-1](#))

PARAMETER		TEST CONDITIONS <sup>(1)</sup>		MIN	TYP <sup>(2)</sup>	MAX	UNIT
I <sub>CC</sub>	Supply current	V <sub>CC</sub> = 5.5 V	All outputs open, T <sub>A</sub> = 25°C		8	10	mA

- (1) Test conditions are C1 – C4 = 1μF at V<sub>CC</sub> = 5V ± 0.5V.
- (2) All typical values are at V<sub>CC</sub> = 5 V and T<sub>A</sub> = 25°C.

## 5.6 Electrical Characteristics: Driver

over recommended ranges of supply voltage and operating free-air temperature range

PARAMETER		TEST CONDITIONS <sup>(1)</sup>		MIN	TYP <sup>(2)</sup>	MAX	UNIT
V <sub>OH</sub>	High-level output voltage	DOUT	R <sub>L</sub> = 3 kΩ to GND	5	7		V
V <sub>OL</sub>	Low-level output voltage <sup>(3)</sup>	DOUT	R <sub>L</sub> = 3 kΩ to GND		-7	-5	V
r <sub>o</sub>	Output resistance	DOUT	V <sub>S+</sub> = V <sub>S-</sub> = 0, V <sub>O</sub> = ±2 V	300			Ω
I <sub>OS</sub> <sup>(4)</sup>	Short-circuit output current	DOUT	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0		±10		mA
I <sub>IS</sub>	Short-circuit input current	DIN	V <sub>I</sub> = 0			200	μA

- (1) Test conditions are C1 – C4 = 1μF at V<sub>CC</sub> = 5V ± 0.5V.
- (2) All typical values are at V<sub>CC</sub> = 5V and T<sub>A</sub> = 25°C.
- (3) The algebraic convention, in which the least-positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
- (4) Not more than one output should be shorted at a time.

## 5.7 Electrical Characteristics: Receiver

over recommended ranges of supply voltage and operating free-air temperature range

PARAMETER		TEST CONDITIONS <sup>(1)</sup>		MIN	TYP <sup>(2)</sup>	MAX	UNIT
V <sub>OH</sub>	High-level output voltage	ROUT	I <sub>OH</sub> = -1mA	3.5			V
V <sub>OL</sub>	Low-level output voltage	ROUT	I <sub>OL</sub> = 3.2mA			0.4	V
V <sub>IT+</sub>	Receiver positive-going input threshold voltage	RIN	V <sub>CC</sub> = 5V T <sub>A</sub> = 25°C		1.7	2.4	V
V <sub>IT-</sub>	Receiver negative-going input threshold voltage	RIN	V <sub>CC</sub> = 5V T <sub>A</sub> = 25°C	0.8	1.2		V
V <sub>hys</sub>	Input hysteresis voltage	RIN	V <sub>CC</sub> = 5V	0.2	0.5	1	V
r <sub>i</sub>	Receiver input resistance	RIN	V <sub>CC</sub> = 5V T <sub>A</sub> = 25°C	3	5	7	kΩ

- (1) Test conditions are C1 – C4 = 1μF at V<sub>CC</sub> = 5V ± 0.5V.
- (2) All typical values are at V<sub>CC</sub> = 5V and T<sub>A</sub> = 25°C.

## 5.8 Switching Characteristics: Driver

$V_{CC} = 5V$ ,  $T_A = 25^\circ C$

PARAMETER		TEST CONDITIONS <sup>(1)</sup>	MIN	TYP	MAX	UNIT
SR	Driver slew rate	$R_L = 3k\Omega$ to $7k\Omega$ , See <a href="#">6-2</a>			30	V/ $\mu$ s
SR(t)	Driver transition region slew rate	$R_L = 3k\Omega$ , $C_L = 2.5nF$ See <a href="#">6-3</a>		3		V/ $\mu$ s
	Data rate	One DOUT switching		250		kbit/s

(1) Test conditions are  $C1 - C4 = 1\mu F$  at  $V_{CC} = 5V \pm 0.5V$ .

## 5.9 Switching Characteristics: Receiver

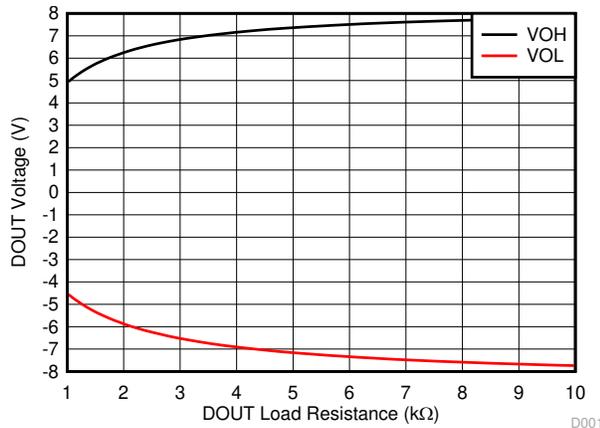
$V_{CC} = 5V$ ,  $T_A = 25^\circ C$  (see [6-1](#))

PARAMETER		TEST CONDITIONS <sup>(1)</sup>	TYP	UNIT
$t_{PLH(R)}$	Receiver propagation delay time, low- to high-level output	$C_L = 50pF$	500	ns
$t_{PHL(R)}$	Receiver propagation delay time, high- to low-level output	$C_L = 50pF$	500	ns

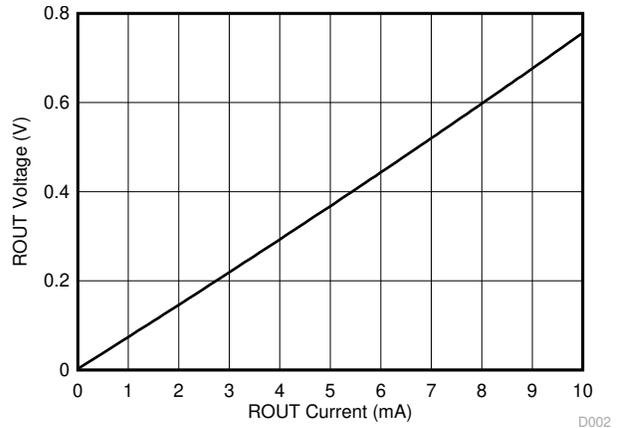
(1) Test conditions are  $C1 - C4 = 1\mu F$  at  $V_{CC} = 5V \pm 0.5V$ .

## 5.10 Typical Characteristics

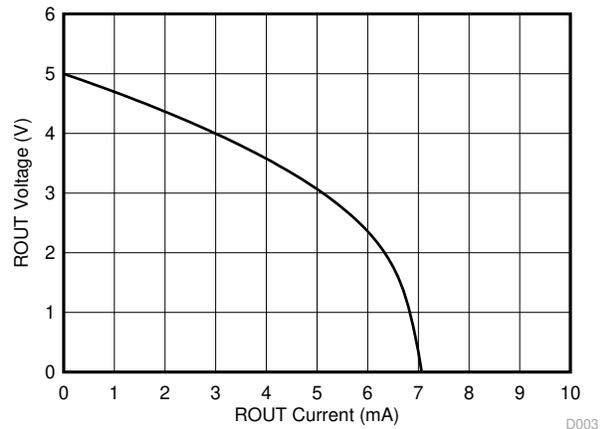
$T_A = 25\text{ }^\circ\text{C}$



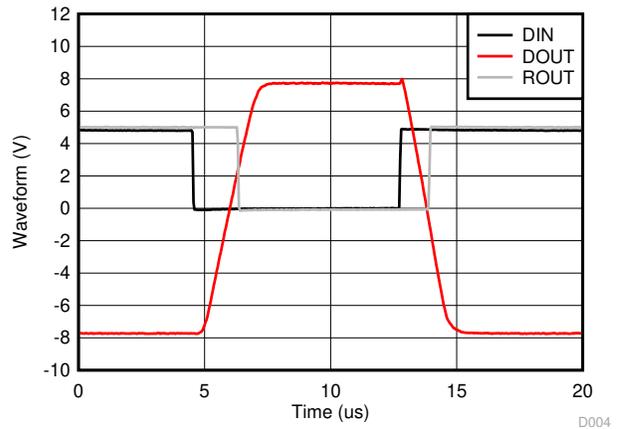
5-1. Driver Output Voltage vs Load Resistance



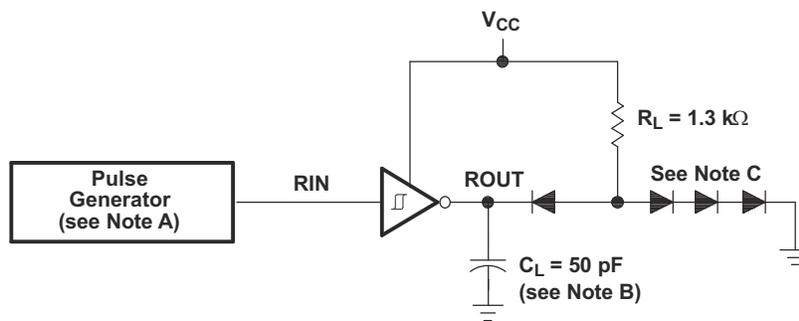
5-2. Receiver Low Output Voltage vs Load Current



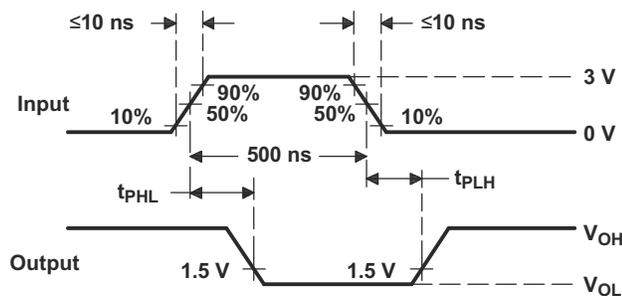
5-3. Receiver High Output Voltage vs Load Current



5-4. Loopback Waveforms Data Rate 120 kbit/s



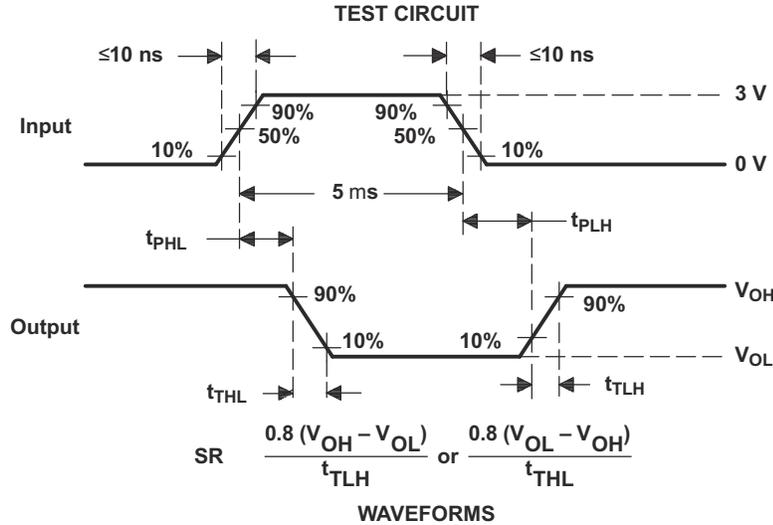
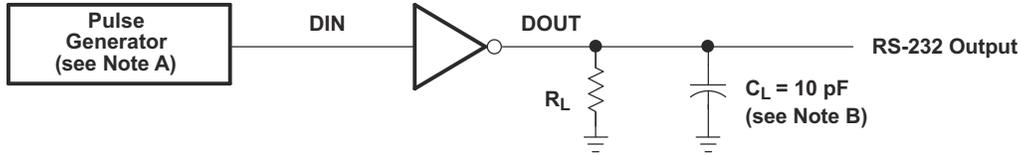
TEST CIRCUIT



WAVEFORMS

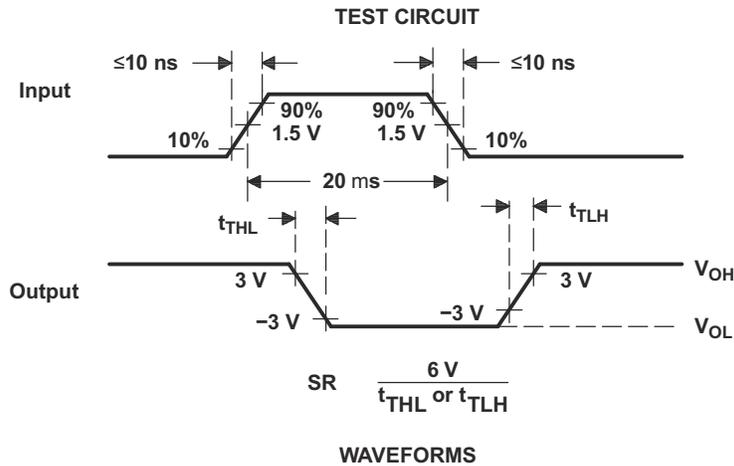
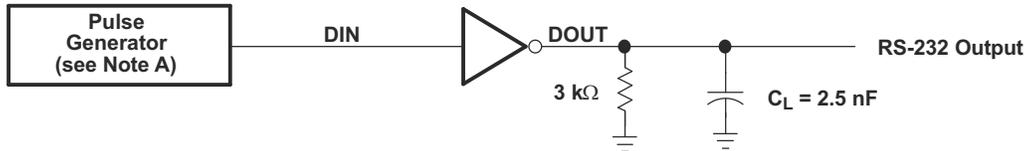
- A. The pulse generator has the following characteristics:  $Z_O = 50\Omega$ , duty cycle  $\leq 50\%$ .
- B.  $C_L$  includes probe and jig capacitance.
- C. All diodes are 1N3064 or equivalent.

**图 6-1. Receiver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurements**



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

**6-2. Driver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurements (5- $\mu$ s Input)**



- A. The pulse generator has the following characteristics:  $Z_O = 50\Omega$ , duty cycle  $\leq 50\%$ .

**6-3. Test Circuit and Waveforms for  $t_{THL}$  and  $t_{TLH}$  Measurements (20- $\mu$ s Input)**

## 6 Detailed Description

### 6.1 Overview

The MAX232E is a dual driver and receiver that includes a capacitive voltage generator using four capacitors to supply TIA/EIA-232-F voltage levels from a single 5V supply. All RS-232 pins have 15kV HBM and IEC61000-4-2 Air-Gap discharge protection. RS-232 pins also have 8kV IEC61000-4-2 contact discharge protection. Each receiver converts TIA/EIA-232-F inputs to 5V TTL/CMOS levels. These receivers have shorted and open fail safe. The receiver can accept up to  $\pm 30\text{V}$  inputs and decode inputs as low as  $\pm 3\text{V}$ . Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels. Outputs are protected against shorts to ground.

### 6.2 Functional Block Diagram

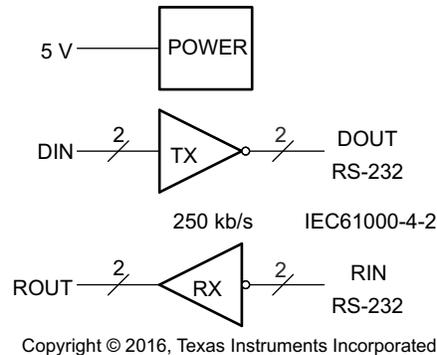


图 6-1. Logic Diagram (Positive Logic)

### 6.3 Feature Description

#### 6.3.1 Power

The power block increases and inverts the 5V supply for the RS-232 driver using a charge pump that requires four  $1\mu\text{F}$  external capacitors.

#### 6.3.2 RS-232 Driver

Two drivers interface standard logic level to RS-232 levels. Internal pullup resistors on DIN inputs ensures a high input when the line is high impedance.

#### 6.3.3 RS-232 Receiver

Two receivers interface RS-232 levels to standard logic levels. An open or shorted to ground input results in a high output on ROUT.

## 6.4 Device Functional Modes

### 6.4.1 V<sub>CC</sub> Powered by 5V

The device is in normal operation.

### 6.4.2 V<sub>CC</sub> Unpowered

When MAX232E is unpowered, it can be safely connected to an active remote RS-232 device.

### 6.4.3 Truth Tables

表 6-1 and 表 6-2 list the functions of this device.

**表 6-1. Function Table for Each Driver**

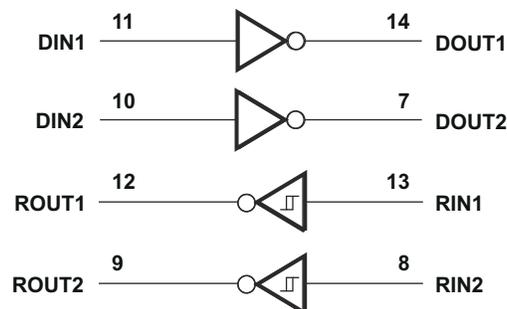
INPUT DIN <sup>(1)</sup>	OUTPUT DOUT
L	H
H	L

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

**表 6-2. Function Table for Each Receiver**

INPUT RIN <sup>(1)</sup>	OUTPUT ROUT
L	H
H	L
Open	H

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



**図 6-2. Logic Diagram (Positive Logic)**

## 7 Applications and Implementation

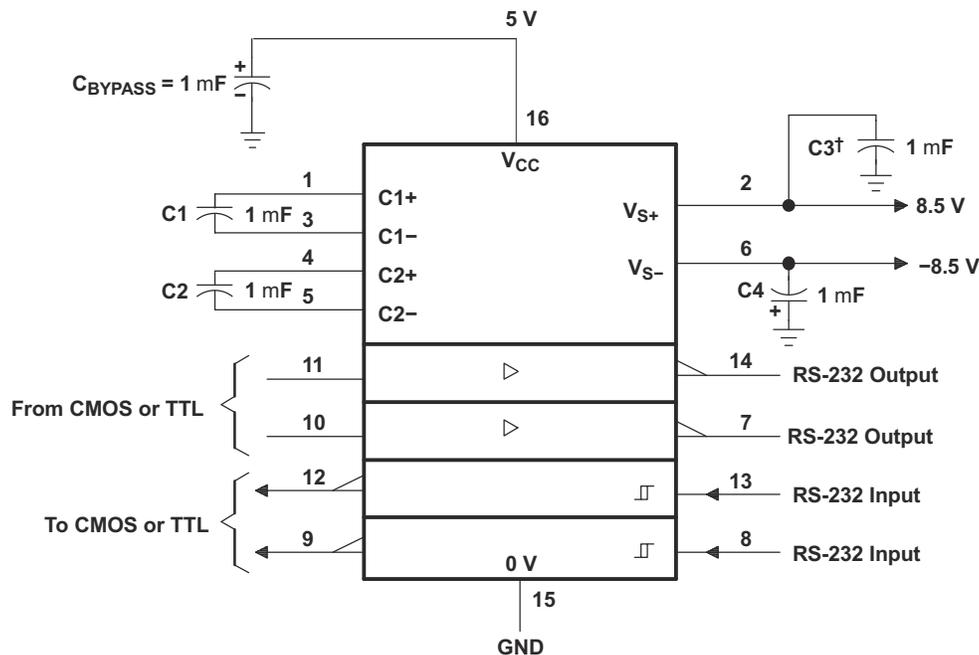
### 注

以下のアプリケーション情報は、TI の製品仕様に含まれるものではなく、TI ではその正確性または完全性を保証いたしません。個々の目的に対する製品の適合性については、お客様の責任で判断していただくこととなります。また、お客様は自身の設計実装を検証しテストすることで、システムの機能を確認する必要があります。

### 7.1 Application Information

For proper operation add capacitors as shown in [図 7-1](#). Pins 9 through 12 connect to UART or general purpose logic lines. RS-232 lines on pins 7, 8, 13, and 14 connect to a connector or cable.

### 7.2 Typical Application



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

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Resistor values shown are nominal.

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

**図 7-1. Typical Operating Circuit**

#### 7.2.1 Design Requirements

- $V_{CC}$  minimum is 4.5V and maximum is 5.5V.
- Maximum recommended bit rate is 250kbit/s.

### 7.2.2 Detailed Design Procedure

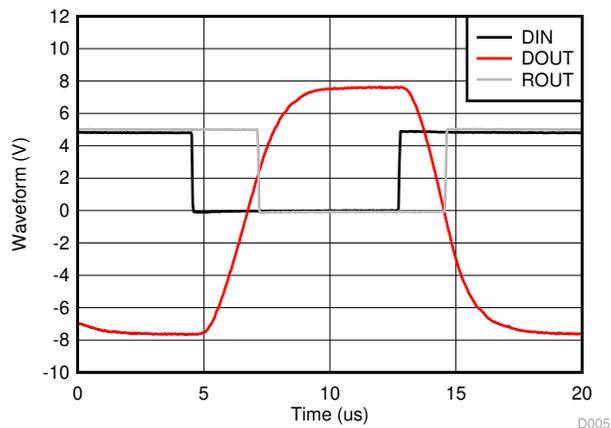
The capacitor type used for C1–C4 is not critical for proper operation. The MAX232E requires 1µF capacitors, although capacitors up to 10µF can be used without harm. Ceramic dielectrics are suggested for capacitors. When using the minimum recommended capacitor values, make sure the capacitance value does not degrade excessively as the operating temperature varies. If in doubt, use capacitors with a larger (for example, 2×) nominal value. The capacitors' effective series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V–.

Use larger capacitors (up to 10µF) to reduce the output impedance at V<sub>S+</sub> and V<sub>S–</sub>.

Bypass V<sub>CC</sub> to ground with at least 1 µF. In applications sensitive to power-supply noise generated by the charge pumps, decouple V<sub>CC</sub> to ground with a capacitor the same size as (or larger than) the charge-pump capacitors (C1–C4).

### 7.2.3 Application Curve

Loopback waveform connects DOUT to RIN.



Date Rate = 120 kbit/s, C<sub>L</sub> = 1 nF

**图 7-2. Loopback Waveforms**

### 7.3 Power Supply Recommendations

The V<sub>CC</sub> voltage should be connected to the same power source used for logic device connected to DIN and ROUT pins. V<sub>CC</sub> should be between 4.5V and 5.5V.

## 7.4 Layout

### 7.4.1 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 MAX232E ground pin and circuit board ground plane as low as possible for best ESD performance. Use wide metal and multiple vias on both sides of ground pin.

### 7.4.2 Layout Example

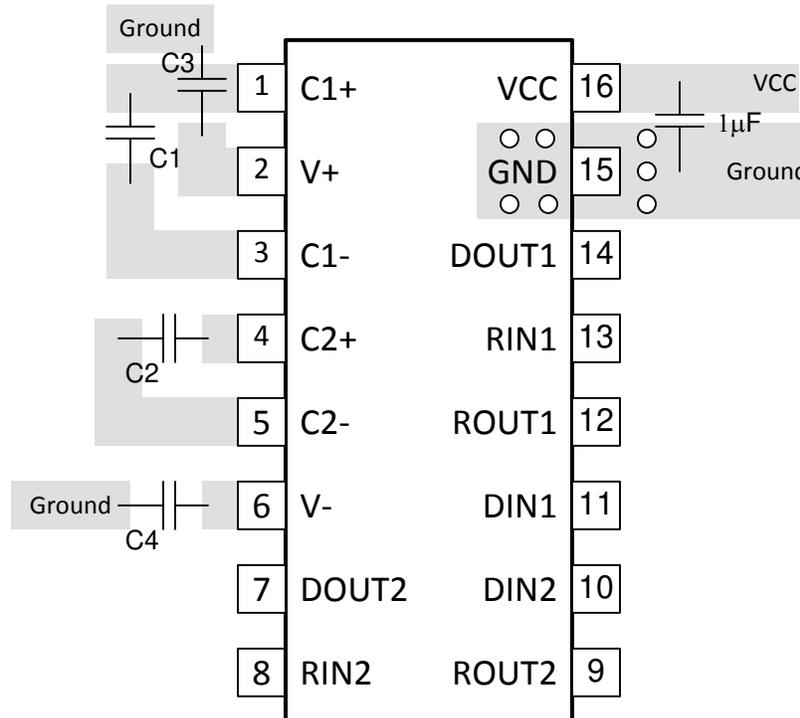


図 7-3. MAX232E Layout

## 8 Device and Documentation Support

### 8.1 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、[ti.com](http://ti.com) のデバイス製品フォルダを開いてください。「更新の通知を受け取る」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

### 8.2 サポート・リソース

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### 8.3 Trademarks

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### 8.4 静電気放電に関する注意事項



この IC は、ESD によって破損する可能性があります。テキサス・インスツルメンツは、IC を取り扱う際には常に適切な注意を払うことを推奨します。正しい ESD 対策をとらないと、デバイスを破損するおそれがあります。

ESD による破損は、わずかな性能低下からデバイスの完全な故障まで多岐にわたります。精密な IC の場合、パラメータがわずかに変化するだけで公表されている仕様から外れる可能性があるため、破損が発生しやすくなっています。

### 8.5 用語集

**TI 用語集** この用語集には、用語や略語の一覧および定義が記載されています。

## 9 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Changes from Revision C (August 2016) to Revision D (February 2024)	Page
• 「製品情報」表を「パッケージ情報」表に変更.....	1
• Changed the <i>Thermal Information</i> table.....	5

Changes from Revision B (November 2009) to Revision C (August 2016)	Page
• 「ESD 定格」表、「機能説明」セクション、「デバイスの機能モード」セクション、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージ、および注文情報」セクションを追加。.....	1
• 「特長」から「±30V 入力レベル」を削除.....	1
• 「注文情報」表を削除 (データシートの末尾にある POA を参照).....	1
• Added MIN value ±3 to "Receiver input voltage (RIN1, RIN2) row in <i>Recommended Operating Conditions</i> ...	4
• Changed R <sub>θJA</sub> values in <i>Thermal Information</i> .....	5
• Deleted table note 3 from <i>Receiver Section Electrical Characteristics</i> .....	5
• Added a new row to the <i>Function Table for Each Receiver</i> .....	11

## 10 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.

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**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)
<a href="#">MAX232ECD</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	0 to 70	MAX232EC
<a href="#">MAX232ECDR</a>	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX232EC
MAX232ECDR.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX232EC
<a href="#">MAX232ECDW</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	0 to 70	MAX232EC
<a href="#">MAX232ECDWR</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	0 to 70	MAX232EC
<a href="#">MAX232ECDWRG4</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	0 to 70	MAX232EC
<a href="#">MAX232ECN</a>	Obsolete	Production	PDIP (N)   16	-	-	Call TI	Call TI	0 to 70	MAX232ECN
<a href="#">MAX232ECPW</a>	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	0 to 70	MA232EC
<a href="#">MAX232ECPWR</a>	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	0 to 70	MA232EC
<a href="#">MAX232ECPWRG4</a>	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	0 to 70	MA232EC
<a href="#">MAX232EID</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	-40 to 85	MAX232EI
<a href="#">MAX232EIDR</a>	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX232EI
MAX232EIDR.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX232EI
MAX232EIDRG4	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX232EI
MAX232EIDRG4.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX232EI
<a href="#">MAX232EIDW</a>	Obsolete	Production	SOIC (DW)   16	-	-	Call TI	Call TI	-40 to 85	MAX232EI
<a href="#">MAX232EIDWR</a>	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX232EI
MAX232EIDWR.A	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX232EI
<a href="#">MAX232EIN</a>	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	MAX232EIN
MAX232EIN.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	MAX232EIN
MAX232EINE4	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	MAX232EIN
<a href="#">MAX232EIPW</a>	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	-40 to 85	MB232EI
<a href="#">MAX232EIPWR</a>	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 85	MB232EI
MAX232EIPWR.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB232EI
MAX232EIPWRG4	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB232EI
MAX232EIPWRG4.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MB232EI

(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.

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## 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
MAX232ECDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX232ECDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX232EIDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX232EIDRG4	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
MAX232EIDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
MAX232EIPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX232EIPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MAX232EIPWRG4	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)
MAX232ECDR	SOIC	D	16	2500	340.5	336.1	32.0
MAX232ECDR	SOIC	D	16	2500	333.2	345.9	28.6
MAX232EIDR	SOIC	D	16	2500	353.0	353.0	32.0
MAX232EIDRG4	SOIC	D	16	2500	353.0	353.0	32.0
MAX232EIDWR	SOIC	DW	16	2000	350.0	350.0	43.0
MAX232EIPWR	TSSOP	PW	16	2000	356.0	356.0	35.0
MAX232EIPWR	TSSOP	PW	16	2000	353.0	353.0	32.0
MAX232EIPWRG4	TSSOP	PW	16	2000	353.0	353.0	32.0

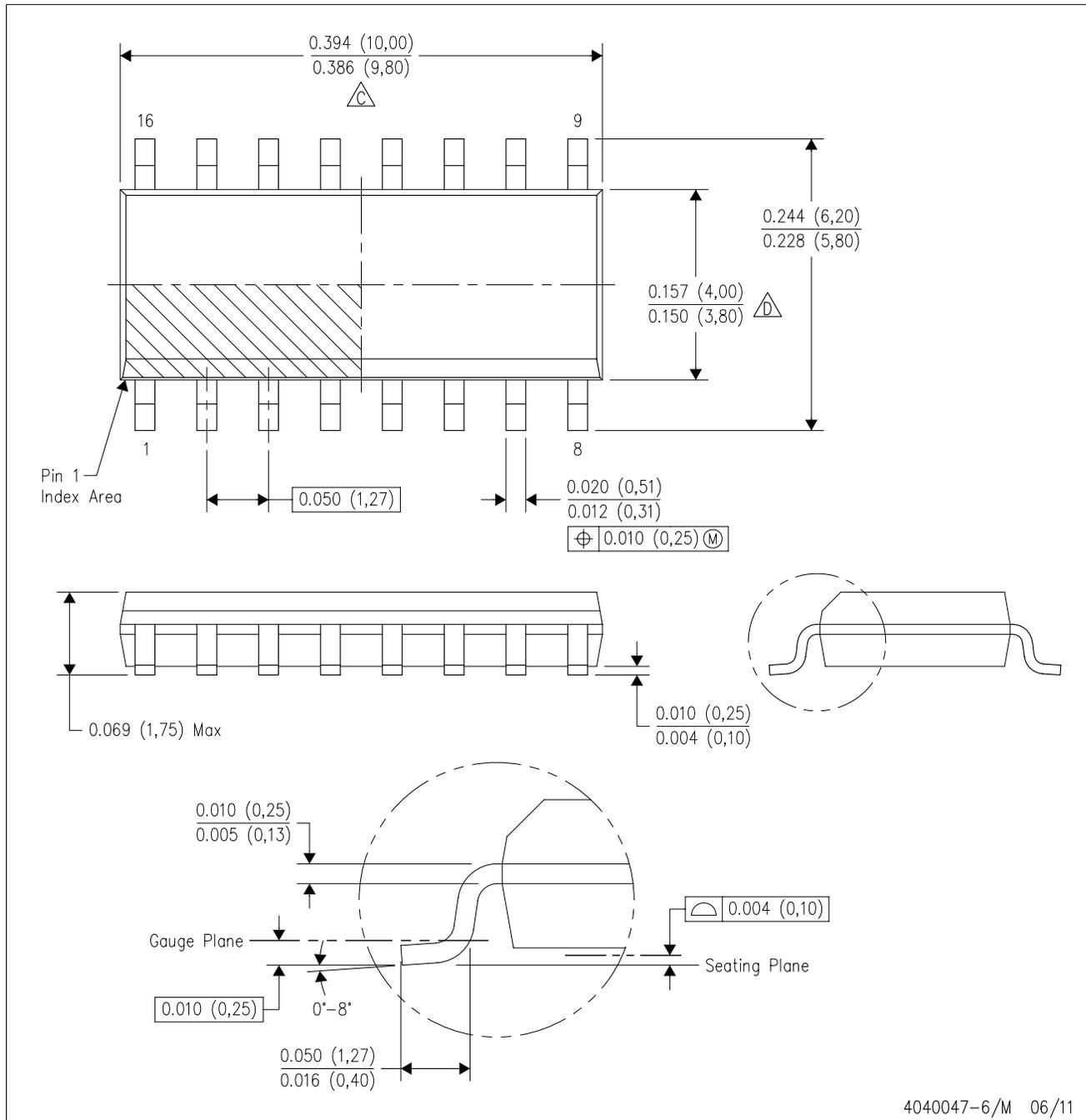
**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
MAX232EIN	N	PDIP	16	25	506	13.97	11230	4.32
MAX232EIN.A	N	PDIP	16	25	506	13.97	11230	4.32
MAX232EINE4	N	PDIP	16	25	506	13.97	11230	4.32

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  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.
  -  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.

## GENERIC PACKAGE VIEW

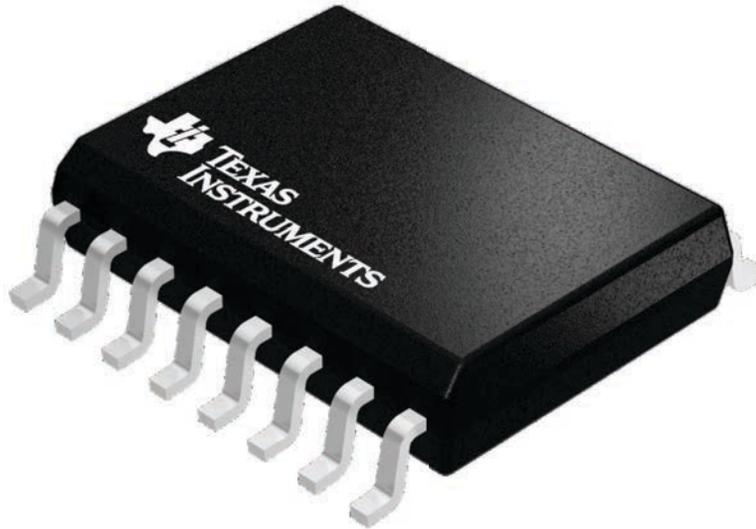
**DW 16**

**SOIC - 2.65 mm max height**

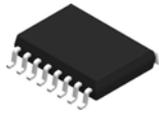
7.5 x 10.3, 1.27 mm pitch

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

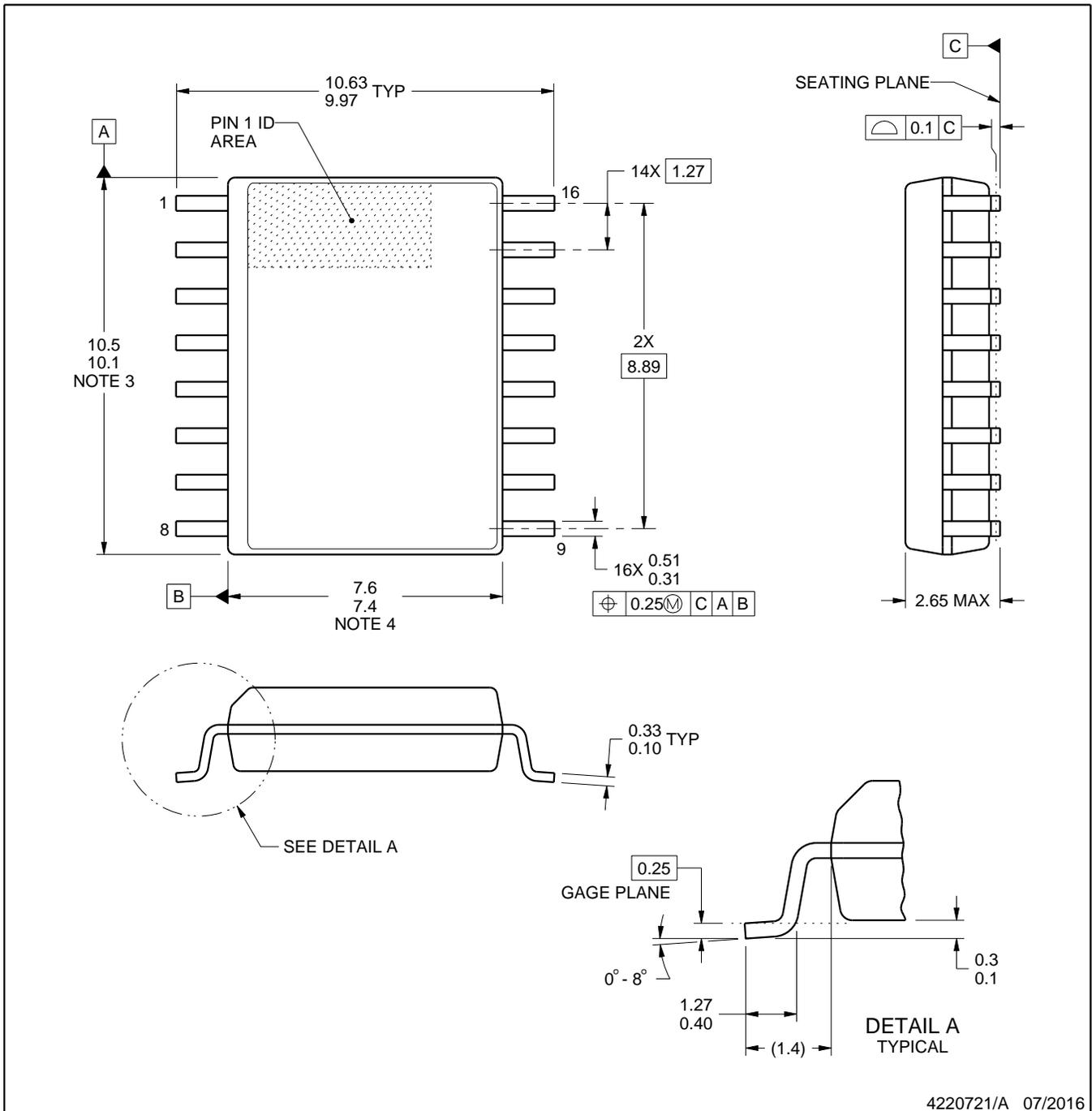


# DW0016A

# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

### NOTES:

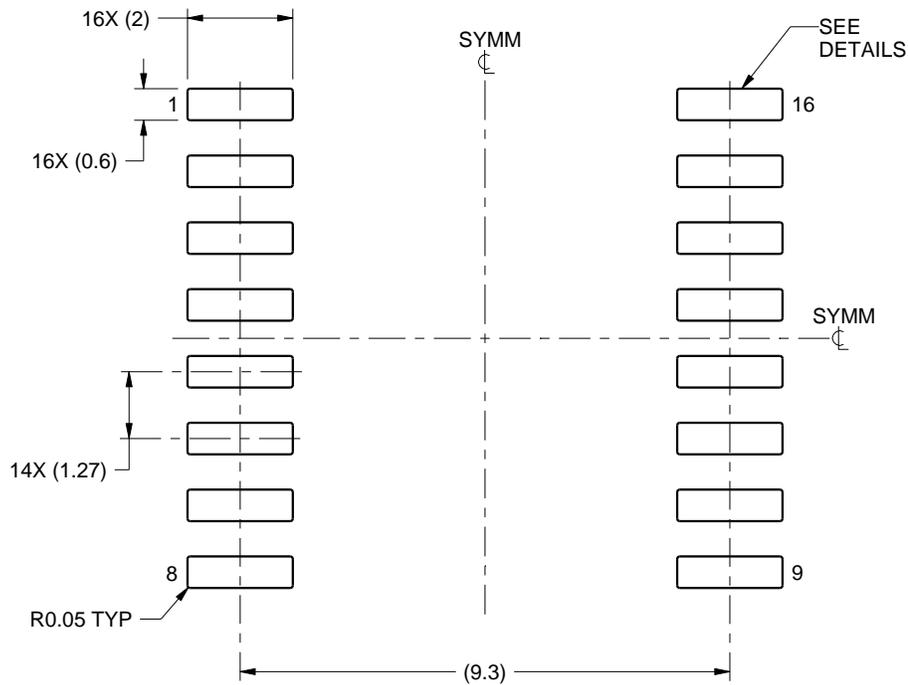
- All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs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

# EXAMPLE BOARD LAYOUT

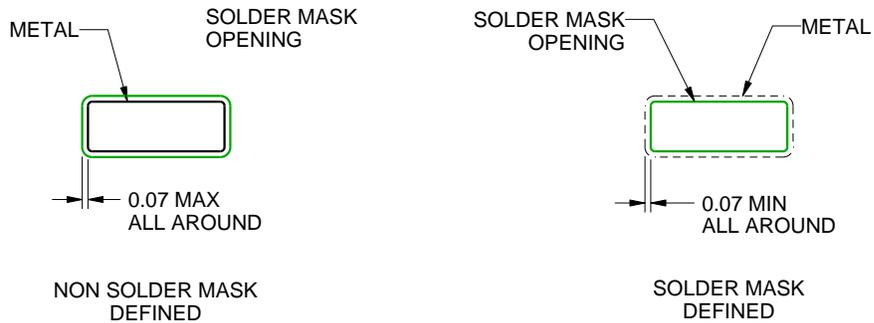
DW0016A

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.

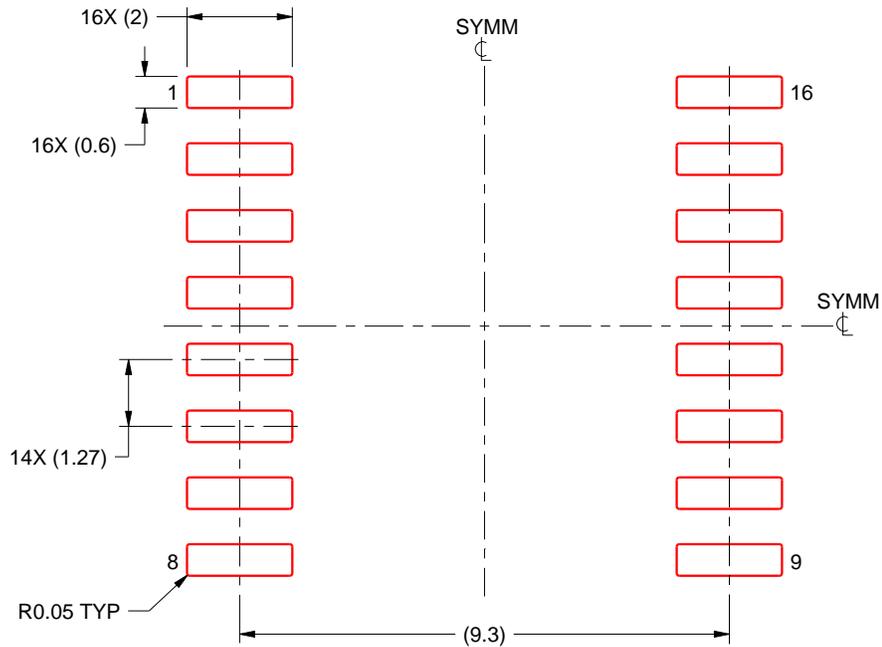
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0016A

SOIC - 2.65 mm max height

SOIC

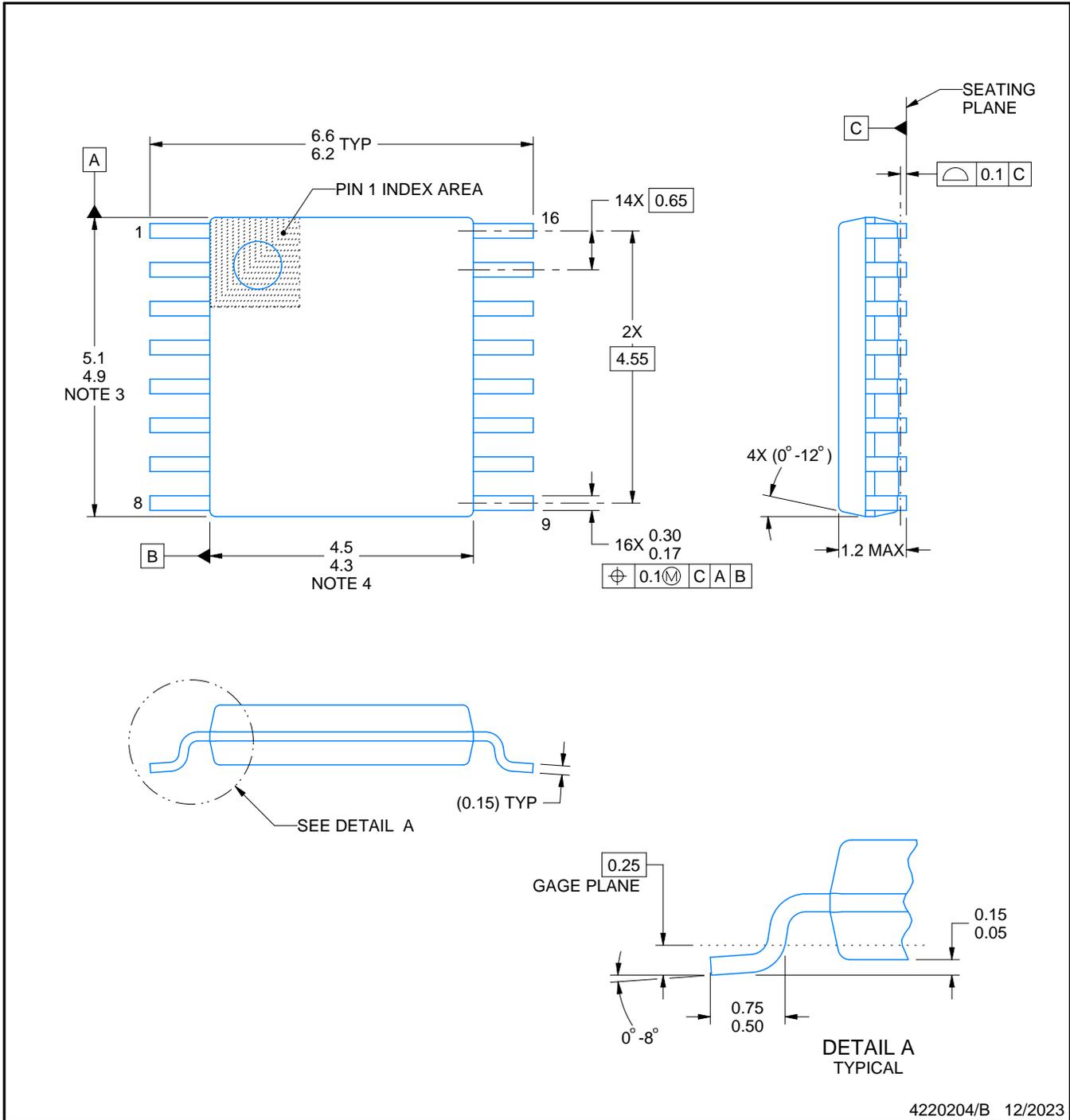


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

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.



4220204/B 12/2023

NOTES:

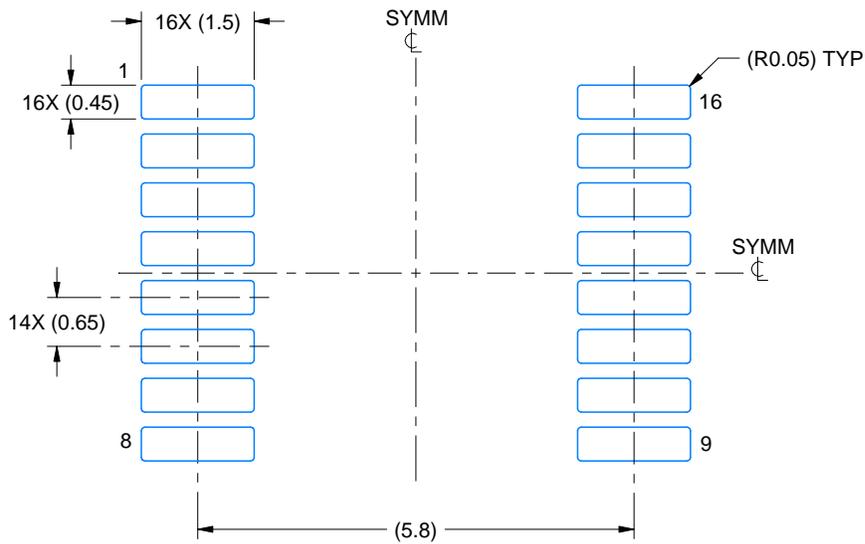
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

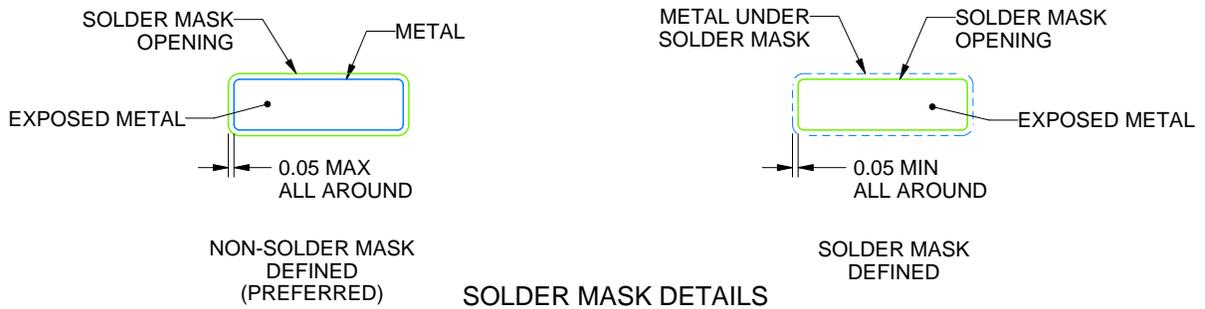
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

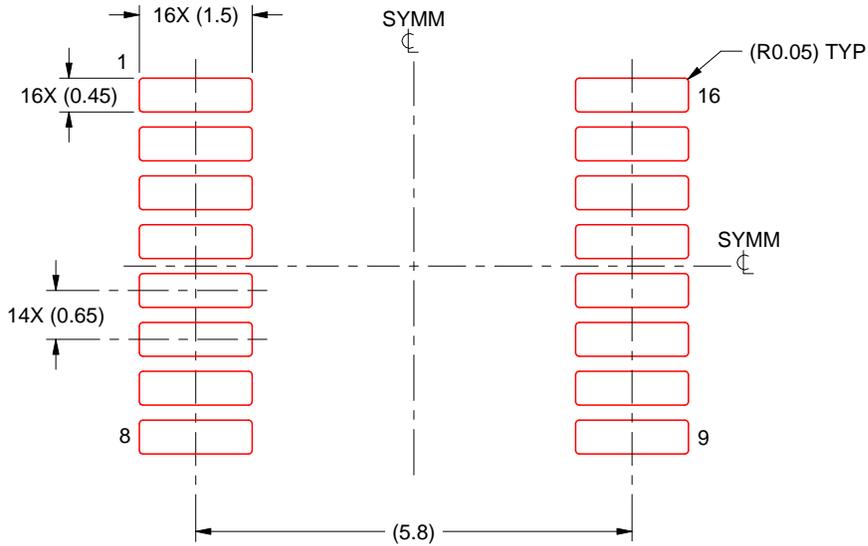
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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/B 12/2023

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.



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