具有 ±15kV ESD 保护功能的 3V 至 5.5V 多通道 RS-232 线路驱动器和接收器

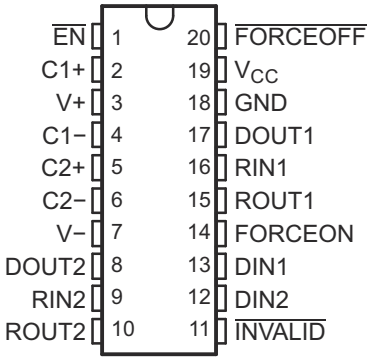
1 特性

- 为 RS-232 总线引脚提供 ESD 保护
  - ±15kV 人体放电模型 (HBM)
  - ±8kV IEC61000-4-2 接触放电
  - ±15kV IEC61000-4-2 气隙放电
- 符合或超出 TIA/EIA-232-F 和 ITU v.28 标准的要求
- 由 3V 至 5.5V V_{CC} 电源供电
- 速率高达 500kbit/s
- 两个驱动器和两个接收器
- 低待机电流：1 μA（典型值）
- 外部电容器：4 × 0.1 μF
- 支持 5V 逻辑输入及 3.3V 电源
- 适合 SNx5C3223E 的备选高速引脚兼容器件 (1Mbit/s)

2 应用

- 电池供电型系统
- PDA
- 笔记本电脑
- 便携式计算机
- 掌上电脑
- 手持设备

DB, DW, OR PW PACKAGE
(TOP VIEW)



3 说明

MAX3223E 由两个线路驱动器、两个线路接收器和一个双电荷泵电路组成，具有引脚对引脚（串行端口连接引脚，包括 GND）±15kV ESD 保护。该器件符合 TIA/EIA-232-F 的要求并在异步通信控制器与串行端口连接器之间提供电气接口。电荷泵和四个小型外部电容器支持由 3V 至 5.5V 单电源供电。该器件以高达 500kbit/s 的典型数据信号传输速率运行，驱动器输出压摆率最大为 30V/μs。

串行端口处于非活动状态时，可提供灵活的电源管理控制选项。当 FORCEON 为低电平且 $\overline{\text{FORCEOFF}}$ 为高电平时，自动断电功能启用。在这种运行模式下，如果器件未检测到有效的 RS-232 信号，则禁用驱动器输出。如果 $\overline{\text{FORCEOFF}}$ 设定为低电平且 EN 为高电平，则驱动器和接收器均关闭，且电源电流降低至 1mA。断开串行端口的连接或关闭外围驱动器会导致发生自动断电情况。当 FORCEON 和 $\overline{\text{FORCEOFF}}$ 均为高电平时可禁用自动断电。启用自动断电的情况下，向任何接收器输入施加有效信号时，器件会自动激活。$\overline{\text{INVALID}}$ 输出用于通知用户任何接收器输入端是否存在 RS-232 信号。如果任何接收器输入电压大于 2.7V 或小于 -2.7V，或者介于 -0.3V 至 0.3V 之间的时间少于 30μs，则 $\overline{\text{INVALID}}$ 为高电平（有效数据）。如果接收器输入电压在 -0.3V 至 0.3V 之间的时间超过 30μs，则 $\overline{\text{INVALID}}$ 为低电平（无效数据）。有关接收器输入电平的信息，请参阅图 5-4。

封装信息

器件型号	封装(1)	封装尺寸(2)
MAX3223E	SOIC（DW，20）	12.8mm × 10.3mm
	SSOP（DB，20）	7.2mm × 7.8mm
	TSSOP（PW，20）	6.5mm x 6.4mm

(1) 有关详细信息，请参阅 节 10。
(2) 封装尺寸（长 x 宽）为标称值，并包括引脚（如适用）。

Table of Contents

4 Specifications

4.1 Absolute Maximum Ratings

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

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

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to network GND.

4.2 Recommended Operating Conditions

See 图 7-1, and (1)

				MIN	NOM	MAX	UNIT
	Supply voltage		V_{CC} = 3.3 V	3	3.3	3.6	V
			V_{CC} = 5 V	4.5	5	5.5	
V_{IH}	Driver and control high-level input voltage	DIN, $\overline{\text{EN}}$, $\overline{\text{FORCEOFF}}$, FORCEON	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 V	2.4			
V_{IL}	Driver and control low-level input voltage	DIN, $\overline{\text{EN}}$, $\overline{\text{FORCEOFF}}$, FORCEON				0.8	V
V_I	Driver and control input voltage	DIN, $\overline{\text{EN}}$, $\overline{\text{FORCEOFF}}$, FORCEON		0		5.5	V
	Receiver input voltage			–25		25	V
T_A	Operating free-air temperature		MAX3223EC	0		70	°C
			MAX3223EI	–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.

4.3 ESD Ratings

				VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	All pins except RIN1, RIN2, DOUT1 and DOUT2 pins	±3000	V
			RIN1, RIN2, DOUT1 and DOUT2 pins to GND	±15000	
		Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002(2)	All pins	±1500	

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

4.4 ESD Ratings - IEC Specifications

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	IEC 61000-4-2 Contact Discharge(1)	±8000	V
		IEC 61000-4-2 Air-gap Discharge(1)	±15,000	

(1) A minimum of 1-µF capacitor between V_{CC} and GND is required to meet the specified IEC 61000-4-2 rating.

4.5 Thermal Information

THERMAL METRIC(1)		DB (SOIC)	DW (SOIC)	PW (TSSOP)	UNIT
		20 PINS	20 PINS	20 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	87.2	76.8	89.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	41.1	39.6	29.0	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	43.3	41.5	41.9	°C/W
ψ_{JT}	Junction-to-top characterization parameter	9.2	12.6	1.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	42.7	40.9	41.3	°C/W

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

4.6 Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see 图 5-5) and (1)

PARAMETER		TEST CONDITIONS		MIN	TYP(2)	MAX	UNIT
I_I	Input leakage current	$\overline{EN}$, $\overline{FORCEOFF}$, FORCEON			±0.01	±1	µA
I_{CC}	Supply current	Auto-powerdown disabled	V_{CC} = 3.3 V or 5 V, T_A = 25°C, No load, $\overline{FORCEOFF}$ and FORCEON at V_{CC}		0.3	1.3	mA
		Powered off	No load, $\overline{FORCEOFF}$ at GND		1	10	µA
		Auto-powerdown enabled	No load, $\overline{FORCEOFF}$ at V_{CC}, FORCEON at GND, All RIN are open or grounded		1	10	

(1) Test conditions are C1 – C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2 – C4 = 0.33 µF at V_{CC} = 5 V ± 0.5 V.
(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

4.7 Driver Section

4.7.1 Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see 图 5-5) and (1)

PARAMETER		TEST CONDITIONS	MIN	TYP(2)	MAX	UNIT
V_{OH}	High-level output voltage	DOUT at R_L = 3 kΩ to GND	5	5.4		V
V_{OL}	Low-level output voltage	DOUT at R_L = 3 kΩ to GND	–5	–5.4		V
I_{IH}	High-level input current	V_I = V_{CC}		±0.01	±1	µA
I_{IL}	Low-level input current	V_I at GND		±0.01	±1	µA
I_{OS}	Short-circuit output current(3)	V_{CC} = 3.6 V, V_O = 0 V		±35	±60	mA
		V_{CC} = 5.5 V, V_O = 0 V				
r_o	Output resistance	V_{CC}, V+, and V– = 0 V, V_O = ±2 V	300	10M		Ω
I_{OZ}	Output leakage current	$\overline{FORCEOFF}$ = GND, V_{CC} = 3 V to 3.6 V, V_O = ±12 V			±25	µA
		$\overline{FORCEOFF}$ = GND, V_{CC} = 4.5 V to 5.5 V, V_O = ±12 V			±25	

(1) Test conditions are C1 – C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2 – C4 = 0.33 µF at V_{CC} = 5 V ± 0.5 V.
(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

(3) 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.

4.7.2 Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see 图 5-5) and (1)

PARAMETER		TEST CONDITIONS		MIN	TYP(2)	MAX	UNIT
	Maximum data rate	C_L = 1000 pF, One DOUT switching,	R_L = 3 kΩ, See 图 5-1	250	500		kbit/s
$t_{sk(p)}$	Pulse skew(3)	C_L = 150 pF to 2500 pF, See 图 5-2	R_L = 3 kΩ to 7 kΩ,		100		ns
SR(tr)	Slew rate, transition region (See 图 5-1)	R_L = 3 kΩ to 7 kΩ, V_{CC} = 3.3 V	C_L = 150 pF to 1000 pF	6		30	V/μs
			C_L = 150 pF to 2500 pF	4		30	

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

4.7.3 ESD Protection

		TYP	UNIT
Driver outputs (DOUTx)	Human-Body Model (HBM)	±15	kV
	IEC61000-4-2, Air-Gap Discharge	±15	
	IEC61000-4-2, Contact Discharge	±8	

4.8 Receiver Section

4.8.1 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP(2)	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = – 1 mA	V_{CC} – 0.6	V_{CC} – 0.1		V
V_{OL}	Low-level output voltage	I_{OL} = 1.6 mA			0.4	V
V_{IT+}	Positive-going input threshold voltage	V_{CC} = 3.3 V		1.6	2.4	V
		V_{CC} = 5 V		1.9	2.4	
V_{IT-}	Negative-going input threshold voltage	V_{CC} = 3.3 V	0.6	1.1		V
		V_{CC} = 5 V	0.6	1.4		
V_{hys}	Input hysteresis (V_{IT+} – V_{IT-})			0.5		V
I_{OZ}	Output leakage current	$\overline{EN}$ = V_{CC}		±0.05		μA
r_i	Input resistance	V_I = ±3 V to ±25 V	3	5		kΩ

(1) Test conditions are C1 – C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2 – C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.
(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

4.8.2 Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (1)

PARAMETER		TEST CONDITIONS	TYP(2)	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	C_L = 150 pF, See 图 5-3	150	ns
t_{PHL}	Propagation delay time, high- to low-level output	C_L = 150 pF, See 图 5-3	150	ns
t_{en}	Output enable time	C_L = 150 pF, R_L = 3 kΩ, See 图 5-4	200	ns
t_{dis}	Output disable time	C_L = 150 pF, R_L = 3 kΩ, See 图 5-4	200	ns
$t_{sk(p)}$	Pulse skew(3)	See 图 5-3	50	ns

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

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.
(3) Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.

4.8.3 ESD Protection

		TYP	UNIT
Receiver inputs (RINx)	Human-Body Model (HBM)	±15	kV
	IEC61000-4-2, Air-Gap Discharge	±15	
	IEC61000-4-2, Contact Discharge	±8	

4.9 Auto-Powerdown Section

4.9.1 Electrical Characteristics

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

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

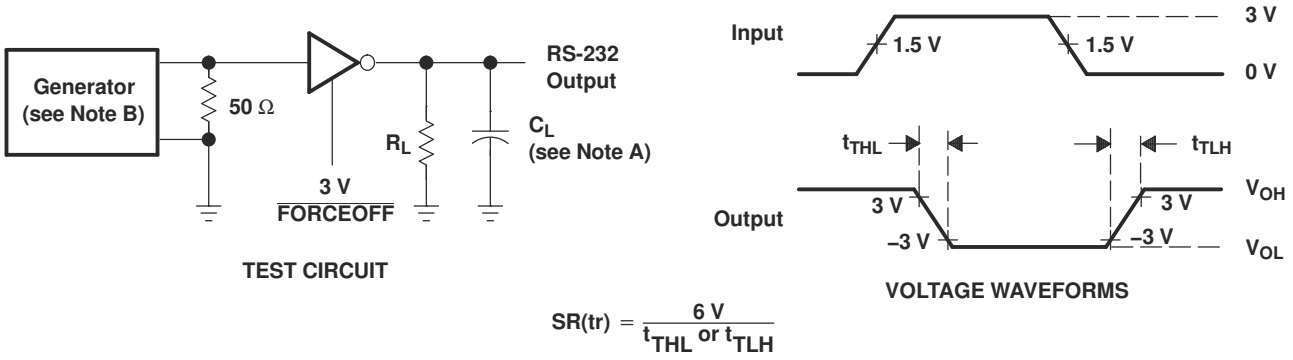
4.9.2 Switching Characteristics

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

PARAMETER		TYP(1)	UNIT
t_{valid}	Propagation delay time, low- to high-level output	1	µs
$t_{invalid}$	Propagation delay time, high- to low-level output	30	µs
t_{en}	Supply enable time	100	µs

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

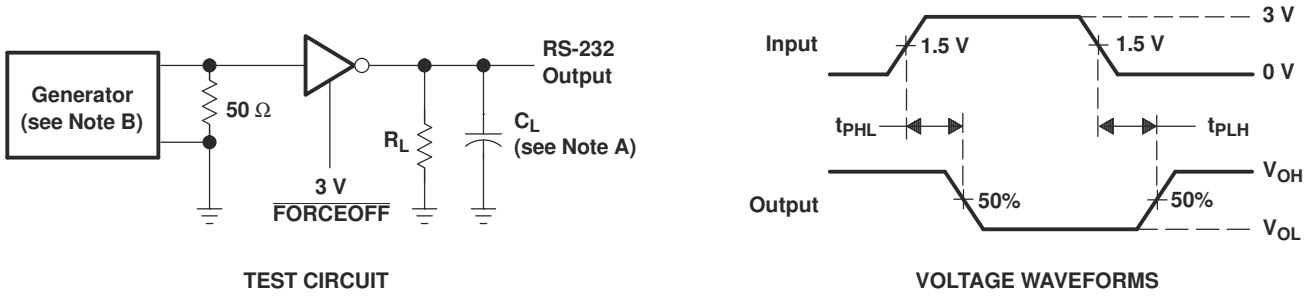
5 Parameter Measurement Information



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.

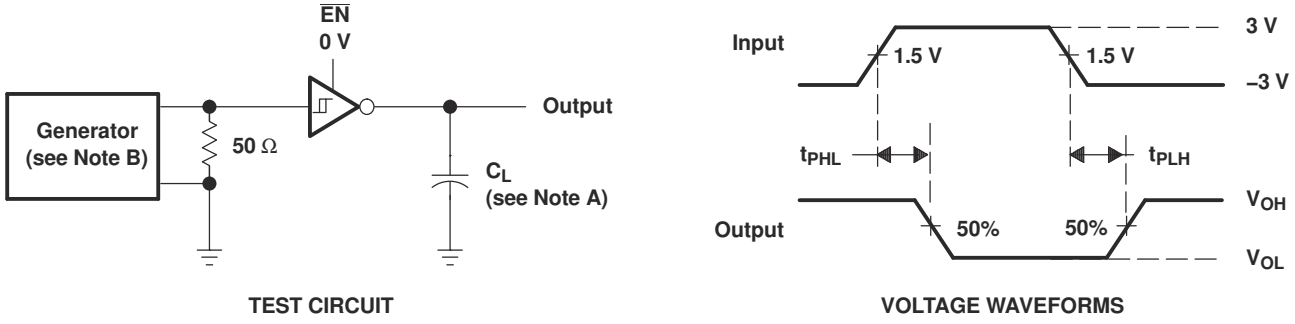
图 5-1. Driver Slew Rate



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.

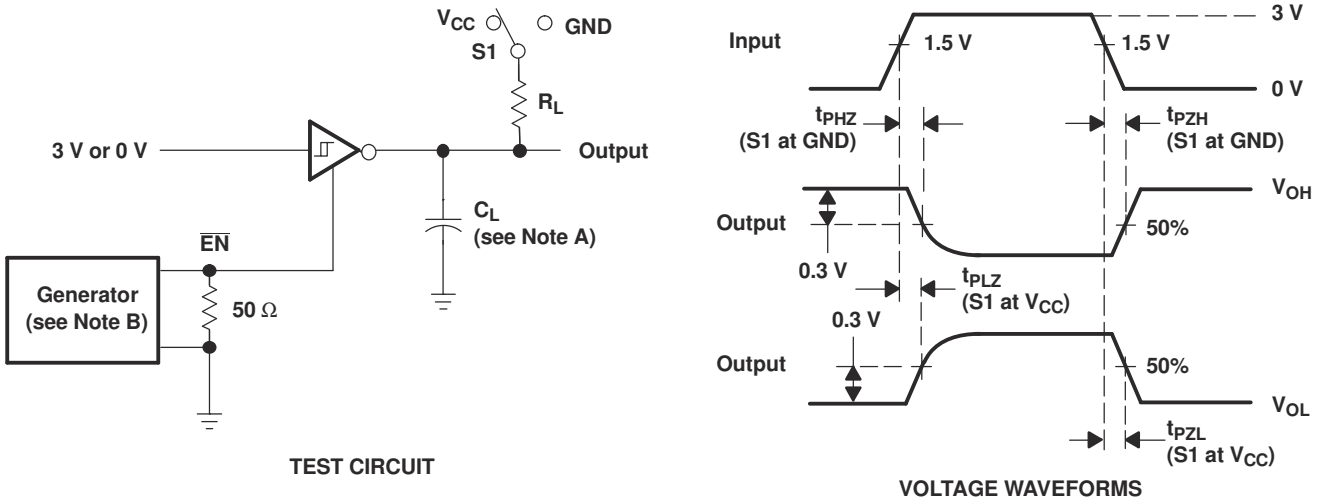
图 5-2. Driver Pulse Skew



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.

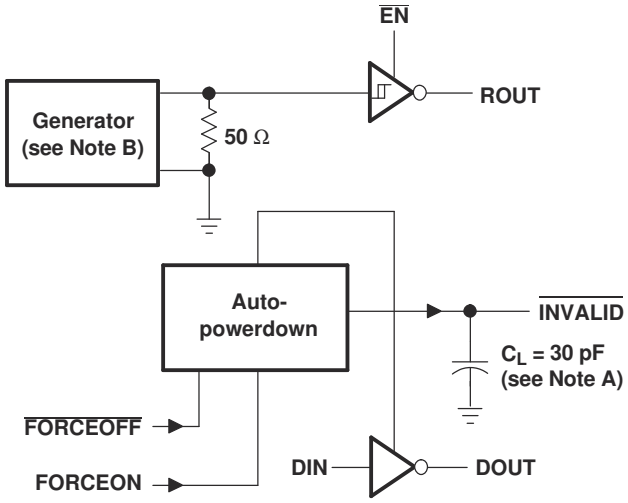
图 5-3. Receiver Propagation Delay Times



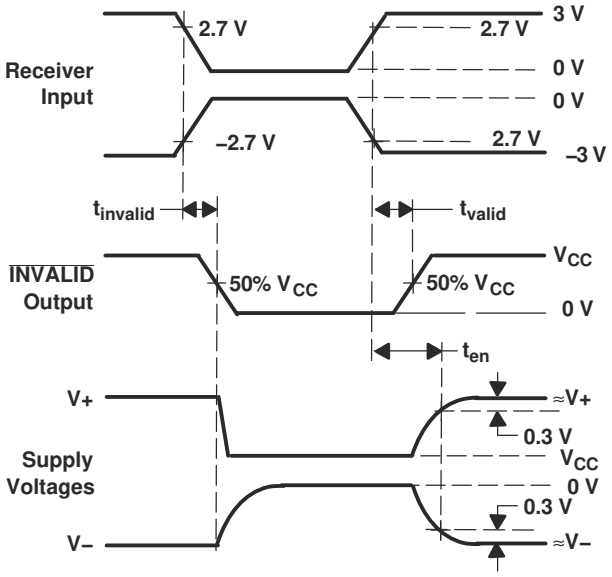
A. C_L includes probe and jig capacitance.

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

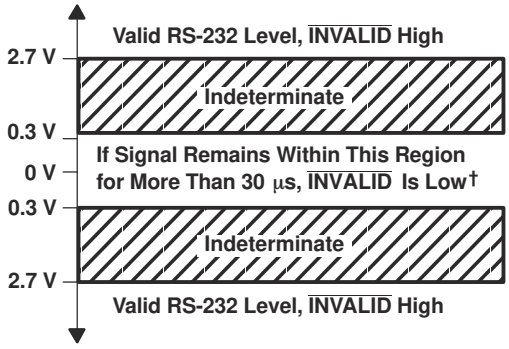
图 5-4. Receiver Enable and Disable Times



TEST CIRCUIT



VOLTAGE WAVEFORMS



† Auto-powerdown disables drivers and reduces supply current to 1 µA

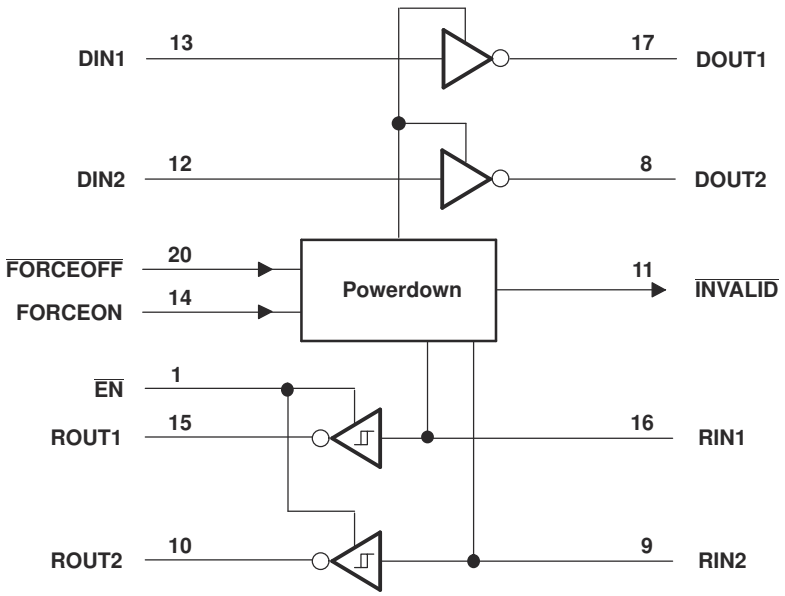
A. C_L includes probe and jig capacitance.

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.

图 5-5. INVALID Propagation Delay Times and Supply Enabling Time

6 Detailed Description

6.1 Functional Block Diagram



Pin numbers are for the DB, DW, and PW packages.

图 6-1. Logic diagram (positive logic)

6.2 Device Functional Modes

Function Table (Each Driver)

INPUTS(1)				OUTPUT DOUT	DRIVER STATUS
DIN	FORCEON	$\overline{\text{FORCEOFF}}$	VALID RIN RS-232 LEVEL		
X	X	L	X	Z	Powered off
L	H	H	X	H	Normal operation with auto-powerdown disabled
H	H	H	X	L	
L	L	H	Yes	H	Normal operation with auto-powerdown enabled
H	L	H	Yes	L	
L	L	H	No	Z	Powered off by auto-powerdown feature
H	L	H	No	Z	

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

Function Table (Each Receiver)

INPUTS(1)			OUTPUT DOUT
RIN	$\overline{\text{EN}}$	VALID RIN RS-232 LEVEL	
L	L	X	H
H	L	X	L
X	H	X	Z
Open	L	No	H

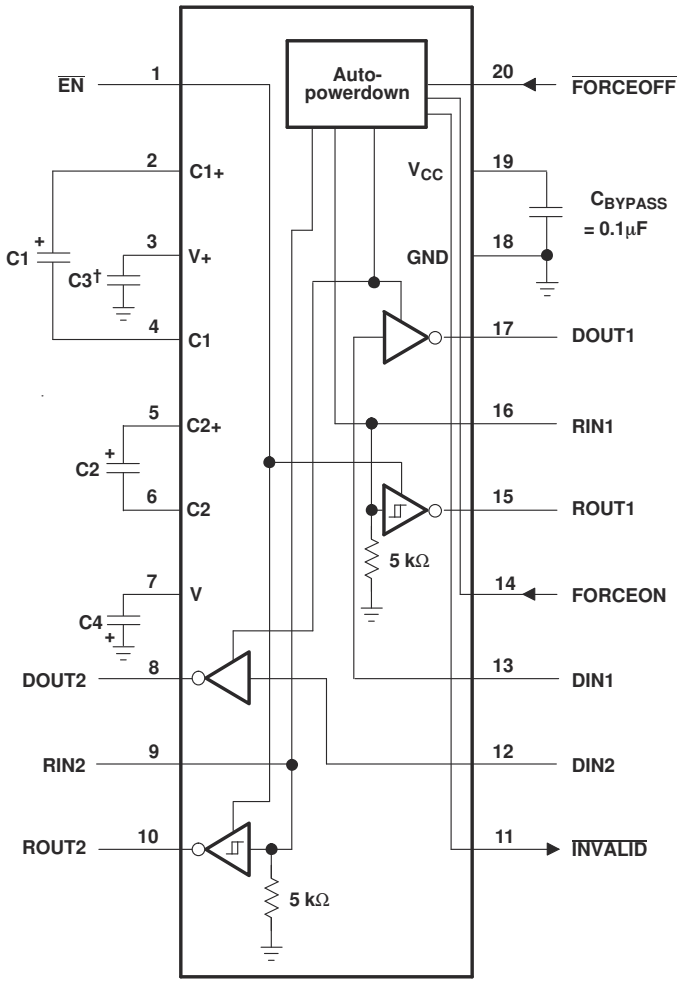
(1) H = high level, L = low level, X = irrelevant,
Z = high impedance (off),
Open = input disconnected or connected driver off

7 Application and Implementation

备注

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客 户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

7.1 Typical Application



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

NOTES: 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.

V_{CC} vs CAPACITOR VALUES

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

图 7-1. Typical Operating Circuit and Capacitor Values

7.1.1 Detailed Design Procedure

MAX3223E has integrated charge-pump that generates positive and negative rails needed for RS-232 signal levels. Main design requirement is that charge-pump capacitor terminals must be connected with recommended capacitor values. Charge-pump rail voltages and device supply pin must be properly bypassed with ceramic capacitors

(1)

8 Device and Documentation Support

8.1 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击 *订阅更新* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

8.2 支持资源

TI E2E™ 支持论坛是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《使用条款》。

8.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.
所有商标均为其各自所有者的财产。

8.4 静电放电警告

静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

8.5 术语表

TI 术语表	本术语表列出并解释了术语、首字母缩略词和定义。

9 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision A (September 2009) to Revision B (December 2023)	Page
• 更改了整个文档中的表格、图和交叉参考的编号格式	1
• Added the *ESD Ratings* tables	3
• Added the *Thermal Information* table	4
• Changed the I_{CC} Auto-powerdown disabled max value from 1 mA to 1.3 mA in the *Electrical Characteristics*	4

Changes from Revision * (January 2006) to Revision A (September 2009)	Page
• 删除了 *RHL 引脚排列* 图	1

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.

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
MAX3223ECDW	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3223EC	Samples
MAX3223ECDWR	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3223EC	Samples
MAX3223EIDBR	ACTIVE	SSOP	DB	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP223EI	Samples
MAX3223EIDW	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3223EI	Samples
MAX3223EIDWR	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3223EI	Samples
MAX3223EIPWR	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP223EI	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.

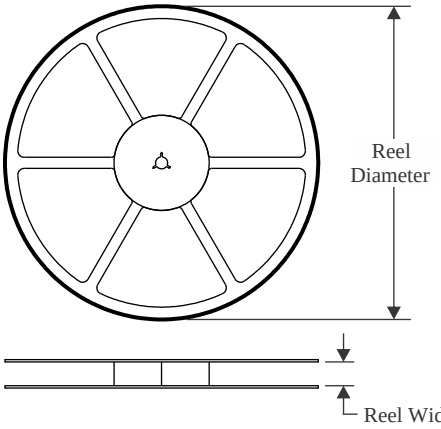
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

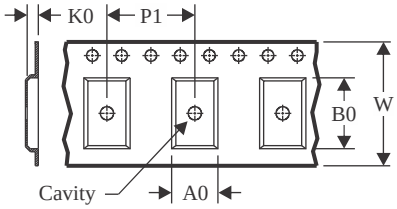
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

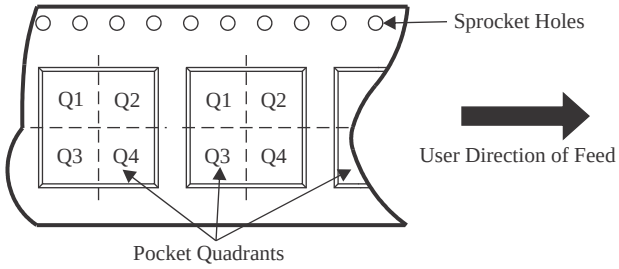


TAPE DIMENSIONS



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

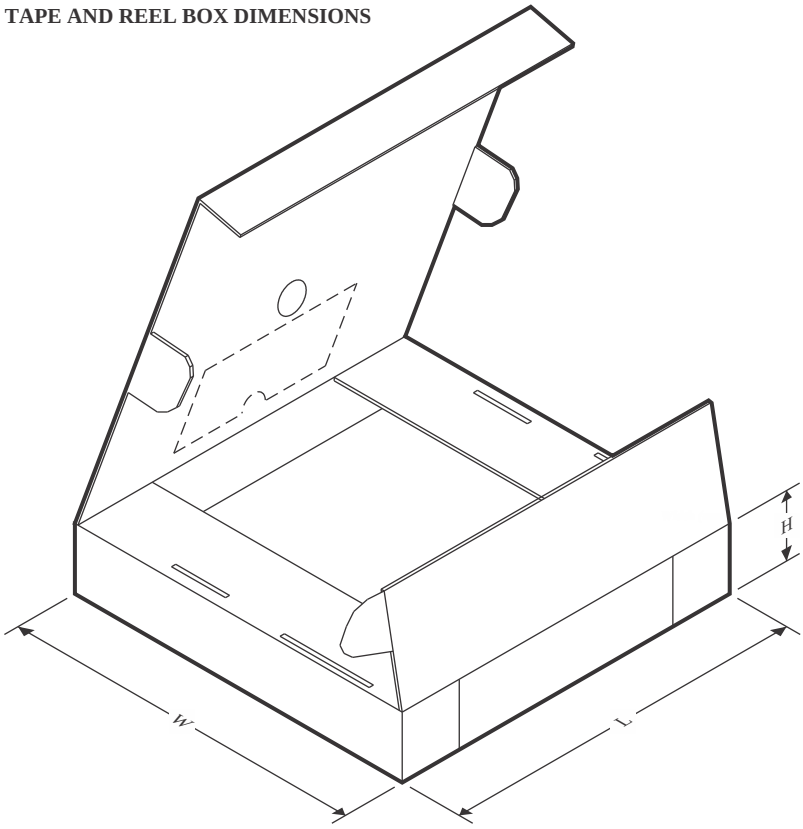
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
MAX3223ECDWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
MAX3223EIDBR	SSOP	DB	20	2000	330.0	16.4	8.2	7.5	2.5	12.0	16.0	Q1
MAX3223EIDBR	SSOP	DB	20	2000	330.0	16.4	8.2	7.5	2.5	12.0	16.0	Q1
MAX3223EIDWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
MAX3223EIPWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	8.0	16.0	Q1

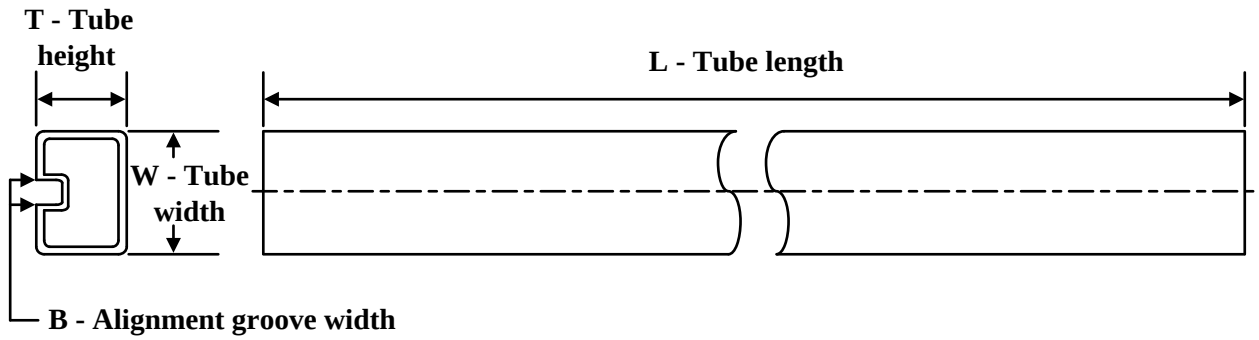
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3223ECDWR	SOIC	DW	20	2000	367.0	367.0	45.0
MAX3223EIDBR	SSOP	DB	20	2000	356.0	356.0	35.0
MAX3223EIDBR	SSOP	DB	20	2000	353.0	353.0	32.0
MAX3223EIDWR	SOIC	DW	20	2000	367.0	367.0	45.0
MAX3223EIPWR	TSSOP	PW	20	2000	356.0	356.0	35.0

TUBE



*All dimensions are nominal

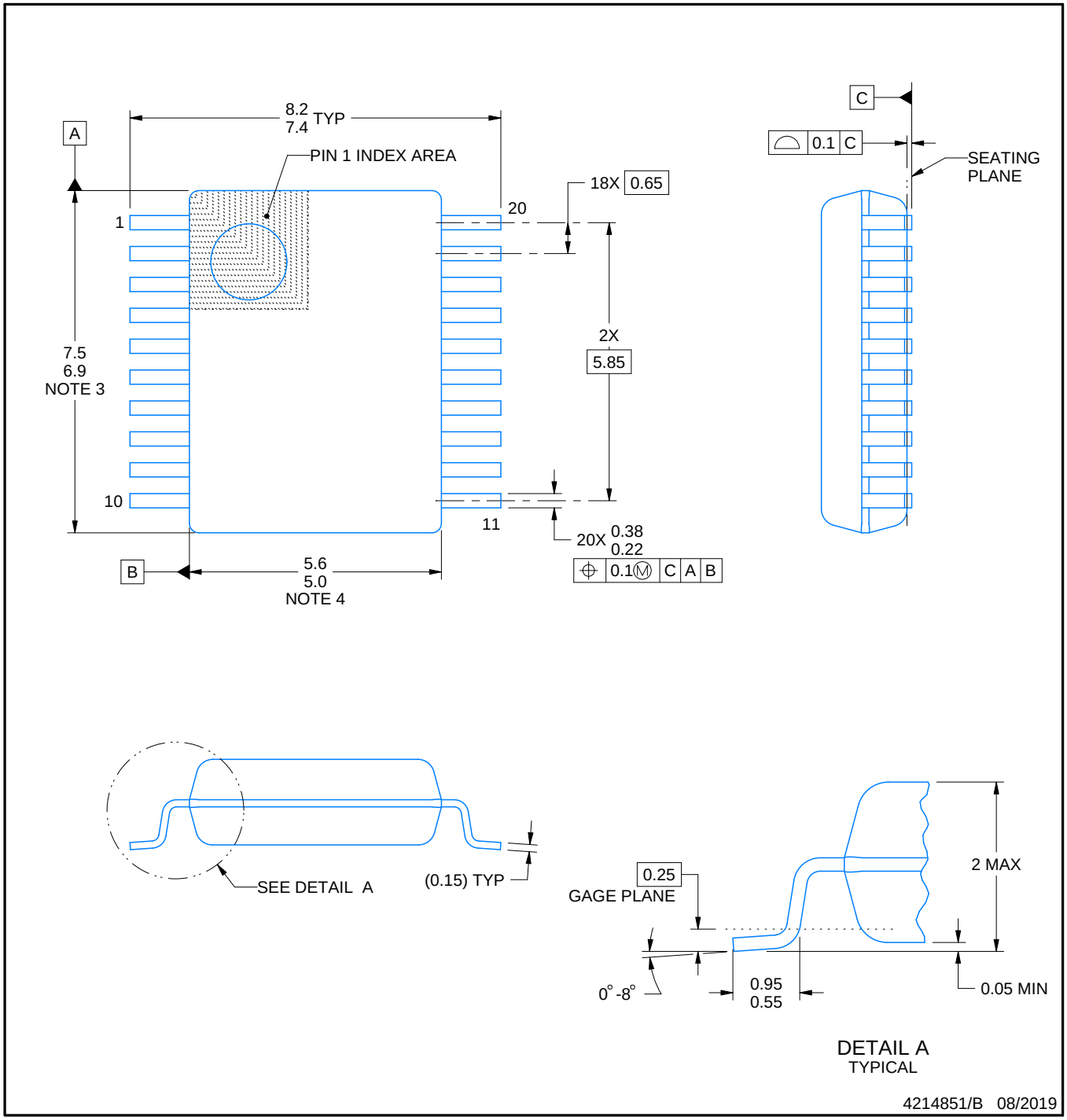
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
MAX3223ECDW	DW	SOIC	20	25	507	12.83	5080	6.6
MAX3223EIDW	DW	SOIC	20	25	507	12.83	5080	6.6

PACKAGE OUTLINE

DB0020A

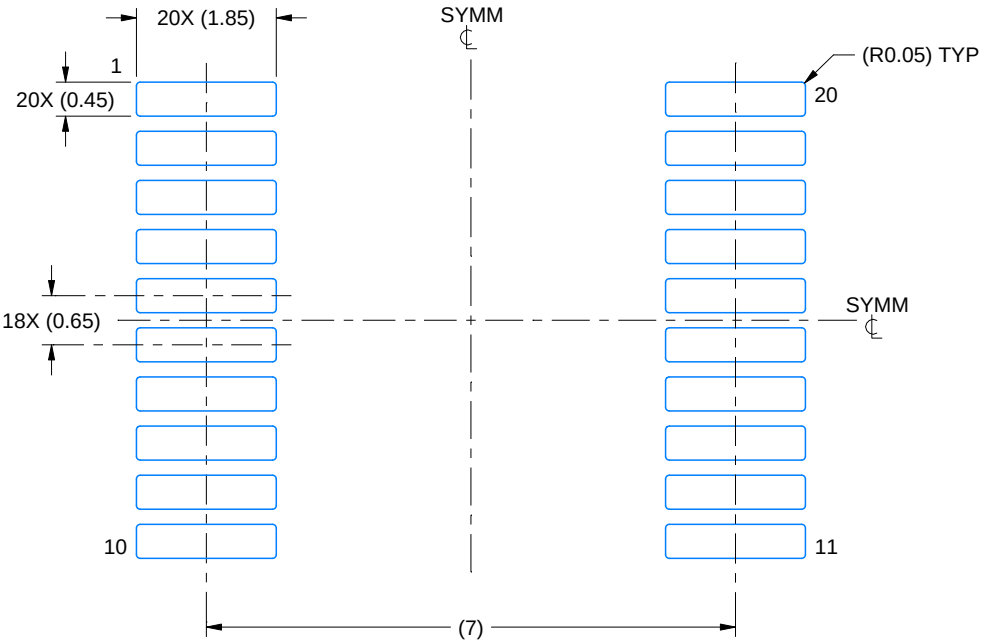
SSOP - 2 mm max height

SMALL OUTLINE PACKAGE

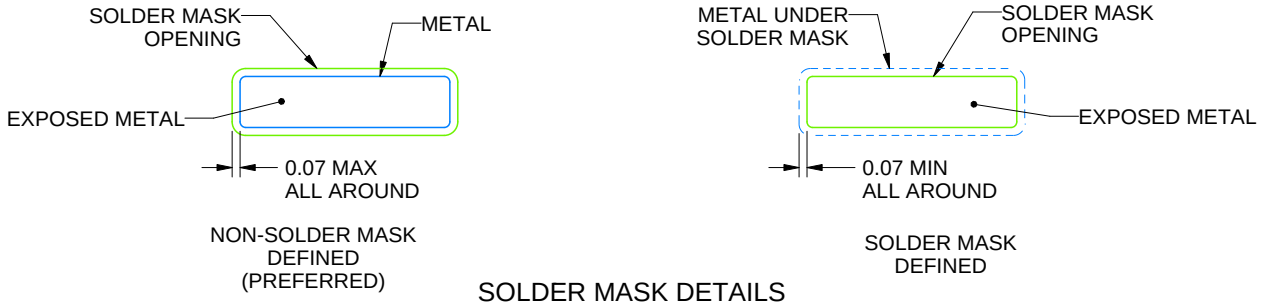


NOTES:

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



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4214851/B 08/2019

NOTES: (continued)

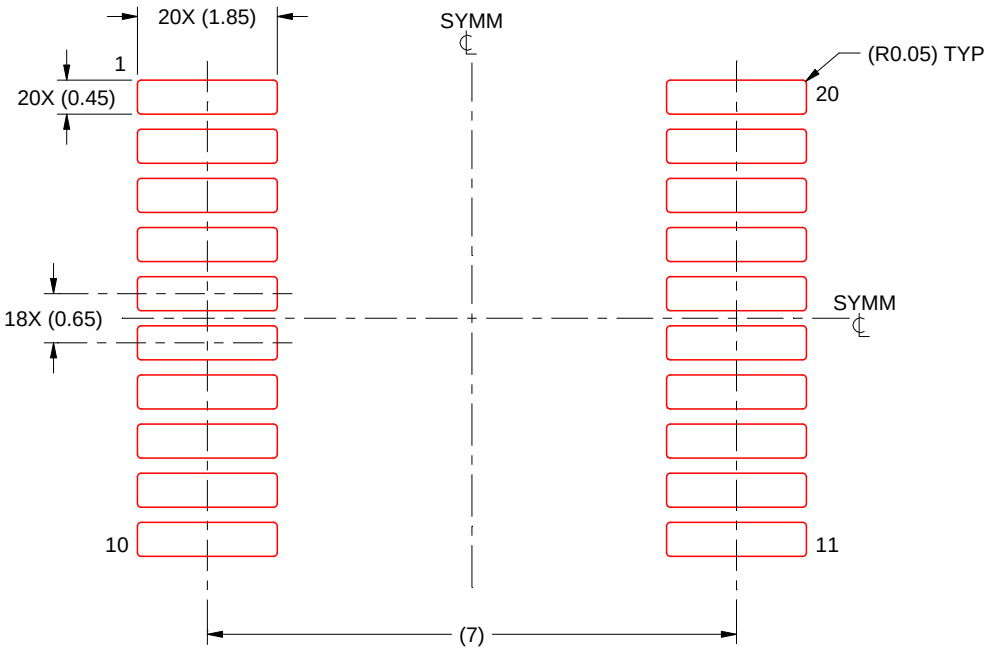
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DB0020A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE

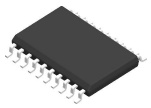


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4214851/B 08/2019

NOTES: (continued)

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

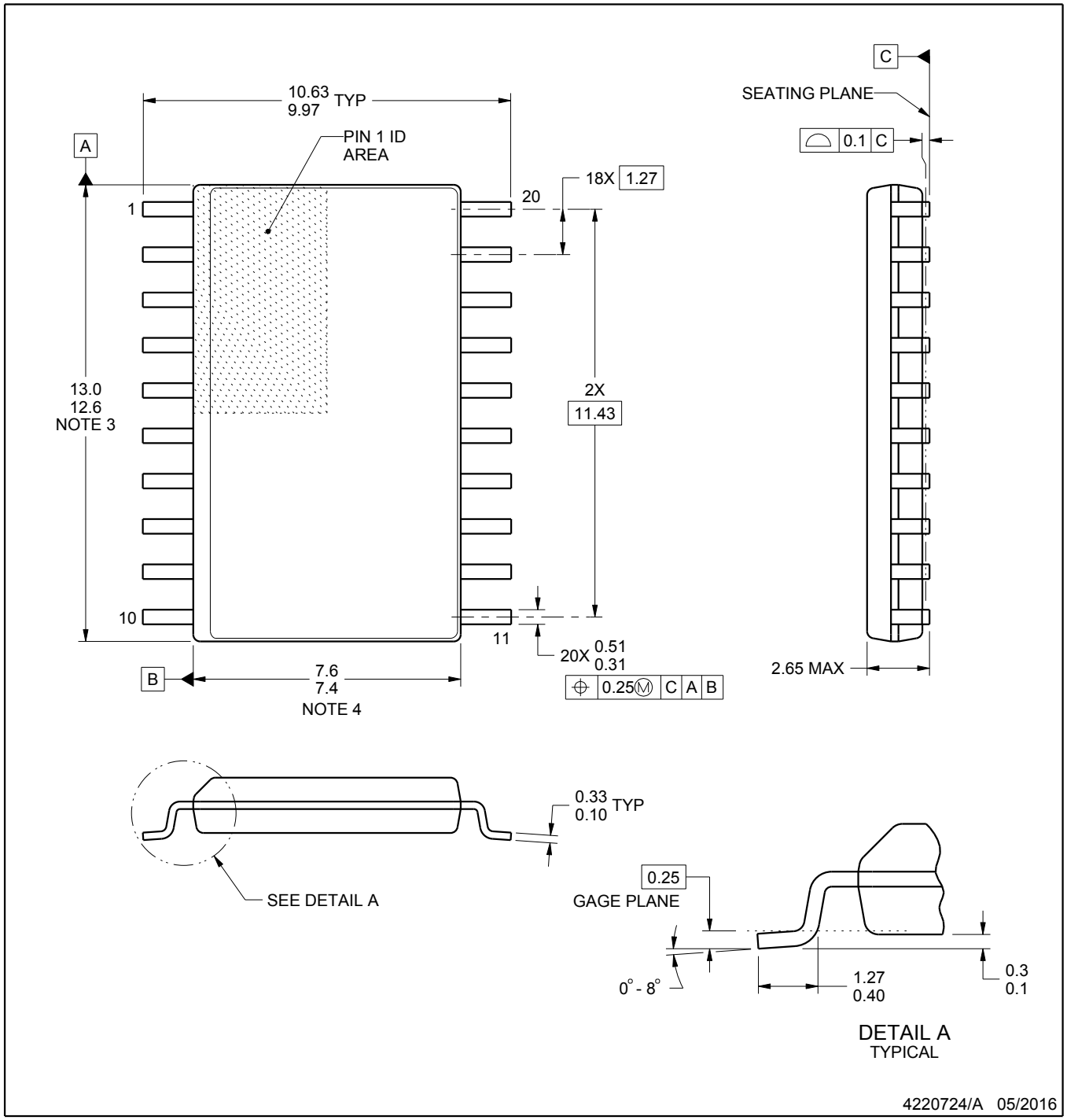


PACKAGE OUTLINE

DW0020A

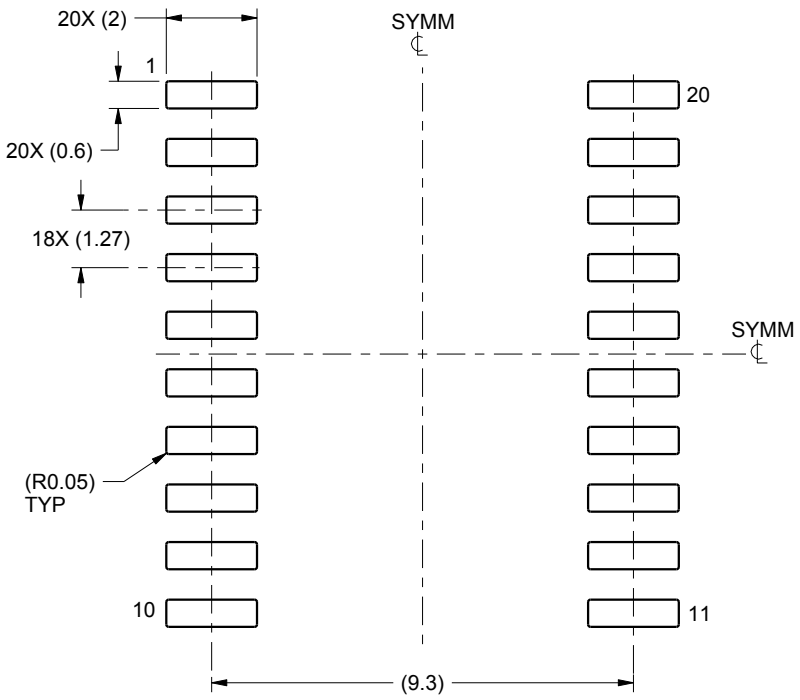
SOIC - 2.65 mm max height

SOIC

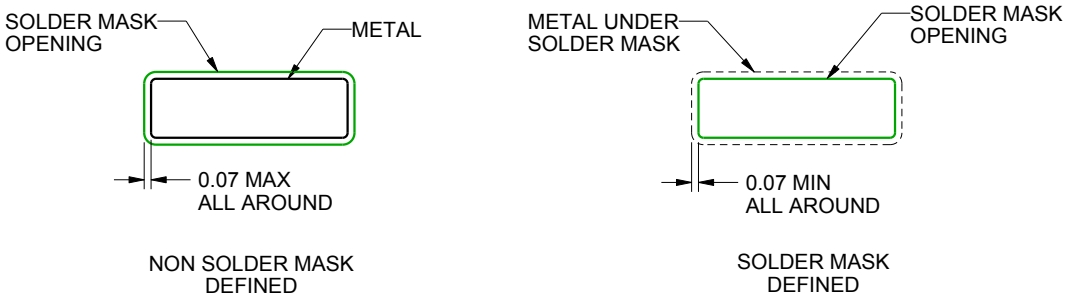


NOTES:

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



LAND PATTERN EXAMPLE
SCALE:6X

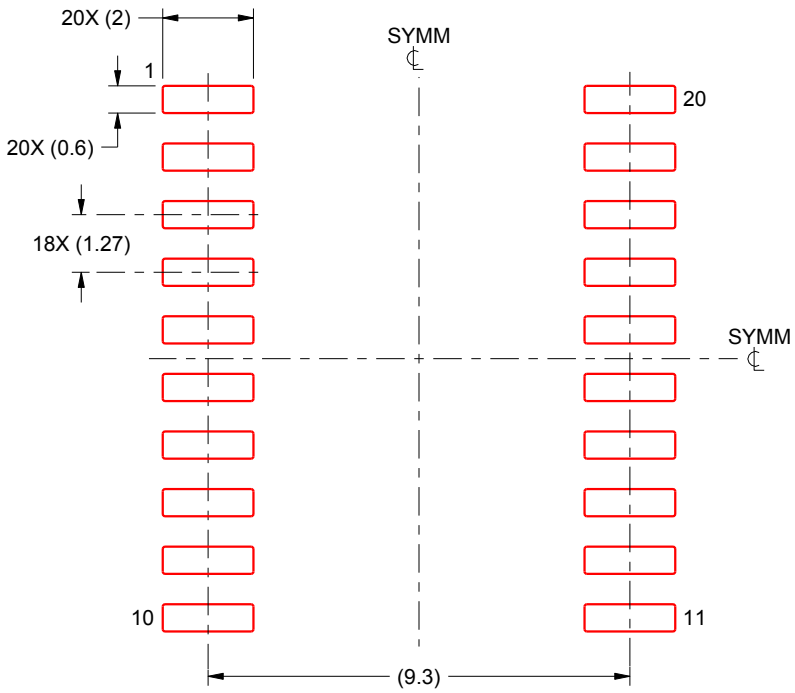


SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

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



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

4220724/A 05/2016

NOTES: (continued)

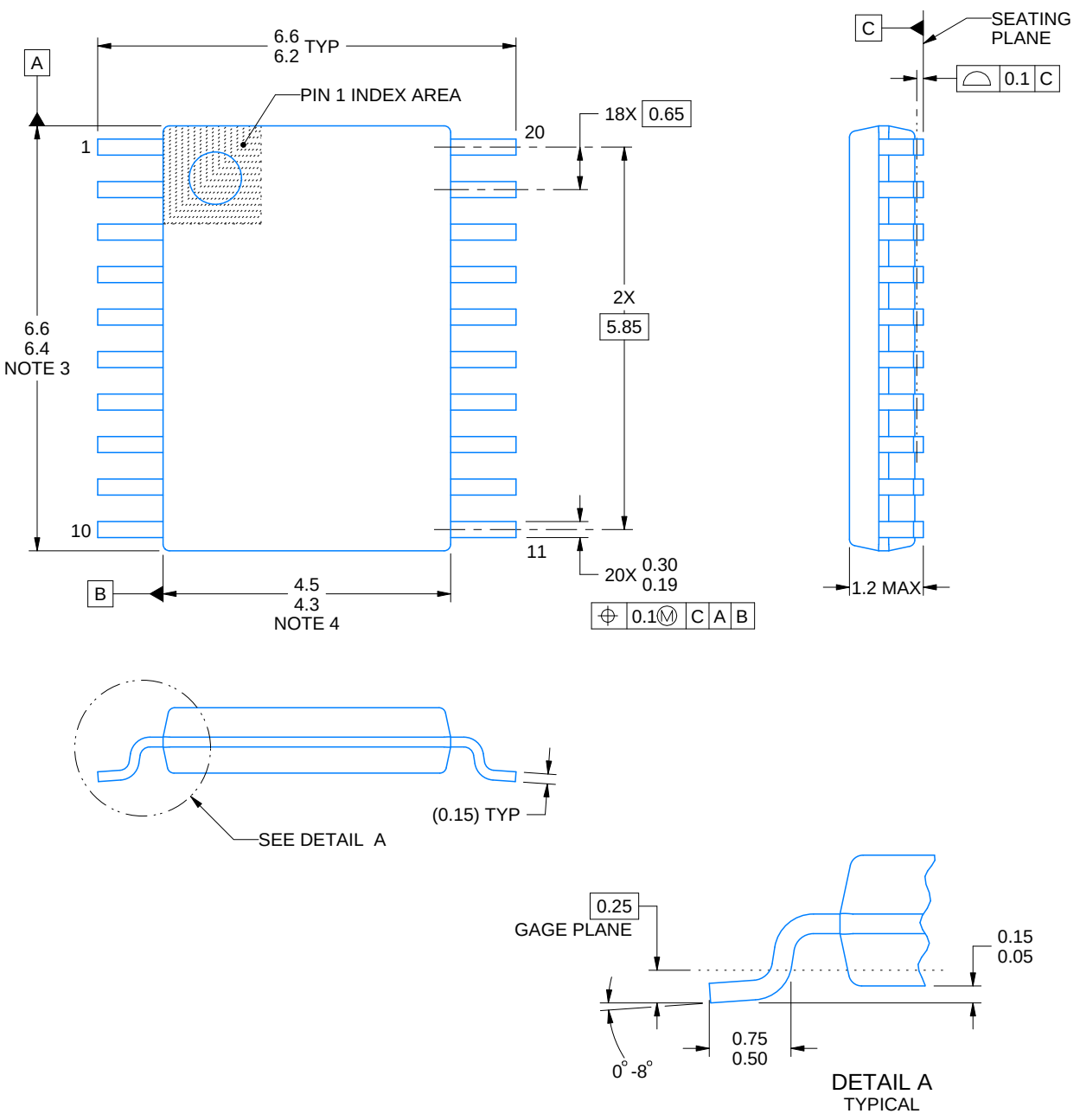
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

PW0020A

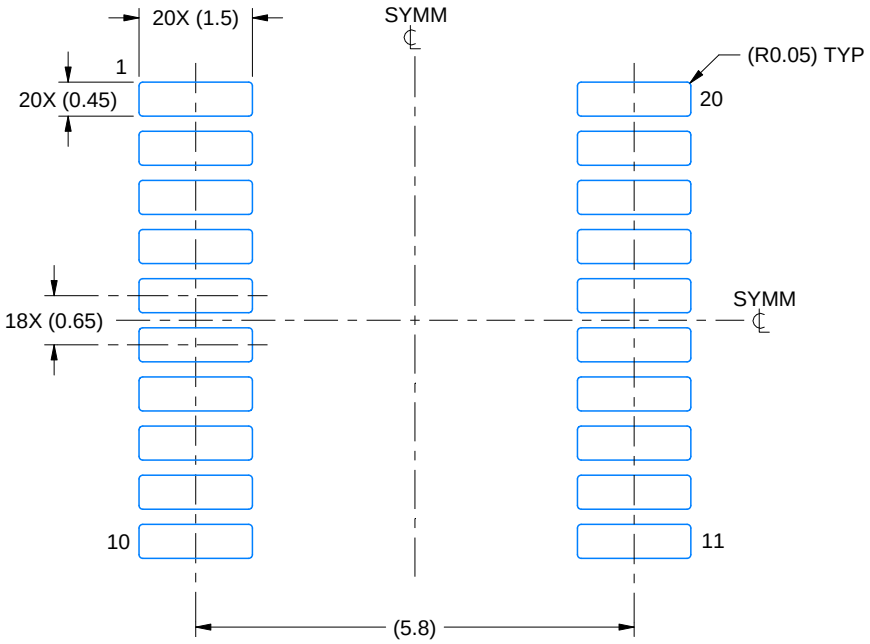
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

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



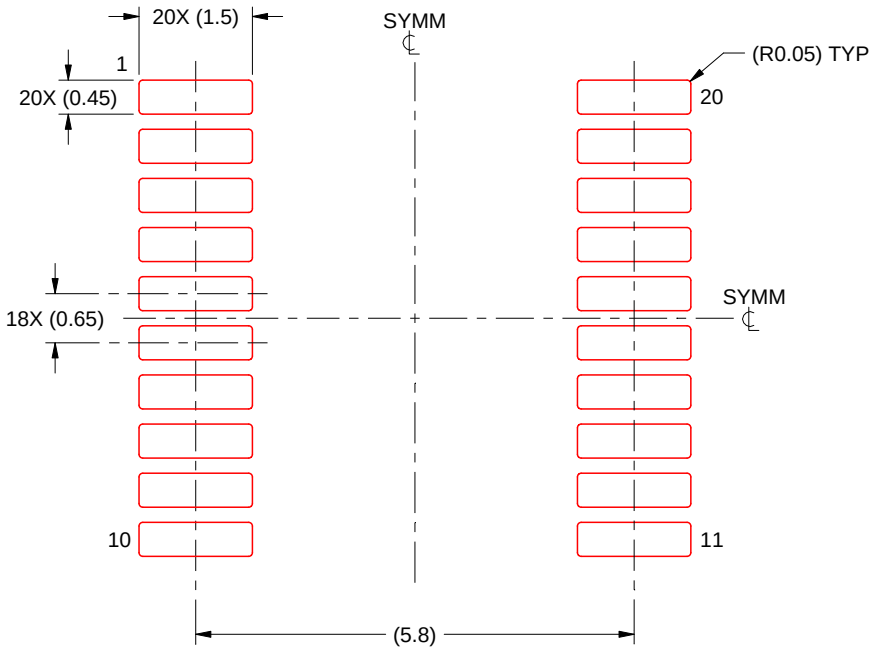
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

SOLDER MASK DETAILS

4220206/A 02/2017

NOTES: (continued)

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



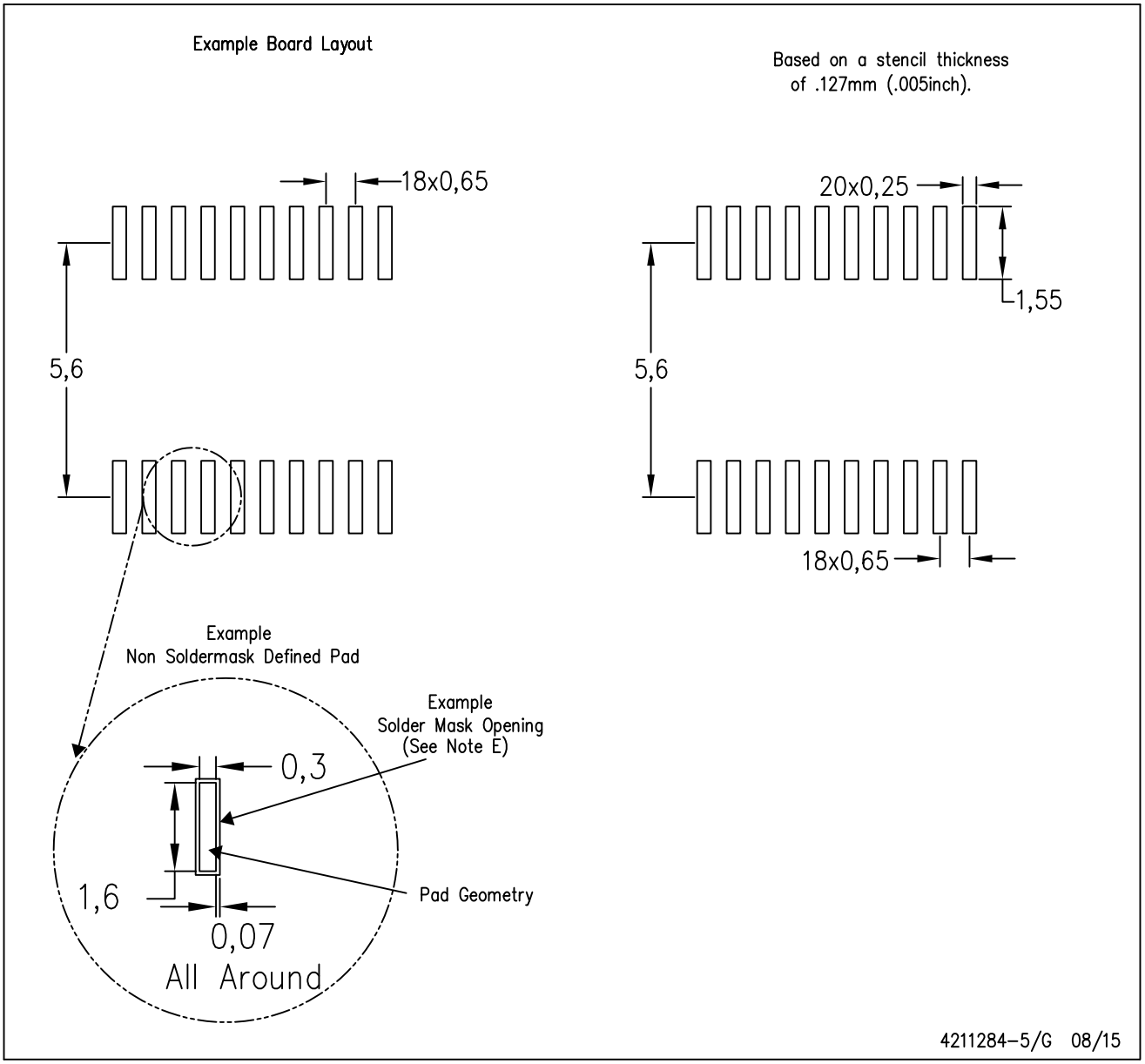
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220206/A 02/2017

NOTES: (continued)

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

PW (R–PDSO–G20) 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 design.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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