

TS3USB221E シングル・イネーブルと IEC レベル 3 ESD 保護を備えた High-Speed USB 2.0 (480Mbps)

1:2 マルチプレクサ / デマルチプレクサ・スイッチ

1 特長

- 2.3V~3.6V の V_{CC} で動作
- スイッチ I/O は最大 5.5V の信号に対応
- 1.8V 互換の制御ピン入力
- \overline{OE} がディセーブルのとき低消費電力モード (1 μ A)
- $r_{ON} = 6\Omega$ (最大値)
- $\Delta r_{ON} = 0.2\Omega$ (標準値)
- $C_{io(ON)} = 7pF$ (最大値)
- 低消費電力 : 30 μ A (最大値)
- JESD 22 準拠で ESD 性能をテスト済み
 - 人体モデルで 7000V (A114-B, Class II)
 - 荷電デバイス・モデルで 1000V (C101)
- I/O ポートから GND への ESD 性能
 - 人体モデルで 12kV (A114-B, Class II)
 - 接触放電で $\pm 7kV$ (IEC 61000-4-2)
- 高帯域幅 : 1GHz (標準値)

2 アプリケーション

- USB 1.0、1.1、2.0 の信号ルーティング
- 携帯電話
- デジタル・カメラ
- ノートブック PC
- USB I/O の拡張
- MHL 1.0

3 概要

TS3USB221E は、USB I/O 数が限られたハブまたはコントローラを備えたハンドセットおよび民生アプリケーション (例: 携帯電話、デジタル・カメラ、ノート PC) での High-Speed USB 2.0 信号のスイッチングに特化して設計された高帯域幅スイッチです。このスイッチは帯域幅が広く (1GHz)、エッジと位相の歪みを最小限に抑えて信号を通過させることができます。このデバイスは、USB ホスト・デバイスからの差動出力を、対応する 2 つの出力のどちらかに多重化します。このスイッチは双方向であり、出力での高速信号の減衰は全くないか、あってもわずかです。TS3USB221E は、ビット間のスキューが小さく、チャンネル間のノイズ分離が大きくなるよう設計されています。また、High-Speed USB 2.0 (480Mbps) などの各種規格に適合しています。

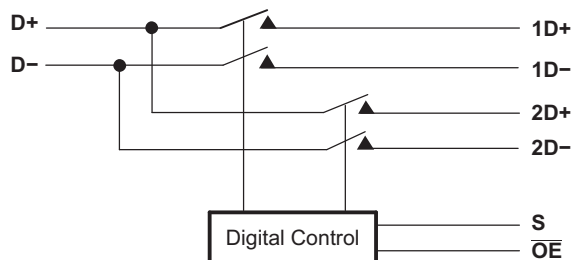
TS3USB221E はすべてのピンに ESD 保護セルが組み込まれており、SON パッケージ (3mm x 3mm) と超小型の μ QFN パッケージ (2mm x 1.5mm) で供給され、-40 $^{\circ}$ C~85 $^{\circ}$ C の自由気流温度範囲で動作が規定されています。

製品情報⁽¹⁾

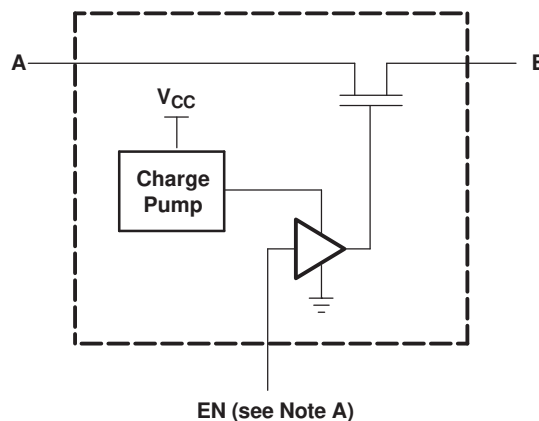
型番	パッケージ	本体サイズ(公称)
TS3USB221E	VSON (10)	3.00mmx3.00mm
	UQFN (10)	1.50mmx2.00mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

ブロック図



概略回路図、各 FET スイッチ (SW)



- A. EN はスイッチに印加される内部イネーブル信号です。

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4 改訂履歴

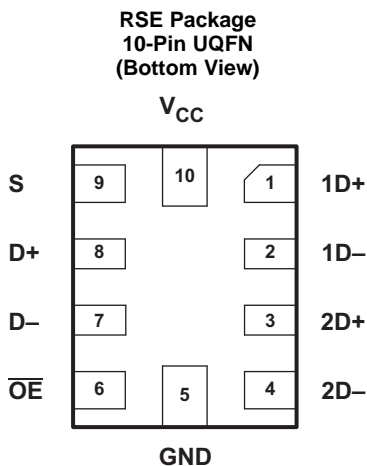
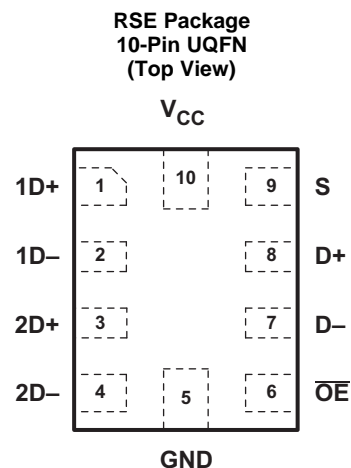
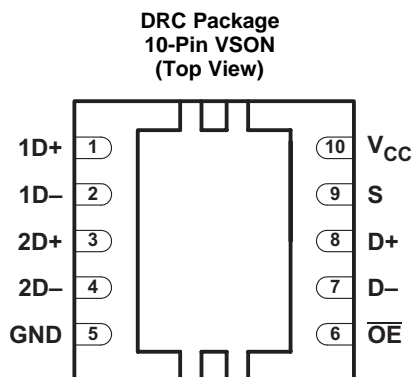
資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision C (April 2015) から Revision D に変更	Page
• V_{CC} の動作範囲を「2.5V~3.3V」から「2.3V~3.6V」に変更	1

Revision B (July 2012) から Revision C に変更	Page
• 「ピン構成および機能」セクション、「ESD 定格」表、「熱に関する情報」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 追加	1
• 「注文情報」表を削除	1

Revision A (February 2010) から Revision B に変更	Page
• 「注文情報」表で、RSE パッケージの上面マーキングを更新	1

5 Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
1D+	1	I/O	USB port 1
1D-	2	I/O	
2D+	3	I/O	
2D-	4	I/O	
GND	5	—	Ground
$\overline{\text{OE}}$	6	I	Bus-switch enable
D-	7	I/O	Common USB port
D+	8	I/O	
S	9	I	Select input
V _{CC}	10	—	Supply voltage

6 Specifications

6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _{CC}	Supply voltage	-0.5	4.6	V
V _{IN}	Control input voltage ⁽²⁾⁽³⁾	-0.5	7	V
V _{I/O}	Switch I/O voltage ⁽²⁾⁽³⁾⁽⁴⁾	-0.5	7	V
I _{IK}	Control input clamp current	V _{IN} < 0	-50	mA
I _{I/OK}	I/O port clamp current	V _{I/O} < 0	-50	mA
I _{I/O}	ON-state switch current ⁽⁵⁾		±120	mA
	Continuous current through V _{CC} or GND		±100	mA
θ _{JA}	Package thermal impedance ⁽⁶⁾	DRC package	48.7	°C/W
		RSE package	243	
T _{stg}	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, 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 ground, unless otherwise specified.
- (3) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (4) V_I and V_O are used to denote specific conditions for V_{I/O}.
- (5) I_I and I_O are used to denote specific conditions for I_{I/O}.
- (6) The package thermal impedance is calculated in accordance with JESD 51-7.

6.2 ESD Ratings

			VALUE	UNIT	
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	All pins except GND, \overline{OE} , S and V _{CC}	±12000	V
			Pins GND, \overline{OE} , S and V _{CC}	±7000	
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	All pins except GND, \overline{OE} , S and V _{CC}	±7000	
			Pins GND, \overline{OE} , S and V _{CC}	±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 ⁽¹⁾.

		MIN	MAX	UNIT
V _{CC}	Supply voltage	2.3	3.6	V
V _{IH}	High-level control input voltage	V _{CC} = 2.3 V to 2.7 V	0.46 × V _{CC}	V
		V _{CC} = 2.7 V to 3.6 V	0.46 × V _{CC}	
V _{IL}	Low-level control input voltage	V _{CC} = 2.3 V to 2.7 V	0.25 × V _{CC}	V
		V _{CC} = 2.7 V to 3.6 V	0.25 × V _{CC}	
V _{I/O}	Data input/output voltage	0	5.5	V
T _A	Operating free-air temperature	-40	85	°C

- (1) All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, SCBA004.

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TS3USB221E		UNIT
		DRC (VSON)	RSE (UQFN)	
		10 PINS	10 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	57.7	169.8	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	87.7	84.7	
R _{θJB}	Junction-to-board thermal resistance	32.6	94.9	
ψ _{JT}	Junction-to-top characterization parameter	8.2	5.7	
ψ _{JB}	Junction-to-board characterization parameter	32.8	94.9	
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	18.5	N/A	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

6.5 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS		MIN	TYP ⁽²⁾	MAX	UNIT
V _{IK}	V _{CC} = 3.6 V, 2.7 V,	I _I = -18 mA			-1.8	V
I _{IN}	Control inputs	V _{CC} = 3.6 V, 2.7 V, 0 V, V _{IN} = 0 V to 3.6 V			±1	μA
I _{OZ} ⁽³⁾	V _{CC} = 3.6 V, 2.7 V, V _O = 0 V to 5.25 V, V _I = 0 V,	V _{IN} = V _{CC} or GND, Switch OFF			±1	μA
I _{OFF}	V _{CC} = 0 V	V _{I/O} = 0 V to 5.25 V			±2	μA
		V _{I/O} = 0 V to 3.6 V			±2	
		V _{I/O} = 0 V to 2.7 V			±1	
I _{CC}	V _{CC} = 3.6 V, 2.7 V, V _{IN} = V _{CC} or GND,	I _{I/O} = 0 V, Switch ON or OFF			30	μA
I _{CC} (low power mode)	V _{CC} = 3.6 V, 2.7 V, V _{IN} = V _{CC} or GND	Switch disabled (OE in high state)			1	μA
I _{CC} ⁽⁴⁾	Control inputs	One input at 1.8 V, Other inputs at V _{CC} or GND	V _{CC} = 3.6 V		20	μA
			V _{CC} = 2.7 V		0.5	
C _{in}	Control inputs	V _{CC} = 3.3 V, 2.5 V, V _{IN} = 3.3 V or 0 V		1.5	2.5	pF
C _{io(OFF)}		V _{CC} = 3.3 V, 2.5 V, V _{I/O} = 3.3 V or 0 V, Switch OFF		3.5	5	pF
C _{io(ON)}		V _{CC} = 3.3 V, 2.5 V, V _{I/O} = 3.3 V or 0 V, Switch ON		6	7.5	pF
r _{ON} ⁽⁵⁾	V _{CC} = 3 V, 2.3 V	V _I = 0 V, I _O = 30 mA		3	6	Ω
		V _I = 2.4 V, I _O = -15 mA		3.4	6	
Δr _{ON}	V _{CC} = 3 V, 2.3 V	V _I = 0 V, I _O = 30 mA		0.2		Ω
		V _I = 1.7, I _O = -15 mA		0.2		
r _{ON(flat)}	V _{CC} = 3 V, 2.3 V	V _I = 0 V, I _O = 30 mA		1		Ω
		V _I = 1.7, I _O = -15 mA		1		

(1) V_{IN} and I_{IN} refer to control inputs. V_I, V_O, I_I, and I_O refer to data pins.

(2) All typical values are at V_{CC} = 3.3 V (unless otherwise noted), T_A = 25°C.

(3) For I/O ports, the parameter I_{OZ} includes the input leakage current.

(4) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.

(5) Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

6.6 Dynamic Electrical Characteristics, $V_{CC} = 3.3\text{ V} \pm 10\%$

 over operating range, $T_A = -40^\circ\text{C}$ to 85°C , $V_{CC} = 3.3\text{ V} \pm 10\%$, $GND = 0\text{ V}$

PARAMETER		TEST CONDITIONS	TYP ⁽¹⁾	UNIT
X_{TALK}	Crosstalk	$R_L = 50$, $f = 250\text{ MHz}$	-40	dB
O_{IRR}	OFF isolation	$R_L = 50$, $f = 250\text{ MHz}$	-40	dB
BW	Bandwidth (-3 dB)	$R_L = 50$	1	GHz

 (1) For Maximum or Minimum conditions, use the appropriate value specified under [Electrical Characteristics](#) for the applicable device type.

6.7 Dynamic Electrical Characteristics, $V_{CC} = 2.5\text{ V} \pm 10\%$

 over operating range, $T_A = -40^\circ\text{C}$ to 85°C , $V_{CC} = 2.5\text{ V} \pm 10\%$, $GND = 0\text{ V}$

PARAMETER		TEST CONDITIONS	TYP ⁽¹⁾	UNIT
X_{TALK}	Crosstalk	$R_L = 50$, $f = 250\text{ MHz}$	-39	dB
O_{IRR}	OFF isolation	$R_L = 50$, $f = 250\text{ MHz}$	-40	dB
BW	Bandwidth (3 dB)	$R_L = 50$	1	GHz

 (1) For Maximum or Minimum conditions, use the appropriate value specified under [Electrical Characteristics](#) for the applicable device type.

6.8 Switching Characteristics, $V_{CC} = 3.3\text{ V} \pm 10\%$

 over operating range, $T_A = -40^\circ\text{C}$ to 85°C , $V_{CC} = 3.3\text{ V} \pm 10\%$, $GND = 0\text{ V}$

PARAMETER		MIN	TYP ⁽¹⁾	MAX	UNIT
t_{pd}	Propagation delay ^{(2) (3)}		0.25		ns
t_{ON}	Line enable time	S to D, nD		30	ns
		\overline{OE} to D, nD		17	
t_{OFF}	Line disable time	S to D, nD		12	ns
		\overline{OE} to D, nD		10	
$t_{SK(O)}$	Output skew between center port to any other port ⁽²⁾		0.1	0.2	ns
$t_{SK(P)}$	Skew between opposite transitions of the same output ($t_{PHL} - t_{PLH}$) ⁽²⁾		0.1	0.2	ns

 (1) For Maximum or Minimum conditions, use the appropriate value specified under [Electrical Characteristics](#) for the applicable device type.

(2) Specified by design

(3) The bus switch contributes no propagational delay other than the RC delay of the on resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 0.25 ns for 10-pF load. Because this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagational delay to the system. Propagational delay of the bus switch, when used in a system, is determined by the driving circuit on the driving side of the switch and its interactions with the load on the driven side.

6.9 Switching Characteristics, $V_{CC} = 2.5\text{ V} \pm 10\%$

 over operating range, $T_A = -40^\circ\text{C}$ to 85°C , $V_{CC} = 2.5\text{ V} \pm 10\%$, $GND = 0\text{ V}$

PARAMETER		MIN	TYP ⁽¹⁾	MAX	UNIT
t_{pd}	Propagation delay ^{(2) (3)}		0.25		ns
t_{ON}	Line enable time	S to D, nD		50	ns
		\overline{OE} to D, nD		32	
t_{OFF}	Line disable time	S to D, nD		23	ns
		\overline{OE} to D, nD		12	
$t_{SK(O)}$	Output skew between center port to any other port ⁽²⁾		0.1	0.2	ns
$t_{SK(P)}$	Skew between opposite transitions of the same output ($t_{PHL} - t_{PLH}$) ⁽²⁾		0.1	0.2	ns

 (1) For Maximum or Minimum conditions, use the appropriate value specified under [Electrical Characteristics](#) for the applicable device type.

(2) Specified by design

(3) The bus switch contributes no propagational delay other than the RC delay of the on resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 0.25 ns for 10-pF load. Because this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagational delay to the system. Propagational delay of the bus switch, when used in a system, is determined by the driving circuit on the driving side of the switch and its interactions with the load on the driven side.

6.10 Typical Characteristics

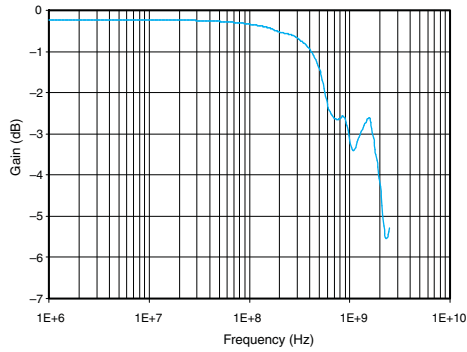


Figure 1. Gain vs Frequency

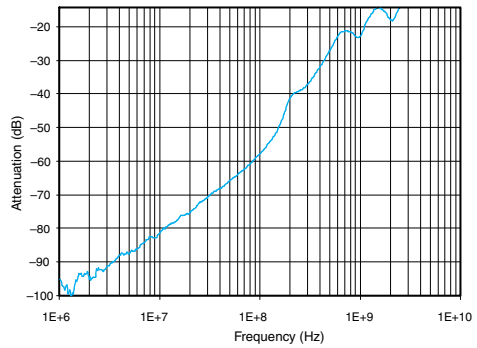


Figure 2. OFF Isolation vs Frequency

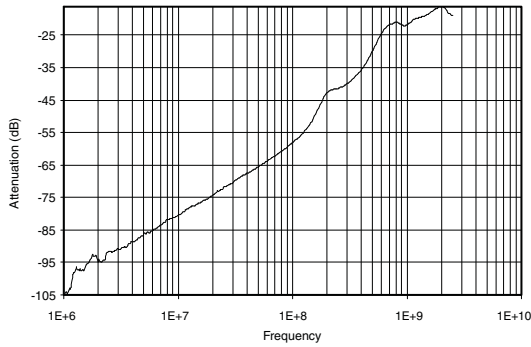


Figure 3. Crosstalk vs Frequency

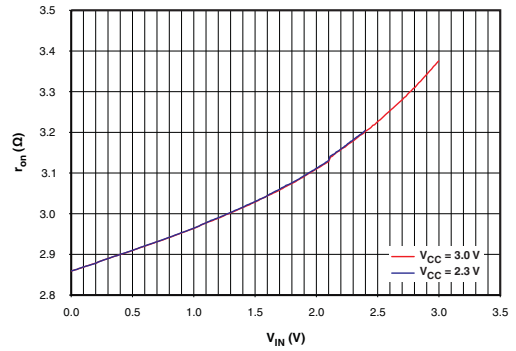


Figure 4. R_{on} vs V_{IN} ($I_{OUT} = -15$ mA)

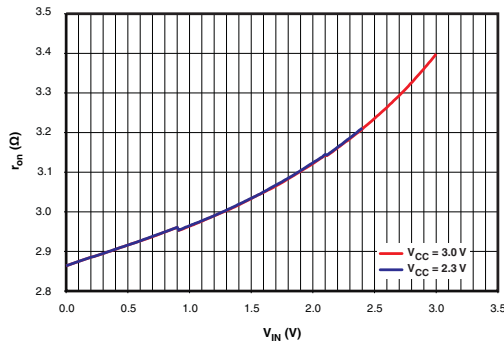
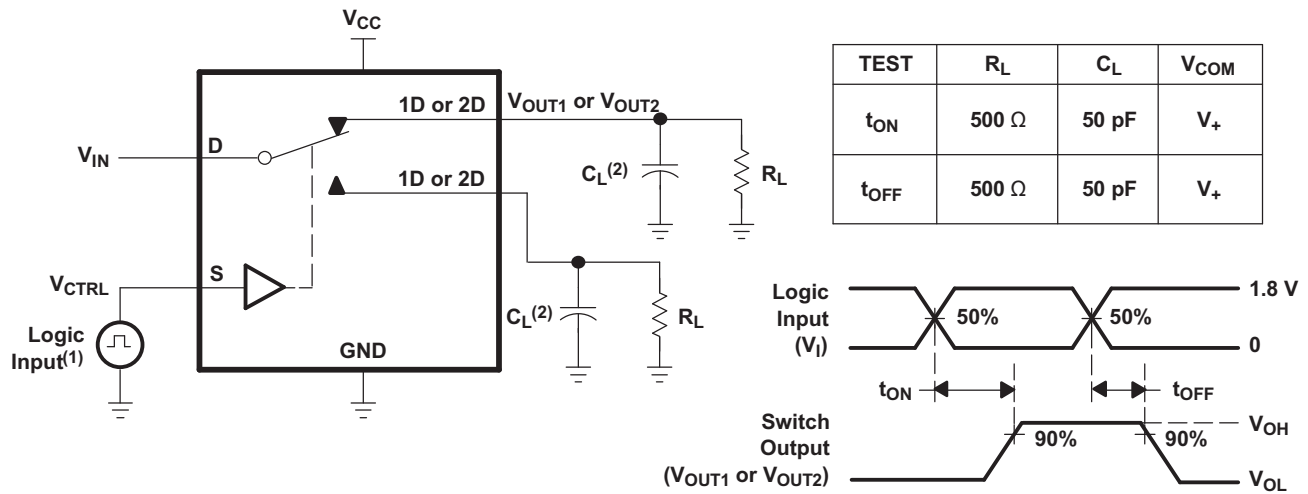


Figure 5. R_{on} vs V_{IN} ($I_{OUT} = -30$ mA)

7 Parameter Measurement Information



- (1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r < 5 ns, t_f < 5 ns.
- (2) C_L includes probe and jig capacitance.

Figure 6. Turnon (T_{ON}) and Turnoff Time (T_{OFF})

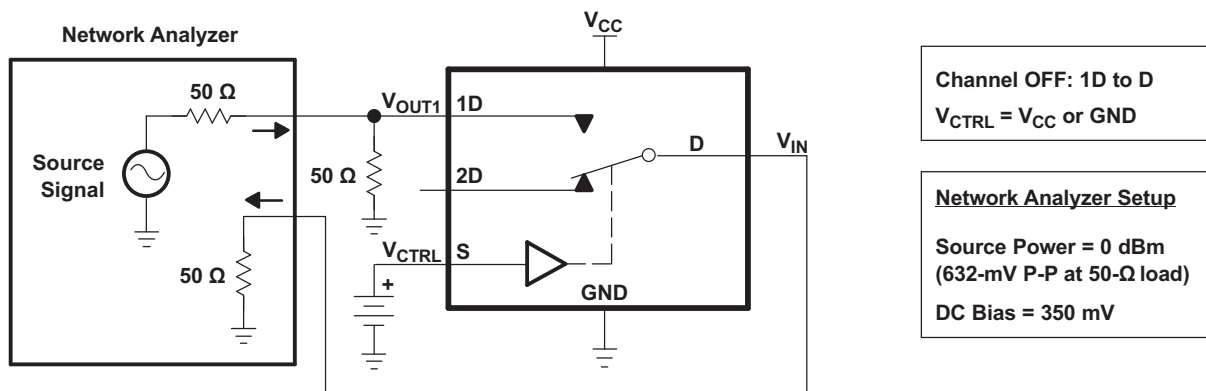


Figure 7. OFF Isolation (O_{ISO})

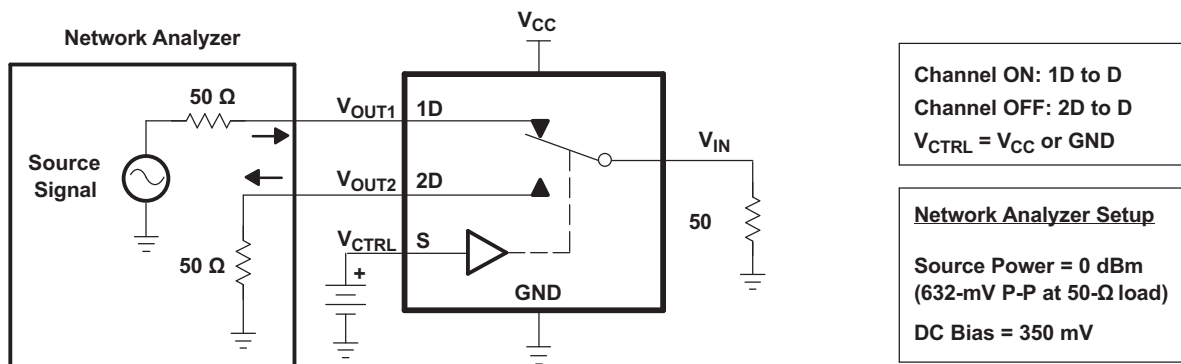


Figure 8. Crosstalk (X_{TALK})

Parameter Measurement Information (continued)

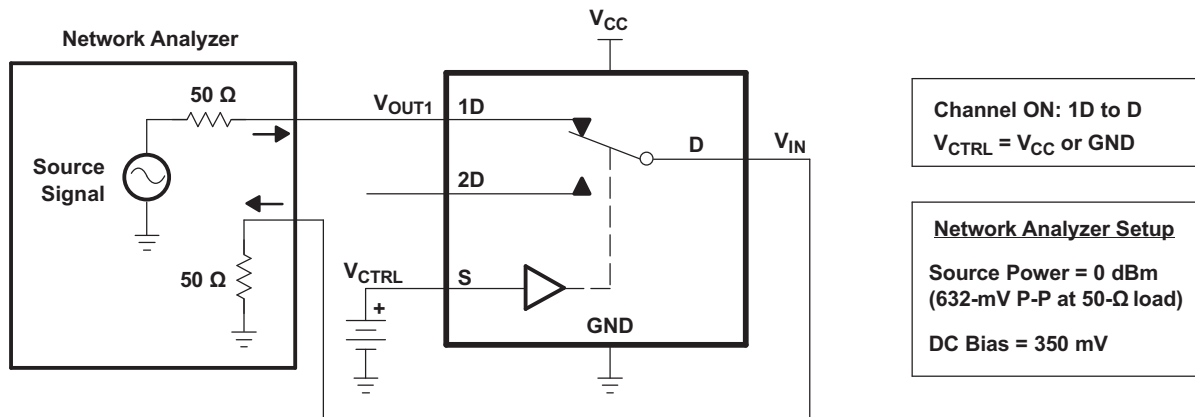


Figure 9. Bandwidth (BW)

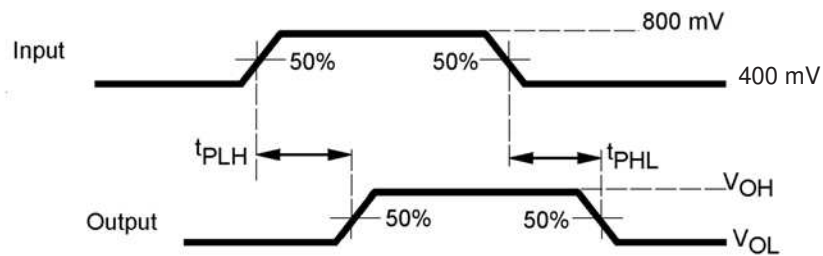


Figure 10. Propagation Delay

Parameter Measurement Information (continued)

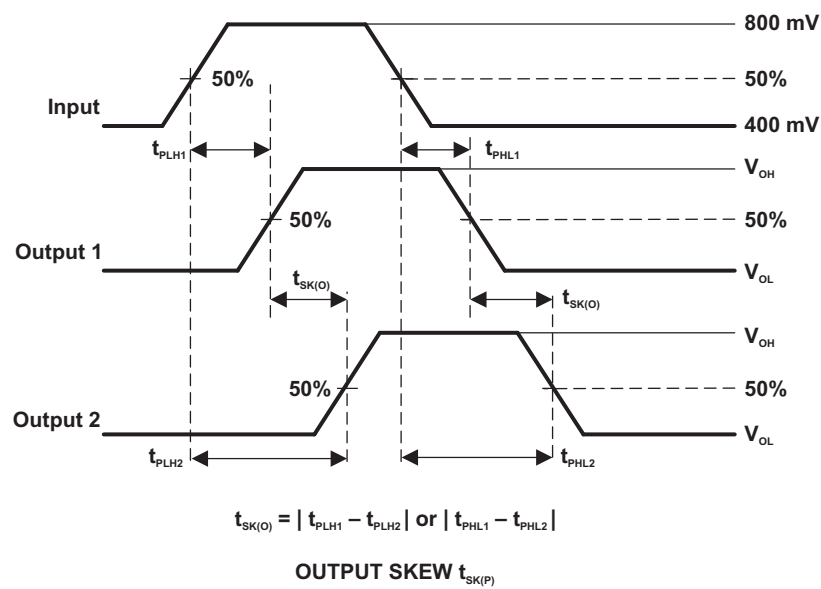
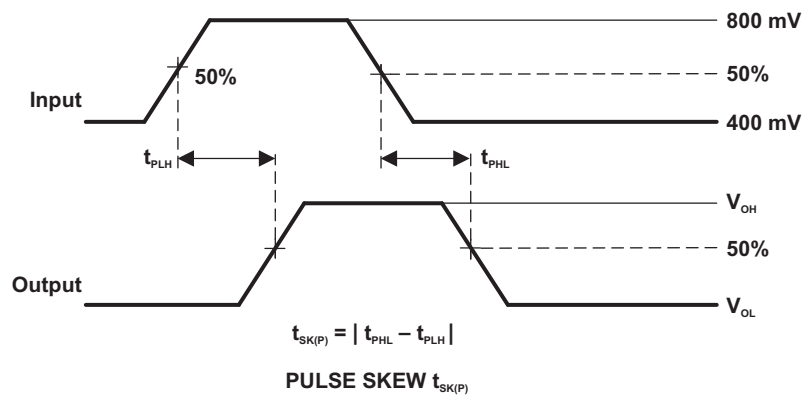


Figure 11. Skew Test

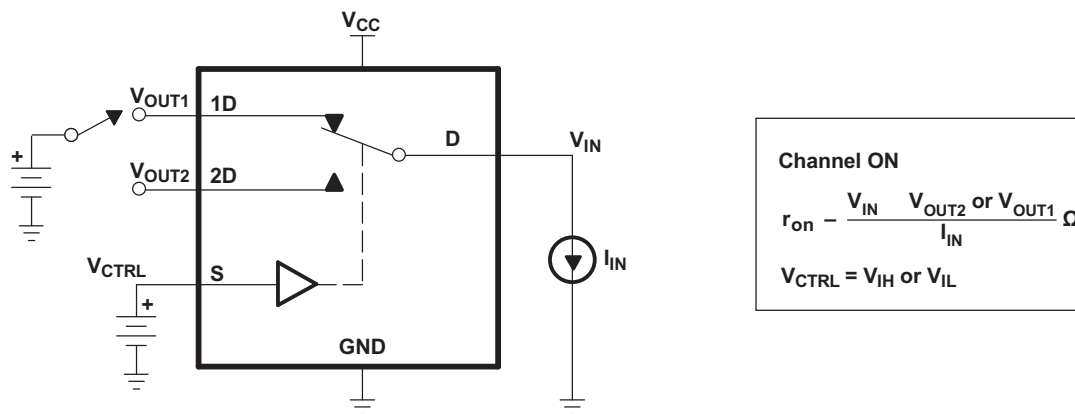


Figure 12. ON-State Resistance (R_{on})

Parameter Measurement Information (continued)

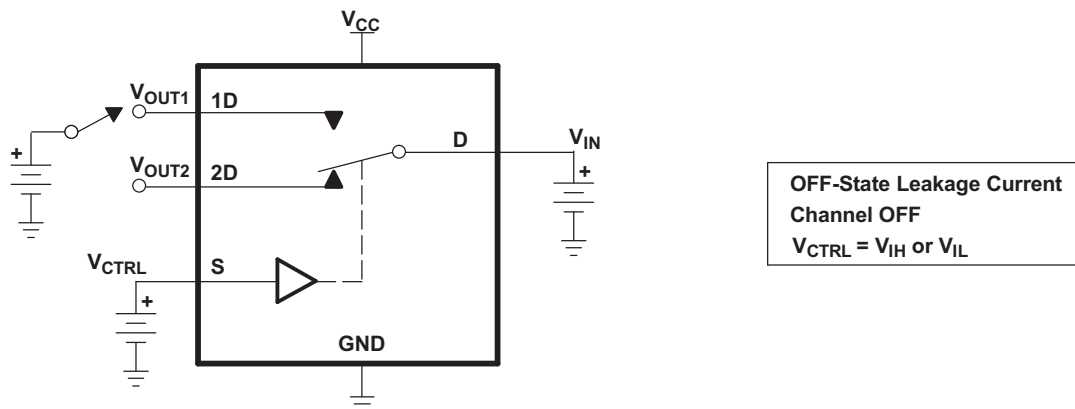


Figure 13. OFF-State Leakage Current

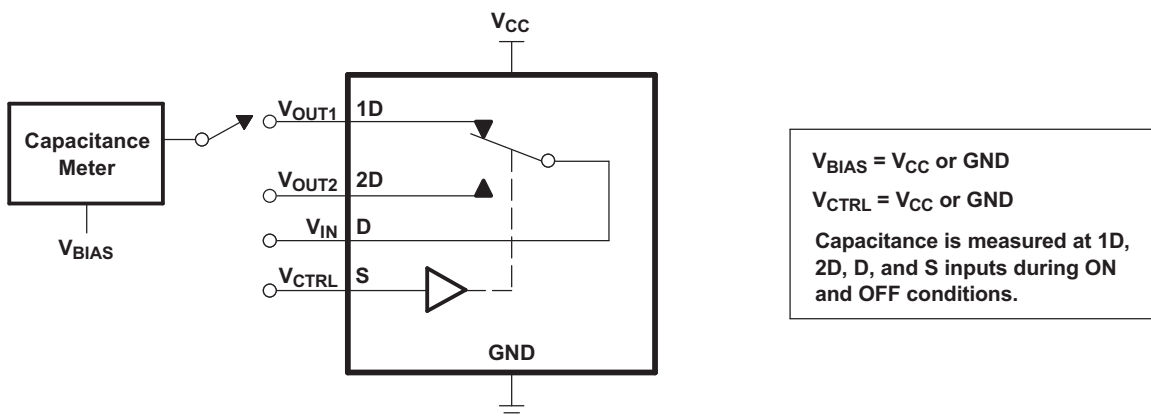


Figure 14. Capacitance

8 Detailed Description

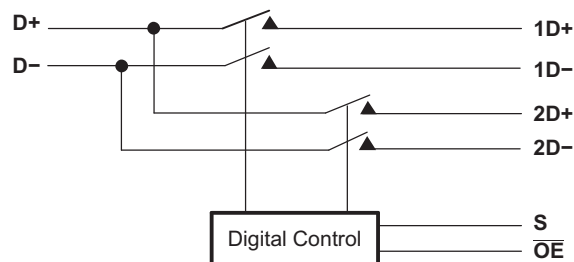
8.1 Overview

The TS3USB221E device is a 2-channel SPDT switch specially designed for the switching of high-speed USB 2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os. The wide bandwidth (1 GHz) of this switch allows signals to pass with minimum edge and phase distortion. The device multiplexes differential outputs from a USB host device to one of two corresponding outputs. The switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. The device also has a low power mode that reduces the power consumption to 1 μA for portable applications with a battery or limited power budget.

The device is designed for low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480 Mbps).

The TS3USB221E device integrates ESD protection cells on all pins, is available in a tiny μQFN package (2 mm \times 1.5 mm) and is characterized over the free-air temperature range from -40°C to 85°C .

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Low Power Mode

The TS3USB221E has a low power mode that reduces the power consumption to 1 μA when the device is not in use. To put the device in low power mode and disable the switch, the bus-switch enable pin $\overline{\text{OE}}$ must be supplied with a logic high signal.

8.4 Device Functional Modes

Table 1. Truth Table

S	$\overline{\text{OE}}$	FUNCTION
X	H	Disconnect
L	L	D = 1D
H	L	D = 2D

9 Application and Implementation

NOTE

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

9.1 Application Information

There are many USB applications in which the USB hubs or controllers have a limited number of USB I/Os. The TS3USB221E solution can effectively expand the limited USB I/Os by switching between multiple USB buses in order to interface them to a single USB hub or controller. TS3USB221E can also be used to connect a single controller to two USB connectors.

9.2 Typical Application

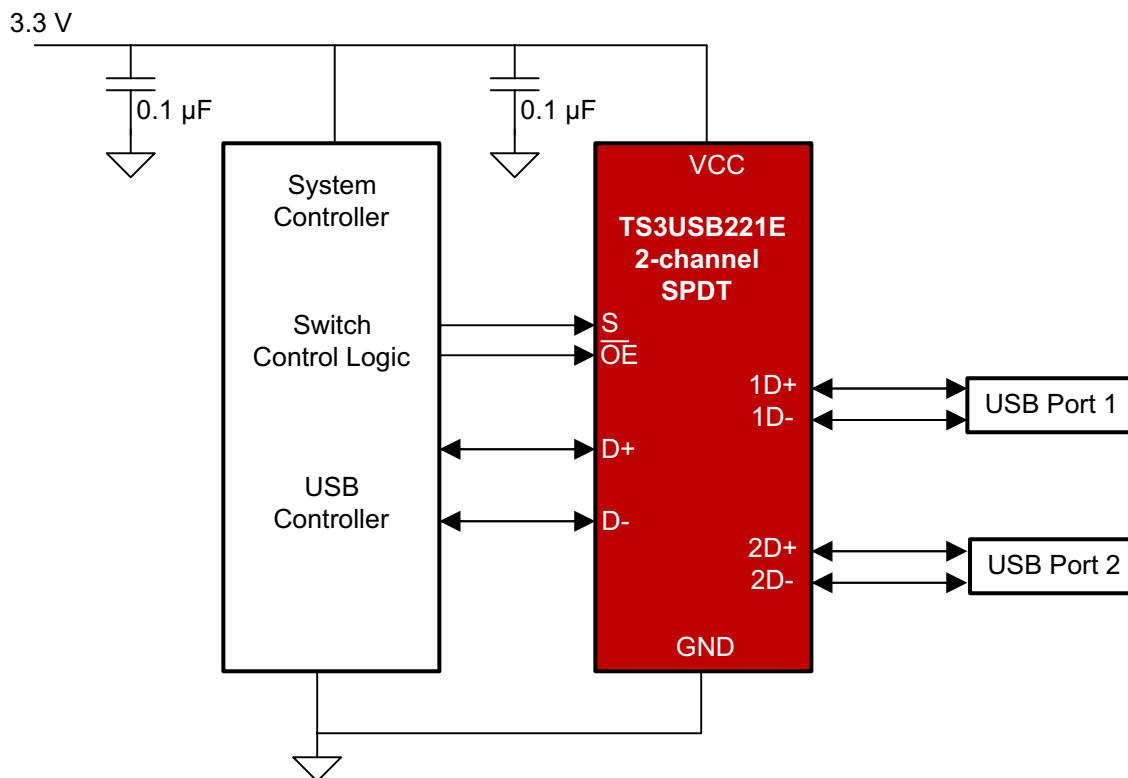


Figure 15. Simplified Schematic

9.2.1 Design Requirements

Design requirements of the USB 1.0, 1.1, and 2.0 standards should be followed.

TI recommends that the digital control pins S and \overline{OE} be pulled up to V_{CC} or down to GND to avoid undesired switch positions that could result from the floating pin.

9.2.2 Detailed Design Procedure

The TS3USB221E can be properly operated without any external components. However, it is recommended that unused pins should be connected to ground through a 50-Ω resistor to prevent signal reflections back into the device.

Typical Application (continued)

9.2.3 Application Curves

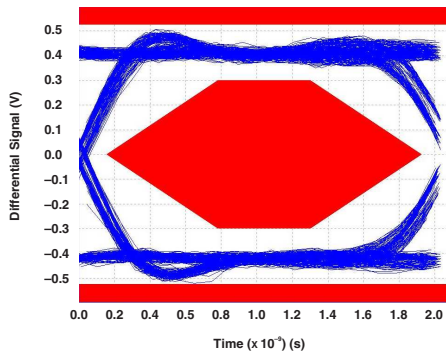


Figure 16. Eye Pattern: 480-Mbps USB Signal With No Switch (Through Path)

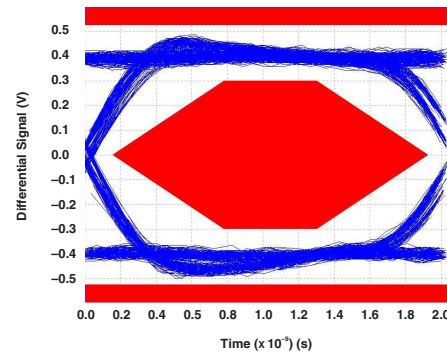


Figure 17. Eye Pattern: 480-Mbps USB Signal With Switch 1D Path

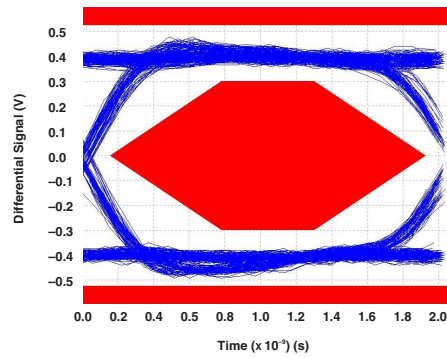


Figure 18. Eye Pattern: 480-Mbps USB Signal With Switch 2D Path

10 Power Supply Recommendations

Power to the device is supplied through the V_{CC} pin and should follow the USB 1.0, 1.1, and 2.0 standards. TI recommends placing a bypass capacitor as close as possible to the supply pin V_{CC} to help smooth out lower frequency noise to provide better load regulation across the frequency spectrum.

11 Layout

11.1 Layout Guidelines

Place supply bypass capacitors as close to V_{CC} pin as possible and avoid placing the bypass caps near the D+/D– traces.

The high speed D+/D– traces should always be matched lengths and must be no more than 4 inches; otherwise, the eye diagram performance may be degraded. A high-speed USB connection is made through a shielded, twisted pair cable with a differential characteristic impedance. In layout, the impedance of D+ and D– traces should match the cable characteristic differential impedance for optimal performance.

Route the high-speed USB signals using a minimum of vias and corners which will reduce signal reflections and impedance changes. When a via must be used, increase the clearance size around it to minimize its capacitance. Each via introduces discontinuities in the signal's transmission line and increases the chance of picking up interference from the other layers of the board. Be careful when designing test points on twisted pair lines; through-hole pins are not recommended.

When it becomes necessary to turn 90°, use two 45° turns or an arc instead of making a single 90° turn. This reduces reflections on the signal traces by minimizing impedance discontinuities.

Do not route USB traces under or near crystals, oscillators, clock signal generators, switching regulators, mounting holes, magnetic devices or IC's that use or duplicate clock signals.

Avoid stubs on the high-speed USB signals because they cause signal reflections. If a stub is unavoidable, then the stub should be less than 200 mm.

Route all high-speed USB signal traces over continuous planes (V_{CC} or GND), with no interruptions.

Avoid crossing over anti-etch, commonly found with plane splits.

Due to high frequencies associated with the USB, a printed circuit board with at least four layers is recommended; two signal layers separated by a ground and power layer as shown in [Figure 19](#).

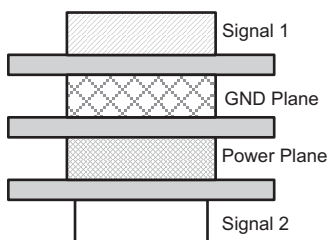


Figure 19. Four-Layer Board Stack-Up

The majority of signal traces should run on a single layer, preferably Signal 1. Immediately next to this layer should be the GND plane, which is solid with no cuts. Avoid running signal traces across a split in the ground or power plane. When running across split planes is unavoidable, sufficient decoupling must be used. Minimizing the number of signal vias reduces EMI by reducing inductance at high frequencies. For more information on layout guidelines, see *High Speed Layout Guidelines (SCAA082)* and *USB 2.0 Board Design and Layout Guidelines (SPRAAR7)*.

11.2 Layout Example

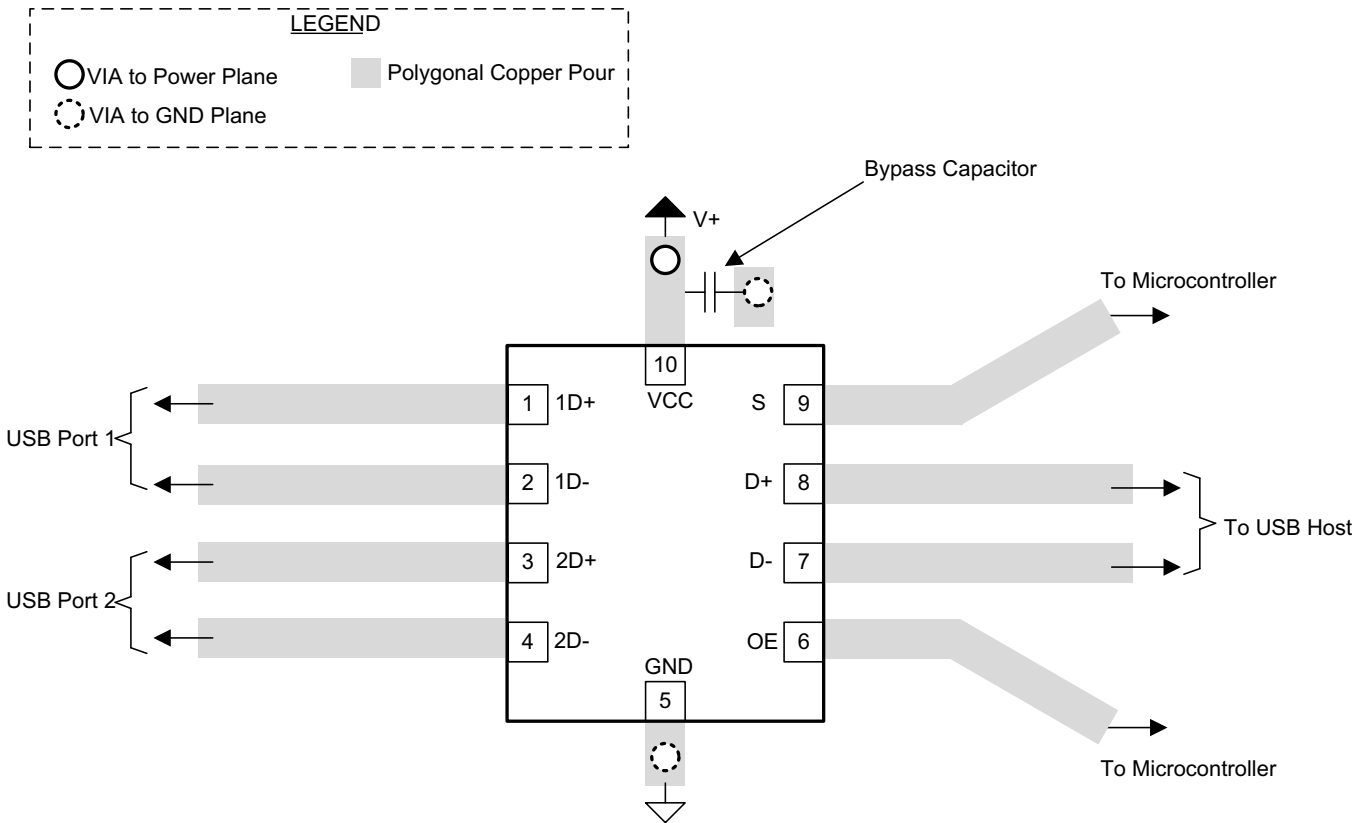


Figure 20. Package Layout Diagram

12 デバイスおよびドキュメントのサポート

12.1 ドキュメントのサポート

12.1.1 関連資料

関連資料については、以下を参照してください。

- 『低速またはフローティングCMOS入力の影響』、[SCBA004](#)
- 『高速レイアウトのガイドライン』、[SCAA082](#)
- 『USB 2.0基板の設計およびレイアウトのガイドライン』、[SPRAAR7](#)

12.2 ドキュメントの更新通知を受け取る方法

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12.3 サポート・リソース

[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.

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12.6 Glossary

[SLYZ022](#) — *TI Glossary*.

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

13 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

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
TS3USB221EDRCR	ACTIVE	VSON	DRC	10	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ZVM	Samples
TS3USB221ERSER	ACTIVE	UQFN	RSE	10	3000	RoHS & Green	NIPDAU NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(LGO, LGR, LGV)	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.

OBSELETE: 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.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

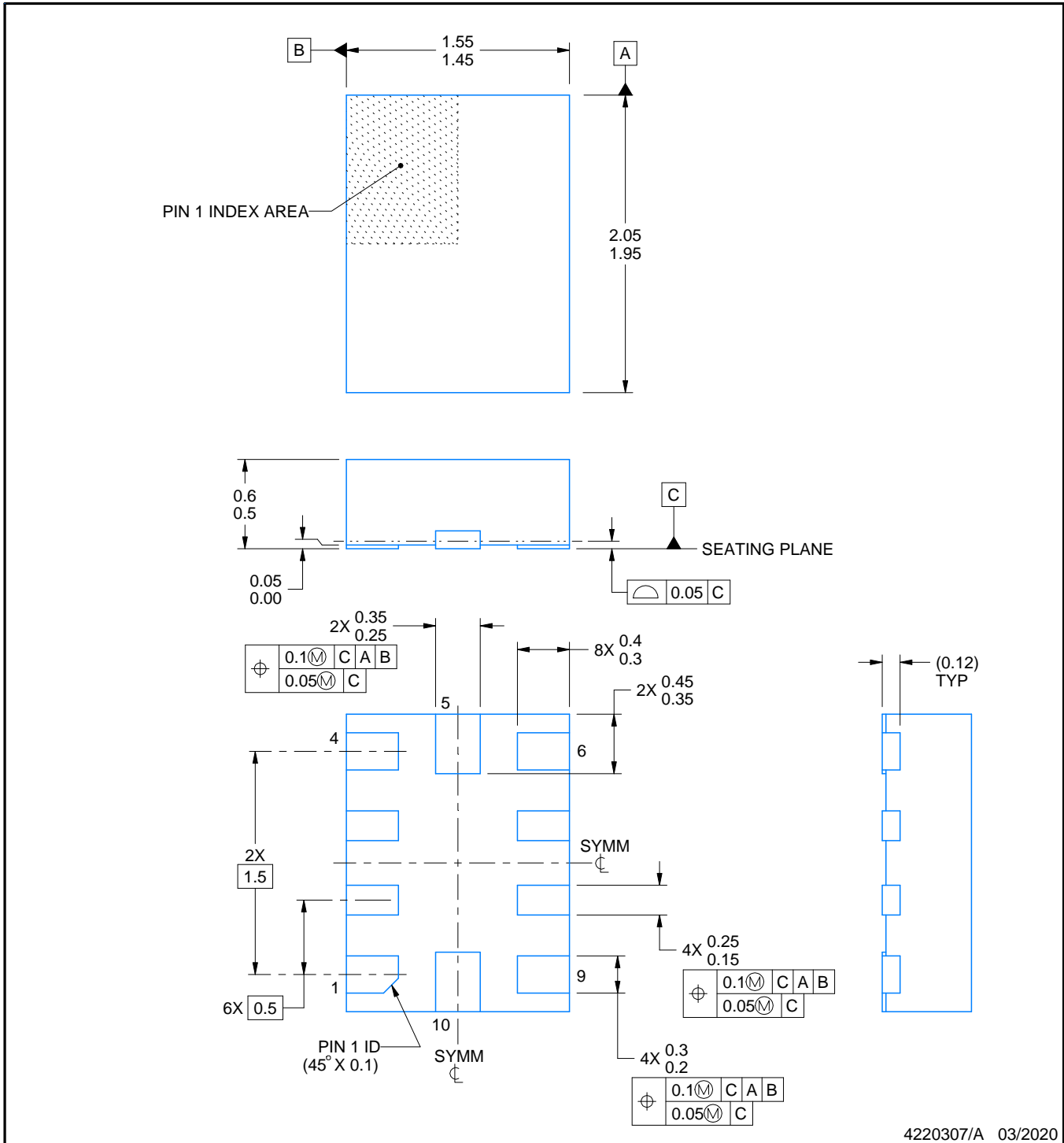
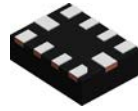
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TS3USB221EDRCR	VSON	DRC	10	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TS3USB221ERSER	UQFN	RSE	10	3000	180.0	9.5	1.7	2.2	0.75	4.0	8.0	Q1
TS3USB221ERSER	UQFN	RSE	10	3000	180.0	8.4	1.68	2.13	0.76	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS3USB221EDRCR	VSON	DRC	10	3000	356.0	356.0	35.0
TS3USB221ERSER	UQFN	RSE	10	3000	189.0	185.0	36.0
TS3USB221ERSER	UQFN	RSE	10	3000	202.0	201.0	28.0



4220307/A 03/2020

NOTES:

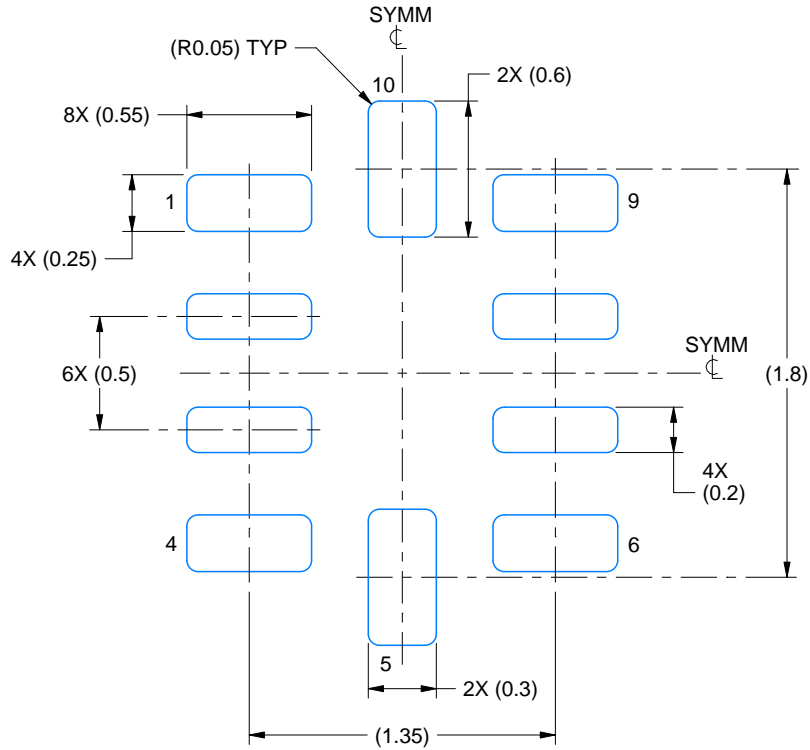
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

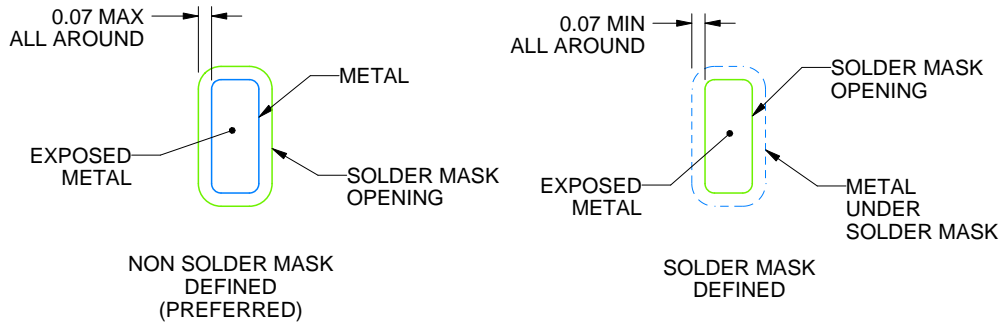
RSE0010A

UQFN - 0.6 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:30X



SOLDER MASK DETAILS
NOT TO SCALE

4220307/A 03/2020

NOTES: (continued)

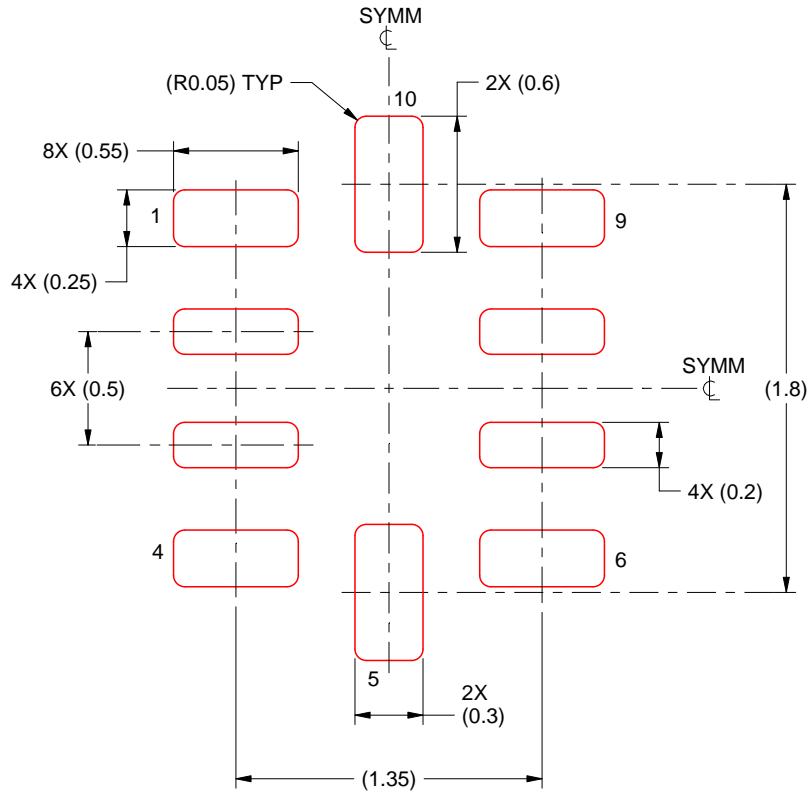
3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

RSE0010A

UQFN - 0.6 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICKNESS
SCALE: 30X

4220307/A 03/2020

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

GENERIC PACKAGE VIEW

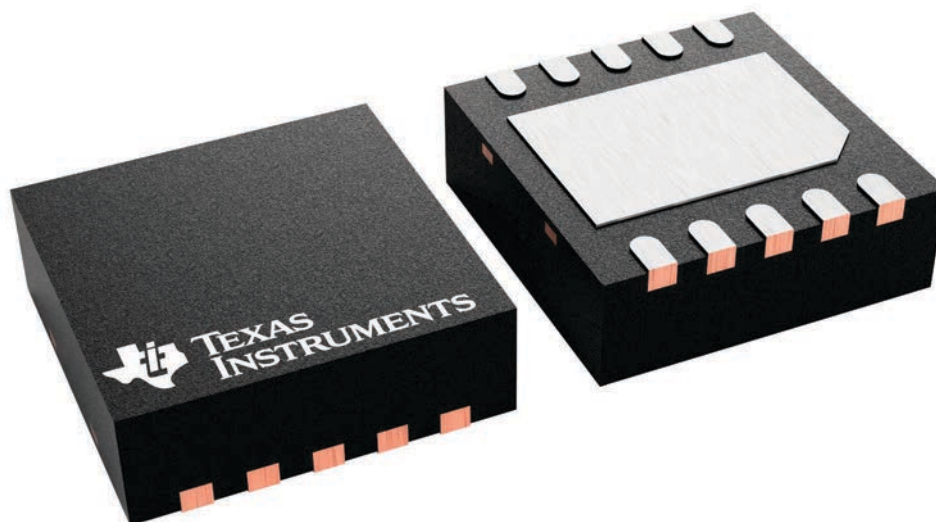
DRC 10

VSON - 1 mm max height

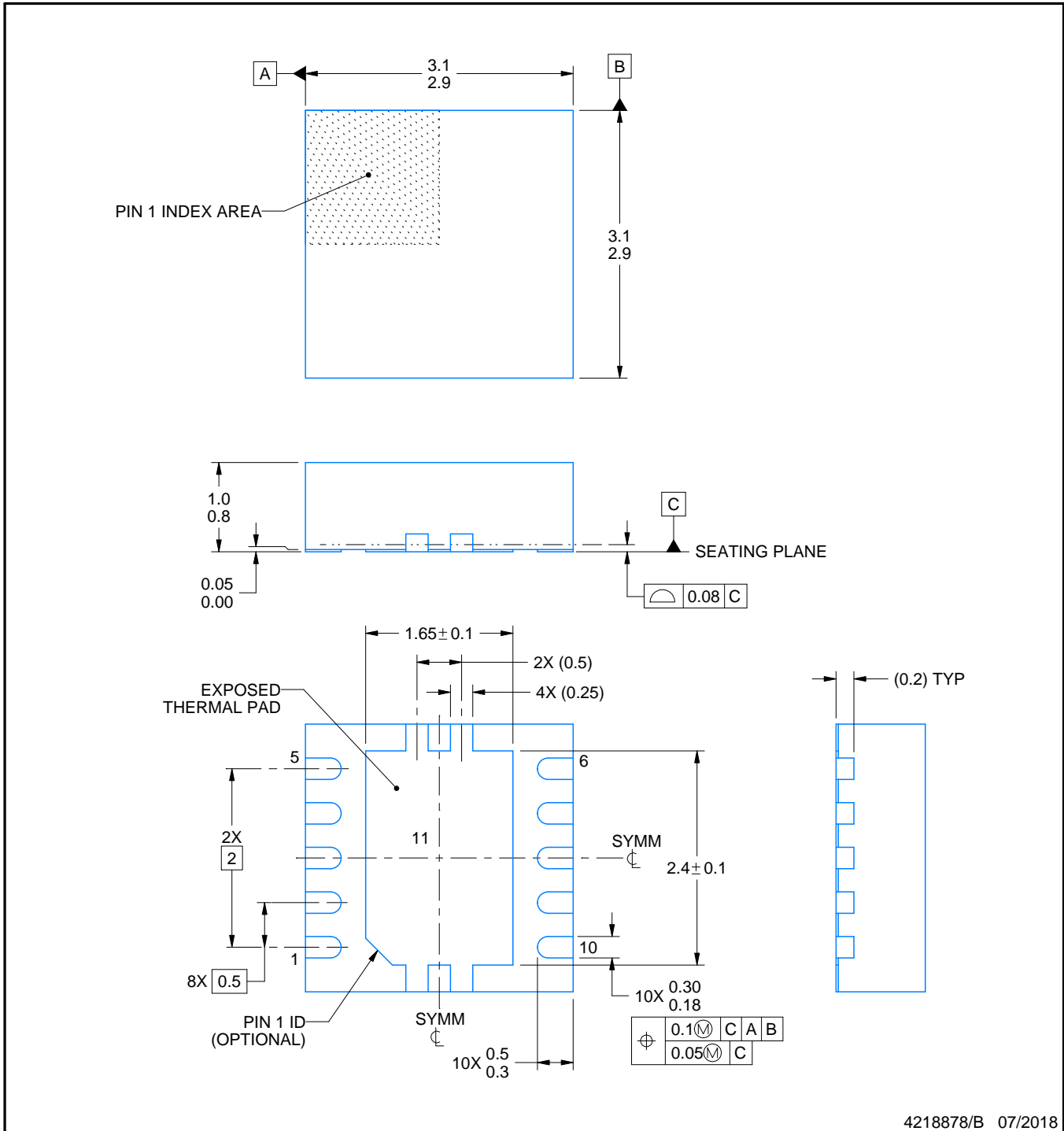
3 x 3, 0.5 mm pitch

PLASTIC SMALL OUTLINE - NO LEAD

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



4226193/A



4218878/B 07/2018

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. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

DRC0010J

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:20X



SOLDER MASK DETAILS

4218878/B 07/2018

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DRC0010J

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 11:
80% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

4218878/B 07/2018

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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