

具有负信号传输能力和 1.8V 逻辑兼容性的USB 2.0 高速 (480 Mbps) 和音频开关

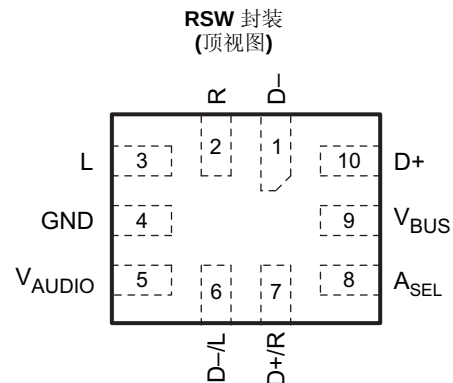
查询样品: **TS5USBA224**

特性

- 高速 USB 开关:
 - 4Ω $R_{\text{DS(on)}}$ (典型值)
 - 12.5pF C_{ON} (典型值)
 - 650MHz 带宽 (-3dB)
- 音频开关:
 - 3Ω $R_{\text{DS(on)}}$ (典型值)
 - 负轨能力
 - 低 THD: $< 0.05\%$
 - 用于开关机噪声 (喀哒声和噼啪声) 抑制的内部并联电阻器
 - 从 V_{AUDIO} (2.7V 至 5.5V) 来供电
- 可兼容 1.8V 的控制输入 (A_{SEL} 和 V_{BUS}) 门限
- I_{OFF} 支持部分断电模式
- 依据 JESD 22 标准对 ESD 性能进行了测试
 - 2000V 人体模型 (A114B, Class II)
 - 1000V 充电器件模型 (C101)
 - 200V 机器模型 (A115-A)

应用

- 手机
- 个人数字助理 (PDA)
- 便携式仪表
- 数码相机
- 便携式导航设备



说明

TS5USBA224 是一款双刀双掷 (DPDT) 多路复用器, 该器件在同一个封装中集成了一个低失真音频开关和一个 USB 2.0 高速 (480Mbps) 开关。这种配置使得系统设计人员能够采用一个用于音频和 USB 数据的公共连接器。音频开关专为允许音频信号摆动至地电位以下而设计, 从而实现了这种公共连接器配置。

TS5USBA224 采用 V_{AUDIO} 来上电。当 A_{SEL} = 高电平时, 将选择音频通路 (而不管 V_{BUS} 上的逻辑电平是多少)。如果 A_{SEL} = 低电平且 V_{BUS} = 高电平, 则选择 USB 通路。否则, 假如 A_{SEL} = 低电平且 V_{BUS} = 低电平, 那将选择音频通路。

另外, TS5USBA224 在音频通路上还布设了并联电阻器, 用于抑制选择音频开关时有可能听到的喀哒声和噼啪声。

订购信息

T_A	封装 ⁽¹⁾ ⁽²⁾		可订购部件号	正面标记
-40°C 至 85°C	QFN 0.4mm 间距 – RSW (无铅型)	卷带	TS5USBA224RSWR	A5R

(1) 封装图样、热数据和符号可登录 www.ti.com.cn/packaging 获取。

(2) 如需了解最新的封装及订购信息, 请参见本文件结尾处的 “Package Option Addendum (封装选项附录)”, 或登录 TI 的网站 www.ti.com 进行查询。



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

SUMMARY OF TYPICAL CHARACTERISTICS

	USB PATH	AUDIO PATH
Number of switches	2	2
ON-state resistance (r_{on})	4 Ω	3 Ω
ON-state resistance match (Δr_{on})	< 0.3 Ω	< 0.3 Ω
ON-state resistance flatness ($r_{on(flat)}$)	N/A	1.5 Ω
Turn-on/turn-off time (t_{ON}/t_{OFF})	< 2 μs	< 4 μs
Bandwidth (BW)	650 MHz	N/A
OFF isolation (O_{ISO})	–22 dB	–83 dB
Crosstalk (X_{TALK})	–31 dB	–83 dB
Total harmonic distortion (THD)	N/A	0.05%

PIN DESCRIPTION TABLE

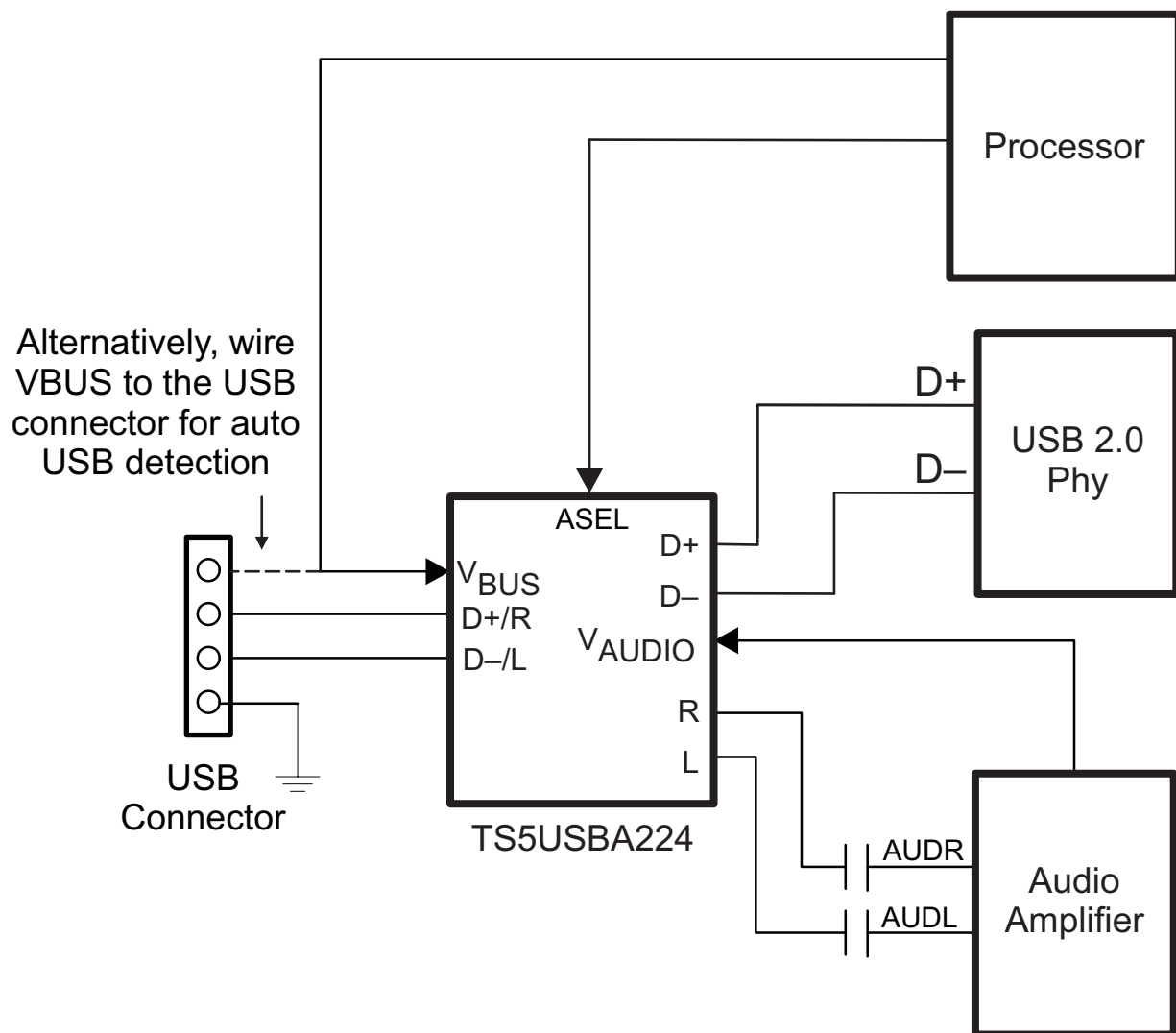
PIN			DESCRIPTION
NO.	NAME	TYPE	
1	D–	I/O	USB Data (Differential –)
2	R	I/O	Right Channel Audio
3	L	I/O	Left Channel Audio
4	GND	Ground	Ground
5	V _{AUDIO}	Power	Supply Voltage
6	D–/L	I/O	USB/Audio Common Connector
7	D+/R	I/O	USB/Audio Common Connector
8	A _{SEL}	Input	Control Input for Audio Path
9	V _{BUS}	Input	Control Input for USB Path
10	D+	I/O	USB Data (Differential +)

FUNCTION TABLE

A _{SEL}	V _{AUDIO}	V _{BUS}	L,R	D+, D–
L	L	L	OFF	OFF
L	L	H	OFF	OFF
L	H	L	ON	OFF
L	H	H	OFF ⁽¹⁾	ON
H	L	L	OFF	OFF
H	L	H	OFF	OFF
H	H	L	ON	OFF
H	H	H	ON	OFF

(1) 100Ω shunt resistors are enabled in this state.

TYPICAL APPLICATION BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS⁽¹⁾⁽²⁾

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

			MIN	MAX	UNIT
V _{AUDIO}	Supply voltage range ⁽³⁾		–0.5	6.5	V
V _{D+} V _{D–}	Analog voltage Range ⁽³⁾		–0.5	6.5	V
V _R V _L			V _{AUDIO} – 6.5	V _{AUDIO} + 0.5	V
I _K	Analog port diode current	V _{D+} , V _{D–} < 0	–50		mA
I _{D+} , I _{D–} I _R , I _L	ON-state switch current	V _{D+} , V _{D–} = 0 to V _{AUDIO} , V _R , V _L V _{D+/R} , V _{D–/L} = V _{AUDIO} – 5.5 V to V _{AUDIO}	–100	100	mA
I _{D+/R} I _{D–/L}	ON-state peak switch current ⁽⁴⁾		–200	200	
V _I	Digital input voltage range		–0.5	6.5	V
I _{IK}	Digital logic input clamp current ⁽³⁾	V _I < 0		–50	mA
I _{AUDIO}	Continuous current through V _{AUDIO}			100	mA
I _{GND}	Continuous current through GND		–100		mA
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) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum.
- (3) All voltages are with respect to ground, unless otherwise specified.
- (4) Pulse at 1-ms duration <10% duty cycle.

PACKAGE THERMAL IMPEDANCE⁽¹⁾

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

PARAMETER	TEST CONDITIONS	TYP	UNIT
θ _{JA}	Package thermal impedance RSW package	175	°C/W

- (1) The package thermal impedance is calculated in accordance with JESD 51-7.

ELECTRICAL CHARACTERISTICS

T_A = –40°C to 85°C, typical values are at V_{AUDIO} = 3.3 V, T_A = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
USB SWITCH					
V _{D+} , V _{D–}	Analog voltage range	0		5.5	V
r _{on}	ON-state resistance V _{AUDIO} = 3 V, V _{BUS} = 5 V, V _{ASEL} = 0 V, V _{D+/D–} = 0 V, 0.4 V, I _{ON} = –8 mA		4	7	Ω
Δr _{on}	ON-state resistance match between channels V _{AUDIO} = 3 V, V _{BUS} = 5 V, V _{ASEL} = 0 V, V _{D+/D–} = 0 V, 0.4 V, I _{ON} = –8 mA			0.3	Ω
I _{D+(OFF)} I _{D–(OFF)}	D+ ,D– OFF leakage current V _{AUDIO} = 3.6 V, V _{BUS} = 0 V, V _{ASEL} = 3.6 V, V _{D+} ,V _{D–} = 0.3 V, V _{D+/R} ,V _{D–/L} = 0.3 V			±50	nA
I _{D+(ON)} I _{D–(ON)}	D+ ,D– ON leakage current V _{AUDIO} = 3.6 V, V _{BUS} = 5 V, V _{ASEL} = 0 V, V _{D+} ,V _{D–} = 0.3 V, V _{D+/R} = Open			±50	nA
AUDIO SWITCH					
V _R , V _L	Analog voltage range	V _{AUDIO} – 5.5		V _{AUDIO}	V
r _{on}	ON-state resistance V _{AUDIO} = 3 V, V _{BUS} = 0 V, V _{ASEL} = 3 V, V _{L/R} = –2 V, 0 V, 0.7 V, I _{ON} = –26 mA		3	5	Ω
Δr _{on}	ON-state resistance match between channels V _{AUDIO} = 3 V, V _{BUS} = 0 V, V _{ASEL} = 3 V, V _{L/R} = 0.7 V, I _{ON} = –26 mA			0.3	Ω

ELECTRICAL CHARACTERISTICS (接下页)

$T_A = -40^\circ\text{C}$ to 85°C , typical values are at $V_{\text{AUDIO}} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$r_{\text{on (flat)}}$	ON-state resistance flatness	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3\text{ V}$, $V_{\text{L/R}} = -2\text{ V}$, 0 V , 0.7 V , $I_{\text{ON}} = -26\text{ mA}$	Switch ON		1.5	2.5	Ω
r_{SHUNT}	Shunt resistance	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $V_{\text{ASEL}} = 0\text{ V}$, $V_{\text{L/R}} = 0.7\text{ V}$, $I_{\text{OSHUNT}} = 10\text{ mA}$	Switch OFF		100	200	Ω
$I_{\text{L(OFF)}}$ $I_{\text{R(OFF)}}$	L , R OFF leakage current	$V_{\text{AUDIO}} = 3.6\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $V_{\text{ASEL}} = 0\text{ V}$, $V_{\text{R}}, V_{\text{L}} = 0.3\text{ V}$, $V_{\text{AUDIO}} - 0.3\text{ V}$, $V_{\text{D+R}}, V_{\text{D-L}} = 0.3\text{ V}$, $V_{\text{AUDIO}} - 0.3\text{ V}$	Switch OFF			± 50	nA
$I_{\text{L(ON)}}$ $I_{\text{R(ON)}}$	L , R ON leakage current	$V_{\text{AUDIO}} = 3.6\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3.6\text{ V}$, $V_{\text{D+R}}, V_{\text{D-L}} = 0.3\text{ V}$, $V_{\text{R}}, V_{\text{L}} = 0.3\text{ V}$, $V_{\text{AUDIO}} - 0.3\text{ V}$, $V_{\text{AUDIO}} - 0.3\text{ V}$, $V_{\text{D+R}}, V_{\text{D-L}} = \text{Open}$	Switch ON			± 50	nA
DIGITAL CONTROL INPUTS (A_{SEL}, V_{BUS})							
V_{IH}	Input logic high	$V_{\text{AUDIO}} = 2.7\text{ V}$ to 5.5 V		1.2			V
V_{IL}	Input logic low	$V_{\text{AUDIO}} = 2.7\text{ V}$ to 5.5 V				0.5	V
I_{IN}	Input leakage current	$V_{\text{AUDIO}} = 3.6\text{ V}$	$V_{\text{IN}} = 3.6\text{ V}$			± 10	μA
			$V_{\text{IN}} = 0\text{ V}$			± 1	
r_{PD1}	Internal pulldown resistance				3		$\text{M}\Omega$
r_{PD2}	Internal pulldown resistance				5		$\text{M}\Omega$

DYNAMIC CHARACTERISTICS

$T_A = -40^{\circ}\text{C}$ to 85°C , typical values are at $V_{\text{AUDIO}} = 3.3\text{ V}$, $T_A = 25^{\circ}\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
USB SWITCH						
t_{ON}	Turn-on time	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$ to 5 V , $V_{\text{ASEL}} = 0\text{ V}$, $V_{\text{D+R, D-L}} = 1\text{ V}$, 图 10		2		μs
t_{OFF}	Turn-off time	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$ to 0 V , $V_{\text{ASEL}} = 0\text{ V}$, $V_{\text{D+R, D-L}} = 1\text{ V}$, 图 10		1		μs
$t_{\text{SK(O)}}$	Channel-to-channel skew	$f = 240\text{ MHz}$, 图 11		35		ps
$t_{\text{SK(P)}}$	Skew of opposite transitions of same output	$f = t\ 240\text{ MHz}$, 图 11		25		ps
$C_{\text{D+(OFF)}}$ $C_{\text{D-(OFF)}}$	D+, D-OFF capacitance	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $A_{\text{SEL}} = 3\text{ V}$, $f = 240\text{ MHz}$		2.8		pF
$C_{\text{D+(ON)}}$ $C_{\text{D-(ON)}}$	D+, D- ON capacitance	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $A_{\text{SEL}} = 0\text{ V}$, $f = 240\text{ MHz}$		12.5		pF
C_{I}	Digital input capacitance	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $A_{\text{SEL}} = 0\text{ V}$, $f = 1\text{ MHz}$		2.2		pF
BW	Bandwidth	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $V_{\text{ASEL}} = 0\text{ V}$, 图 12		650		MHz
O_{ISO}	OFF Isolation	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3\text{ V}$, $R_{\text{L}} = 50\ \Omega$, $f = 240\text{ MHz}$, 图 14		-22		dB
X_{TALK}	Crosstalk	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $V_{\text{ASEL}} = 0\text{ V}$, $R_{\text{L}} = 50\ \Omega$, $f = 240\text{ MHz}$, 图 13		-31		dB
AUDIO SWITCH						
t_{ON}	Turn-on time	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$ or 5 V , $V_{\text{ASEL}} = 0\text{ V}$ to 3 V , $V_{\text{D+R, D-L}} = 1\text{ V}$, 图 10		4		μs
t_{OFF}	Turn-off time	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3\text{ V}$ to 0 V , $V_{\text{D+R, D-L}} = 1\text{ V}$, 图 10		1		μs
$C_{\text{L(OFF)}}$ $C_{\text{R(OFF)}}$	L, R OFF capacitance	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $V_{\text{ASEL}} = 0\text{ V}$, $f = 20\text{ kHz}$		4.5		pF
$C_{\text{L(ON)}}$ $C_{\text{R(ON)}}$	L, R ON capacitance	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3\text{ V}$, $f = 20\text{ kHz}$		15		pF
O_{ISO}	OFF Isolation	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 5\text{ V}$, $V_{\text{ASEL}} = 0\text{ V}$, $R_{\text{L}} = 50\ \Omega$, $f = 20\text{ kHz}$, 图 14		-83		dB
X_{TALK}	Crosstalk	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3\text{ V}$, $R_{\text{L}} = 50\ \Omega$, $f = 20\text{ kHz}$, 图 13		-83		dB
THD	Total harmonic distortion	$V_{\text{AUDIO}} = 3\text{ V}$, $V_{\text{BUS}} = 0\text{ V}$, $V_{\text{ASEL}} = 3\text{ V}$, $f = 20\text{ Hz}$ to 20 kHz , $R_{\text{L}} = 600\ \Omega$, $V_{\text{IN}} = 2\text{ Vpp}$		0.05		%
SUPPLY						
V_{AUDIO}	Power supply voltage		2.7		5.5	V
I_{AUDIO}	Positive supply current	$V_{\text{AUDIO}} = 3.6\text{ V}$, $V_{\text{BUS}} = 0$ or 5 V , $V_{\text{ASEL}} = 0$ to 3.6 V , $I_{\text{OUT}} = 0$		6	10	μA
I_{OFF}	Power off leakage current	$V_{\text{AUDIO}} = 0\text{ V}$, $V_{\text{D+R, D-L, D+, D-, L, R}} = 0$ to 5.5 V			± 10	μA

TYPICAL CHARACTERISTICS

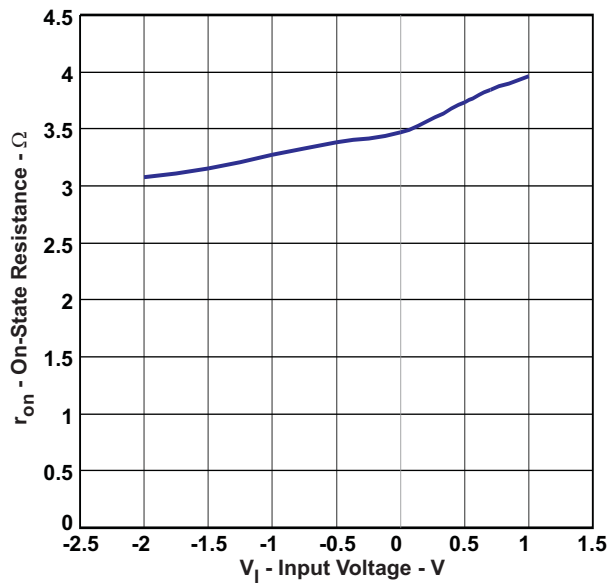
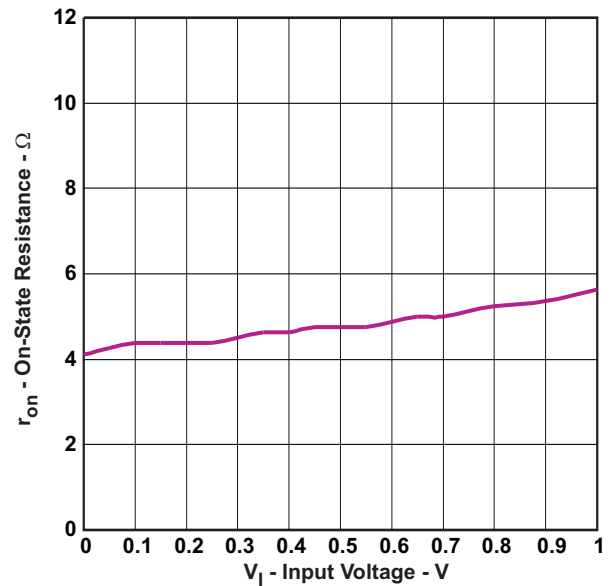
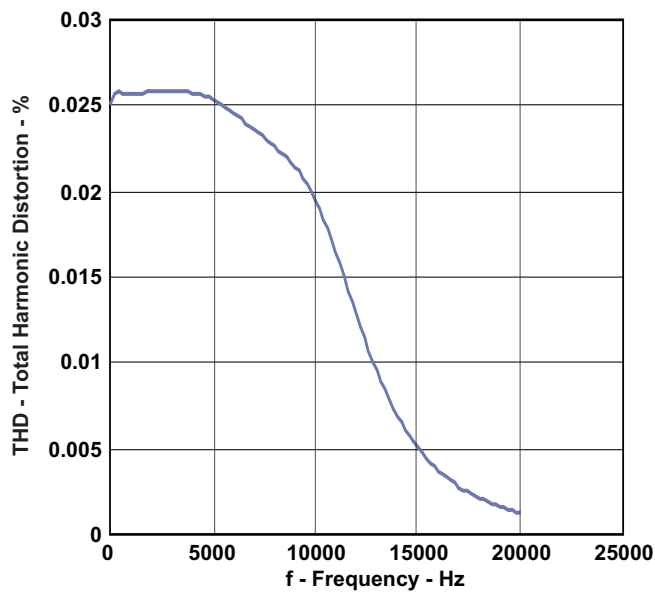
图 1. ON Resistance vs V_I for Audio Switch图 2. ON Resistance vs V_I for USB Switch

图 3. THD vs Frequency for Audio Switch

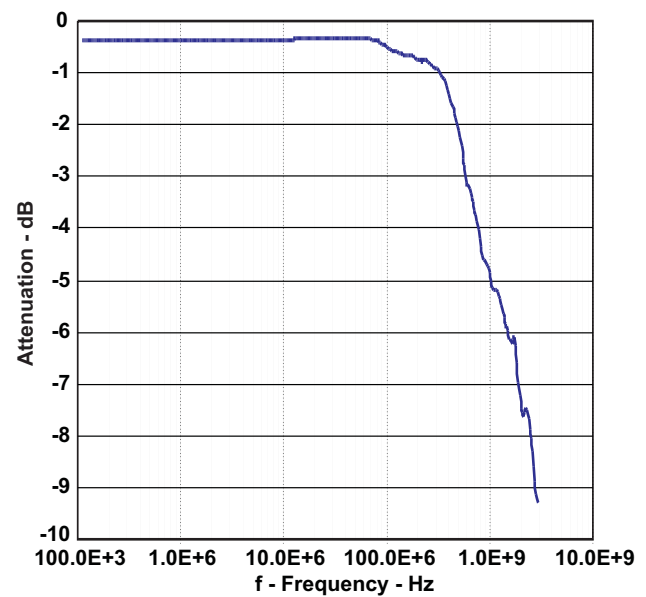


图 4. Gain vs Frequency for USB Switch

TYPICAL CHARACTERISTICS (接下页)

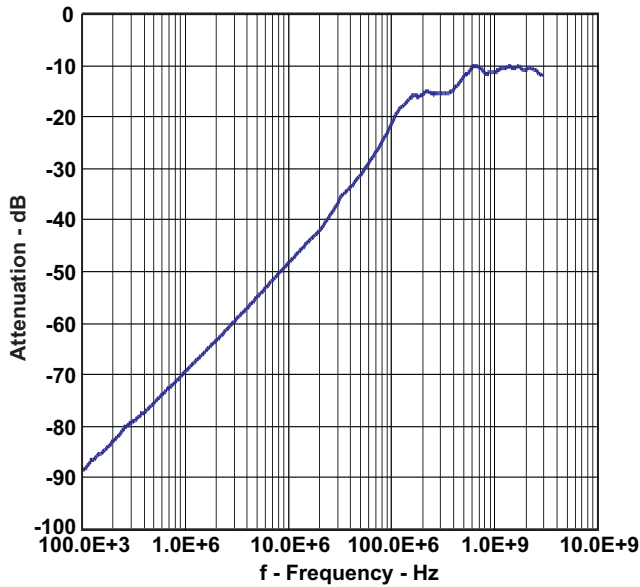


图 5. Off Isolation vs Frequency for Audio Switch

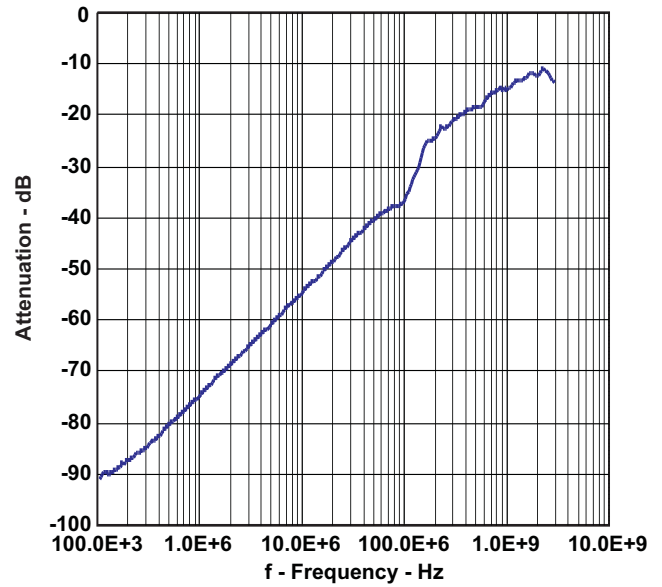


图 6. Off Isolation vs Frequency for USB Switch

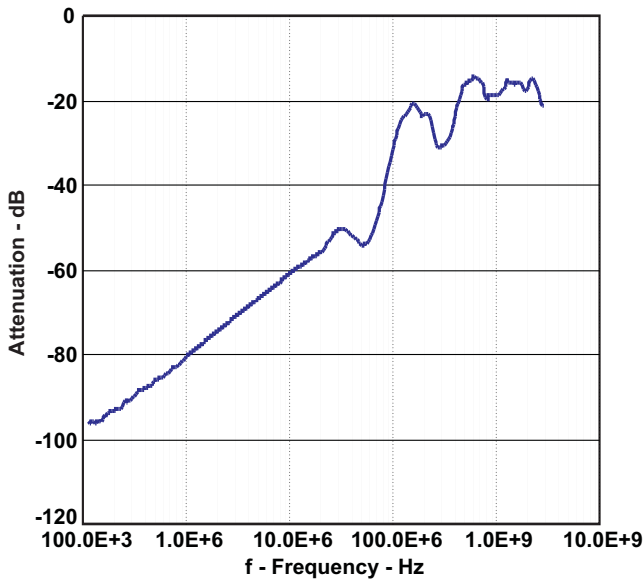


图 7. Cross Talk vs Frequency for Audio Switch

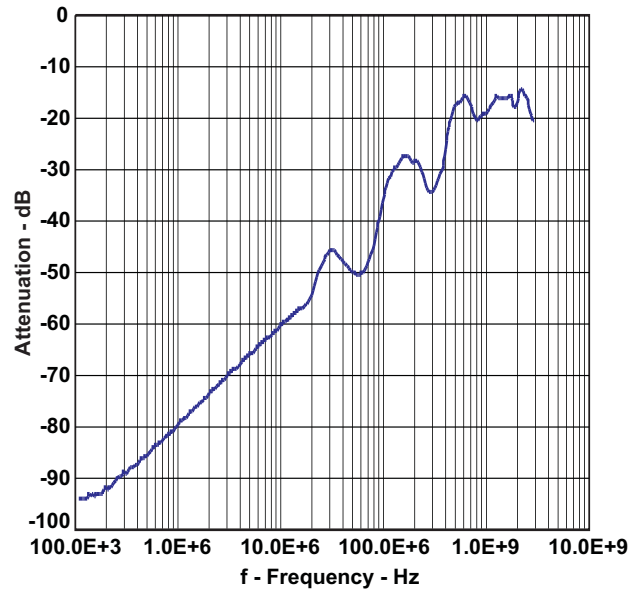


图 8. Cross Talk vs Frequency for USB Switch

TYPICAL CHARACTERISTICS (接下页)

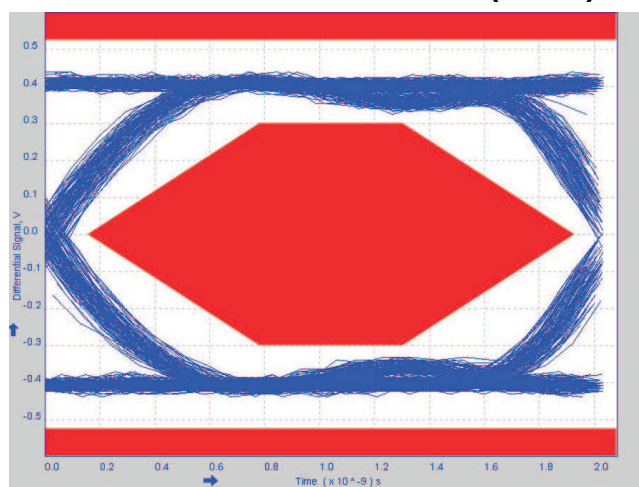
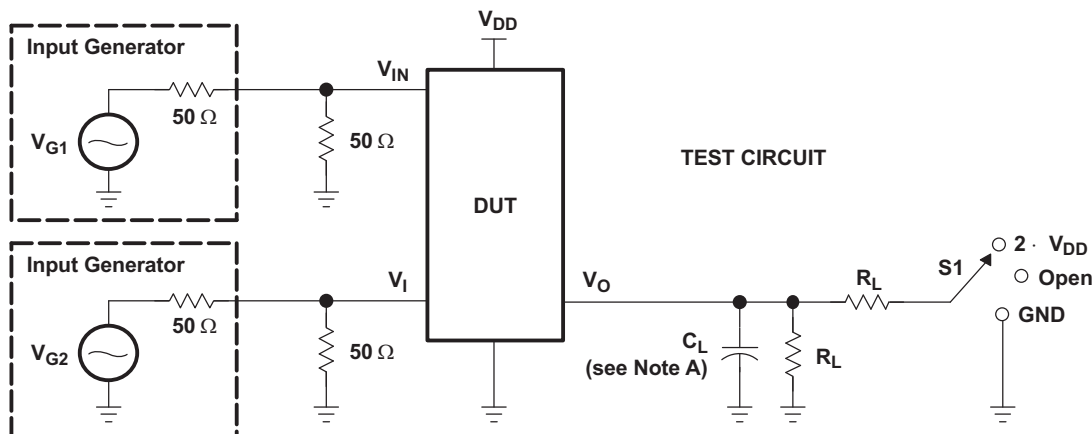
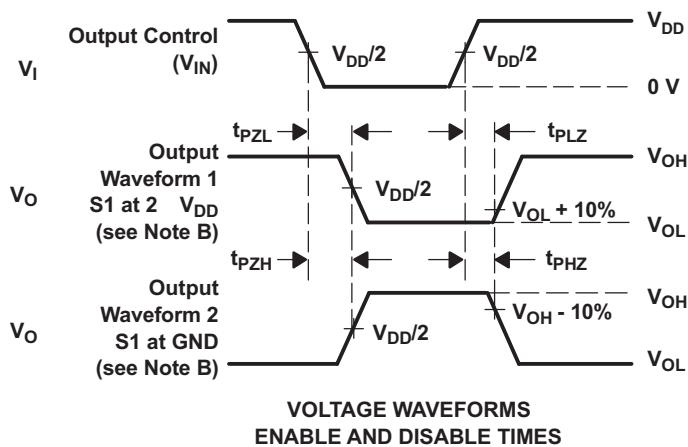


图 9. USB 2.0 Eye Pattern for USB Switch

PARAMETER MEASUREMENT INFORMATION (Enable and Disable Times)



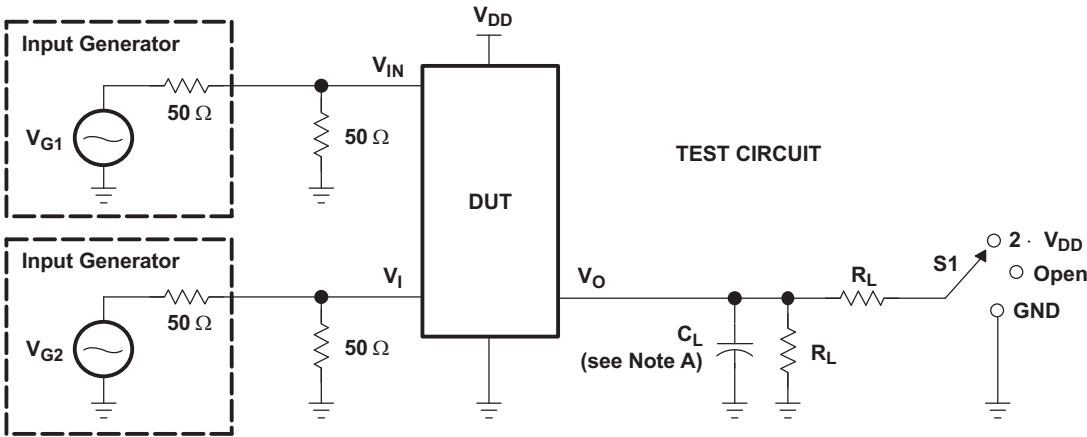
TEST	$V_{\text{AUDIO}} (V_{\text{DD}})$	S1	R_L	V_{in}	C_L	V_{Δ}
$t_{\text{PLZ}}/t_{\text{PZL}}$	3.3 V	$2 \cdot V_{\text{DD}}$	200 Ω	GND	10 pF	0.3 V
$t_{\text{PHZ}}/t_{\text{PZH}}$	3.3 V	GND	200 Ω	V_{DD}	10 pF	0.3 V



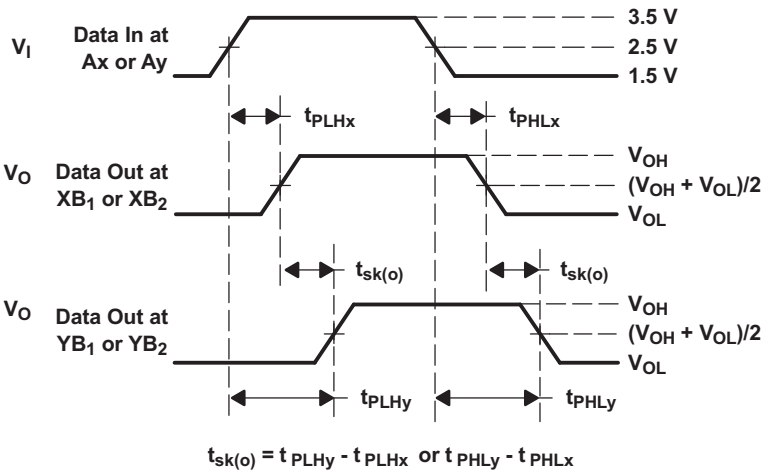
- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: $\text{PRR} \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 - D. The outputs are measured one at a time, with one transition per measurement.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} or t_{OFF} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} or t_{ON} .

图 10. Test Circuit and Voltage Waveforms

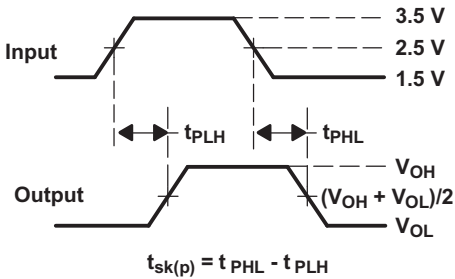
**PARAMETER MEASUREMENT INFORMATION
(Skew)**



TEST	V _{AUDIO} (V _{DD})	S1	R _L	V _{in}	C _L
t _{sk(o)}	3.3 V ± 0.3 V	Open	200 Ω	V _{DD} or GND	10 pF
t _{sk(p)}	3.3 V ± 0.3 V	Open	200 Ω	V _{DD} or GND	10 pF



**VOLTAGE WAVEFORMS
OUTPUT SKEW (t_{sk(o)})**

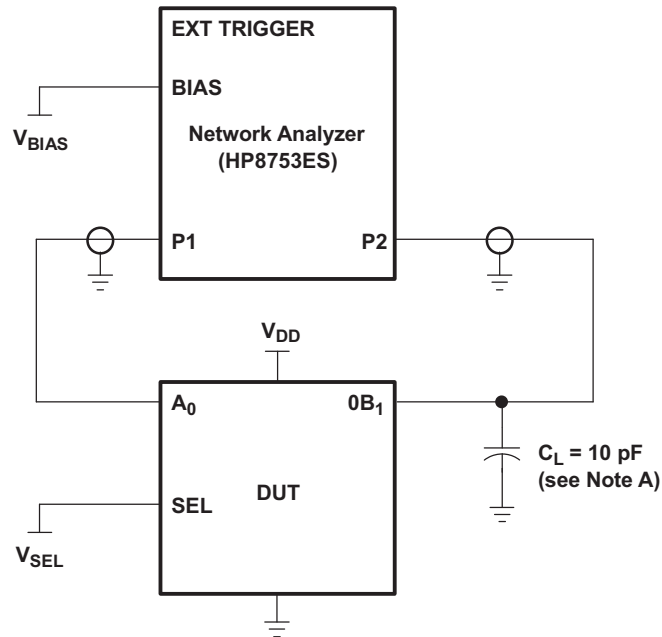


**VOLTAGE WAVEFORMS
PULSE SKEW [t_{sk(p)}]**

- NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time, with one transition per measurement.

图 11. Test Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION



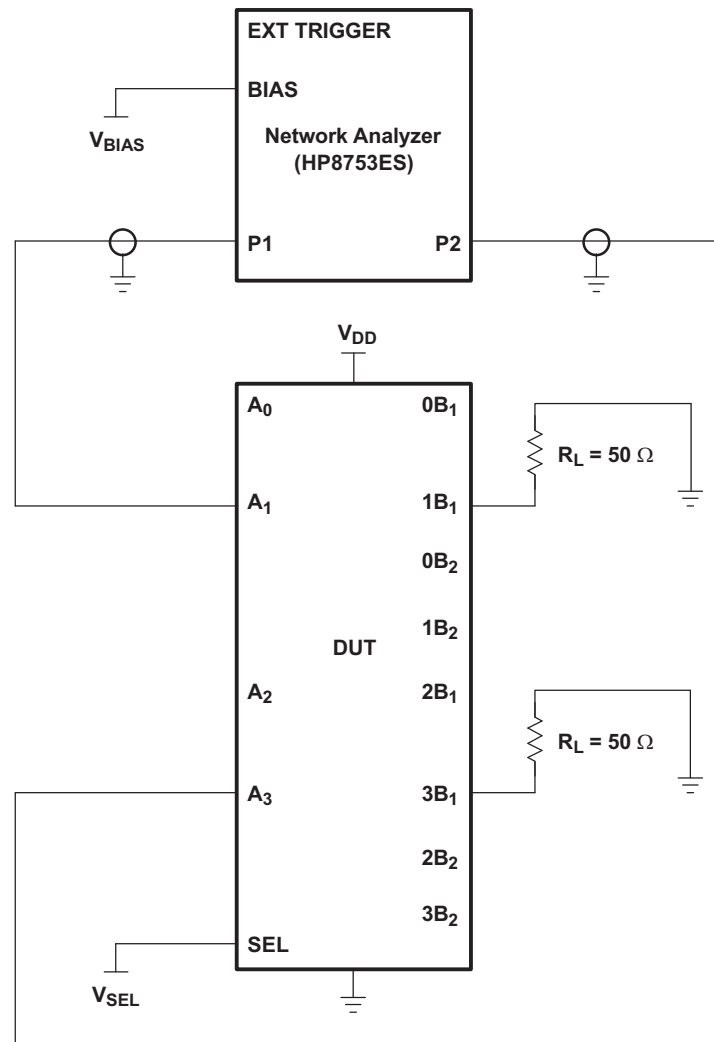
A. C_L includes probe and jig capacitance.

图 12. Test Circuit for Frequency Response (BW)

Frequency response is measured at the output of the ON channel. For example, when $V_{SEL} = 0$ and A_0 is the input, the output is measured at $0B_1$. All unused analog I/O ports are left open.

HP8753ES Setup

Average = 4
 RBW = 3 kHz
 $V_{BIAS} = 0.35$ V
 ST = 2 s
 P1 = 0 dBm

PARAMETER MEASUREMENT INFORMATION (continued)

- A. C_L includes probe and jig capacitance.
- B. A 50- Ω termination resistor is needed to match the loading of the network analyzer.

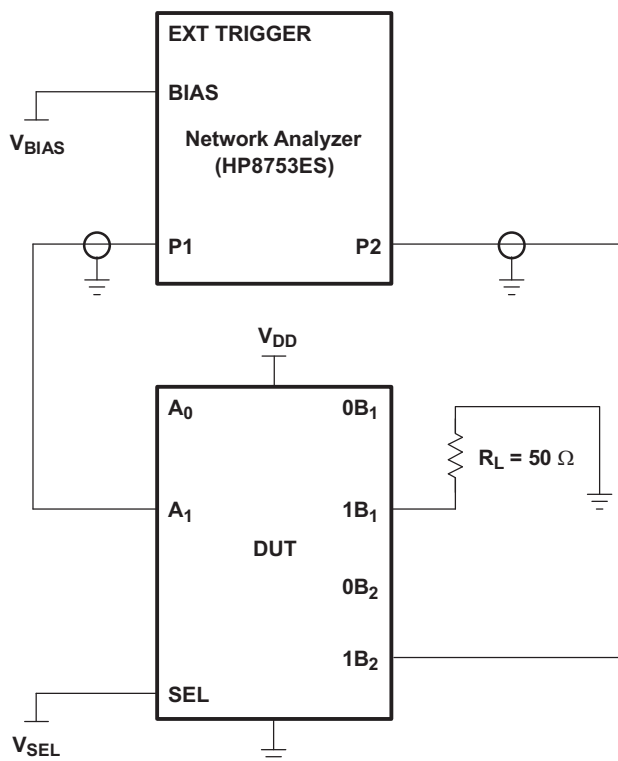
图 13. Test Circuit for Crosstalk (X_{TALK})

Crosstalk is measured at the output of the nonadjacent ON channel. For example, when $V_{SEL} = 0$ and A_1 is the input, the output is measured at A_3 . All unused analog input (A) ports are connected to GND, and output (B) ports are left open.

HP8753ES Setup

Average = 4
 RBW = 3 kHz
 $V_{BIAS} = 0.35\text{ V}$
 ST = 2 s
 P1 = 0 dBm

PARAMETER MEASUREMENT INFORMATION (continued)



- A. C_L includes probe and jig capacitance.
- B. A 50- Ω termination resistor is needed to match the loading of the network analyzer.

图 14. Test Circuit for OFF Isolation (O_{iso})

OFF isolation is measured at the output of the OFF channel. For example, when $V_{SEL} = GND$ and A_1 is the input, the output is measured at $1B_2$. All unused analog input (A) ports are connected to ground, and output (B) ports are left open.

HP8753ES Setup

Average = 4
 RBW = 3 kHz
 $V_{BIAS} = 0.35\text{ V}$
 ST = 2 s
 P1 = 0 dBm

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
TS5USBA224RSWR	ACTIVE	UQFN	RSW	10	3000	RoHS & Green	NIPDAU NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(A5R, A5V)	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.

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TAPE AND REEL INFORMATION



*All dimensions are nominal

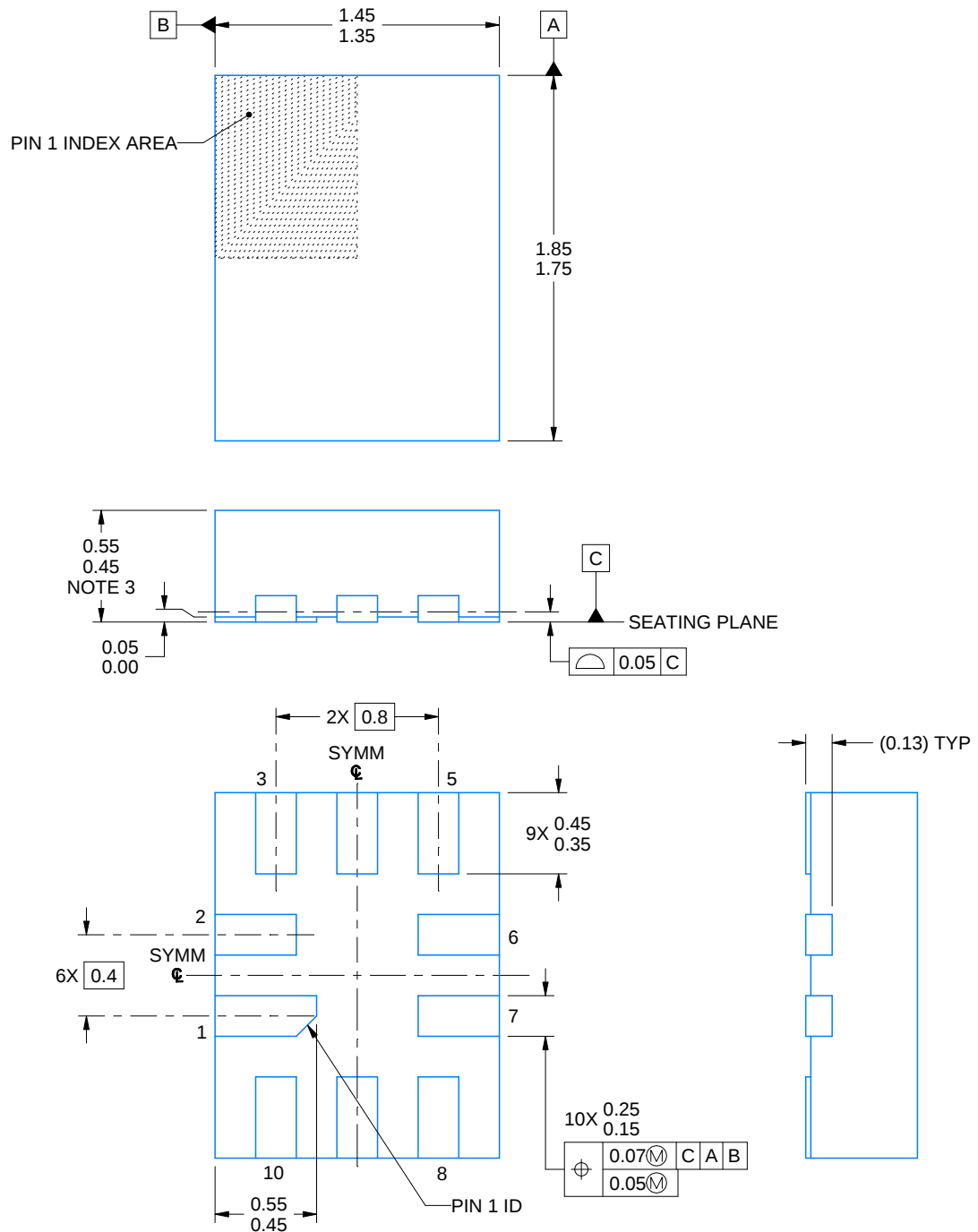
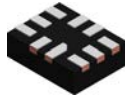
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TS5USBA224RSWR	UQFN	RSW	10	3000	180.0	9.5	1.6	2.0	0.8	4.0	8.0	Q1
TS5USBA224RSWR	UQFN	RSW	10	3000	180.0	8.4	1.59	2.09	0.72	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS5USBA224RSWR	UQFN	RSW	10	3000	189.0	185.0	36.0
TS5USBA224RSWR	UQFN	RSW	10	3000	202.0	201.0	28.0



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NOTES:

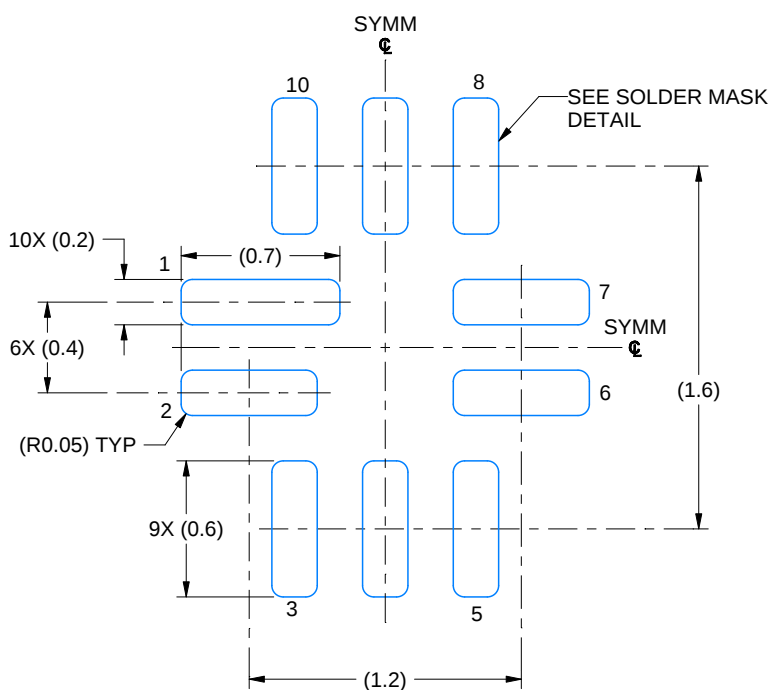
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package complies to JEDEC MO-288 variation UDEE, except minimum package height.

EXAMPLE BOARD LAYOUT

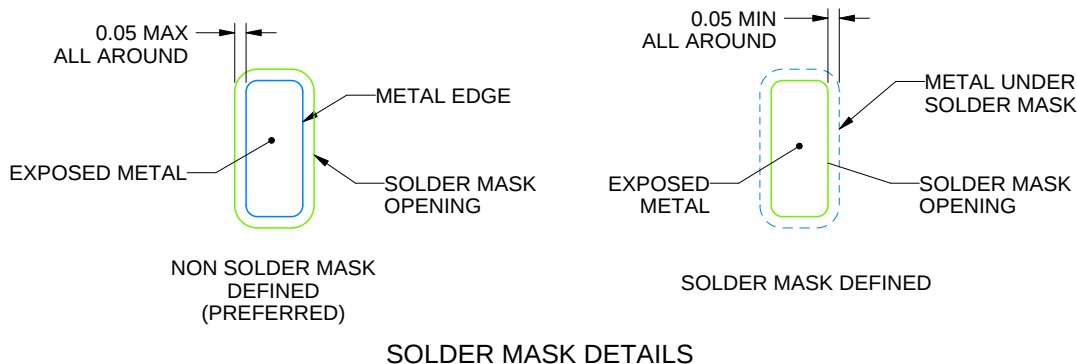
RSW0010A

UQFN - 0.55 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 30X



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NOTES: (continued)

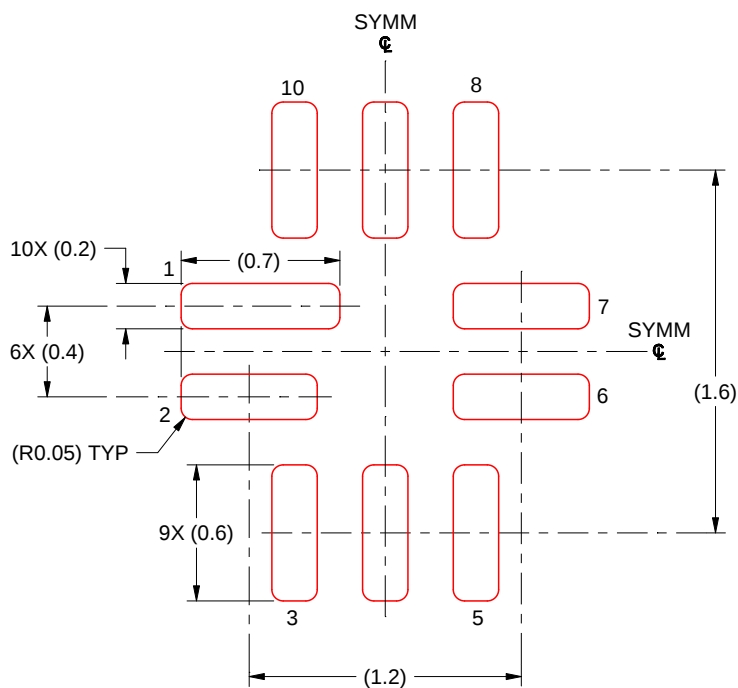
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slue271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

RSW0010A

UQFN - 0.55 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 30X

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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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