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FSA201 — USB2.0 带负信号功能的全速音频开关

产品特性

- 3Ω 典型导通电阻
- -3db 带宽 > 250MHz
- 低功耗
- 10-引脚 MSOP 和
10-引脚 MicroPak™ (1.6 x 2.1mm) 无铅封装
- 通用D+/R、D-/L端口断电保护
- 自动检测开关路径选择的V_{BUS}

应用

- 手机、PDA、数码相机和笔记本
- 液晶显示器、电视和机顶盒

说明

FSA201是一款双刀双掷(DPDT)复用器，它将低失真音频与USB2.0全速(FS)开关路径结合在一起。

这种配置使音频和USB数据能够共享一个通用连接器端口。

该架构的设计旨在允许音频信号摆动到地电压以下。这意味着通用USB和耳机插孔可用于个人媒体播放器和类似的便携式外围设备。

由于USB2.0是便携设备共享数据路径的行业标准，所以FSA221还具有V_{bus}检测能力。

FSA201具有断电特性，以在V_{BUS}不存在时将电流消耗降至最低。此断电电路仅供通用D+/R、D-/L端口使用。

典型应用包括便携式和消费电子应用（例如手机、数码相机及带集线器或控制器的笔记本电脑）的开关。

订购信息

器件型号	封装号码	包装说明
FSA201L10X	MAC010A	10-引脚 MicroPak，JEDEC MO-255，1.6 x 2.1mm
FSA201MUX	MUA10A	10-引脚 MSOP，JEDEC MO-187，3.0mm 宽

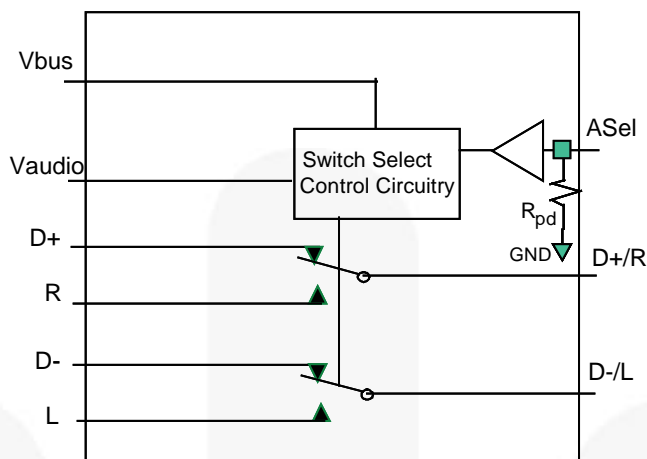


图1. FSA201 模拟符号

引脚配置

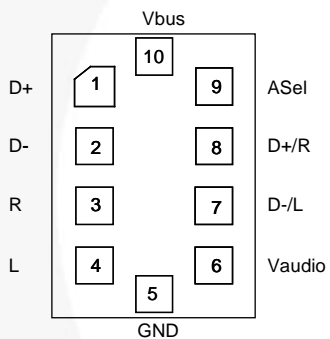


图2. MicroPak™ 10-引脚

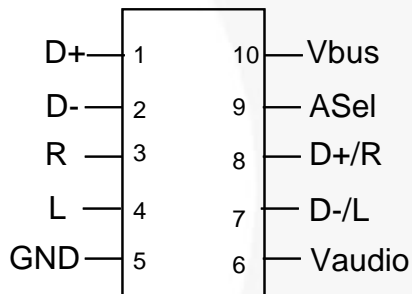


图3. MSOP 10-引脚

引脚描述

引脚号	名称	说明
1, 2	D+, D-	USB 数据总线输入源
6	V _{音频}	电源 (音频)
3, 4	R, L	音频右和左输入源
9	A _{SEL}	存在 V _{音频} 供应时, 选择音频覆盖自动 USB 探测
10	V _{BUS}	电源 (USB) 和自动 USB 开关路径选择
8, 7	D+/R, D-/L	USB 和音频通用连接器端口

真值表

A _{SEL} ¹	V _{音频}	V _{BUS}	L, R	D+, D-
低	低	低	关断	关断
低	低	高 ⁽²⁾	关断	打开
低	高 ⁽²⁾	低	打开	关断
低	高 ⁽²⁾	高 ⁽²⁾	关断	打开
高	低	低	关断	关断
高	低	高 ⁽²⁾	关断	打开
高	高 ⁽²⁾	低	打开	关断
高	高 ⁽²⁾	高 ⁽²⁾	打开	关断

说明:

1. A_{SEL}-若无外部连接, 内部电阻器将提供自动V_{BUS}探测。当 V_{音频}覆盖 USB 路径时, 即使存在V_{BUS}, 将A_{SEL}强制为高。
2. H - 为满足 USB2.0 V_{BUS} 要求而定义的阈值和系统音频电源阈值 (参见 DC 表)。

功能说明

FSA201 是 USB 和音频开关的结合，可共享 USB 连接器 D+/D- 线路与立体音频编解码输出。开关已最优化，可实现全速 USB 信号，并且包含自动 V_{BUS}- 探测电路。当 USB 连接器（不是耳机）连接至超便携装置，开关将自动配置以进行全速 USB 数据转换。

如果没有探测到 V_{BUS}，但是存在音频，开关将配置为低失真音频转换路径。音频转换路径还处理负信号（低至 -2V），从而消除对大耦合电容器的需求。

在 V_{BUS} 为自动推进装置或 V_{BUS} 未移除的应用中，A_{SEL} 引脚在软件控制下，提供切换至音频路径的能力。

A_{SEL} 引脚由接地电阻器在内部终止（典型值为 3M Ω ），并且无需标准超便携（手机、MP3 或便携媒体播放器）连接。FSA201

V_{BUS} 引脚电源不保证移除的应用中，使用 A_{SEL} 引脚，GPIO 引脚可用于将全速 USB 模式转换成音频模式。

正常操作中，FSA201 V_{BUS} 引脚必须直接连接至 V_{BUS} 或 > 3.8V 的电源上，不能连接在控制低至 3.6V 的 LDO 或可能降至 3.8V

以下的 V_{bat} 生成电源（参见应用框图）。

应用框图

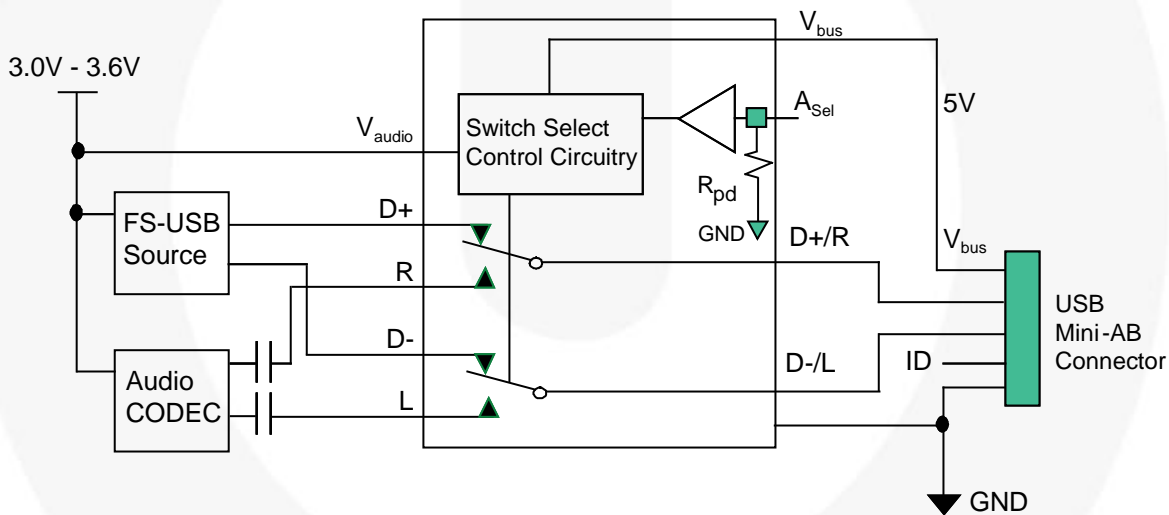


图4. 应用框图

绝对最大额定值

应力超过绝对最大额定值，可能会损坏设备。

在推荐的工作条件之上，该器件可能无法正常运行或操作，且不建议让器件在这些条件下长期工作。

此外，过度暴露在高于推荐的工作条件下，会影响器件的可靠性。绝对最大额定值仅是额定应力值。

符号	参数		最小值	最大值	单位
$V_{\text{音频}}/V_{\text{BUS}}$	电源电压		-0.5	6.0	V
V_{SW}	开关I/O电压 ³	D+, D-, D+/R, D-/L 引脚	$V_{\text{BUS}} - 7.0$	$V_{\text{BUS}} + 0.3$	V
		右, 左, 引脚	$V_{\text{音频}} - 7.0$	$V_{\text{音频}} - 0.3$	V
A_{SEL}	控制输入电压		-0.5	6.0	V
I_{IK}	输入箝位二极管电流		-50		mA
I_{SW}	开关输入/输出 (连续) 电流	USB		50	mA
		音频		250	
I_{SWPEAK}	峰值开关电流 (脉冲间隔 1ms, 占空比 <10%)	USB		100	mA
		音频		500	
T_{STG}	存储温度范围		-65	+150	°C
T_{J}	最大结温			+150	°C
T_{L}	引脚温度 (焊接, 10 秒)			+260	°C
ESD	人体模式(JEDEC: JESD22-A114)	输入/输出至地		10	kV
		全部其他引脚		8	
	充电放电模式(JEDEC: JESD22-C101)				

注意：

3. 当测量输入与输出二极管电流额定值时，该输入与输出可能超出负额定值。

推荐工作条件

推荐的操作条件表定义了真实器件的工作条件。指定推荐的工作条件，以确保设备的最佳性能达到数据表中的规格。

飞兆半导体建议不要超过推荐工作条件，也不能按照绝对最大额定值进行设计。

符号	参数		最低	最大值
$V_{\text{音频}}$	电源电压		2.7V	3.6V
V_{BUS}	电源电压		4.25V	5.50V
A_{SEL}	控制输入电压		0V	$V_{\text{音频}}$
V_{SW}	开关I/O电压		$V_{\text{音频}} - 6.5V$	$V_{\text{音频}} - 0.3V$
T_{A}	工作温度		-40°C	85°C
θ_{JA}	热阻 (大气)	MicroPak 10		330°C/W (估计)

直流电气特性

若无其他说明，所有典型值都在 25°C 下测得。

符号	参数	V _{音频} (V)	条件	T _A =- 40°C 至 +85°C			单位
				最小 值	典型 值	最大 值	
通用引脚							
V _{IK}	箝位二极管电压	2.7	I _{IK} =-18mA			-1.2	V
V _{IH}	控制输入高电平	2.5 至 3.6		1.3			
V _{IL}	控制输入低电平	2.5 至 3.6				0.5	
I _{IN}	ASEL 输入高电流	3.6	V _{CNTRL} =0V 至 3.6V	-3		3	μA
I _关	电源关闭漏电流 (公共端口 仅为 D+/R, D-/L)	V _{音频} = V _{BUS} =0V	公共端口(D+/R, D-/L) V _{SW} = 0V 至 5.5V			1	μA
I _{开(关)}	端口 D+、D- 、R、L 的断电漏电流	3.6	V _{BUS} =0V, 5.5V, D+/R, D- /L=0.3V, V _{音频} - 0.3V, D+ , D- , R, L=0.3V, V _{音频} - 0.3V 或浮动, 图14	-50	10	50	nA
I _{NC(开)}	端口D+/R或者D- /L的导通漏电流	3.6	V _{BUS} =0V, 5.5V, D+/R, D- /L=0.3V, V _{音频} - 0.3V , D+ , D- , R, L=浮动, 图15	-100	50	100	nA
USB 转换路径		V _{BUS} (V)					
	USB模拟信号范围			0		3.6	V
R _{ONUSB}	FS 开关导通电阻 ⁽⁴⁾	4.25	V _{D+/D-} =0V, 3.0V, I _开 =-8mA 图6, 图13		3	6	Ω
Δ R _{ONUSB}	FS Delta R _开 ^(4, 6)	4.25	V _{D+/D-} =3V, I _开 =-8mA		0.35		Ω
音频转换路径		V _{音频} (V)					
	音频模拟信号范围			V _{音频} - 6.5		V _{音频}	V
R _{ONAUDIO}	音频接通电阻 ⁽⁷⁾	2.7	V _{L/R} =-2V, 0V, 0.7V, V _{音频} -0.7V, V _{音频} I _开 =-100mA, V _{BUS} =0V 图5, 图13		0.5	1.0	Ω
Δ R _{ONAudio}	音频 Delta R _{ON} ⁽⁴⁾	2.7	V _{L/R} =0.7V I _{ON} =-100mA		0.01	0.10	Ω
R _{FLAT} (音频)	音频 R _开 平整度 ⁽⁵⁾	2.7	V _{L/R} =-2V, 0V, 0.7V, 2V, 2.7V I _{ON} =-100mA			0.35	Ω

说明:

4. Δ R_{ON}=R_{ON max} - R_{ON min}, 在相同 V_{CC}、温度和电压下进行的测量。最糟情况信号路径、音频或 USB 通道特点。
5. 平整度定义为在指定工作范围以内通态电阻最大值与最小值之间的差；
6. 由产品特性保证，未经生产测试。
7. 在指定通过电流下，开关导通电阻决定于通过开关指定电流的A和B引脚之间的电压差。

直流电气特性 (续)

若无其他说明，所有典型值都在 25°C 下测得。

符号	参数	V _{音频} (V)	条件	T _A =- 40°C 至 +85°C			单位
				最小 值	典型 值	最大 值	
电源							
V _{busth}	V _{BUS} 阈值电压			3.2		3.8	V
V _{audioth}	V _{音频} 阈值			0.5		1.5	V
ICC (音频)	静态电源电流 (音频)	3.0	V _{ASEL} =0 至 V _{音频} , I _{OUT} =0			10	μA
ICC(VBUS)	静态电源电流 (V _{BUS})		V _{ASEL} =0 至 V _{音频} , I _{OUT} =0 V _{BUS} =5.5V			20	μA
ICCT	提高各控制电压的 I _{CC} 电流和V _{CC}	3.0	V _{ASEL} =2.6V, V _{BUS} =浮动			15	μA
			V _{ASEL} =1.8V, V _{BUS} =浮动			18	

交流电气特性

若无其他说明，所有典型值都在 $V_{\text{音频}}=3.3\text{V}$ 、 $V_{\text{BUS}}=5.0$ 且 25°C 下测得。

符号	参数	$V_{\text{音频}}/V_{\text{BUS}}$ (V)	条件	$T_A=-40^{\circ}\text{C}$ 至 $+85^{\circ}\text{C}$			单位
				最小值	典型值	最大值	
t_{ONAUDIO1}	开机时间 $V_{\text{音频}} \uparrow$ 至输出	$V_{\text{BUS}} = 0\text{V}$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图18			10	μs
$t_{\text{OFFAUDIO1}}$	关机时间 $V_{\text{BUS}} \uparrow$ 至输出	$V_{\text{AUDIO}}=2.7$ 促进 $V_{\text{BUS}} \uparrow$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图18			10	μs
t_{ONAUDIO2}	开机时间 A_{SEL} 至输出	$V_{\text{BUS}}=4.25\text{V}$ $V_{\text{音频}}=2.7$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图17			1	μs
$t_{\text{OFFAUDIO2}}$	关机时间 A_{SEL} 至输出	$V_{\text{BUS}}=4.25\text{V}$ $V_{\text{音频}}=2.7$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图18			1	μs
t_{ONAUDIO3}	开机时间 $V_{\text{BUS}} \downarrow$ 至输出	$V_{\text{音频}}=2.7$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图17			10	μs
t_{ONUSB}	开机时间 $V_{\text{USB}} \uparrow$ 至输出	$V_{\text{音频}} = 2.7$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图18			10	μs
t_{OFFUSB}	关机时间 $V_{\text{USB}} \downarrow$ 至输出	$V_{\text{音频}}=2.7$	$V_{\text{D+R, D-/L}}=1.0\text{V}$ $R_L=50\Omega$, $C_L=50\text{pF}$ 图16, 图18			10	μs
t_{PUSB}	USB开关传输延迟 ⁽⁶⁾	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$R_L=50\Omega$, $C_L=50\text{pF}$ 图19		0.25		ns
O_{IRRUSB}	断开-隔离 - USB	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}$, $R_T=50\Omega$, $C_L=0\text{pF}$ 图8, 图24		-55		dB
O_{IRRA}	断开-隔离 - 音频	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}$, $R_T=50\Omega$, $C_L=0\text{pF}$ 图7, 图24		-37		dB
X_{talkUSB}	非相邻通道串扰 - USB	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}$, $R_T=50\Omega$, $C_L=0\text{pF}$ 图10, 图25		-49		dB

符号	参数	$V_{\text{音频}}/V_{\text{BUS}}$ (V)	条件	$T_A = -40^\circ\text{C}$ 至 $+85^\circ\text{C}$			单位
				最小值	典型值	最大值	
XtalkA	非相邻通道串扰 - 音频	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$f=6\text{MHz}$, $R_T=50\Omega$, $C_L=0\text{pF}$ 图9, 图25		-39		dB
BW	-3db 带宽	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=4.25\text{V}$	$R_T=50\Omega$, $C_L=0\text{pF}$, 信号 0dBm 图11, 图12, 图23		400		MHz
THD	总谐波失真度	$V_{\text{音频}}=2.7$ $V_{\text{BUS}}=0\text{V}$	$f=20\text{Hz}$ to 20kHz , $R_L=32\Omega$, $V_{R,L}=2V_{pp}$ 图28		0.05		%
电源电压抑制比	电源抑制比	$V_{\text{音频}}=3.3$ $V_{\text{BUS}}=0\text{V}$	$f=217\text{Hz}$ 开 $V_{\text{音频}}$ $V_{R,L}=1.0\text{V}$, $R_T=32\Omega$, $V_{\text{Ripple}}=600\text{mV}_{pp}$		-56		dB

注意：

8. 由产品特性保证，未经生产测试。

全速 USB 相关的交流电气特性

符号	参数	V _{音频} / V _{BUS} (V)	条件	T _A =-40°C 至 +85°C			单位
				最小值	典型值	最大值	
t _{SK(O)}	通道间相位差 ⁽⁹⁾	V _{音频} =2.7V V _{BUS} =4.25V	t _R =t _F =12ns (10-90%)，当 6MHz C _L =50pF, R _L =50Ω 图20 时, 图21		150		ps
t _{SK(P)}	在相同输出下，反向转换的时滞 ⁽⁹⁾	V _{音频} =2.7V V _{BUS} =4.25V	t _R =t _F =12ns (10-90%)，当 6MHz C _L =50pF, R _L =50Ω 图20 时, 图21		150		ps
T _J	总抖动 ⁽⁹⁾	V _{音频} =2.7V V _{BUS} =4.25V	R _L =50Ω, C _L =50pF, t _R =t _F =12ns (10-90%)，需 12Mbps (PRBS=2 ¹⁵ - 1)		1.6		ns

注意：

9. 由产品特性保证，未经生产测试。

电容值

符号	参数	V _{音频} / V _{BUS} (V)	条件	T _A =-40°C 至 +85°C			单位
				最小值	典型值	最大值	
C _{IN (ASEL)}	控制引脚输入电容 (ASEL)	V _{音频} =2.7V V _{BUS} =4.25V	V _{Bias} =0.2V		2.5		pF
CON(D+/R, D-/L)	D+/R, D-/L (公用端口)，根据电流容量	V _{音频} =2.7V V _{BUS} =4.25V A _{SEL} =0V (CONUSB)	V _{Bias} =0.2V, f=6MHz 图27		25		pF
		V _{音频} =2.7V V _{BUS} =4.25V A _{SEL} =2.7V (CONAudio)	V _{Bias} =0.2V, f=6MHz 图27		29		
COFF(D+, D-)	USB 输入源断电容	V _{音频} =2.7V V _{BUS} =4.25V A _{SEL} =2.7V	f=6MHz, 图26		5		pF
C _{OFF(R/L)}	音频输入源断电容	V _{音频} =2.7V V _{BUS} =4.25V A _{SEL} =0V	f=6MHz, 图26		17		pF

典型特性

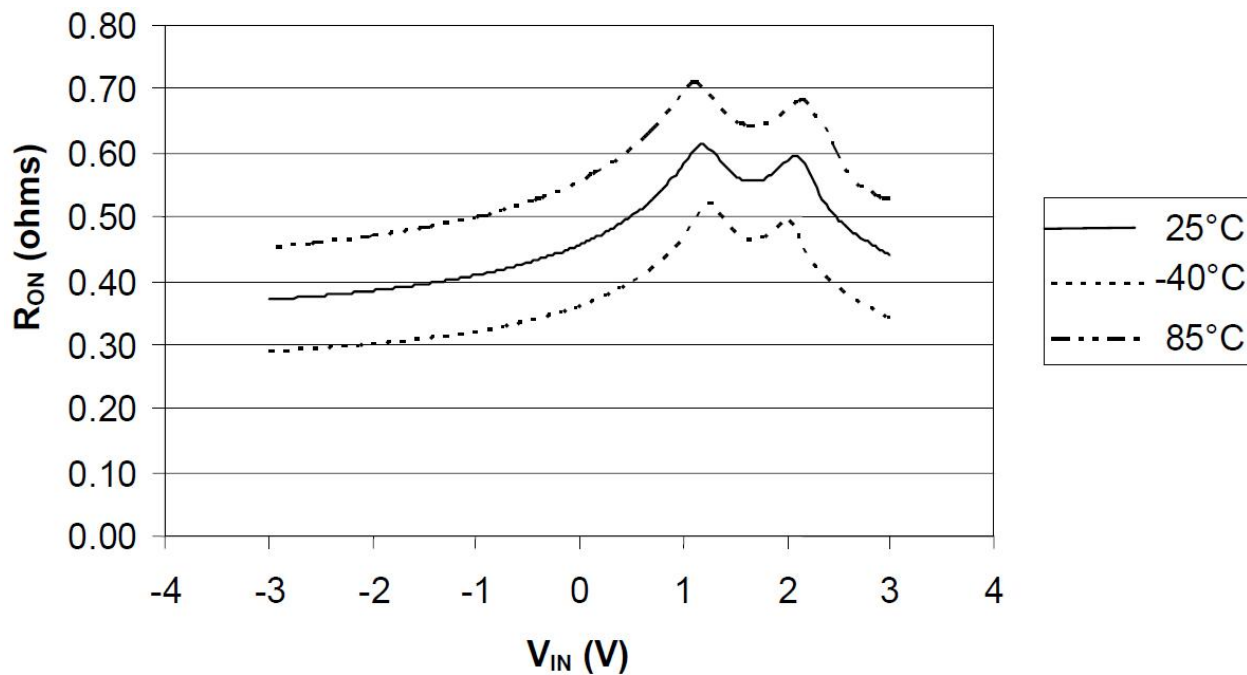


图5. R_{ON} 音频特征 (R_{ON} 音频 R, $V_{音频}=2.7V$)

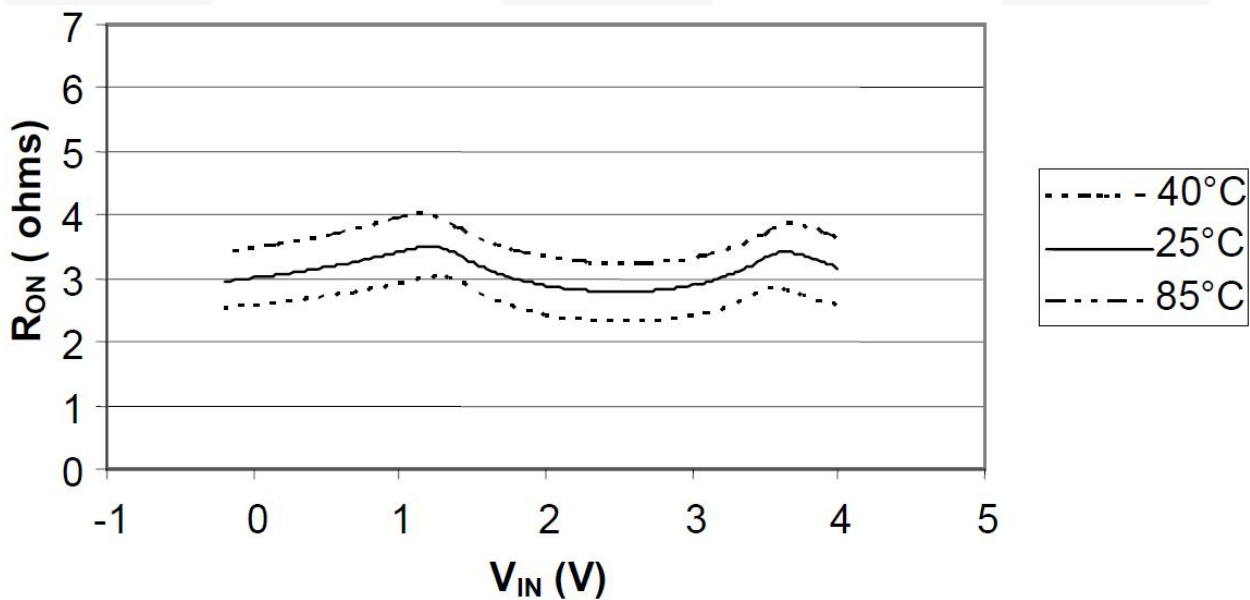


图6. R_{ON} USB 特征 (R_{ON} USB D+)

典型特性 (续)

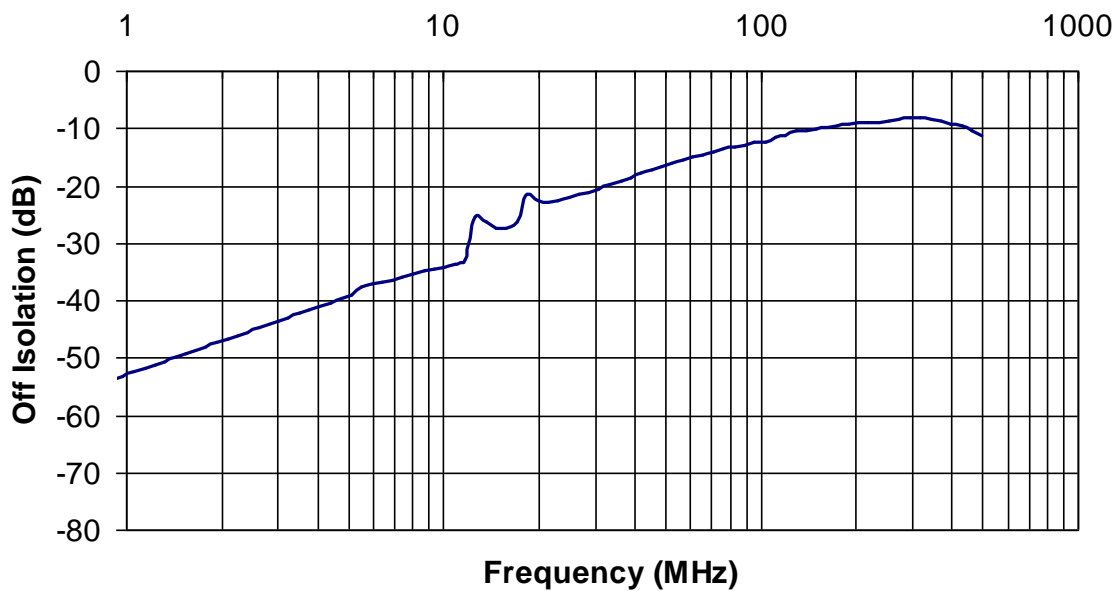


图7. VCC (VAUDIO)=2.7V时, 断开-隔离 (音频) 特性, 频率响应

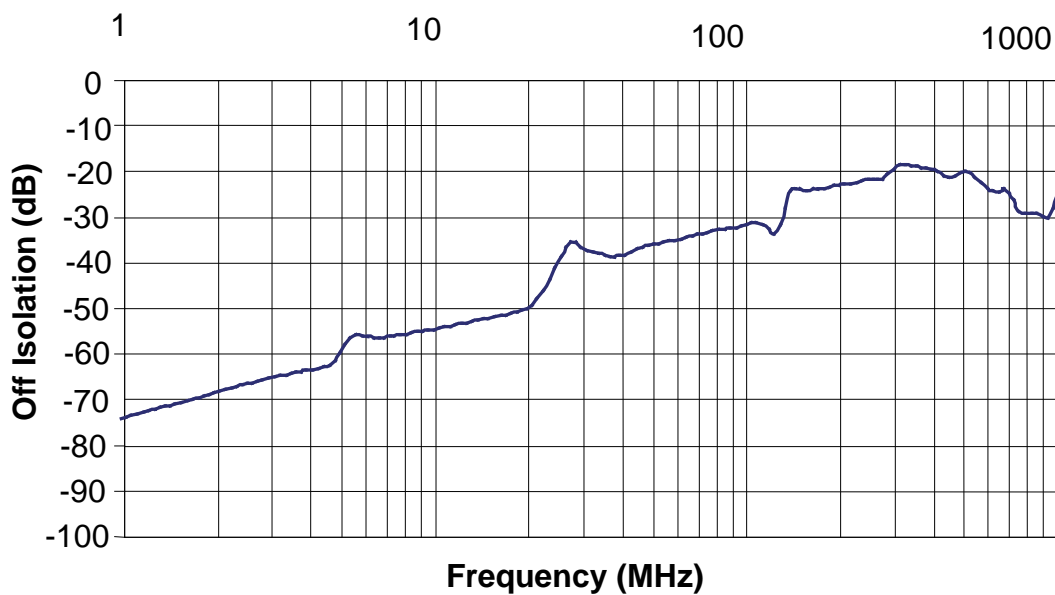


图8. VCC (VBUS)=4.25V时, 断开-隔离 (USB) 特性, 频率响应

典型特性 (续)

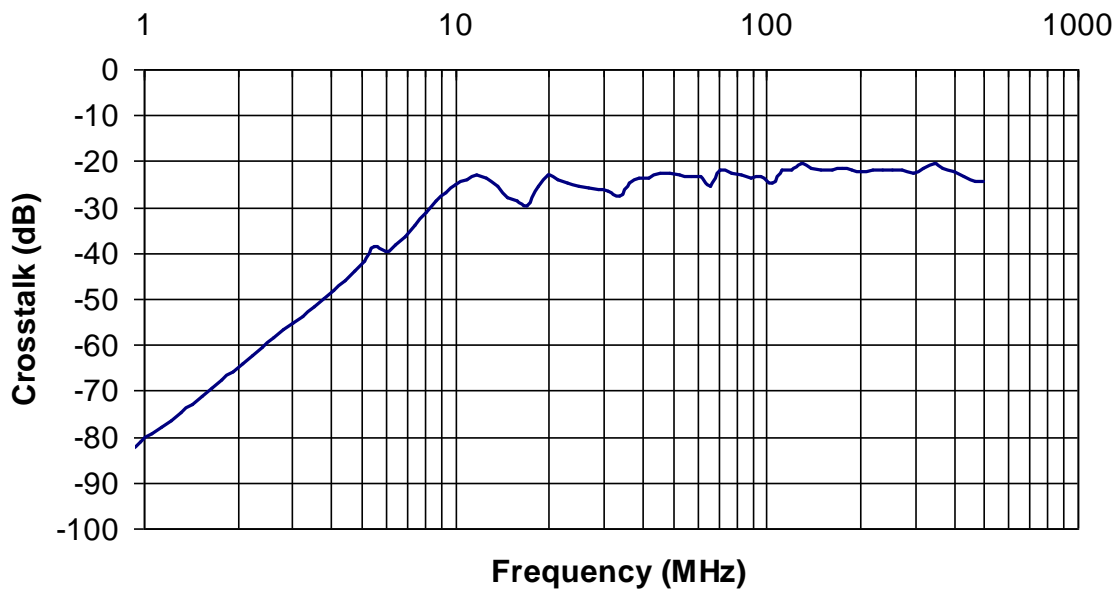


图9. $V_{CC}(V_{\text{音频}})=2.7V$ 时, 非相邻通道间串扰(音频)特性

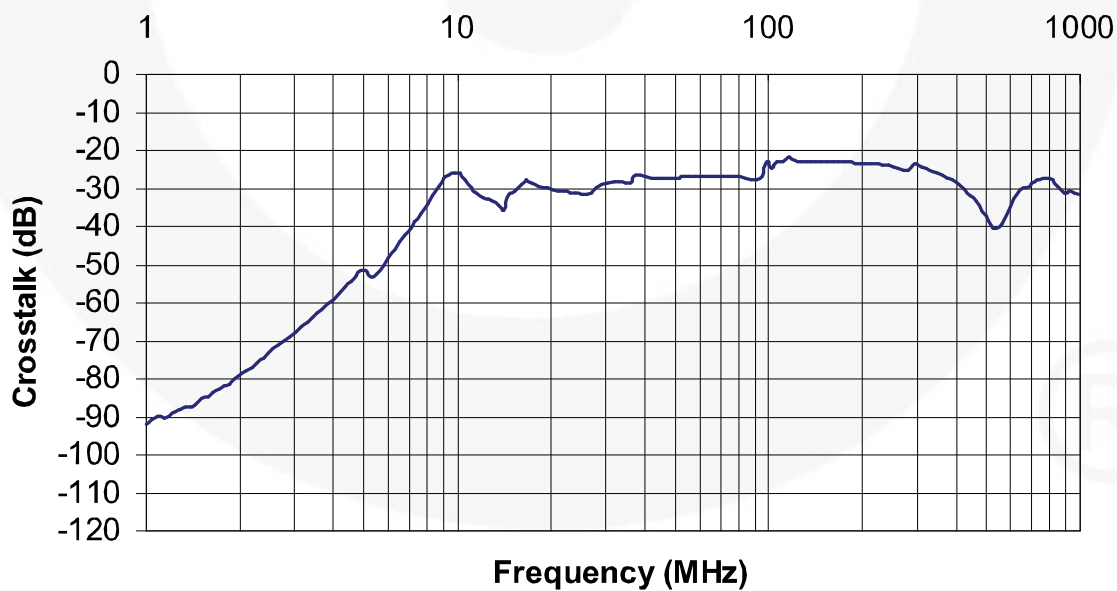


图10. $V_{CC}(V_{\text{总线}})=4.25V$ 时, 非相邻通道间串扰(USB)特性

典型特性 (续)

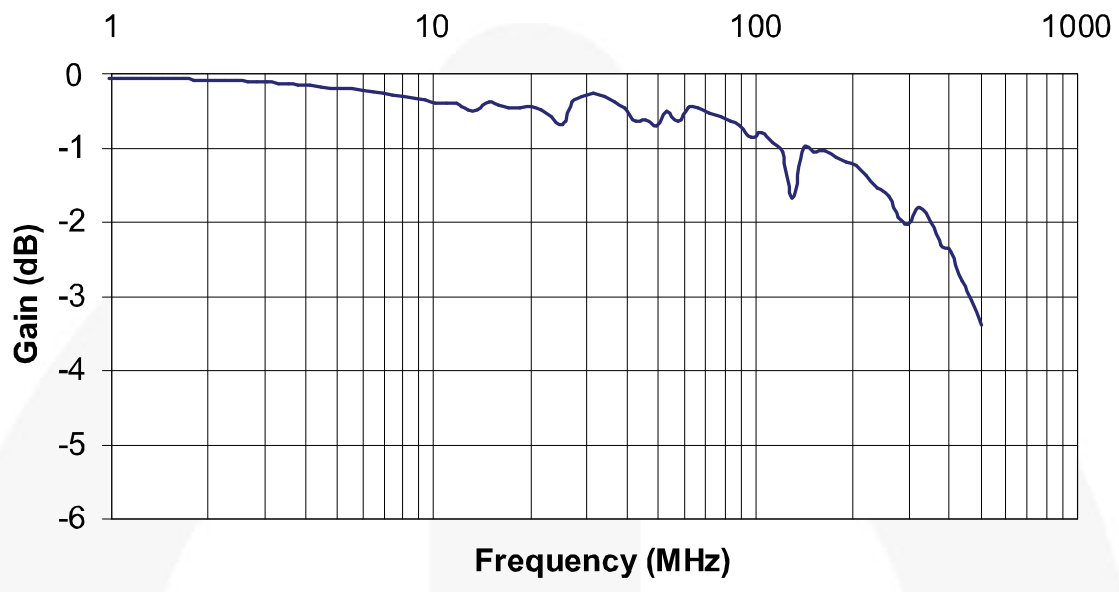


图11. $C_L=0pF$, $V_{CC}(V_{AUDIO})=2.7V$ 时, 带宽特性, 频率响应

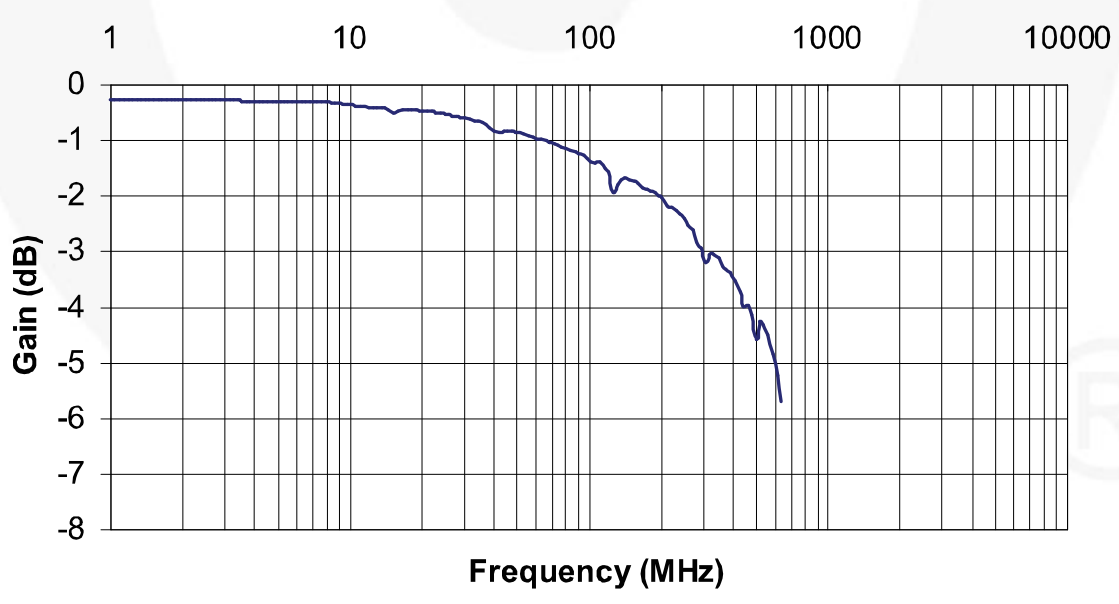


图12. $V_{CC}(V_{音频})=2.7V$ 时, 带宽特性, 频率响应

测试框图

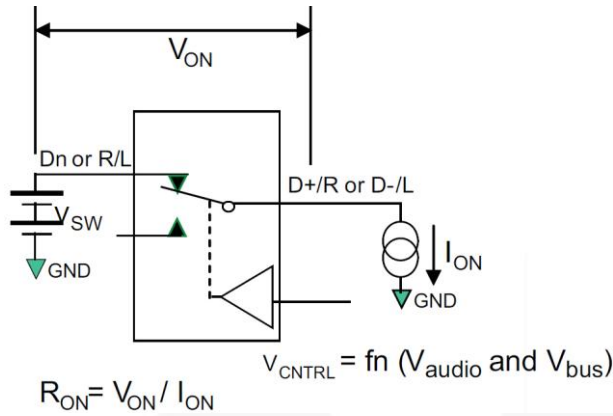


图13. 导通电阻

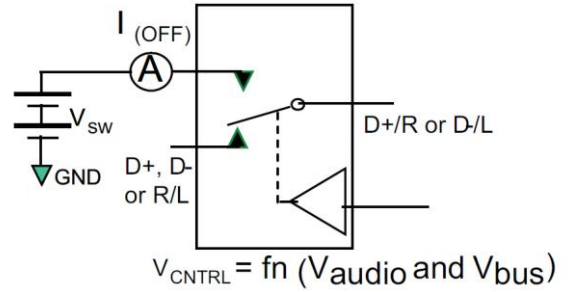


图14. 关断漏电流

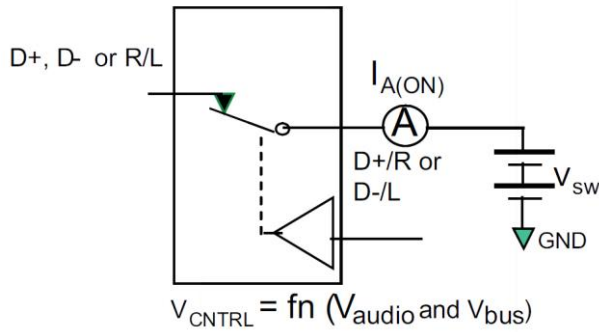


图15. 导通漏电流

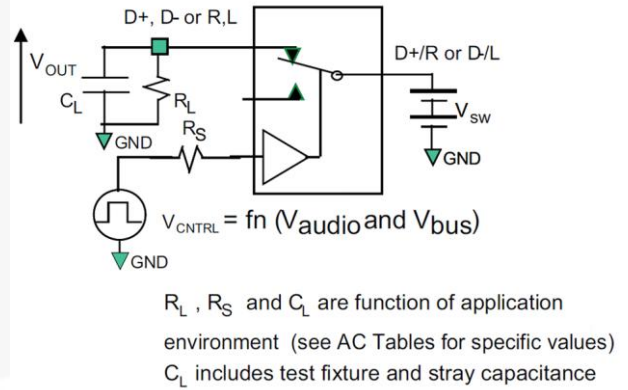


图16. 交流测试电路负载

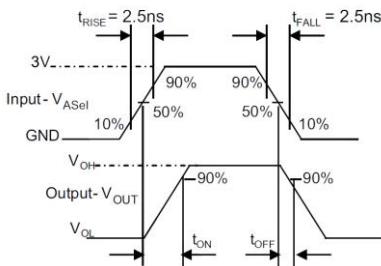


图17. 开通/关断波形(A_SEL)

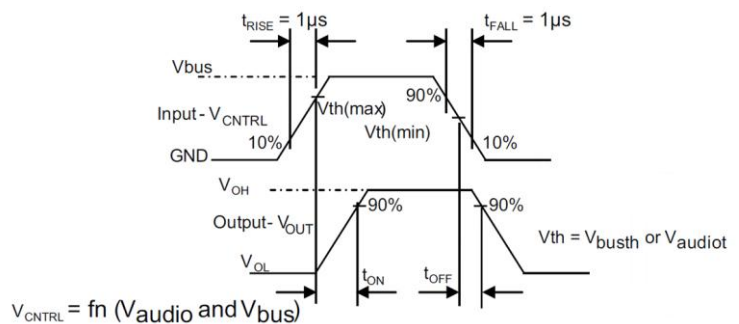


图18. 开启 / 断开波形 (USB/音频)

测试框图(续)

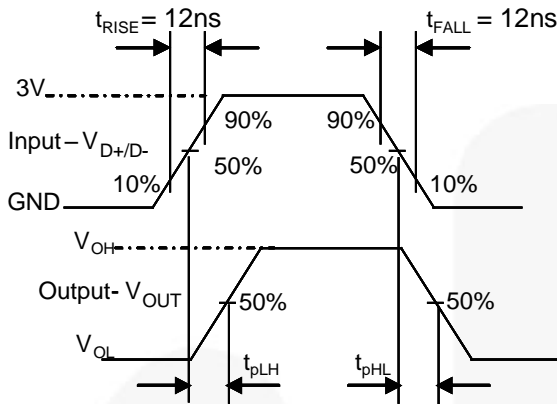


图19. USB 开关传播延迟波形

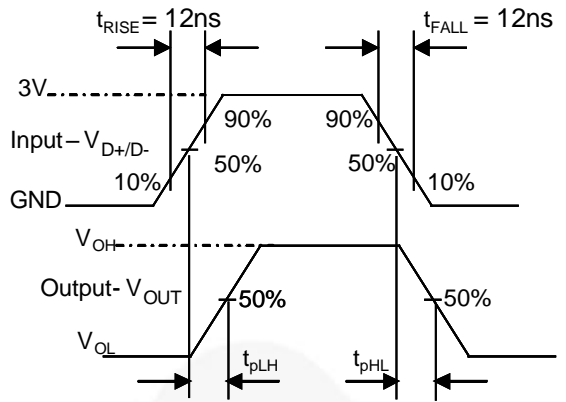


图20. 脉冲偏斜: $t_{sk(P)} = |t_{pHL} - t_{pLH}|$

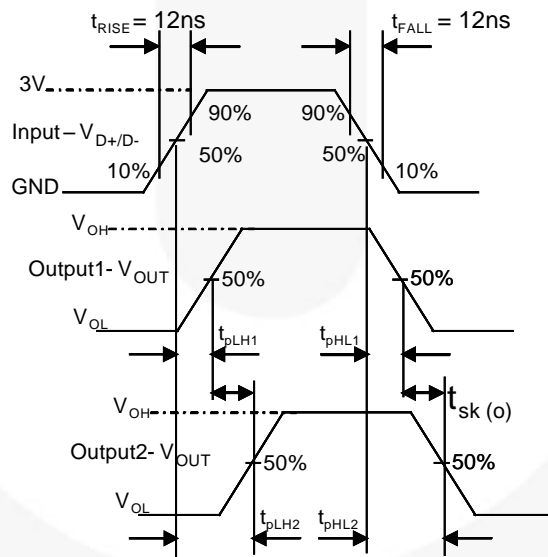


图21. 输出偏斜: $t_{sk(O)} = |t_{pLH1} - t_{pLH2}|$ OR $|t_{pHL1} - t_{pHL2}|$

图22.

测试框图(续)

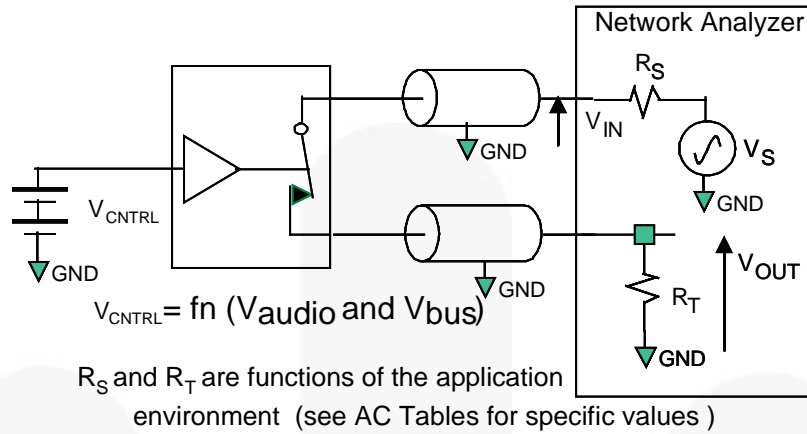


图23. USB 带宽

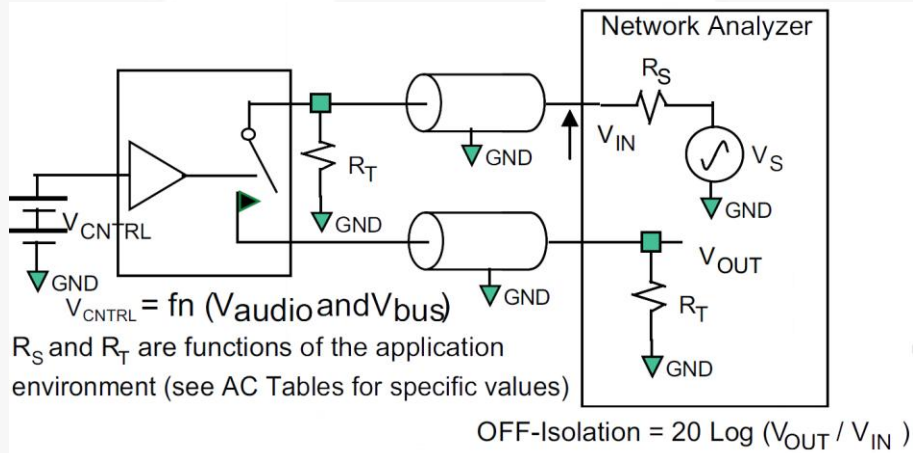


图24. 通道的关断隔离

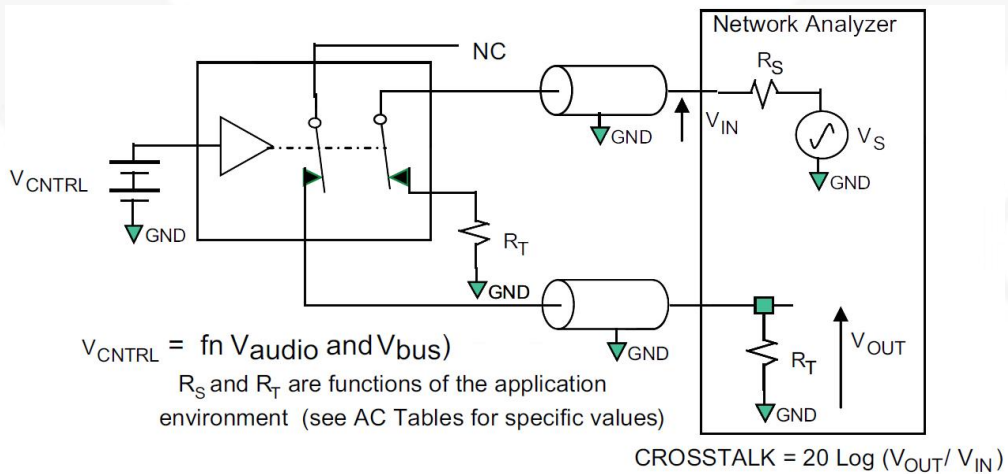


图25. 非相邻通道间串扰

测试框图(续)

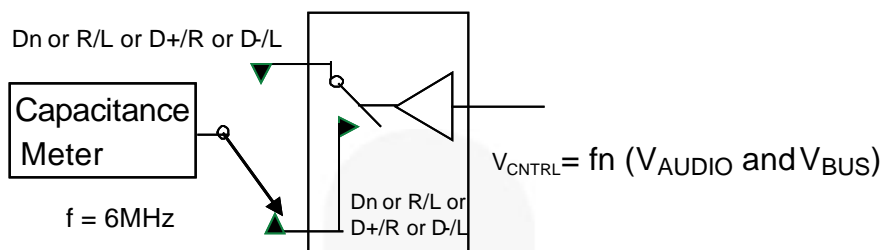


图26. 通道关断电容

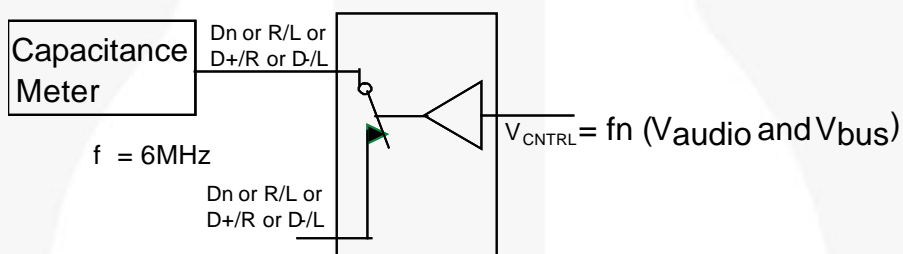


图27. 通道导通电容

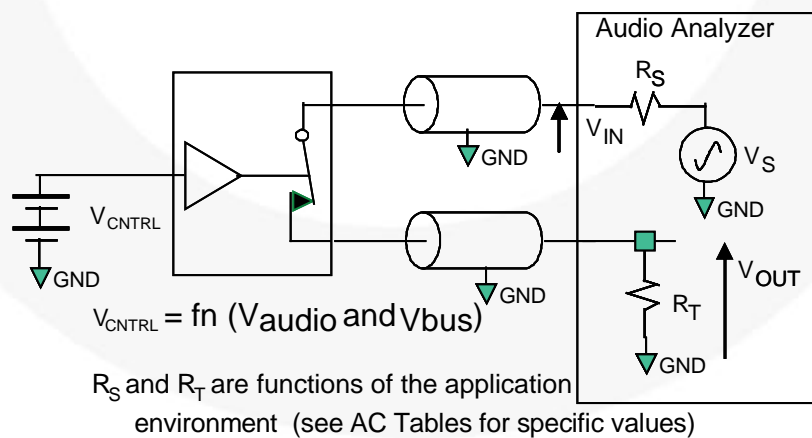


图28. 总谐波失真度

物理尺寸

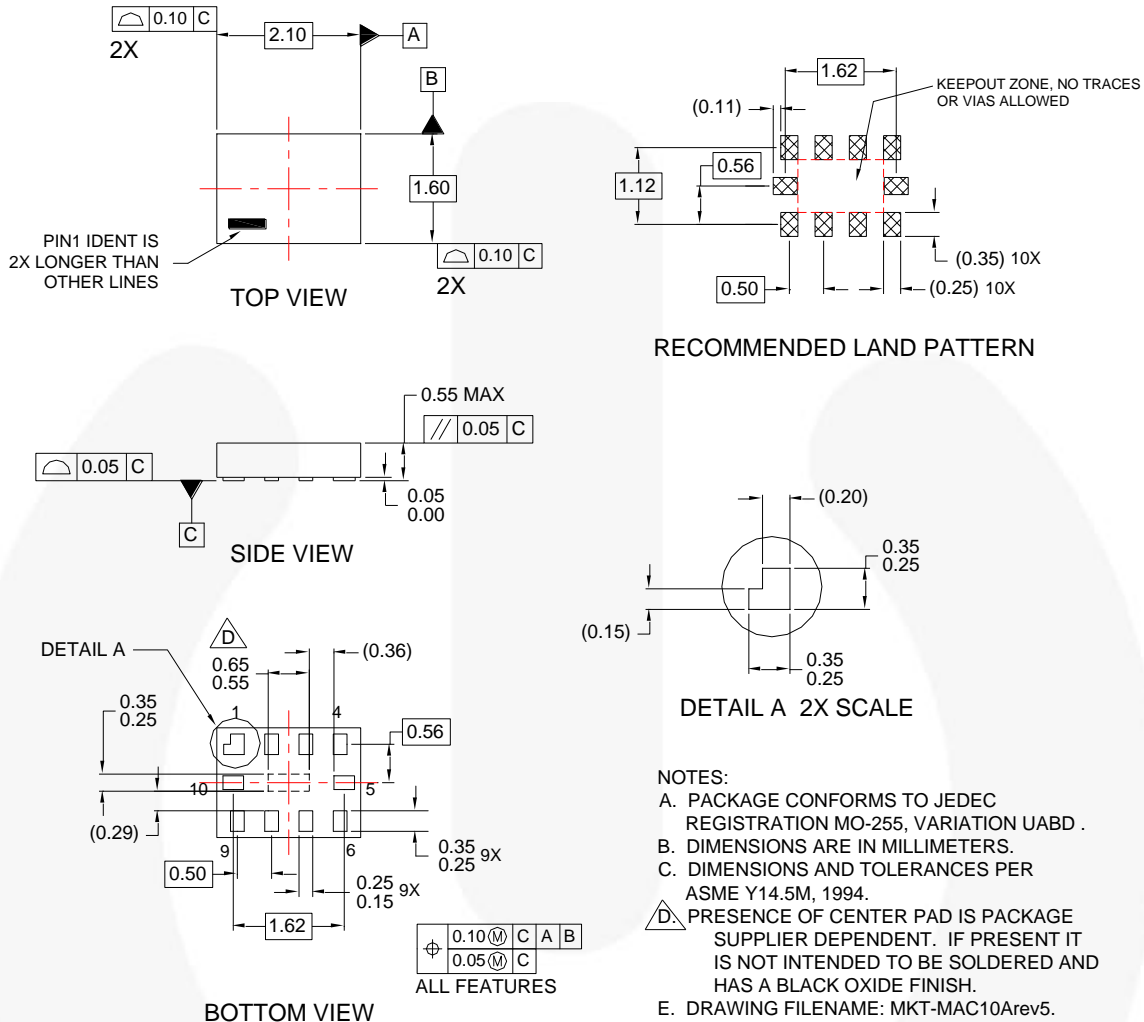


图29. 10-Lead MicroPak™

封装标志符	磁带部分	号码腔	型腔状态	封带状态
L10X	空白段 (始点终点)	125 (典型值)	空	密封
	载体	5000	装满	密封
	空白片尾 (插孔末端)	75 (典型值)	空	密封

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物理尺寸

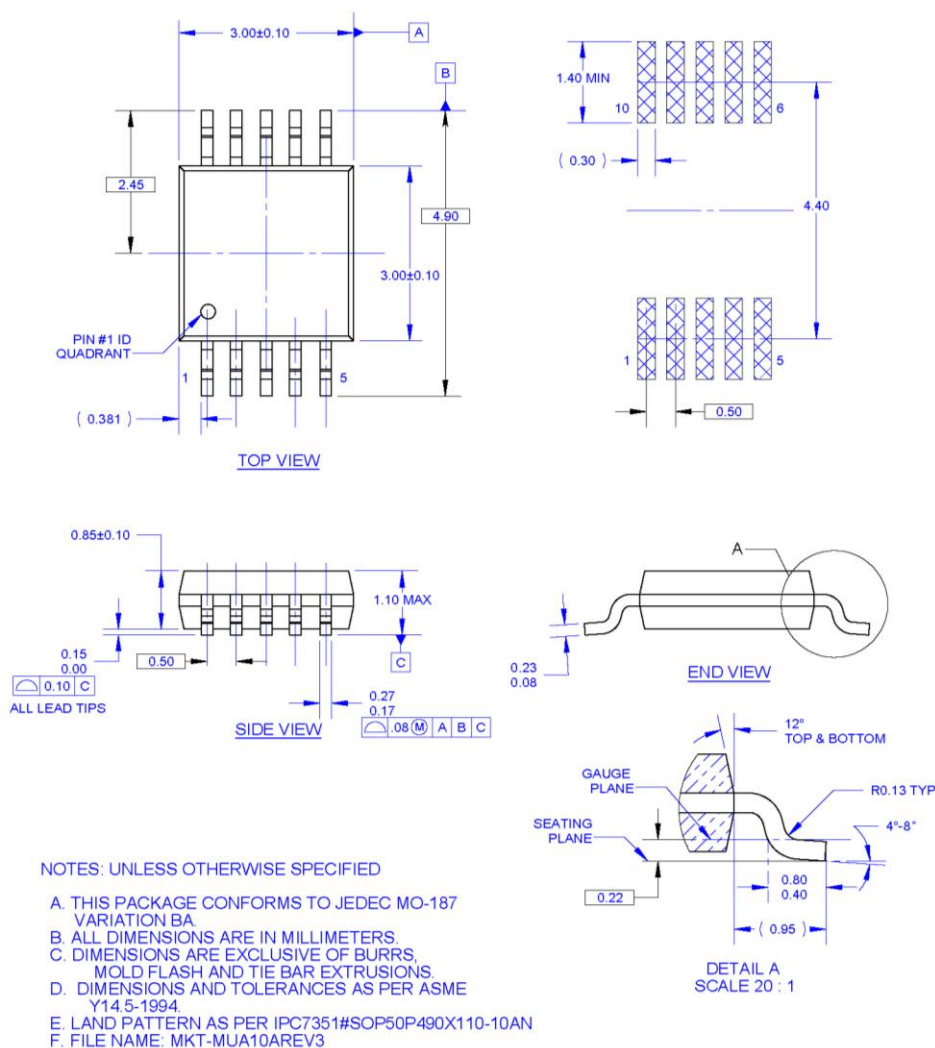


图30. 8-引脚小尺寸封装(MSOP)

磁带尺寸	A	B	C	D	N	W1	W2	W3
	13	0.059	0.512	0.795	7.008	0.448	0.724	0.486-0.606
(12mm)	(330)	(1.5)	(13)	(20.2)	(178)	(12.4)	(18.4)	(11.9-15.4)

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DEUXPEED®	Making Small Speakers Sound Louder and Better™	SmartMax™	Tran SiC™
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EcoSPARK®	MICROCOUPLER™	Solutions for Your Success™	TRUECURRENT®*
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