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FSA3030 — 高速 USB2.0/具有负摆幅音频功能的移动高清链路技术 (MHL™)

产品特性

- 低导通电容：4.2 pF/5 pF MHL/USB (典型值)
- 低功耗：30 μ A (最大值)
- 支持 MHL 版本 2.0
- MHL 数据速率：4.0 Gbps
- 音频摆幅：-1.5 V 至 +1.5 V (典型值)
- 12-引脚 UMLP 封装 (1.8 x 1.8mm)
- 所有 USB 端口上的过压容差 (OVT) 达到 5.25 V, 无外部组件

应用

- 手机和数码相机

说明

FSA3030 是一款双向、低功率、高速、3:1、USB2.0、MHL™ 技术和音频开关。它配置为双刀三掷 (DP3T) 开关, 专门针对高速或全速 USB 端口、移动高清链路源 (根据 MHL 修订版 2.0 规范) 与负摆幅能力音频之间的切换进行了优化。

FSA3030 包含开关 I/O 引脚上的特殊电路, 用于电源 V_{CC} 断开 ($V_{CC}=0$) 的应用, 使该器件能承受过压条件。此开关设计用于将电流消耗降低至最低, 即使应用于控制引脚上的控制电压低于电源电压 (V_{CC}) 时也是如此。该特性特别适合手机等移动应用, 可直接连接基带处理器的通用 I/O。其他应用包括便携手机、数码相机和笔记本电脑中实现开关和连接器共用功能。

订购信息

器件型号	顶标	工作温度范围	封装
FSA3030UMX	LU	-40 至 +85° C	12-引脚, 超薄膜塑无铅封装 (UMLP), 1.8mm x 1.8 mm

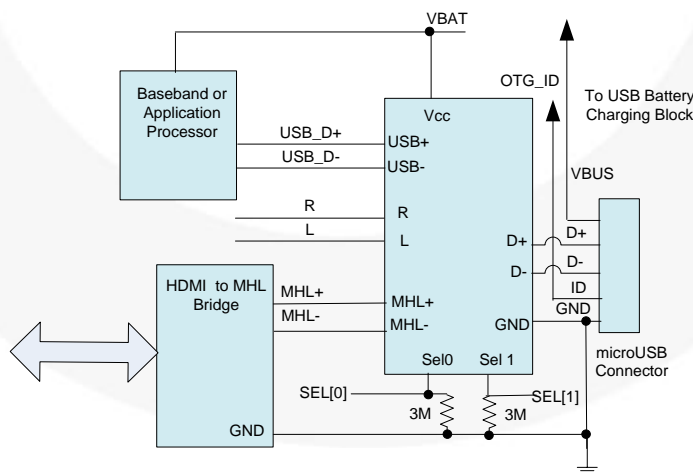


图 1. 典型应用

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模拟符号

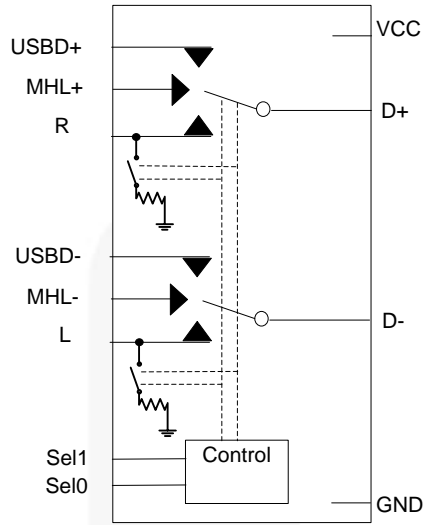


图 2. 模拟符号

Table 1. 数据开关选择真值表

SEL1 ⁽¹⁾	SELO ⁽¹⁾	分流	功能
0	0	启用	D+/D- 连接到 USB+/USB-
0	1	禁用	D+/D- 连接到 R/L
1	0	启用	D+/D- 连接到 MHL+/MHL-
1	1	启用	D+/D- 高阻态

注意:

1. 严禁悬空或断连控制输入。为了保证默认开关在 USB 位置闭合, 需使用弱下拉电阻 (3 MΩ) 把 SEL[0:1] 引脚连接到 GND 接地, 以将静态电流消耗降至最低。

引脚布局

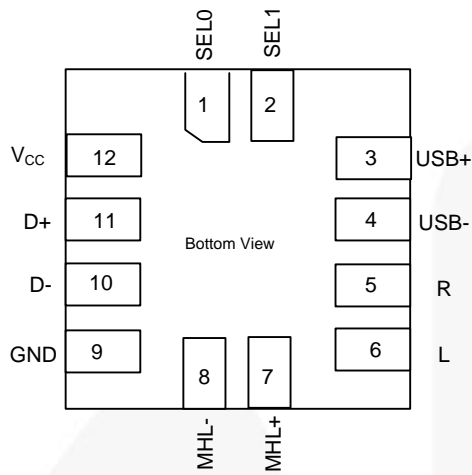


图 3. 引脚配置

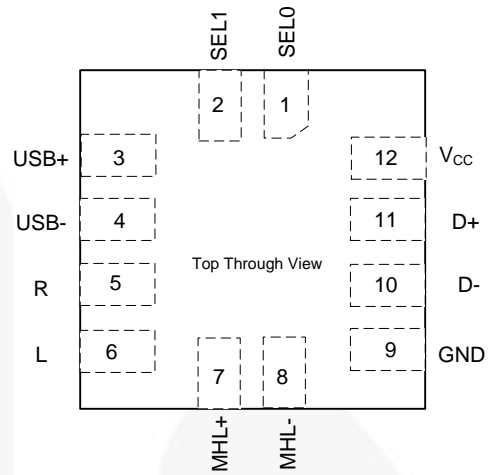


图 4. 顶视图

引脚说明

引脚号	名称	说明
1	SEL0	数据开关选择
2	SEL1	数据开关选择
3	USB1+	USB 差分数据 (正)
4	USB1-	USB 差分数据 (负)
5	R	音频 (右)
6	L	音频 (左)
7	MHL+	MHL 差分数据 (正)
8	MHL-	MHL 差分数据 (负)
9	GND	接地
10	D-	数据开关输出 (正)
11	D+	数据开关输出 (负)
12	V _{cc}	来自系统的设备电源

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。

在超出推荐的工作条件的情况下，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_{CC}	电源电压	-0.5	6.0	V	
V_{CNTRL}	直流输入电压 (SEL[1:0]) ⁽²⁾	-0.5	V_{CC}	V	
$V_{SW}^{(3)}$	直流开关 I/O 电压 ⁽²⁾	USB	-0.5	V_{CC}	V
		MHL	-0.5	V_{CC}	
		AUDIO	-2.0	3	
I_{IK}	直流输入二极管电流	-50		mA	
I_{OUT}	开关直流输出电流 (连续)	USB		60	mA
		MHL		60	mA
		音频		60	mA
$I_{OUTPEAK}$	开关直流输出峰值电流 (脉冲时间为 1 ms, 占空比 <10%)	USB		150	mA
		MHL		150	mA
		音频		150	mA
T_{STG}	存储温度	-65	+150	°C	
MSL	潮湿敏感度 JEDEC J-STD-020A		1		
ESD	IEC 61000-4-2, 4 级, 用于 D+/D- 和 V_{CC} 引脚 ⁽⁴⁾	接触式		8	kV
	IEC 61000-4-2, 4 级, 用于 D+/D- 和 V_{CC} 引脚 ⁽⁴⁾	空气放电		15	
	人体模型, JEDEC: JESD22-A114	全部引脚		3.5	
	充电器件模式, JESD22-C101			2	

说明:

- 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。
- V_{SW} 指模拟数据开关路径 (USB、MHL 和音频)。
- 在使用 TVS 二极管的系统环境中进行测试。

推荐工作条件

推荐的操作条件表定义了器件的真实工作条件。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	最小值	最大值	单位
V_{CC}	电源电压	2.5	4.5	V
$t_{RAMP(VCC)}$	电源转换速率	100	1000	$\mu\text{s}/\text{V}$
Θ_{JA}	热阻		230	°C/W
V_{CNTRL}	控制输入电压 (SEL[1:0]) ⁽⁵⁾	0	4.5	V
$V_{SW(USB)}$	开关输入/输出电压 (USB 开关路径)	-0.5	3.6	V
$V_{SW(MHL)}$	开关输入/输出电压 (MHL 开关路径)	1.65	3.45	V
$V_{SW(AUD)}$	开关输入/输出电压 (音频开关路径)	-1.5	3.0	V
T_A	工作温度	-40	+85	°C

注意:

- 控制输入必须保持高电平或低电平，不允许悬空。

直流电气特性

若无其他说明，所有典型值都在 $T_A=25^\circ\text{C}$ 下测得。

符号	参数	条件	V _{CC} (V)	T _A =-40° C 至 +85° C			单位
				最小值	典型值	最大值	
V _{IK}	箝位二极管电压	I _{IN} =-18 mA	2.5			-1.2	V
V _{IH}	控制输入高电平 SEL[1:0]		2.5 至 4.50	1.0			V
V _{IL}	控制输入低电平 SEL[1:0]		2.5 至 4.50			0.5	V
I _{IN}	控制输入漏电流 SEL[1:0]	V _{SW} (USB/MHL)=0 to 3.6 V, V _{SW} (AUD)=0 to 3.0 V, V _{CTRL} =0 to V _{CC}	4.5	-0.5		0.5	μA
I _{OZ} (MHL)	开放 MHL 数据路径关断状态漏电流	V _{SW} =1.65 ≤ MHL ≤ 3.45 V SEL[1:0]=V _{CC}	4.5	-1		1	μA
I _{OZ} (USB)	开放 USB 数据路径关断状态漏电流	V _{SW} =0 ≤ USB ≤ 3.6 V SEL[1:0]=V _{CC}	4.5	-0.5		0.5	μA
I _{OL} (MHL)	封闭 MHL 数据路径导通状态漏电流 ⁽⁶⁾	V _{SW} =1.65 ≤ MHL ≤ 3.45 V, SEL0=GND, SEL1=V _{CC} , 另一侧 开关浮动	4.5	-0.75		0.75	μA
I _{OL} (USB)	封闭 USB 数据路径导通状态漏电流 ⁽⁶⁾	V _{SW} =0 ≤ USB ≤ 3.6 V SEL[1:0]=GND, 另一侧开关浮动	4.5	-0.75		0.75	μA
I _{OL} (AUD)	封闭 ⁽⁶⁾ 音频数据路径导通状态漏电流	V _{SW} =-1.5 ≤ R/L ≤ 1.5 V SEL1=GND, SEL0=V _{CC} , 另一侧开关 浮动	4.5	-1.0		1.0	μA
I _{OFF}	关机漏电流 (全部输入/输出端口)	V _{SW} (USB/MHL)=0 to 3.6 V, V _{SW} (AUD)=0 to 3.0 V, 图 5	0	-1		1	μA
R _{ON} (USB)	HS 开关导通电阻 (USB 至 D 路径)	V _{SW} =0.4 V, I _{ON} =-8 mA, SEL[1:0]=GND, 图 6	2.5			4.5	Ω
R _{ON} (MHL)	HS 开关导通电阻 (MHL 至 D 路径)	V _{SW} =V _{CC} -1050 mV, SEL0=GND, SEL1=V _{CC} I _{ON} =-8 mA, 图 6	2.5			5	Ω
R _{ON} (AUDIO)	音频开关导通电阻 (R/L 路径)	V _{SW} = -1.5 V to 1.5 V, SEL1=GND, SEL0=V _{CC} , I _{ON} =-24 mA, 图 6	2.5			4	Ω
ΔR _{ON} (MHL)	R _{ON} 在 MHL 正负极之间的差异	V _{SW} =V _{CC} -1050 mV, SEL0=GND, SEL1=V _{CC} , I _{ON} =-8 mA, 图 6,	2.5			0.03	Ω
ΔR _{ON} (USB)	R _{ON} 在 USB 正负极之间的差异	V _{SW} =0.4V, I _{ON} = - 8mA, SEL[1:0]=GND, 图 6	2.5			0.18	Ω
R _{ONF} (MHL)	R _{ON} MHL 路径平坦度	V _{SW} =1.65 to 3.45V, SEL0=GND, SEL1=V _{CC} , I _{ON} =-8 mA, 图 6	2.5			1	Ω
R _{ONFA} (AUDIO)	R _{ON} 音频路径平坦度	V _{SW} =-1.5 V to 1.5 V, SEL1=GND, SEL0=V _{CC} , I _{ON} =-24 mA, 图 6	2.5			0.1	Ω
R _{SH}	分流电阻		3.6			125 200	Ω
I _{CC}	静态电流	V _{CTRL} =0 或 4.5 V, I _{OUT} =0	4.5			30	μA
I _{CCT}	每个控制引脚静态电流 Δ 增 量	V _{CTRL} =1.65 V, I _{OUT} =0	4.5			18	μA
		V _{CTRL} =2.5 V, I _{OUT} =0	4.5			10	

注意:

6. 对于该项测试，使用相应的悬空开关引脚将数据开关闭合。

交流电气特性

若无其他说明, 所有典型值都在 $V_{CC}=3.3\text{ V}$, $T_A=25^\circ\text{ C}$ 下测得。

符号	参数	条件	V_{CC} (V)	$T_A=-40^\circ\text{ C}$ 至 $+85^\circ\text{ C}$			单位
				最小值	典型值	最大值	
t_{ONUSB}	USB 导通时间, SEL[1:0] 至输出	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW(USB)}=0.8\ \text{V}$, $V_{SW(MHL)}=3.3\ \text{V}$, $V_{SW(AUD)}=1.5\ \text{V}$, 图 7, 图 8	2.5 至 3.6		445	600	ns
t_{OFFUSB}	USB 关断时间, SEL[1:0] 至输出	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW(USB)}=0.8\ \text{V}$, $V_{SW(MHL)}=3.3\ \text{V}$, $V_{SW(AUD)}=1.5\ \text{V}$, 图 7, 图 8	2.5 至 3.6		445	600	ns
t_{ONAUD}	音频导通时间, SEL[1:0] 至输出	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW(USB)}=0.8\ \text{V}$, $V_{SW(MHL)}=3.3\ \text{V}$, $V_{SW(AUD)}=1.5\ \text{V}$, 图 7, 图 8	2.5 至 3.6		445	600	ns
t_{OFFAUD}	音频关断时间, SEL[1:0] 至输出	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW(USB)}=0.8\ \text{V}$, $V_{SW(MHL)}=3.3\ \text{V}$, $V_{SW(AUD)}=1.5\ \text{V}$, 图 7, 图 8	2.5 至 3.6		445	600	ns
t_{ONMHL}	MHL 导通时间, SEL[1:0] 至输出	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW(USB)}=0.8\ \text{V}$, $V_{SW(MHL)}=3$, $V_{SW(AUD)}=1.5\ \text{V}$	2.5 至 3.6		445	600	ns
t_{OFFMHL}	MHL 关断时间, SEL[1:0] 至输出	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{SW(USB)}=0.8\ \text{V}$, $V_{SW(MHL)}=3.3\ \text{V}$, $V_{SW(AUD)}=1.5\ \text{V}$, 图 7, 图 8	2.5 至 3.6		445	600	ns
t_{PD}	传输延迟 ⁽⁷⁾	$C_L=5\ \text{pF}$, $R_L=50\ \Omega$, 图 7	2.5 至 3.6		0.25		ns
t_{BBM}	先开后合 ⁽⁷⁾	$R_L=50\ \Omega$, $C_L=5\ \text{pF}$, $V_{AUD}=1.5\ \text{V}$, $V_{MHL}=3.3\ \text{V}$, $V_{USB}=0.8\ \text{V}$, 图 10	2.5 至 3.6		350		ns
$O_{IRR(MHL)}$	关断隔离 ⁽⁷⁾	$V_S=1\ \text{V}_{pk-pk}$, $R_L=50\ \Omega$, $f=240\ \text{MHz}$, 图 11	2.5 至 3.6		-33		dB
$O_{IRR(USB)}$		$V_S=400\ \text{mV}_{pk-pk}$, $R_L=50\ \Omega$, $f=240\ \text{MHz}$, 图 11	2.5 至 3.6		-38		dB
$Xtalk_{MHL}$	非相邻通道 ⁽⁷⁾ 串扰	$V_S=1\ \text{V}_{pk-pk}$, $R_L=50\ \Omega$, $f=240\ \text{MHz}$, 图 12	2.5 至 3.6		-44		dB
$Xtalk_{USB}$		$V_S=400\ \text{mV}_{pk-pk}$, $R_L=50\ \Omega$, $f=240\ \text{MHz}$, 图 12	2.5 至 3.6		-39		dB
$Xtalk_{AUD}$		$V_S=100\ \text{mV}_{RMS}$, $R_L=32\ \Omega$, $f=20\ \text{kHz}$, 图 12	2.5 至 3.6		-70		dB
THD	总谐波失真度 ⁽⁷⁾	$R_L=32\ \Omega$, $V_{SW}=2\ \text{V}_{pk-pk}$, $f=20\ \text{Hz}$ to $20\ \text{kHz}$, $V_{BIAS}=0\ \text{V}$	2.5		0.01		%
BW	S_{DD21} 差分 -3db 带宽 ⁽⁷⁾	$V_{IN}=1\ \text{V}_{pk-pk}$, 共模电压 $=V_{CC} - 1.1\ \text{V}$, MHL 路径, $R_L=50\ \Omega$, $C_L=0\ \text{pF}$, 图 13	2.5 至 3.6		2.0		GHz
		$V_{IN}=400\ \text{mV}_{pk-pk}$, 共模电压 $=0.2\ \text{V}$, USB 路径, $R_L=50\ \Omega$, $C_L=0\ \text{pF}$, 图 13			1.80		
		音频路径, $R_L=50\ \Omega$, $C_L=0\ \text{pF}$			50		MHz

注意:

7. 由产品特性保证。

USB 高速交流电气特性

若无其他说明, 所有典型值都在 $T_A=25^\circ\text{C}$ 下测得。

符号	参数	条件	V_{CC} (V)	典型值	单位
$t_{SK(P)}$	在相同输出下, 反向转换的时滞 ⁽⁸⁾	$C_L=5\text{ pF}$, $R_L=50\ \Omega$, 图 14	3.0 至 3.6	3	ps
t_J	总抖动 ⁽⁸⁾	$R_L=50\ \Omega$, $C_L=5\text{ pF}$, $t_R=t_F=500\text{ ps}$ (10–90%) at 480 Mbps, PN7	3.0 至 3.6	15	ps

注意:

8. 由产品特性保证。

MHL 交流电气特性

若无其他说明, 所有典型值都在 $T_A=25^\circ\text{C}$ 下测得。

符号	参数	条件	V_{CC} (V)	典型值	单位
$t_{SK(P)}$	在相同输出下, 反向转换的时滞 ⁽⁹⁾	$R_{PU}=50\ \Omega$ to V_{CC} , $C_L=0\text{ pF}$	3.0 至 3.6	3	ps
t_J	总抖动 ⁽⁹⁾	$f=2.25\text{ Gbps}$, PN7, $R_{PU}=50\ \Omega$ 至 V_{CC} , $C_L=0\text{ pF}$	3.0 至 3.6	26	ps

注意:

9. 由产品特性保证。

电容值

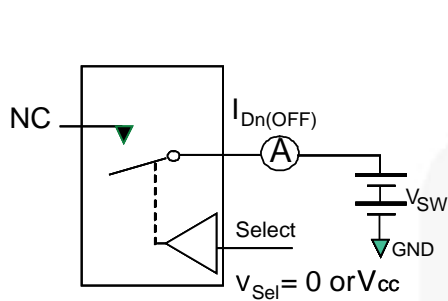
若无其他说明, 所有典型值都在 $T_A=25^\circ\text{C}$ 下测得。

符号	参数	条件	典型值	单位
C_{IN}	控制引脚输入电容 ⁽¹⁰⁾	$V_{CC}=0\text{ V}$, $f=1\text{ MHz}$	1.5	pF
$C_{ON(USB)}$	USB 路径导通电容 ⁽¹⁰⁾	$V_{CC}=3.3\text{ V}$, $f=240\text{ MHz}$, 图 15	6.5	
$C_{OFF(USB)}$	USB 路径关断电容 ⁽¹⁰⁾	$V_{CC}=3.3\text{ V}$, $f=240\text{ MHz}$, 图 16	2.5	
$C_{ON(MHL)}$	MHL 路径导通电容 ⁽¹⁰⁾	$V_{CC}=3.3\text{ V}$, $f=240\text{ MHz}$, 图 15	6.5	
$C_{OFF(MHL)}$	MHL 路径关断电容 ⁽¹⁰⁾	$V_{CC}=3.3\text{ V}$, $f=240\text{ MHz}$, 图 16	2.5	
$C_{ON(AUD)}$	音频路径导通电容 ⁽¹⁰⁾	$V_{CC}=3.3\text{ V}$, $f=1\text{ MHz}$, 图 15	8.0	
$C_{OFF(AUD)}$	音频路径关断电容 ⁽¹⁰⁾	$V_{CC}=3.3\text{ V}$, $f=1\text{ MHz}$, 图 16	2.5	

注意:

10. 由产品特性保证。

测试框图



**Each switch port is tested separately

图 5. 关断漏电

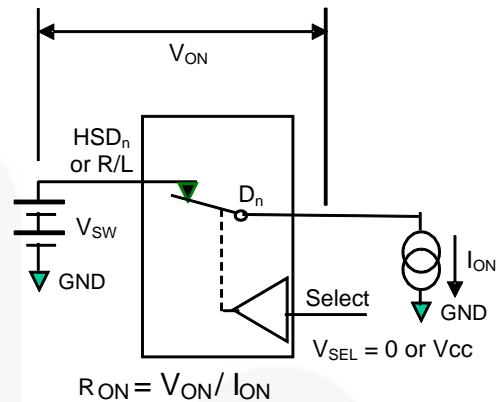
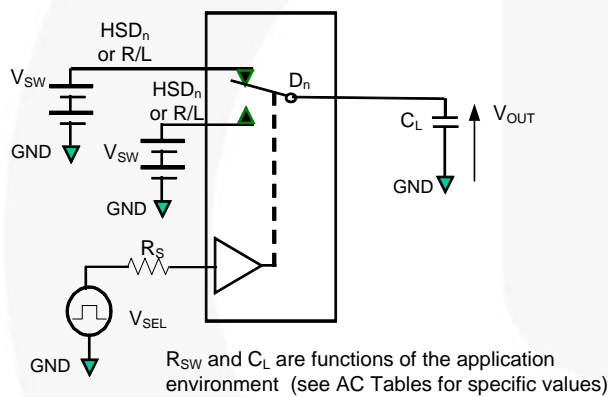


图 6. 导通电阻



R_{SW} and C_L are functions of the application environment (see AC Tables for specific values)

图 7. 交流测试电路负载

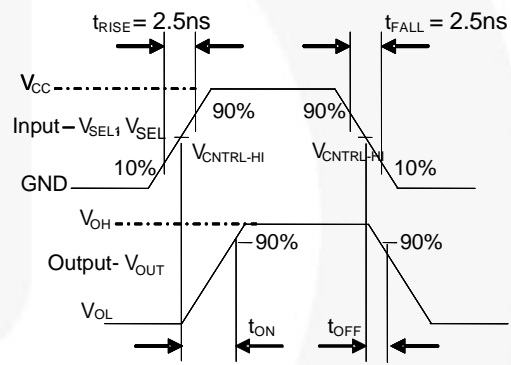


图 8. 开通/关断波形

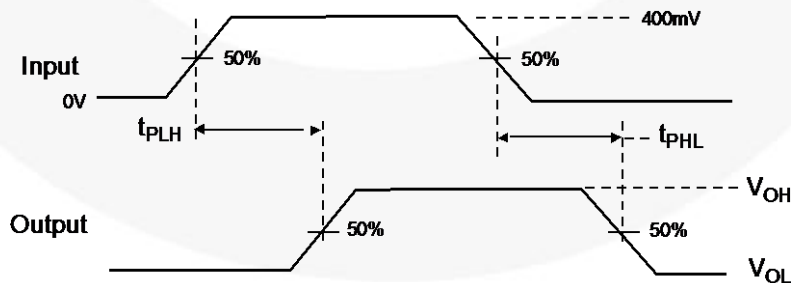
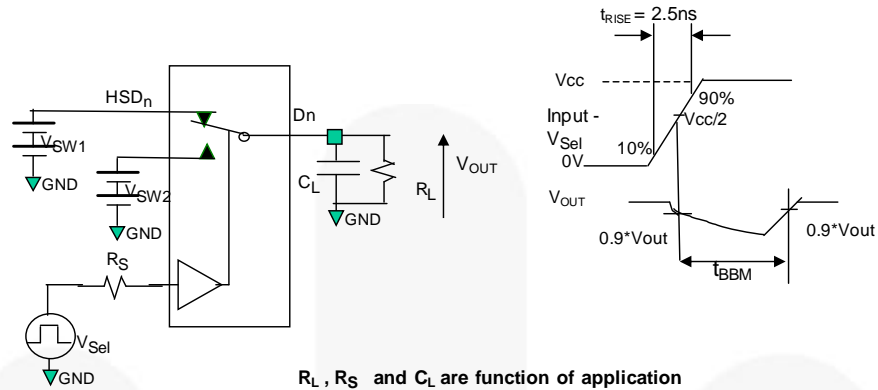


图 9. 传输延迟 ($t_{rtf} = 500ps$)

注意:

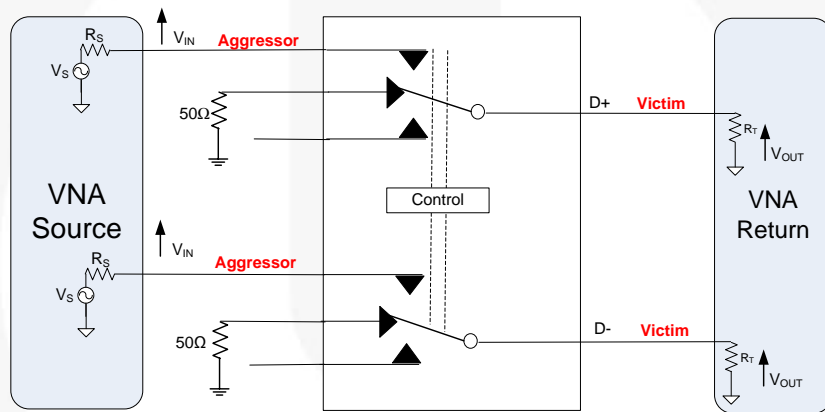
11. HSD_n 指高速数据 USB 或 MHL 路径。

测试框图



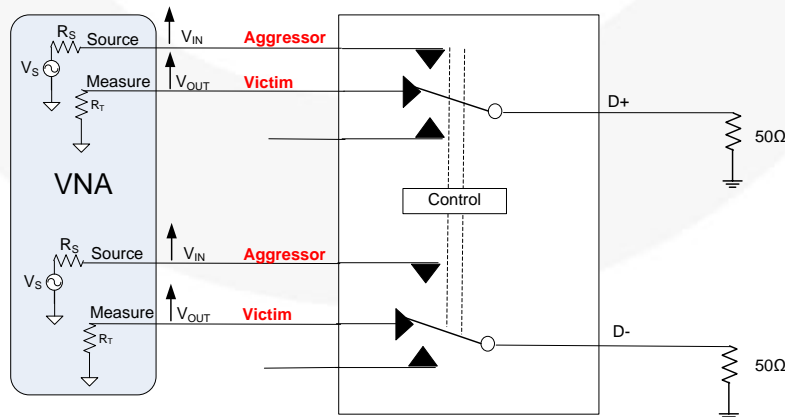
R_L , R_S and C_L are function of application environment (see AC Tables for specific values)
 C_L includes test fixture and stray capacitance

图 10. 先开后合间隔时序



V_S , R_S and R_T are functions of the application environment (see AC/DC Tables for values).
 Off Isolation = $20 \text{ Log} (V_{OUT} - V_{IN})$

图 11. 沟道关断隔离 (SDD21)



V_S , R_S and R_T are functions of the application environment (see AC/DC Tables for values).
 Off Isolation = $20 \text{ Log} (V_{OUT} - V_{IN})$

图 12. 非相邻通道间串扰 (SDD21)

测试框图

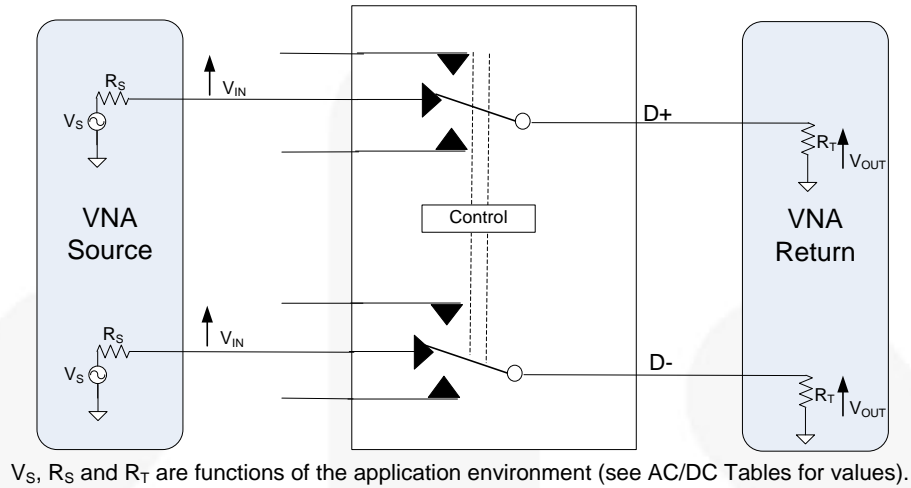


图 13. 插入损耗 (SDD21)

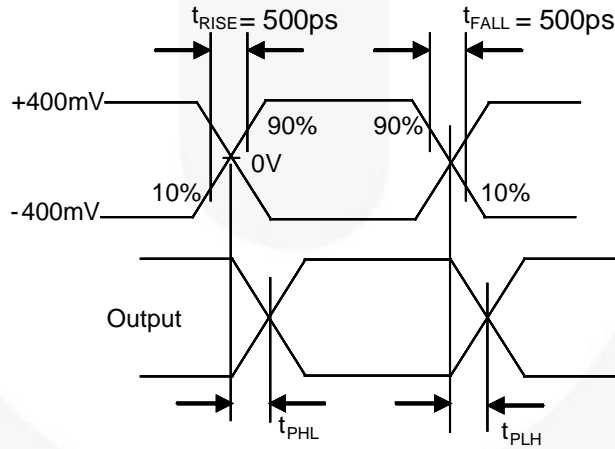


图 14. 内部成对时滞测试 $t_{SK(P)}$

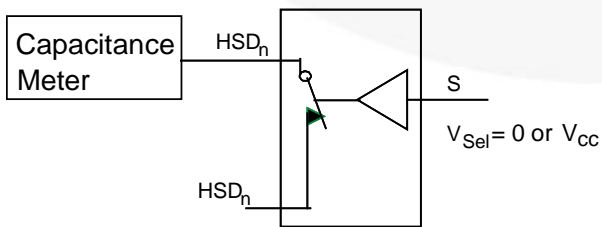


图 15. 通道导通电容

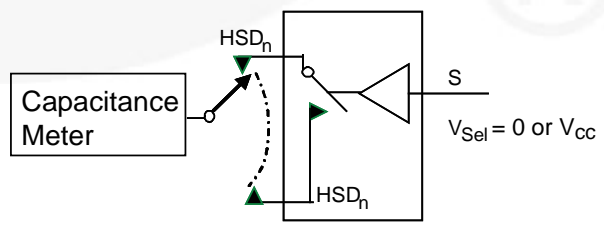


图 16. 通道关断电容

功能说明

插入损耗

FSA3030

在移动数字视频应用中的主要优点之一就是接收信号的插入损耗低，因为该插入损耗通过了开关。这就使收到的眼图信号劣化程度降至最低。测量高数据速率信道质量的方法之一就是使用平衡端口和四端口差分 S 参数分析法，尤其是 SDD21。

带宽测量使用 S 参数 SDD21 方法。



图 17. MHL 路径 SDD21 插入损耗曲线



图 18. USB 路径 SDD21 插入损耗曲线

典型应用

图 19 显示利用 V_{BAT} 连接的 FSA3030。通过微型 USB 连接器进行制造测试时，阻值为 3M 的电阻器确保 FSA3030 配置连接到基带或应用处理器。

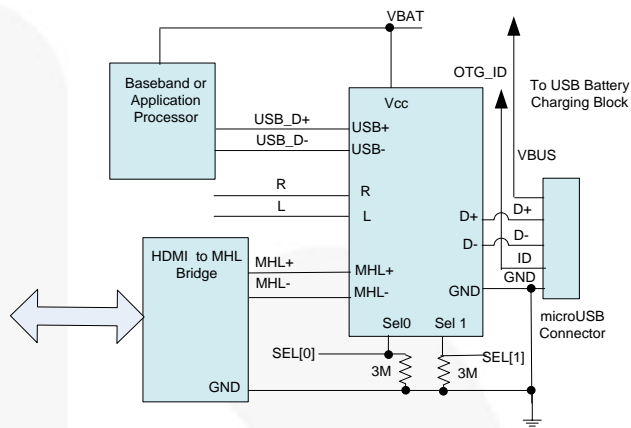
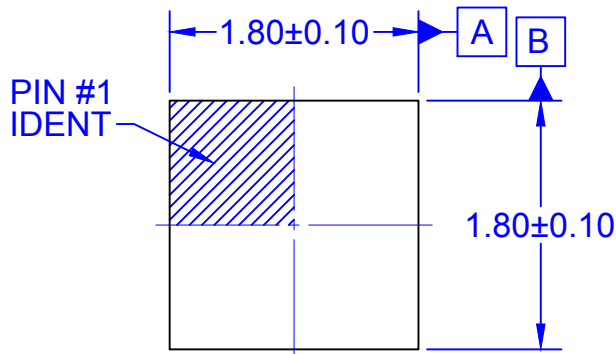


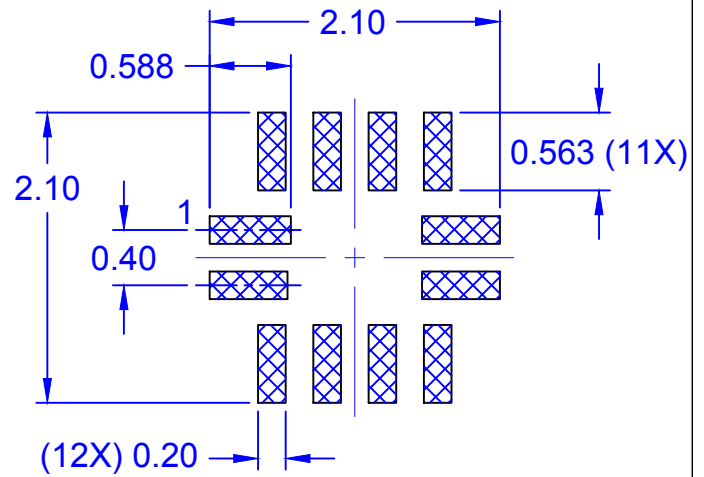
图 19. MHL 路径 SDD21 插入损耗曲线

产品规格尺寸

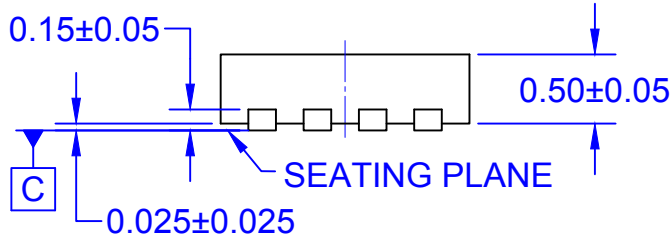
说明	标称值 (mm)
总高度	0.50
封装离板高度	0.012
引脚厚度	0.15
引脚宽度	0.20
引脚长度	0.40
引脚间距	0.40
器件长度 (X)	最小值: 1.70, 标称值: 1.80, 最大值: 1.90
器件宽度 (Y)	最小值: 1.70, 标称值: 1.80, 最大值: 1.90
引脚 1 标称长度	0.40
引脚 1 标称宽度	0.20
引脚 1 标称锥长度	0.10
引脚 1 标称锥深度	0.10
引脚 1 标称尖非锥宽度	0.10



TOP VIEW



RECOMMENDED LAND PATTERN

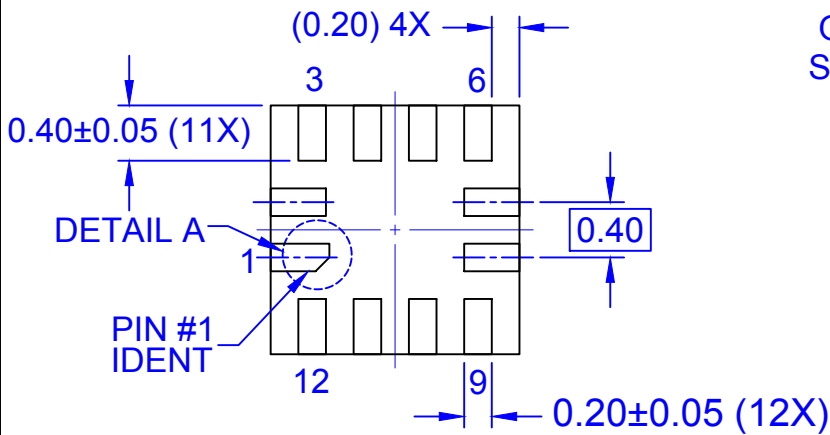


SIDE VIEW



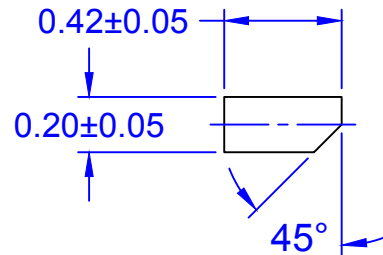
LEAD
OPTION 1
SCALE 2:1

LEAD
OPTION 2
SCALE 2:1



BOTTOM VIEW

⊕	0.10	C	A	B
	0.05	C		



DETAIL A
SCALE 2:1

NOTES:

- A. PACKAGE DOES NOT CONFORM TO ANY JEDEC STANDARD.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.
- D. DRAWING FILENAME: MKT-UMLP12ArevF

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