19-4127; Rev 0; 5/08

MAXIM

USB 2.0高速差分8:1复用器

概述

高速、差分USB模拟多路复用器MAX4999是一款低导通电容(C_{ON})开关，可理想用于USB服务器/大容量存储器。MAX4999用于USB 2.0低速/全速/高速应用，支持高达480Mbps的数据速率。

MAX4999为差分8:1多路复用器，MAX4999具有3个控制信号通路的数字输入。典型应用包括8路USB主机与一个USB外设之间的切换。

为将功耗降至最低，可利用使能输入(EN)关闭所有通道并将器件置于高阻态(待机模式)，关闭电荷泵。

MAX4999采用+3.0V至+3.6V供电，工作在-40°C至+85°C扩展级温度范围。器件提供5mm x 5mm、32引脚TQFN封装。

应用

键盘、视频、鼠标(KVM)

服务器/RAID

大容量存储

工作站

特性

- ◆ +3.0V至+3.6V单电源供电
- ◆ 6.5Ω (典型值)低导通电阻(R_{ON})
- ◆ -3dB带宽：1200MHz (典型值)
- ◆ 使能输入可将所有通道置于高阻态(待机模式)
- ◆ 低工作电流(1µA)及超低待机静态电流(30nA)
- ◆ 低门限，用于1.8V低压系统时无需电平转换
- ◆ 小尺寸32引脚、5mm x 5mm、TQFN封装

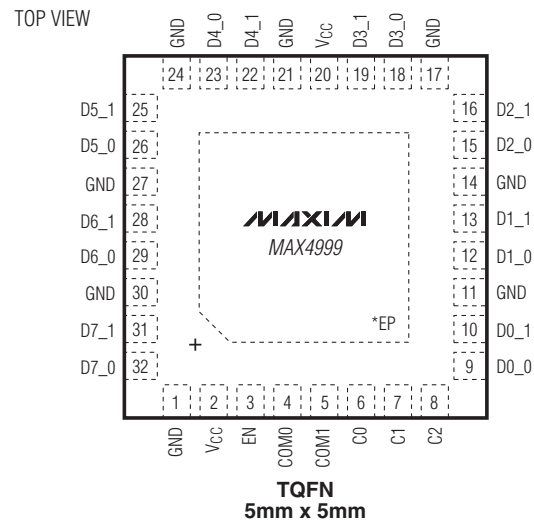
定购信息

PART	TEMP RANGE	PIN-PACKAGE
MAX4999ETJ+	-40°C to +85°C	32 TQFN-EP*

+表示无铅封装。

**EP = 裸焊盘。*

引脚配置



TQFN
5mm x 5mm

*CONNECT EXPOSED PAD TO GND.

ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND.)
V_{CC} .....-0.3V to +4V
All Other Pins (Note 1).....-0.3V to +4V
Continuous Current (COM_ to any switch) .....±60mA
Peak Current (COM_ to any switch) (pulsed at 1ms, 10% duty cycle).....±120mA
Continuous Power Dissipation (T_A = +70°C)
32-Lead TQFN (derate 34.5mW/°C above +70°C) 2759mW
Junction-to-Case Thermal Resistance (θ_{JC}) (Note 2)
32-Lead TQFN .....2.0°C/W
Junction-to-Ambient Thermal Resistance (θ_{JA}) (Note 2)
32-Lead TQFN .....29°C/W
Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: Signals exceeding GND are clamped by internal diodes. Limit forward-diode current to maximum current rating.
Note 2: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maxim-ic.com.cn/thermal-tutorial**.

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +3.0V to +3.6V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.3V and T_A = +25°C.) (Note 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
POWER SUPPLY						
Supply Voltage	V_{CC}		3.0		3.6	V
Quiescent Supply Current	I_O	Charge pump on			5	µA
		Charge pump off			1	
ANALOG SWITCH						
On-Resistance	R_{ON}	$I_{COM\_}$ = ±10mA		6.5	12	Ω
On-Resistance Match	ΔR_{ONSC}	$V_{COM\_}$ = 1V, T_A = +25°C			0.8	Ω
On-Resistance Match Between Channels	ΔR_{ONBC}	$V_{COM\_}$ = 1V, T_A = +25°C			1	Ω
Leakage Current COM_, D_0, D_1	I_L	V_{CC} = +3.6V	-1		+1	µA
SWITCH AC PERFORMANCE (Note 4)						
Crosstalk	V_{DCT1}	Any switch to non-paired switch at 500MHz (Figure 3)		-30		dB
Off-Isolation	V_{OFF}	Any switch to non-paired switch at 240MHz (Figure 3)		-27		dB
Bandwidth -3dB	BW	R_L = 45Ω unbalanced (Figure 3)		1200		MHz
On-Capacitance	C_{ON}	f = 1MHz		6		pF
		Taken from S11 parameters at f = 240MHz		3.0		
Off-Capacitance	C_{OFF}	f = 1MHz, COM_		5		pF
		Taken from S11 parameters at f = 240MHz		3.0		
Propagation Delay	t_{PD}	R_L = R_S = 50Ω (Figure 2)		300		ps
Turn-On Time	t_{ON}	V_{D0} or V_{D1} = +1.5V, R_L = 300Ω, C_L = 35pF, V_{IH} = V_{CC}, V_{IL} = 0V (Figure 1)		10		µs

ELECTRICAL CHARACTERISTICS

(V_{CC} = +3.0V to +3.6V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.3V and T_A = +25°C.) (Note 3)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Turn-Off Time	t_{OFF}	V_{D0} or V_{D1} = +1.5V, R_L = 300Ω, C_L = 35pF, V_{IH} = V_{CC}, V_{IL} = 0V (Figure 1)		10		µs
Output Skew Same Port	t_{PD}	Skew between any D_0, D_1 line, same port 45Ω unbalanced I/O, f = 240MHz (Figure 2)		30		ps
SWITCH LOGIC						
Input Logic Low	V_{IL}	V_{CC} = +3.0V			0.6	V
Input Logic High	V_{IH}	V_{CC} = +3.6V	1.7			V
Input Logic Hysteresis	V_{HYST}			200		mV
Input Leakage Current	I_{LEAK}	V_{CC} = +3.6V, $V_{COM\_}$ = 0V or V_{CC}	-1		+1	µA
ESD PROTECTION						
All Pins		Human Body Model		±2		kV

Note 3: All units are 100% production tested at T_A = +85°C. Limits over the operating temperature range are guaranteed by design and not production tested.

Note 4: Guaranteed by design.

测试电路/时序图

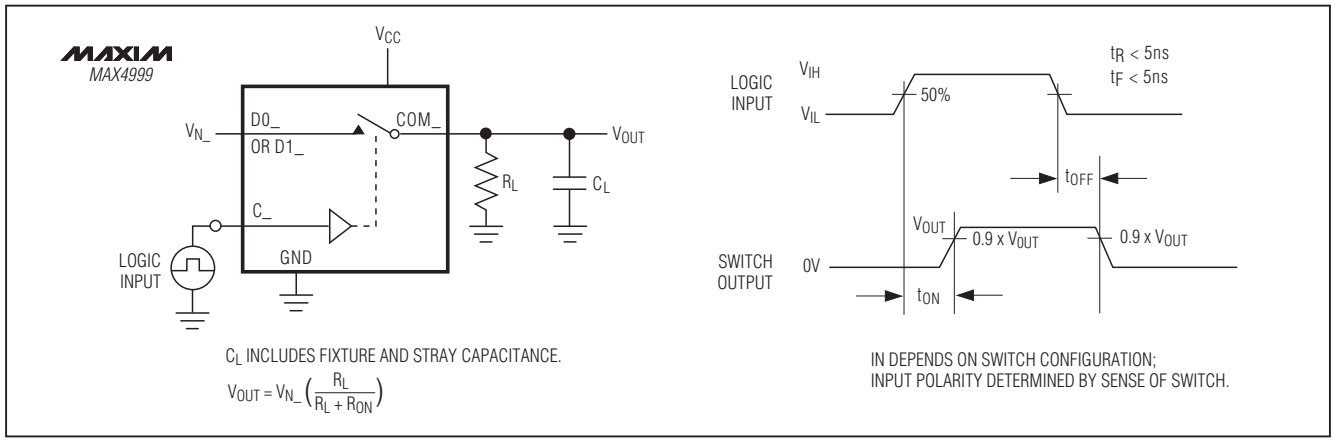


图1. 开关时间

测试电路/时序图(续)

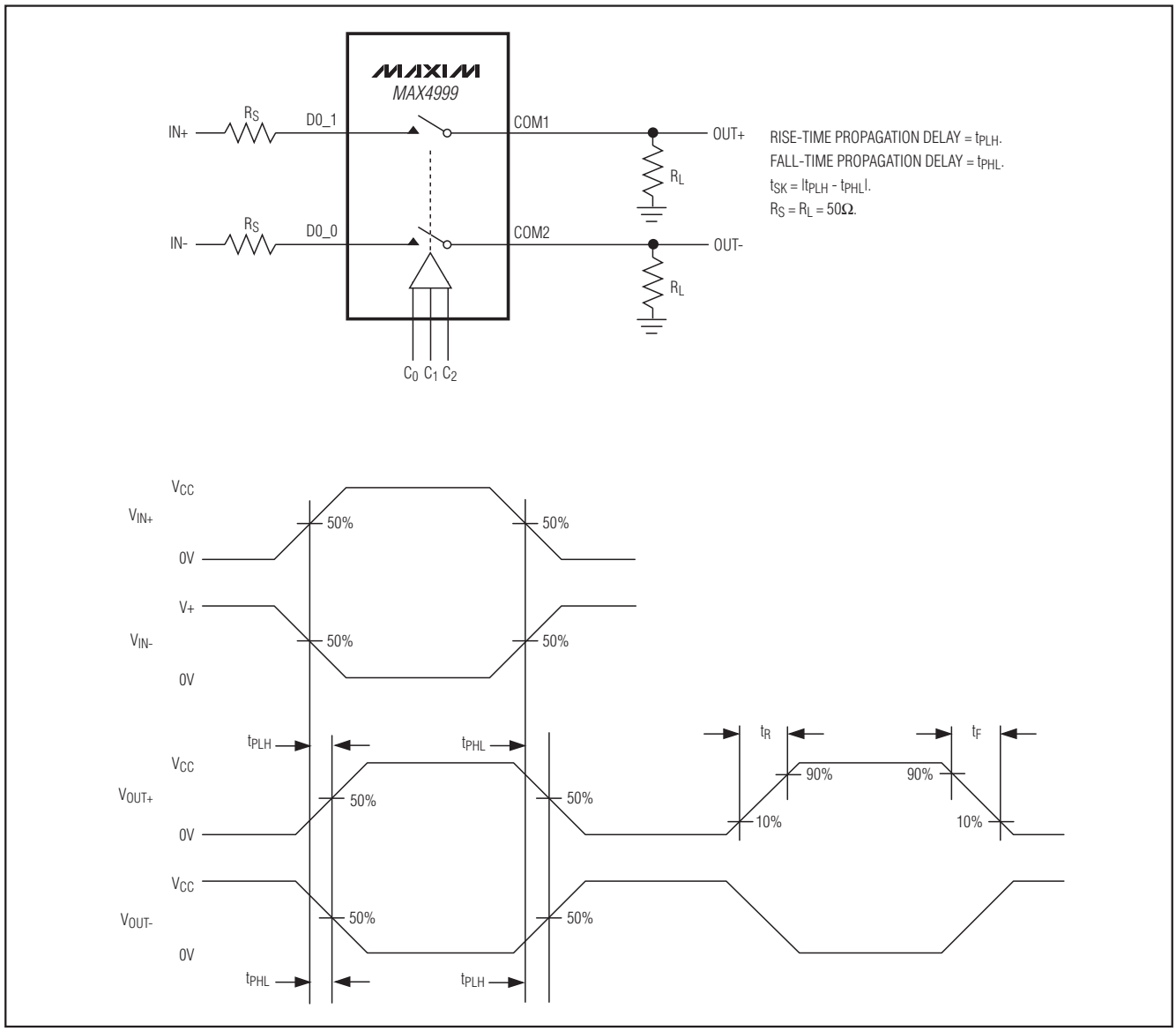


图2. 传输延迟和偏移

测试电路/时序图(续)

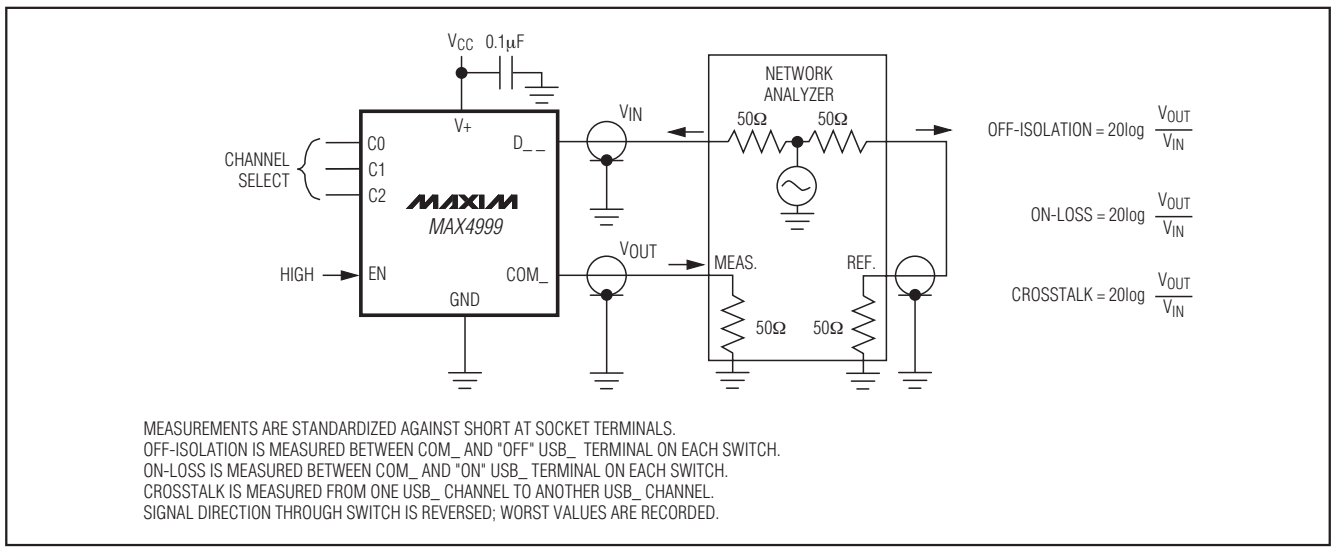
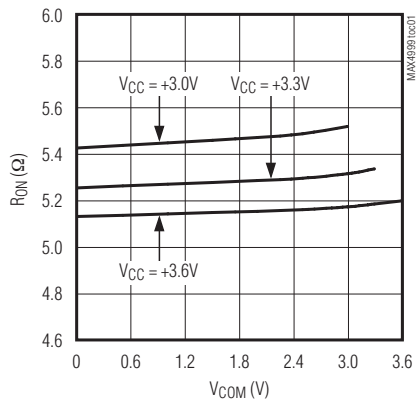


图3. 关断隔离、导通损耗和串扰

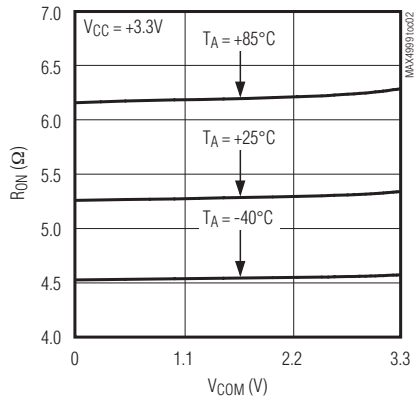
典型工作特性

(V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted.)

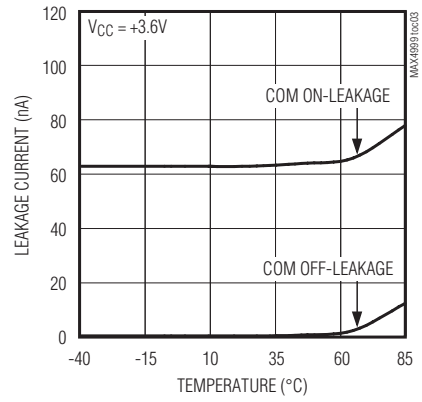
ON-RESISTANCE vs. V_{COM}



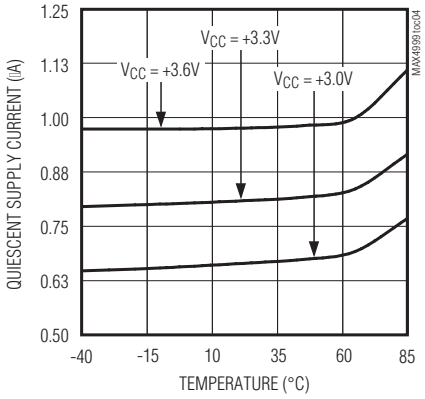
ON-RESISTANCE vs. V_{COM}



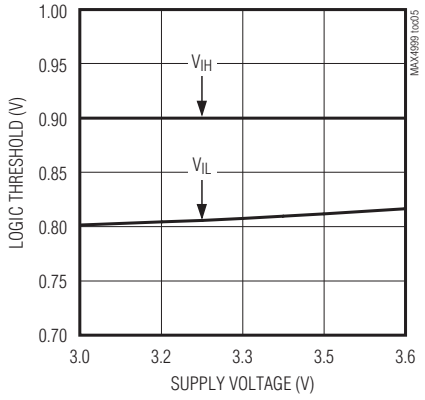
LEAKAGE CURRENT vs. TEMPERATURE



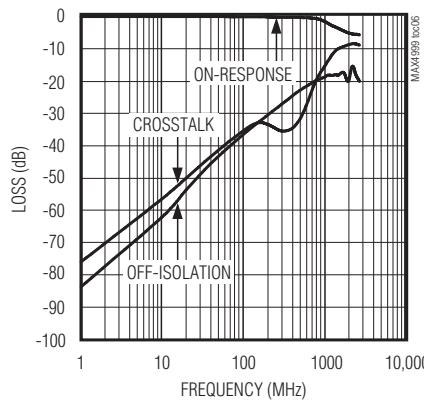
QUIESCENT SUPPLY CURRENT vs. TEMPERATURE



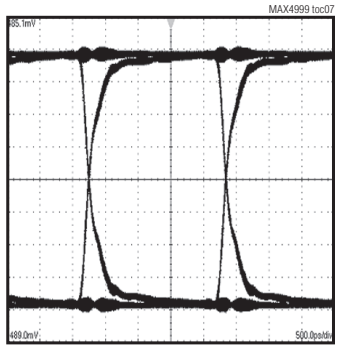
LOGIC THRESHOLD vs. SUPPLY VOLTAGE



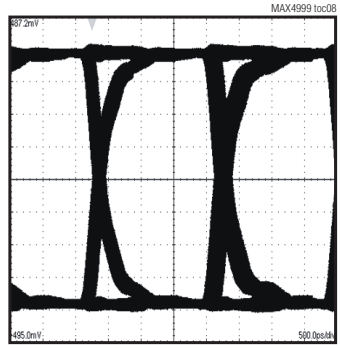
FREQUENCY RESPONSE



EYE DIAGRAM - SINGLE



EYE DIAGRAM - DOUBLE



引脚说明

引脚	名称	功能
1, 11, 14, 17, 21, 24, 27, 30	GND	地。
2, 20	V_{CC}	电源输入。在尽量靠近V_{CC}处用一个0.1µF电容将V_{CC}旁路至GND。
3	EN	使能输入。
4	COM0	模拟开关的公共D-端。
5	COM1	模拟开关的公共D+端。
6	C0	控制输入0。
7	C1	控制输入1。
8	C2	控制输入2。
9	D0_0	模拟开关0的D-端。
10	D0_1	模拟开关0的D+端。
12	D1_0	模拟开关1的D-端。
13	D1_1	模拟开关1的D+端。
15	D2_0	模拟开关2的D-端。
16	D2_1	模拟开关2的D+端。
18	D3_0	模拟开关3的D-端。
19	D3_1	模拟开关3的D+端。
22	D4_1	模拟开关4的D+端。
23	D4_0	模拟开关4的D-端。
25	D5_1	模拟开关5的D+端。
26	D5_0	模拟开关5的D-端。
28	D6_1	模拟开关6的D+端。
29	D6_0	模拟开关6的D-端。
31	D7_1	模拟开关7的D+端。
32	D7_0	模拟开关7的D-端。
—	EP	裸焊盘。将EP连接至GND或悬空。

详细说明

MAX4999差分高速USB模拟复用器具有高性能信号切换所需的低导通电容(C_{ON})和低导通电阻(R_{ON})。低C_{ON}专为USB服务器/大容量存储设备设计。该器件非常适合高速USB 2.0 (480Mbps)应用，同时也支持USB低速/全速应用。

数字控制输入(C0、C1、C2)

MAX4999提供了3路数字控制输入(C0、C1、C2)选择COM_和D-/D+通道之间的模拟信号通路。MAX4999的真值表如*功能框图/真值表*所示，满幅驱动控制输入可将功耗降至最小。

使能输入(EN)

MAX4999有一个使能输入，拉至低电平时，器件处于待机模式。待机模式下，所有通道为高阻态，内部电荷泵关闭，使静态电流降至最低。正常工作时，将EN拉高。

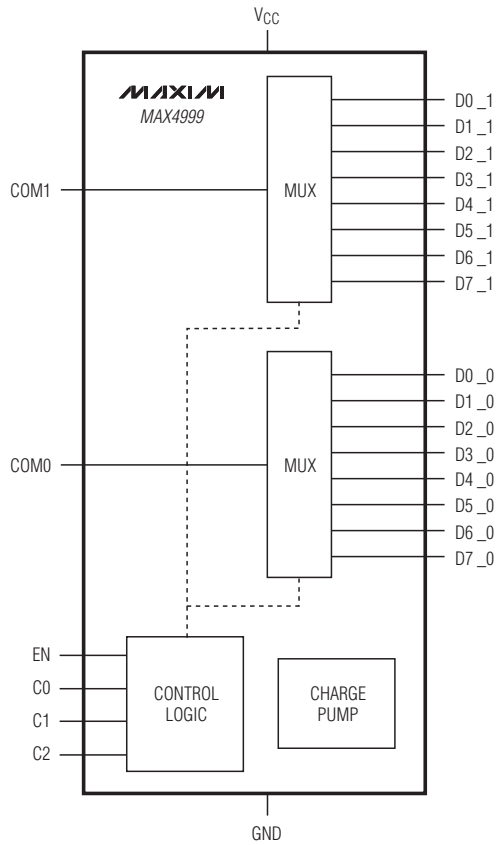
模拟信号电平

COM1端的信号被切换到D_ _1端；COM0端的信号被切换到D_ _0端。该复用器为双向工作，COM_和D-/D+端可配置为输入或输出。此外，只要信号处于正常工作范围，MAX4999也可用于切换非USB信号。

MAX4999有一个内部电荷泵，允许信号电平高于电源电压。请将模拟输入/输出信号的电平限制在*Absolute Maximum Ratings*中列出的额定值以内。

USB 2.0高速差分8:1复用器

功能框图/真值表



MAX4999				
EN	**C2**	**C1**	**C0**	**FUNCTION**
1	0	0	0	COM_→D0
1	0	0	1	COM_→D1
1	0	1	0	COM_→D2
1	0	1	1	COM_→D3
1	1	0	0	COM_→D4
1	1	0	1	COM_→D5
1	1	1	0	COM_→D6
1	1	1	1	COM_→D7
0	X	X	X	STANDBY MODE. ALL SWITCHES IN HIGH-IMPEDANCE STATE. CHARGE PUMP IS OFF.

X = DON'T CARE

应用信息

增加USB通道

MAX4999具有一个使能输入，允许两片MAX4999级连使用，以实现16个USB通道的复用。图4所示典型应用电路将单个USB公共端复用到8个通道(8:1)，传输性能请参考*典型工作特性*中的Eye Diagram - Single图。图5所示2片MAX4999配置能够将USB公共端复用到16个USB通道(16:1)，传输性能请参考*典型工作特性*中的Eye Diagram - Double图。MAX4999为对称设计，所以两个公共端可以用非常短的连接线并联，构成16:1配置。采用16:1配置时，将第二个器件的COM0和COM1互换，可以使D+和D-引脚反向，大大减少过孔和交叉引线(图5)。

USB开关

MAX4999模拟复用器完全符合USB 2.0规范，MAX4999的低导通电阻和低导通电容使其非常适合高性能开关应用。

电路板布局

高速切换需要合理的电路布局和设计，以优化系统性能。尽量缩短电阻受控的PCB走线，选择高质量陶瓷电容(X7R、X5R或更好)作为旁路，并将电容尽量靠近器件放置，采用尽可能大的接地面积。

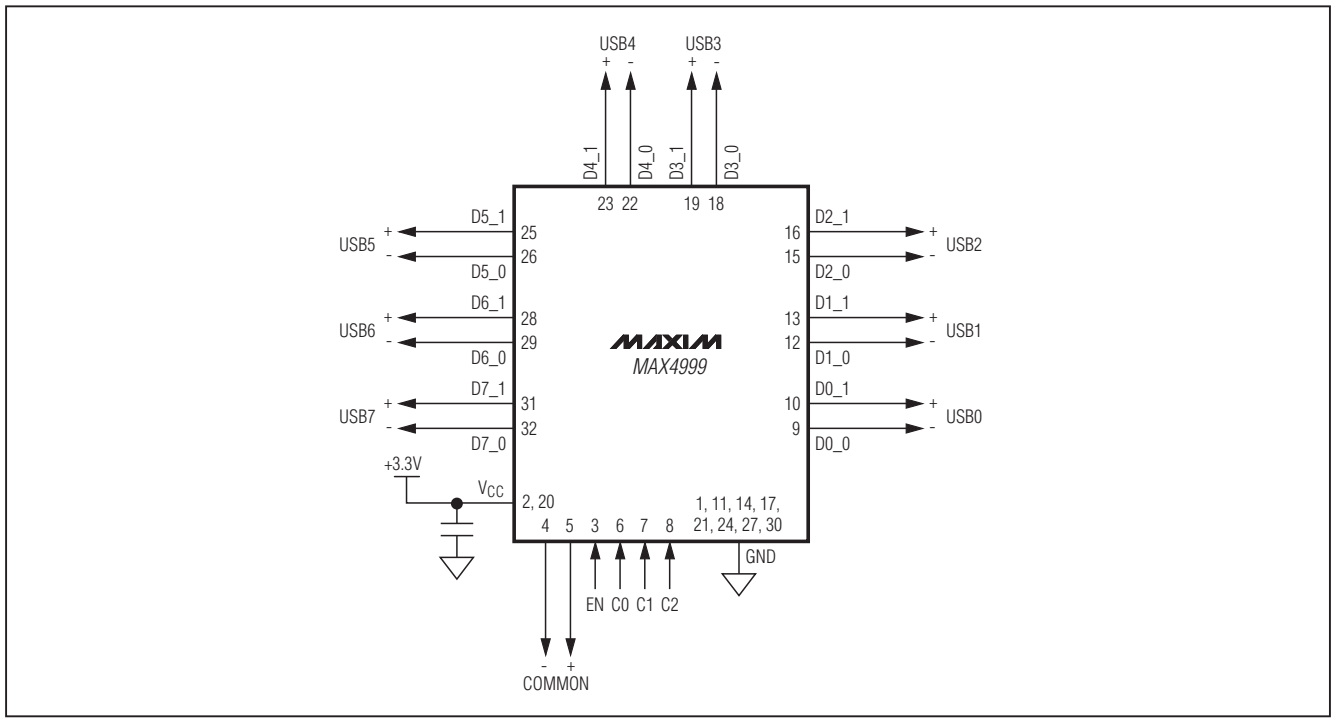


图4. MAX4999实现8路差分通道复用(8:1)

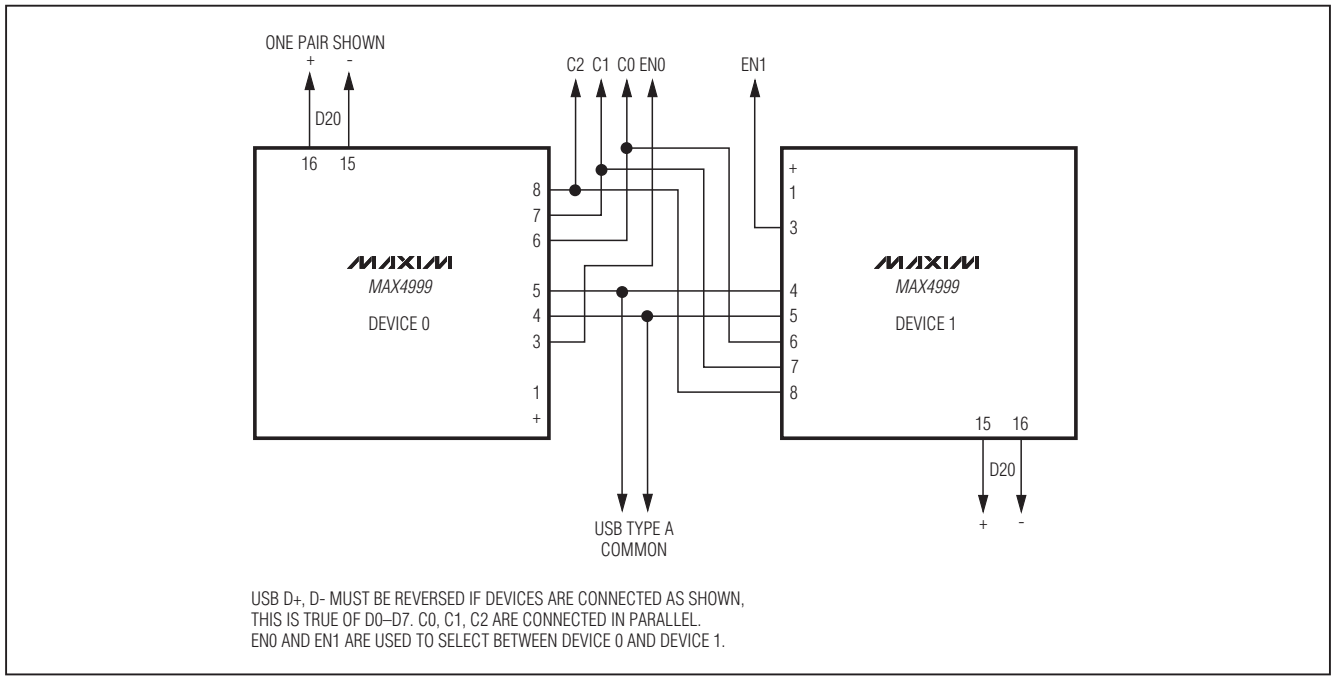


图5. 2片MAX4999实现16:1 USB连接

USB 2.0高速差分8:1复用器

芯片信息

PROCESS: CMOS

封装信息

如需最近的封装外形信息，请查询
www.maxim-ic.com.cn/packages。

封装类型	封装编码	文档编号
32 TQFN-EP	T3255-4	**21-0140**

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