

2.5Gbps PCI Express 无源开关

概述

MAX4888/MAX4889 高速无源开关可在两个指定端口之间切换 PCI Express® (PCIe) 数据。MAX4888 是四路单刀/双掷 (4 x SPDT) 开关, 非常适合在两个端口之间切换 2 路单向 PCIe 数据。MAX4889 是八路单刀/双掷 (8 x SPDT) 开关, 能够在四个端口之间切换 4 路单向 PCIe 数据。MAX4888/MAX4889 具有一个数字控制输入 (SEL), 用于切换信号路径。

MAX4888/MAX4889 工作于 3.0V 至 3.6V 单电源, 并可工作在低至 +1.65V 的电压。MAX4888 提供 3.5mm x 5.5mm、28 引脚 TQFN 封装; MAX4889 提供 3.5mm x 9.0mm、42 引脚 TQFN 封装。工作温度范围为 -40°C 至 +85°C。

应用

台式计算机
服务器/存储区域网
膝上型电脑

特性

- ◆ 1.65V 至 3.6V 单电源供电
- ◆ 相同线对的输出偏差为 7ps
- ◆ 120μA (最大值) 低静态电流
- ◆ 支持 PCIe Gen I 数据速率
- ◆ 顺畅的引脚排列, 便于布线
- ◆ 引脚兼容于工业标准产品
- ◆ 无铅封装

订购信息/选型指南

PART	PIN-PACKAGE	CONFIGURATION	PKG CODE
MAX4888ETI+	28 TQFN-EP*	Two Half Lanes	T283555-1
MAX4889ETO+	42 TQFN-EP*	Four Half Lanes	T423590M-1

注: 所有器件指定工作在 -40°C 至 +85°C 温度范围。

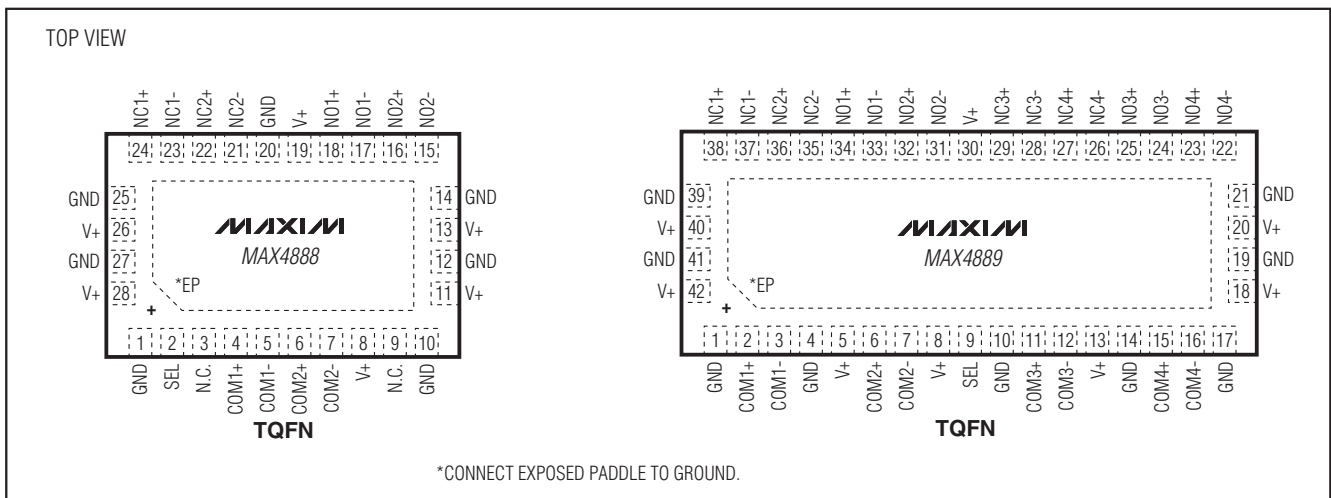
+ 表示无铅封装。

*EP = 裸焊盘。

PCI Express 是 PCI-Sig Corp. 的注册商标。

典型应用电路在数据资料的最后给出。

引脚配置



2.5Gbps PCI Express 无源开关

MAX4888/MAX4889

ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND, unless otherwise noted.)

V+	.....-0.3V to +4V
SEL, COM__, NO__, NC_ (Note 1)	.....-0.3V to (V+ + 0.3V)
I COM__ - NO__ I, I COM__ - NC_ I (Note 1)	.....0 to 2V
Continuous Current (COM__ to NO__/NC__)	.....±70mA
Peak Current (COM__ to NO__/NC__)	.....±70mA
(pulsed at 1ms, 10% duty cycle)	.....±70mA
Continuous Current (SEL)	.....±30mA
Peak Current (SEL)	.....±30mA
(pulsed at 1ms, 10% duty cycle)	.....±150mA

Continuous Power Dissipation (T_A = +70°C)

28-Pin TQFN (derate 20.8mW/°C above +70°C)	....1666.7mW
42-Pin TQFN (derate 35.7mW/°C above +70°C)	....2857.1mW
Operating Temperature Range	.....-40°C to +85°C
Storage Temperature Range	.....-65°C to +150°C
Lead Temperature (soldering, 10s)	.....+300°C
Junction Temperature	.....+150°C

Note 1: Signals on SEL, NO__, NC__ or COM__ exceeding V+ or GND are clamped by internal diodes. Limit forward-diode current to maximum current rating.

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+ = 3.0V to 3.6V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V+ = 3.3V, T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ANALOG SWITCH						
Analog-Signal Range	V _{COM_} , V _{NO_} , V _{NC_}		-0.1	(V+ - 1.2)		V
Voltage Between COM and NO/NC	I V _{COM_} - V _{NO_} I, I V _{COM_} - V _{NC_} I		0		1.8	V
On-Resistance	R _{ON}	V+ = 3.0V, I _{COM_} = 15mA, V _{NO_} or V _{NC_} = 0V, 1.8V		7		Ω
On-Resistance Match Between Pairs of Same Channel	ΔR _{ON}	V+ = 3.0V, I _{COM_} = 15mA, V _{NO_} or V _{NC_} = 0V (Notes 3, 4)		0.1	1	Ω
On-Resistance Match Between Channels	ΔR _{ON}	V+ = 3.0V, I _{COM_} = 15mA, V _{NO_} or V _{NC_} = 0V (Notes 3, 4)		0.6	2	Ω
On-Resistance Flatness	R _{FLAT(ON)}	V+ = 3.0V, I _{COM_} = 15mA V _{NO_} or V _{NC_} = 0V, 1.8V (Notes 4, 5)		0.06	2	Ω
NO_ or NC_ Off-Leakage Current	I _{NO_(OFF)} I _{NC_(OFF)}	V+ = 3.6V; V _{COM_} = 0V, 1.8V; V _{NO_} or V _{NC_} = 1.8V, 0V	-1		+1	μA
COM_ On-Leakage Current	I _{COM_(ON)}	V+ = 3.6V; V _{COM_} = 0V, 1.8V; V _{NO_} or V _{NC_} = V _{COM_} or unconnected	-1		+1	μA

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ELECTRICAL CHARACTERISTICS (continued)

(V+ = 3.0V to 3.6V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V+ = 3.3V, T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DYNAMIC							
Turn-On Time	t _{ON}	V _{NO_} or V _{NC_} = 1.0V, R _L = 50Ω, Figure 1			90	250	ns
Turn-Off Time	t _{OFF}	V _{NO_} or V _{NC_} = 1.0V, R _L = 50Ω, Figure 1			10	50	ns
Propagation Delay	t _{PD}	R _S = R _L = 50Ω, unbalanced, Figure 2			50		ps
Output Skew Between Pairs	t _{SK1}	R _S = R _L = 50Ω, unbalanced; skew between any two pairs, Figure 2			50		ps
Output Skew Between Same Pair	t _{SK2}	R _S = R _L = 50Ω, unbalanced; skew between two lines on same pair, Figure 2			10		ps
On-Loss	G _{LOS}	R _S = R _L = 50Ω, unbalanced, Figure 3	1MHz < f < 100MHz		-0.5		dB
			500MHz < f < 1.25GHz		-1.4		
Crosstalk	V _{CT1}	Crosstalk between any two pairs, R _S = R _L = 50Ω, unbalanced, Figure 3	f = 50MHz		-53		dB
			f = 1.25GHz		-32		
Signaling Data Rate	BR	R _S = R _L = 50Ω			3.0		Gbps
Off-Isolation	V _{ISO}	Signal = 0dBm, R _S = R _L = 50Ω, Figure 3	f = 10MHz		-56		dB
			f = 1.25GHz		-26		
NO_/NC_ Off-Capacitance	C _{NO_/NC_(OFF)}	Figure 4			1		pF
COM_ On-Capacitance	C _{COM_(ON)}	Figure 4			2		pF
LOGIC INPUT							
Input-Logic Low	V _{IL}					0.5	V
Input-Logic High	V _{IH}			1.4			V
Input-Logic Hysteresis	V _{HYST}				100		mV
Input Leakage Current	I _{IN}	V _{SEL} = 0V or V+		-1		+1	μA
POWER SUPPLY							
Power-Supply Range	V+			1.65		3.60	V
V+ Supply Current	I+	V _{SEL} = 0V or V+	MAX4888			60	μA
			MAX4889			120	

Note 2: All units are 100% production tested at T_A = +85°C. Limits over the operating temperature range are guaranteed by design and characterization and are not production tested.

Note 3: ΔR_{ON} = R_{ON} (MAX) - R_{ON} (MIN).

Note 4: Guaranteed by design. Not production tested.

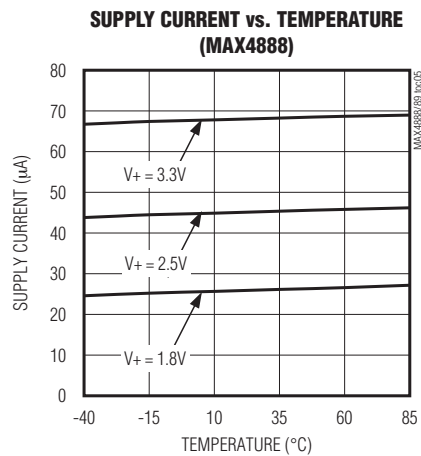
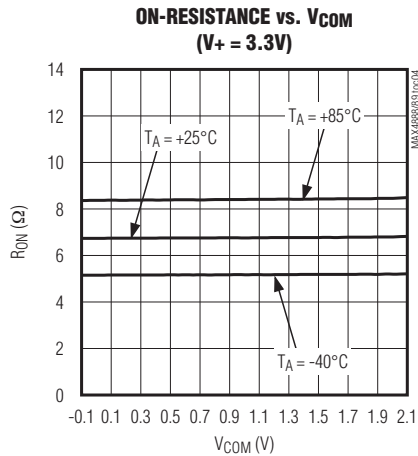
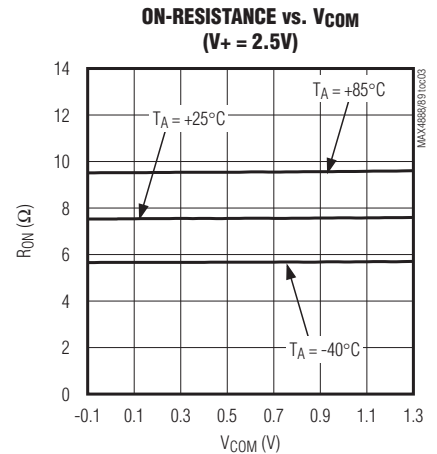
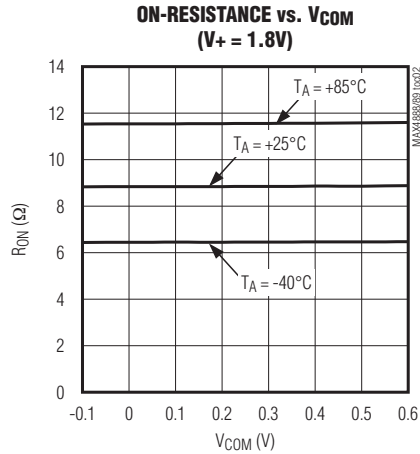
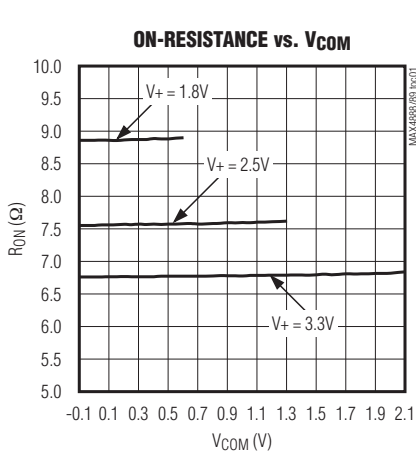
Note 5: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

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MAX4888/MAX4889

典型工作特性

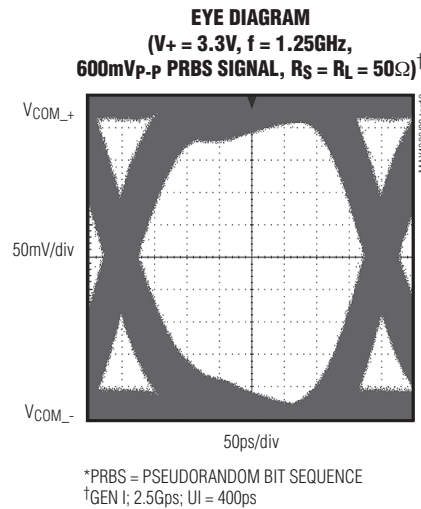
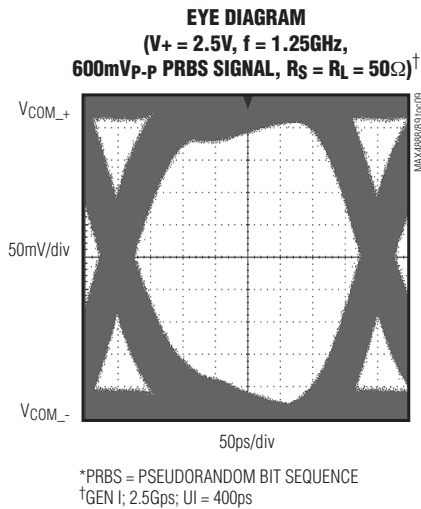
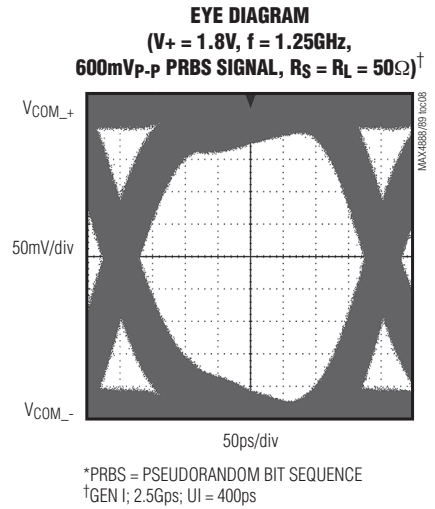
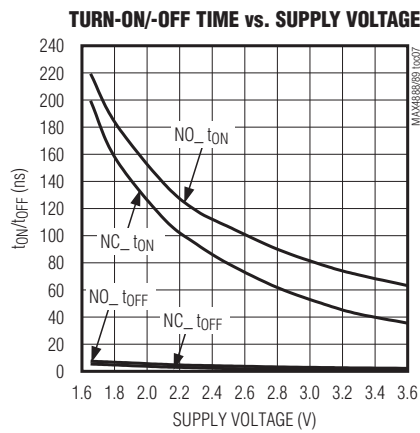
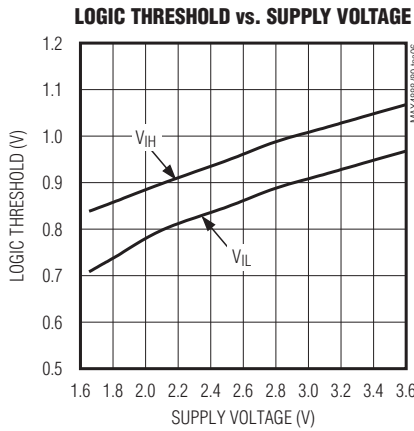
($T_A = +25^\circ\text{C}$, unless otherwise noted.)



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典型工作特性(续)

($T_A = +25^\circ\text{C}$, unless otherwise noted.)



MAX4888/MAX4889

2.5Gbps PCI Express无源开关

MAX4888/MAX4889

引脚说明

引脚		名称	功能
MAX4888	MAX4889		
1, 10, 12, 14, 20, 25, 27	1, 4, 10, 14, 17, 19, 21, 39, 41	GND	地。
2	9	SEL	数字控制输入。
3, 9	—	N.C.	没有连接, 内部无连接。
4	2	COM1+	模拟开关1, 公共端正端。
5	3	COM1-	模拟开关1, 公共端负端。
6	6	COM2+	模拟开关2, 公共端正端。
7	7	COM2-	模拟开关2, 公共端负端。
8, 11, 13, 19, 26, 28	5, 8, 13, 18, 20, 30, 40, 42	V+	正电源电压输入, 将V+连接到1.65V至3.6V的电源电压。利用0.1 μ F电容将V+旁路至GND, 电容须尽可能靠近器件放置(请参考电路板布局部分)。
15	31	NO2-	模拟开关2, 常开端负端。
16	32	NO2+	模拟开关2, 常开端正端。
17	33	NO1-	模拟开关1, 常开端负端。
18	34	NO1+	模拟开关1, 常开端正端。
21	35	NC2-	模拟开关2, 常闭端负端。
22	36	NC2+	模拟开关2, 常闭端正端。
23	37	NC1-	模拟开关1, 常闭端负端。
24	38	NC1+	模拟开关1, 常闭端正端。
—	11	COM3+	模拟开关3, 公共端正端。
—	12	COM3-	模拟开关3, 公共端负端。
—	15	COM4+	模拟开关4, 公共端正端。
—	16	COM4-	模拟开关4, 公共端负端。
—	22	NO4-	模拟开关4, 常开端负端。
—	23	NO4+	模拟开关4, 常开端正端。
—	24	NO3-	模拟开关3, 常开端负端。
—	25	NO3+	模拟开关3, 常开端正端。
—	26	NC4-	模拟开关4, 常闭端负端。
—	27	NC4+	模拟开关4, 常闭端正端。
—	28	NC3-	模拟开关3, 常闭端负端。
—	29	NC3+	模拟开关3, 常闭端正端。
EP	EP	EP	裸焊盘, 将EP连接至GND。

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测试电路/时序图

MAX4888/MAX4889

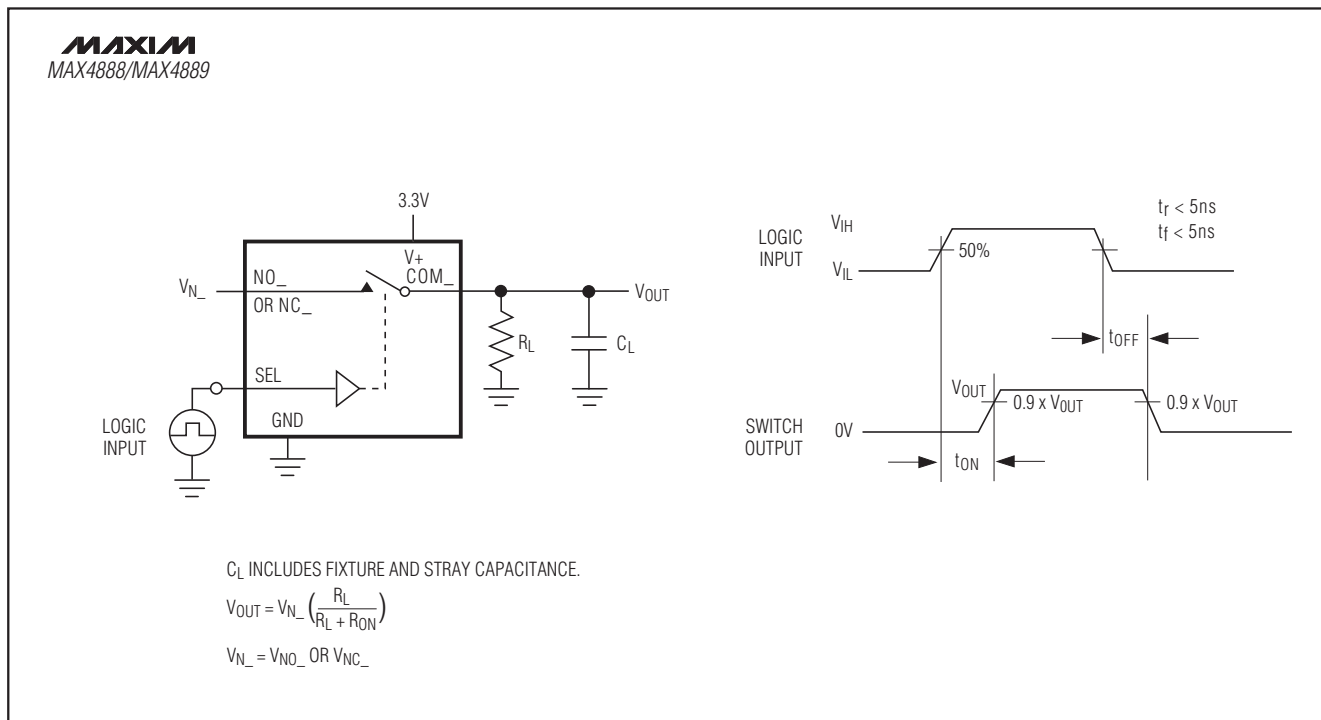


图1. 开关时序

2.5Gbps PCI Express 无源开关

测试电路/时序图(续)

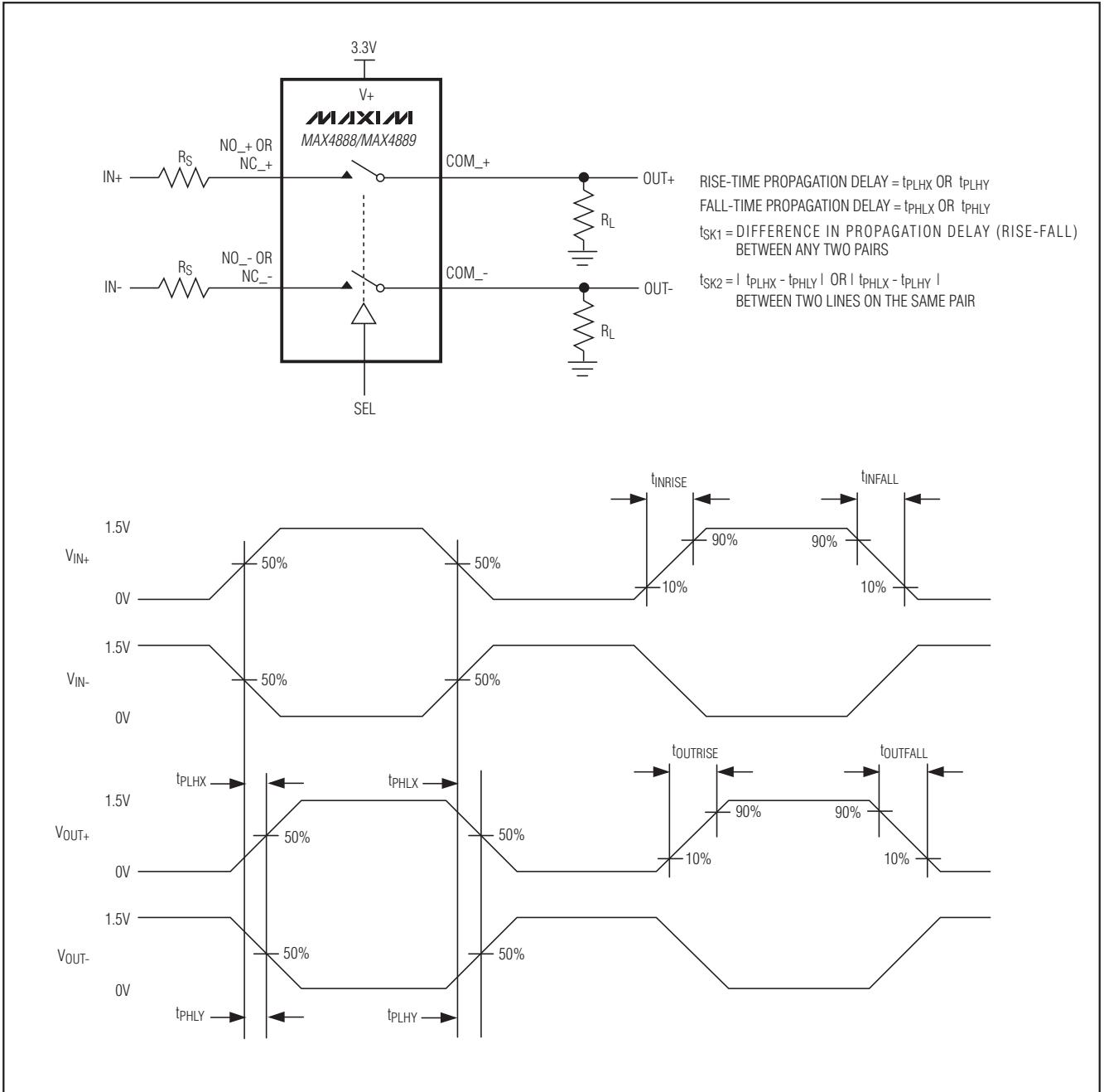


图2. 传输延时和输出偏差

2.5Gbps PCI Express 无源开关

测试电路/时序图(续)

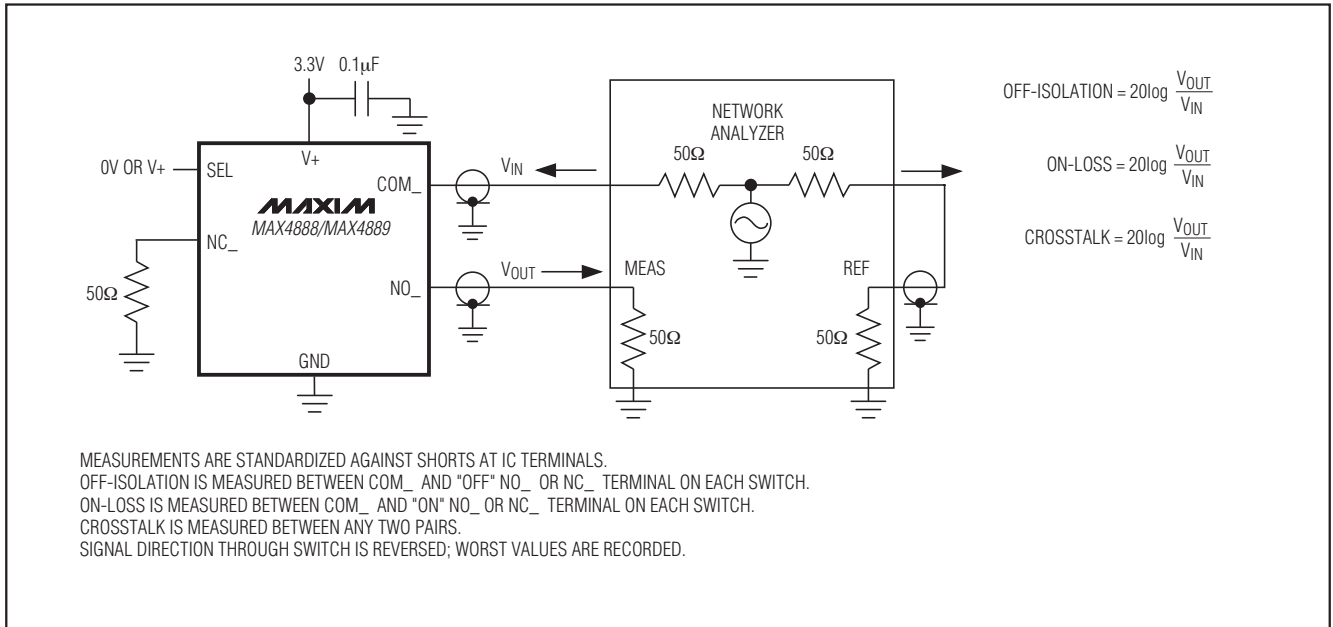


图3. 导通损耗、关断隔离和串扰

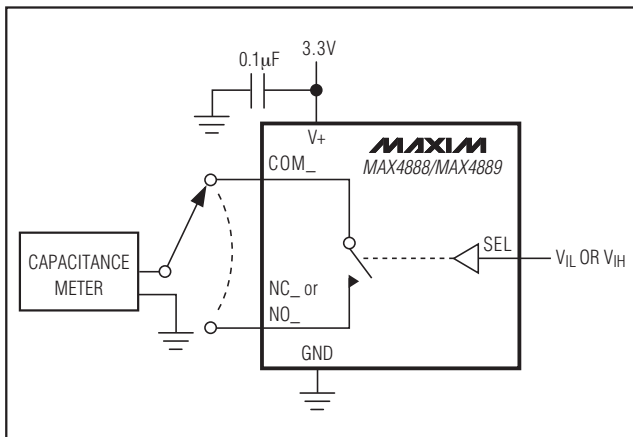


图4. 通道的通/断电容

详细说明

MAX4888/MAX4889 高速无源开关用于切换两个端口之间的 PCIe 数据。MAX4888/MAX4889 可理想用于 PCIe 信号切换，改变系统配置。例如：在图形卡设计中，MAX4888/

MAX4889 能够将一组 16 通道总线转换成两组 8 个通道。MAX4888/MAX4889 具有一个数字控制输入 (SEL)，用于切换信号通道。

MAX4888/MAX4889 指标定义在 3.0V 至 3.6V 电源电压范围，也可以工作在低至 1.65V 的电源电压。

数字控制输入 (SEL)

MAX4888/MAX4889 提供了一个数字控制输入 (SEL)，在 COM_ 和 NO_ / NC_ 之间选择信号通道。在功能框图/真值表中给出了 MAX4888/MAX4889 的真值表。以满摆幅信号驱动 SEL 能够使功耗最小。

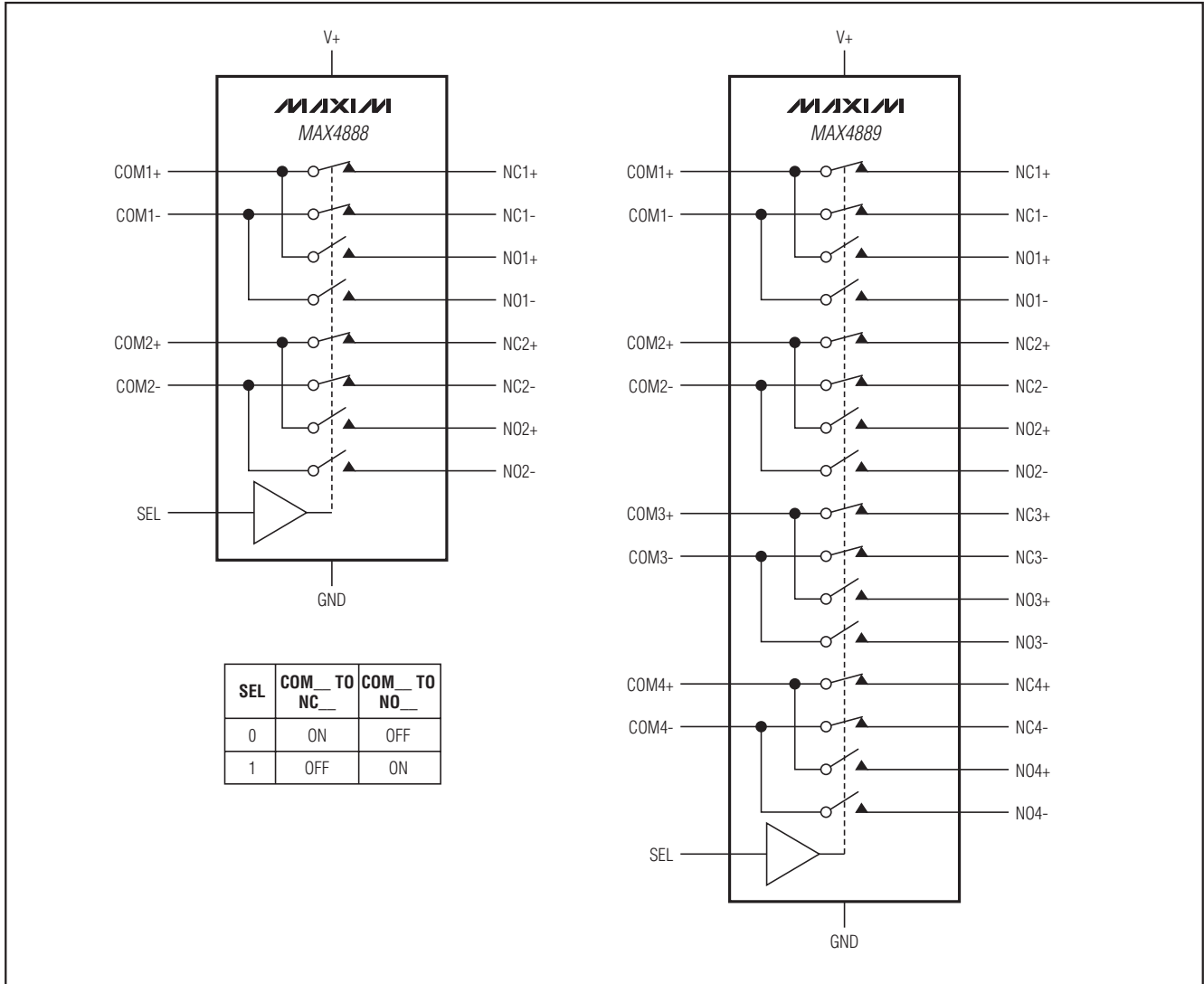
模拟信号电平

MAX4888/MAX4889 能够接受标准 PCIe 信号，最大值为 $V_+ - 1.2V$ 。COM_+ 通道的信号可以切换到 NO_+ 或 NC_+ 通道；COM_- 通道的信号可以切换到 NO_- 或 NC_- 通道。MAX4888/MAX4889 为双向开关，COM_、NO_ 和 NC_ 既可以作为输入端，也可以作为输出端。

2.5Gbps PCI Express 无源开关

MAX4888/MAX4889

功能框图/真值表



2.5Gbps PCI Express 无源开关

应用信息

PCIe 开关

MAX4888/MAX4889 主要用于重新分配 PCIe 信号(见图5)。例如,在图形卡设计中,有些厂商已经发现将一组16通道的PCIe总线分成两组8通道的总线,系统性能有可能提高两倍。两个比较突出的应用实例为SLI™(缩放链路接口)和CrossFire™。MAX4889允许计算机主板配合单个16通道的图形卡工作,并且可以在以后更新为双卡工作形式。用户通过跳线设置或通过软件更改控制位,可以实现单卡或双卡工作模式的切换,使同一主板可以工作在两种卡模式下。

电路板布局

高速开关要求合理的电路板布局和设计流程,以优化系统性能。使用阻抗受控的PCB引线并使引线尽可能短或遵循PCIe规范对布线阻抗的要求。确保电源旁路电容尽可能靠近器件放置,建议使用多个旁路电容。将所有接地端和裸焊盘连接到一个较大的接地平面。

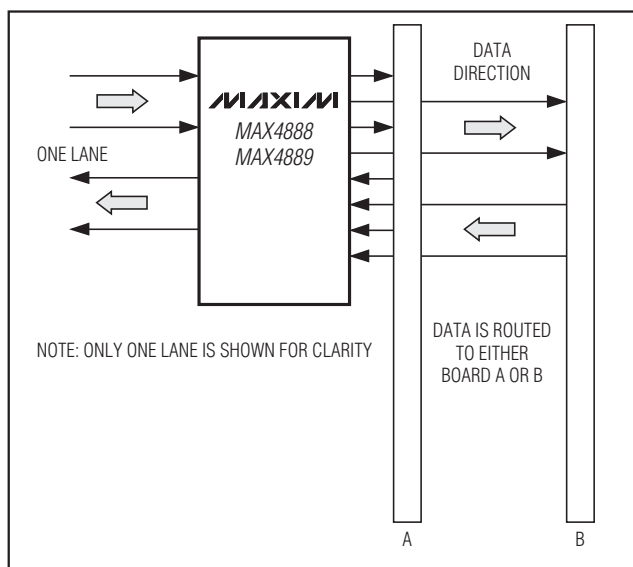


图5. MAX4888/MAX4889用作单向开关

芯片信息

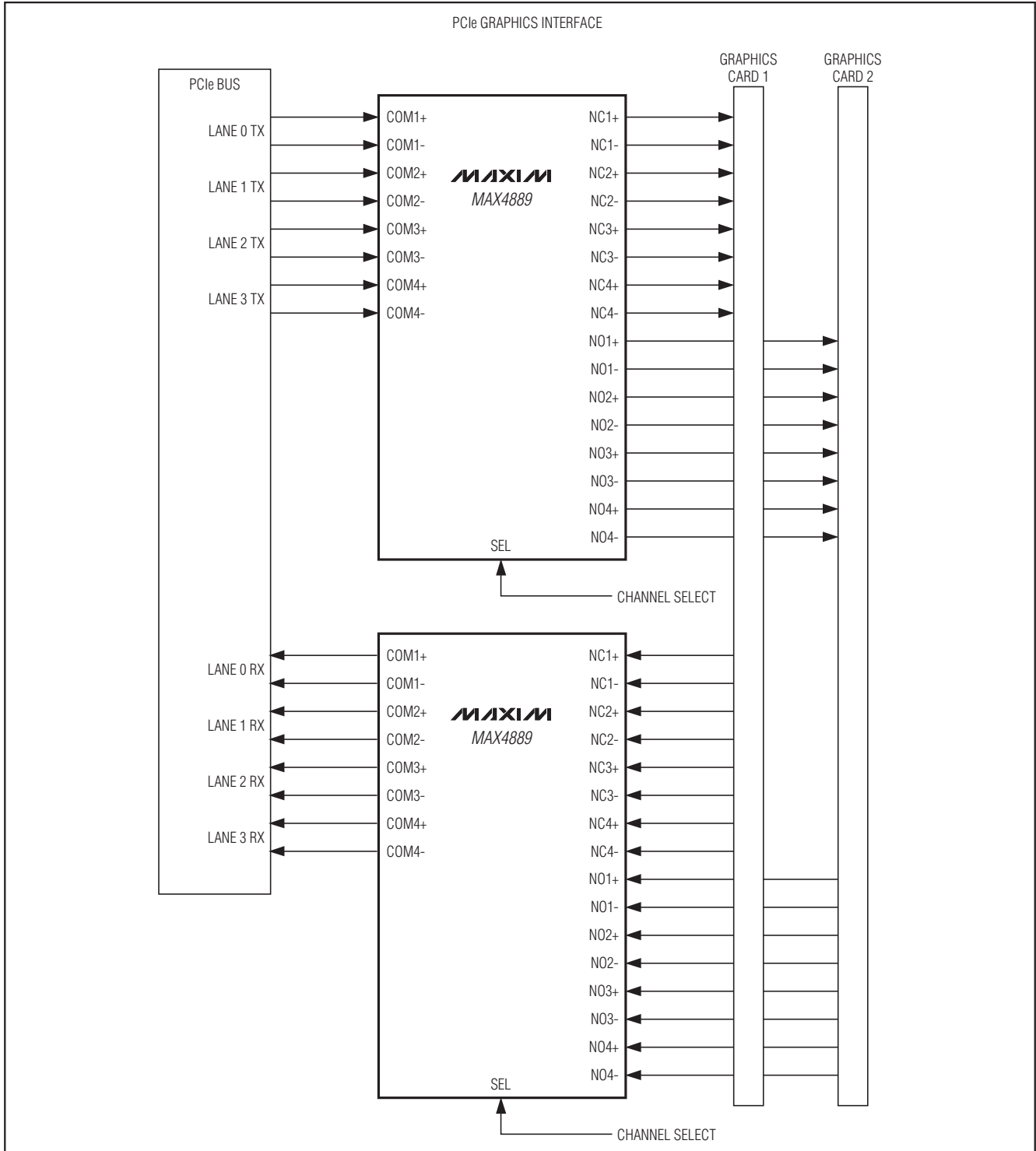
PROCESS: CMOS

CrossFire是ATI Technologies, Inc.的商标。
SLI是NVIDIA Corporation的商标。

2.5Gbps PCI Express 无源开关

典型应用电路

MAX4888/MAX4889

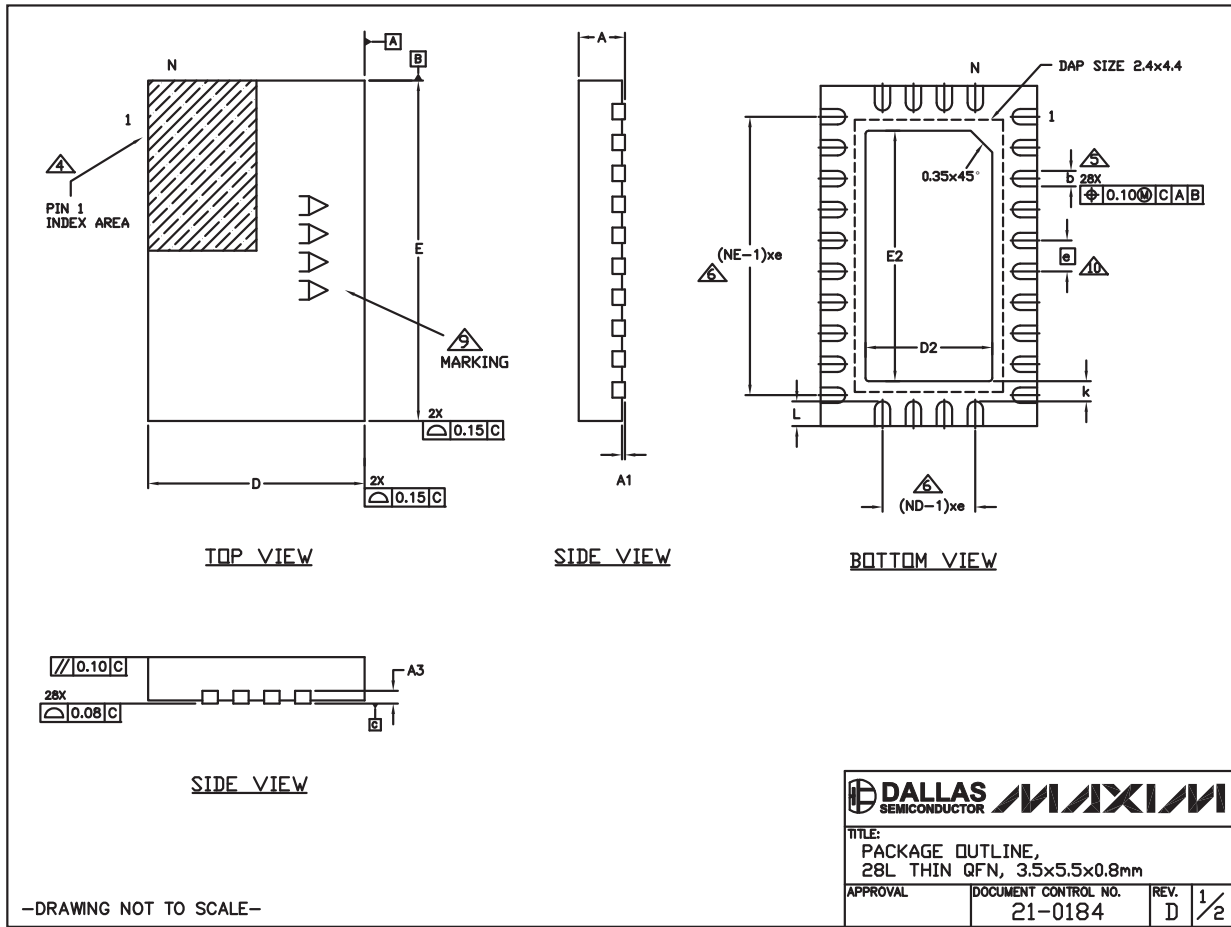


2.5Gbps PCI Express 无源开关

封装信息

(本数据资料提供的封装图可能不是最近的规格, 如需最近的封装外形信息, 请查询 www.maxim-ic.com.cn/packages.)

MAX4888/MAX4889



28L THIN QFN:EPS

2.5Gbps PCI Express 无源开关

MAX4888/MAX4889

封装信息(续)

(本数据资料提供的封装图可能不是最近的规格, 如需最近的封装外形信息, 请查询 www.maxim-ic.com.cn/packages.)


COMMON DIMENSIONS				
REF.	MIN.	NOM.	MAX.	NOTE
A	0.70	0.75	0.80	
A1	0	-	0.05	
A3	0.20 REF.			
b	0.20	0.25	0.30	
D	3.40	3.50	3.60	
E	5.40	5.50	5.60	
e	0.50 BSC.			
k	0.25	-	-	
L	0.30	0.40	0.50	ALL PINS
N	28			
ND	4			
NE	10			

PKG. CODE	EXPOSED PAD VARIATIONS					
	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
T283555-1	1.95	2.05	2.15	3.95	4.05	4.15

NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25mm AND 0.30mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS. COPLANARITY SHALL NOT EXCEED 0.08mm.
8. WARPAGE SHALL NOT EXCEED 0.10mm.
9. MARKING IS FOR PACKAGE ORIENTATION PURPOSE ONLY.
10. LEAD CENTERLINES DEFINED BY DIMENSION e±0.05.

-DRAWING NOT TO SCALE-

	
TITLE: PACKAGE OUTLINE, 28L THIN QFN, 3.5x5.5x0.8mm	
APPROVAL	DOCUMENT CONTROL NO. 21-0184
REV.	D 2/2

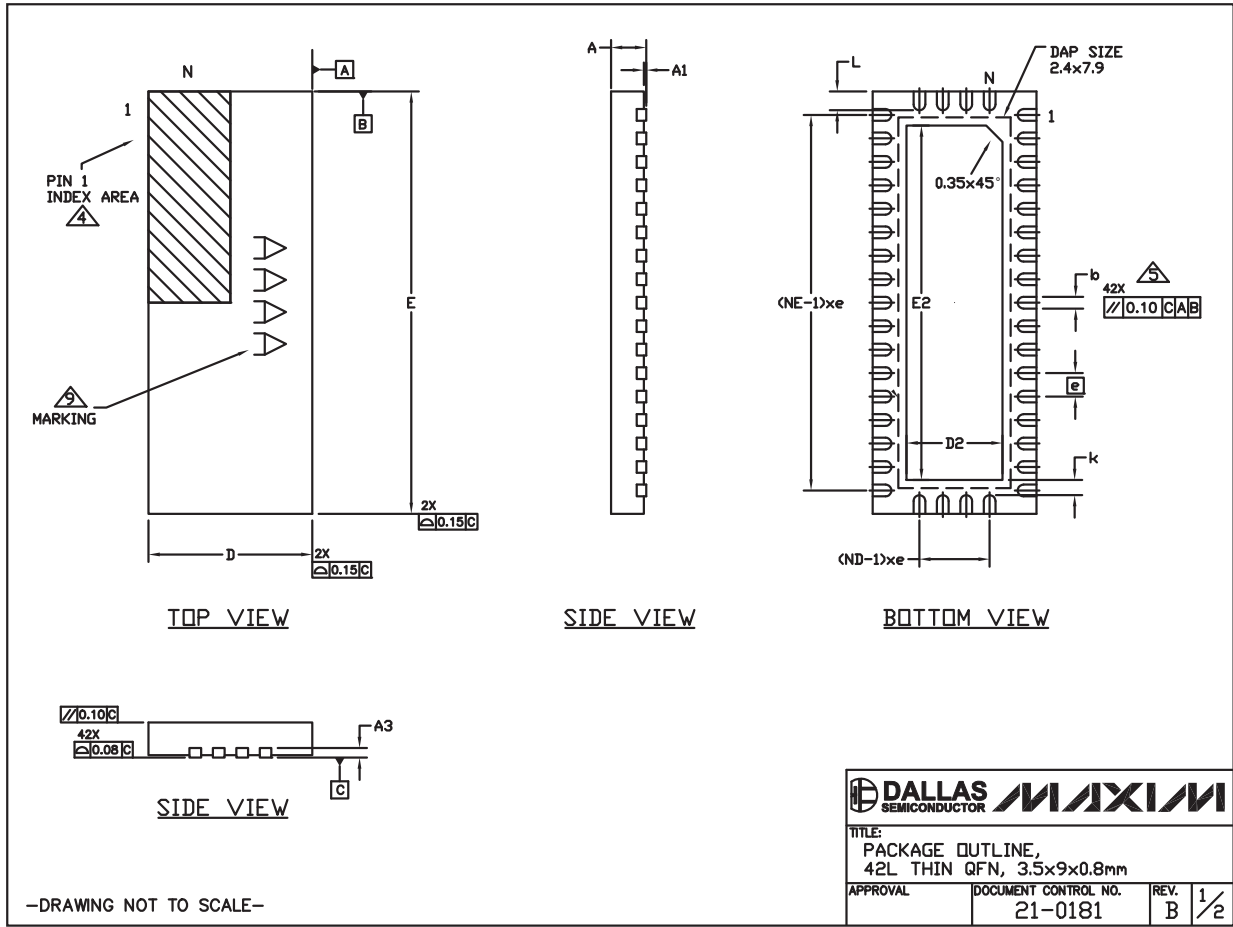
2.5Gbps PCI Express 无源开关

封装信息(续)

(本数据资料提供的封装图可能不是最近的规格, 如需最近的封装外形信息, 请查询 www.maxim-ic.com.cn/packages.)

MAX4888/MAX4889

42L THIN QFN:EPS



2.5Gbps PCI Express 无源开关

封装信息(续)

(本数据资料提供的封装图可能不是最近的规格, 如需最近的封装外形信息, 请查询 www.maxim-ic.com.cn/packages.)


COMMON DIMENSIONS				
REF.	MIN.	NOM.	MAX.	NOTE
A	0.70	0.75	0.80	
A1	0	-	0.05	
A3	0.20 REF.			
b	0.20	0.25	0.30	
D	3.40	3.50	3.60	
E	8.90	9.00	9.10	
e	0.50 BSC.			
k	0.25	-	-	
L	0.35	0.40	0.45	ALL PINS
N	42			
ND	4			
NE	17			

PKG. CODE	EXPOSED PAD VARIATIONS					
	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
T423590-1	1.95	2.05	2.15	7.45	7.55	7.65
T423590M-1	1.95	2.05	2.15	7.45	7.55	7.65

NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25mm AND 0.30mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS. COPLANARITY SHALL NOT EXCEED 0.08mm.
8. WARPAGE SHALL NOT EXCEED 0.10mm.
9. MARKING IS FOR PACKAGE ORIENTATION PURPOSE ONLY.
10. LEAD CENTERLINES TO BE AT DEFINED BY DIMENSION e ± 0.05 .

-DRAWING NOT TO SCALE-

	
TITLE: PACKAGE OUTLINE, 42L THIN QFN, 3.5x9x0.8mm	
APPROVAL	DOCUMENT CONTROL NO. 21-0181
REV. B	2/2

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