

Mux & Switch

Design Guide

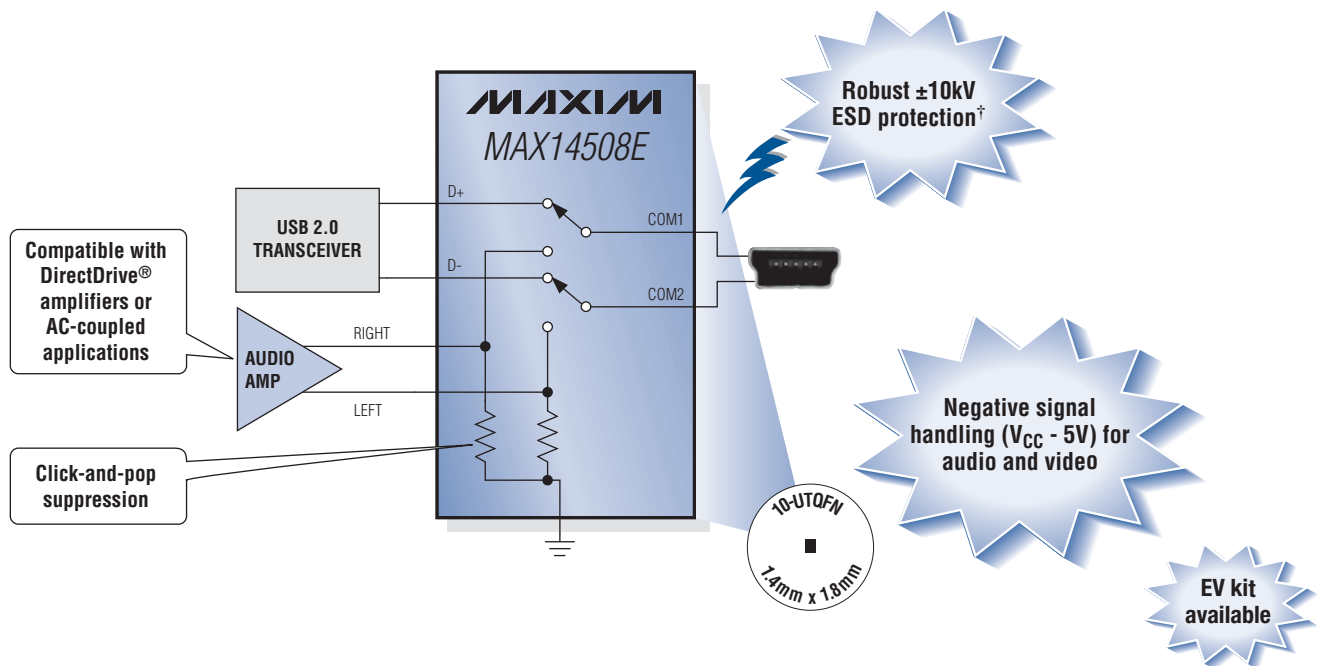


24th Edition

July 2008

Tiny Hi-Speed USB/audio/video switches enable single connector

Industry's best-protected, high-integration switches



Optimize performance

- USB 2.0 (480Mbps) compliant
- Low 0.05% THD+N (audio)
- High 950MHz bandwidth

Save board space

- Interface to small USB connectors

Part	Configuration	Supply Voltage (V)	V_{BUS} Detection/Enable	Fault Protection	Shunt Resistors
MAX14508E	DPDT	2.7 to 5.0	Enable	✓	✓
MAX14509E*			Enable		
MAX14509AE			V_{BUS}		✓
MAX14510E*			V_{BUS}		
MAX14511E*			Enable		

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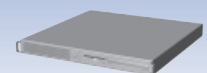
Computing



Consumer



Medical



Enterprise

DirectDrive is a registered trademark of Maxim Integrated Products, Inc.

*Future product—contact factory for availability. Specifications are preliminary.

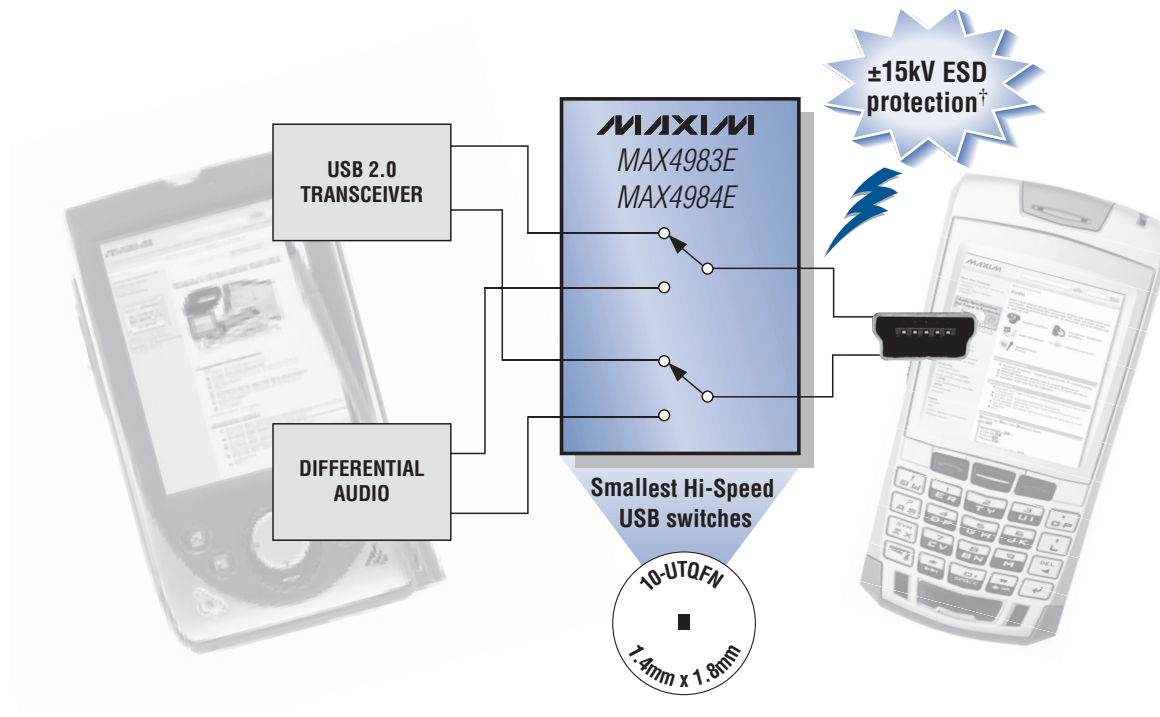
†Human Body Model.

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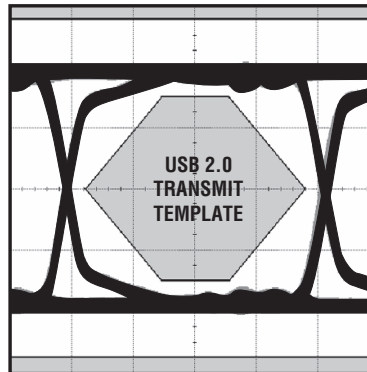


Most robust Hi-Speed USB switches

480Mbps DPDT switches in 1.4mm x 1.8mm UTQFN package



USB 2.0-COMPLIANT EYE DIAGRAM



Hi-Speed USB switching

- High 950MHz bandwidth
- Low 6.5pF on-capacitance
- Save board space and cost
- Integrated ±15kV ESD protection†
- Tiny, 1.4mm x 1.8mm UTQFN package

Perfect for portable applications

- 2.8V to 5.5V power-supply range
- Fault protected against shorts
- Low 0.6µA supply current
- Low 2µW power consumption

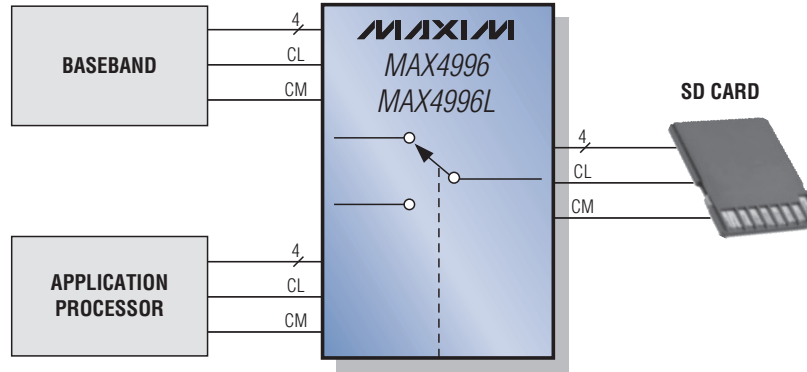
Part	Enable	Package (mm x mm)
MAX4983E	Active low	10-UTQFN (1.4 x 1.8)
MAX4984E	Active high	

†Human Body Model and Air Gap Discharge.

Hex SPDT switches simplify adding high-capacity SD memory cards

Feature low power, high bandwidth, and low R_{ON}

The MAX4996/MAX4996L are hex SPDT* switches for multiplexing high-frequency signals up to 670MHz. Their low on-resistance (2.0Ω , typ), low on-capacitance (6pF , typ), and low current consumption ($2\mu\text{A}$, max) make them ideal for adding SD memory cards to portable applications.



Best combination of low current consumption, low R_{ON} , and small package

2 μA current consumption



1.3 Ω R_{ON} (at 5V)



Space-saving package



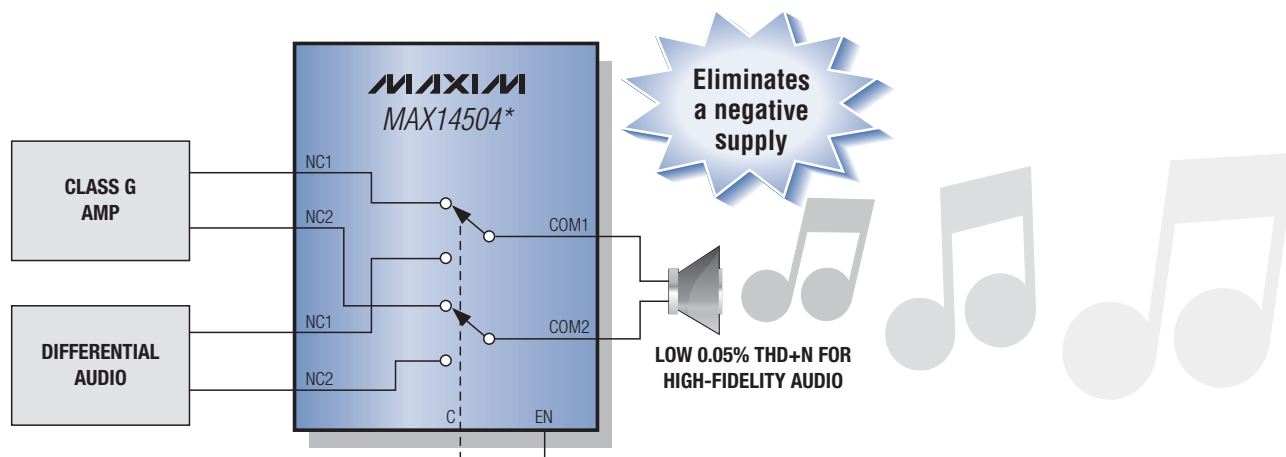
Switches for high-speed applications

Part	Configuration	Application	Supply Voltage (V)	R_{ON} (Ω)	C_{ON} (pF)	Package (mm x mm)
MAX4947	Hex SPDT	SDIO	1.8 to 5.5	5.5	30	25-UCSP™ (2.5 x 2.5),
MAX4948						24-TQFN (4 x 4)
MAX4760	Quad DPDT	USB	1.8 to 5.5	2.0	25	36-UCSP (3 x 3),
MAX4761	Quad SPST					36-TQFN (6 x 6)
MAX4996	Hex SPDT	SD 2.0	2.5 to 5.5	2.0	6	24-TQFN (3.5 x 3.5)
MAX4996L						

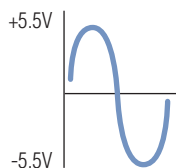
UCSP is a trademark of Maxim Integrated Products, Inc.

*Hex SPDT switches = triple DPDT switches.

Switch large signals with a single supply and integrated charge pump



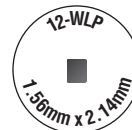
Compatible with Class G or AC-coupled loads



Low 0.2 μ A shutdown supply current



Space-saving package



Supports high audio quality

- $\pm 5.5\text{V}$ analog signal range
- Low 0.05% THD+N
- Integrated shunt resistors available for click-and-pop suppression

Ideal for portable applications

- 2.5V to 5.5V power-supply range
- Low 0.2 μ A shutdown supply current
- Tiny 12-bump WLP package

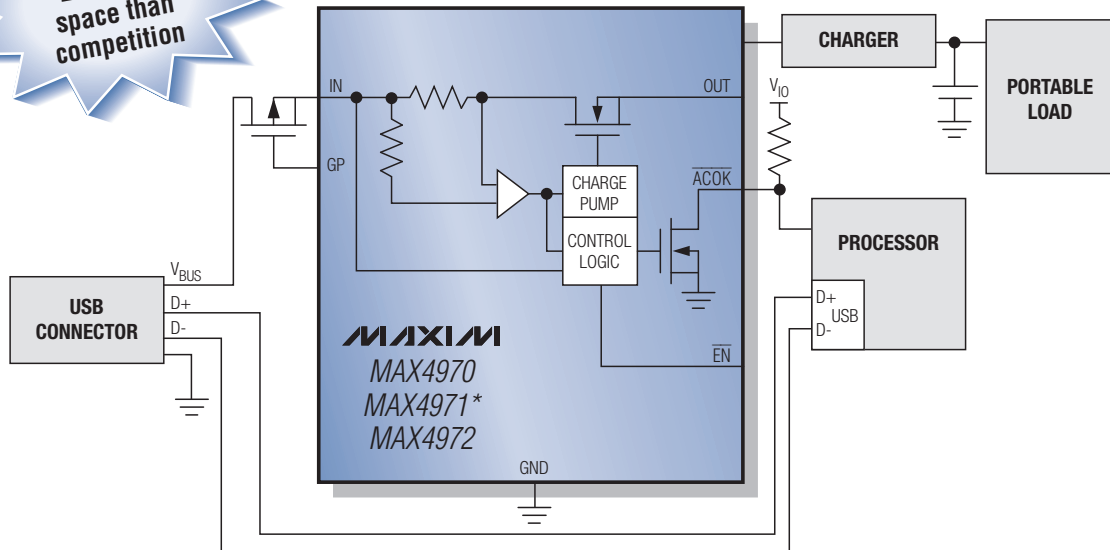
Part	Configuration	Shunt Resistors	Signal Range	Package (mm x mm)
MAX14504*	Dual SPDT	—	$-V_{CC}$ to $+V_{CC}$	12-WLP (1.56 x 2.14)
MAX14505*		NO and NC input		
MAX14505A*		NO and NC input	0 to $+V_{CC}$	
MAX14506*		—		

*Future product—contact factory for availability. Specifications are preliminary.

Industry's smallest overvoltage protectors with negative polarity protection

Ultra-low 40mΩ R_{ON} in a tiny, 2mm x 1.5mm WLP

40% less R_{ON},
25% less
space than
competition



Superior protection

- Up to +28V overvoltage
- Down to -28V negative polarity**
- ±15kV ESD protection on input†
- Thermal shutdown

Save cost and space

- Eliminate at least seven external components
- 25% smaller than competitors

Part	Overvoltage Trip Level (V)	Undervoltage Trip Level (V)	R _{ON} (mΩ)	Features	Overcurrent Mode	Package (mm x mm)	
MAX4970	5.80	2.45	40	EN input, negative overvoltage protection	Autoretry	12-WLP (2 x 1.5)	
MAX4971*	6.35						
MAX4972	4.65						
MAX4978	5.70	2.63	85	Active current limit, battery overcharge protection		Autoretry	8-TDFN (2 x 3)
MAX4979*	6.80						
MAX4980	5.70						
MAX4981	5.70	4.15	80	Negative polarity protection**		Autoretry	8-μDFN (2 x 2)
MAX4943*	7.40						
MAX4944	6.35						
MAX4945	5.80	2.45	80	Negative polarity protection**	Latchoff	8-μDFN (2 x 2)	
MAX4949	8.90						

Additional overvoltage protectors are available—contact the factory for unlisted options.

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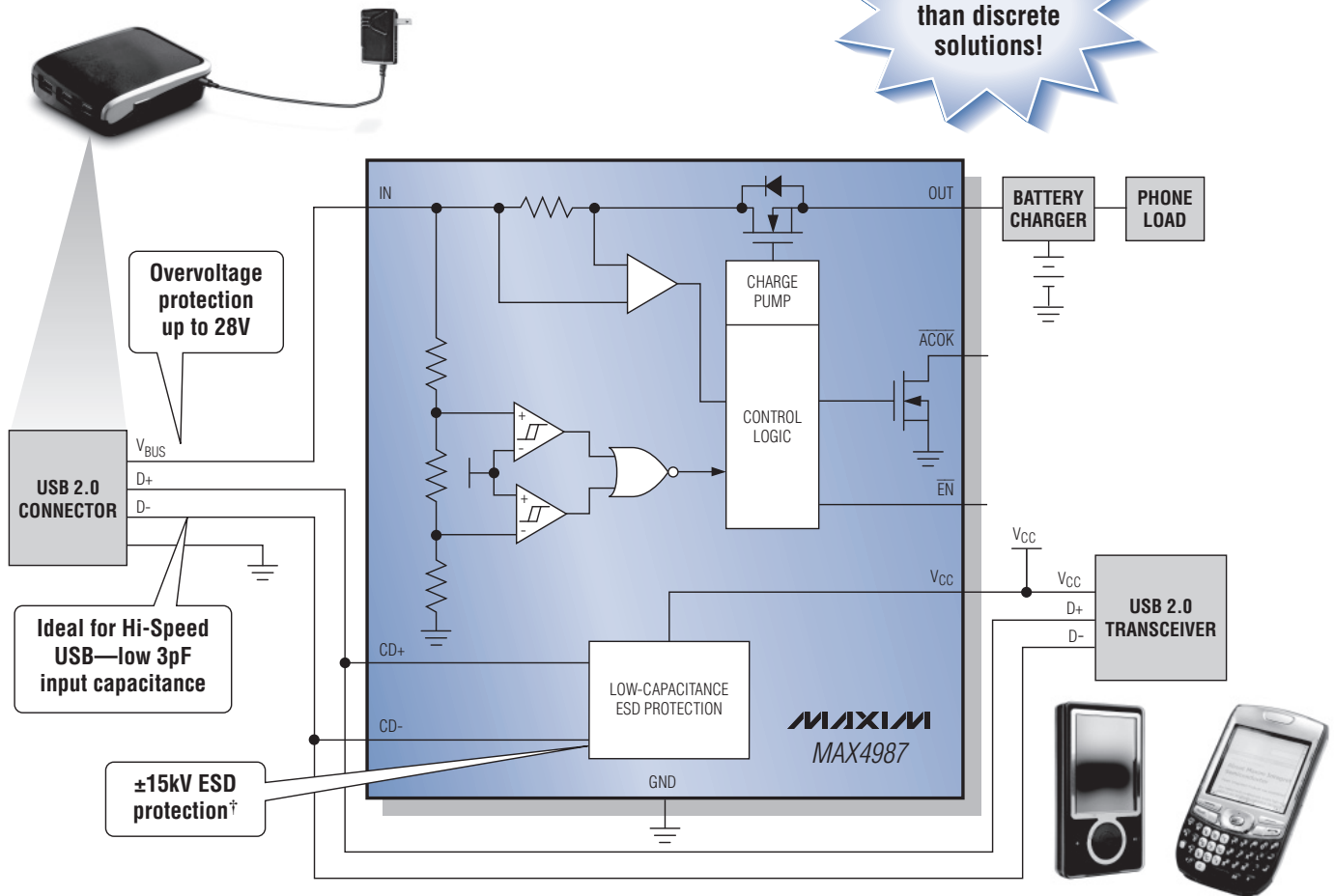
**Optional. Requires external pFET.

†Human Body Model. Requires 1μF capacitor on IN; ±2kV ESD protection (Human Body Model) requires no capacitor.

Protect USB ports against overvoltage and ESD faults

Highest level of protection in a tiny, 2mm x 3mm TDFN

59% smaller than discrete solutions!



Adds robust protection

- 28V overvoltage
- ±15kV ESD[†]
- 1.5A (min) overcurrent
- Thermal shutdown

Reduces component count

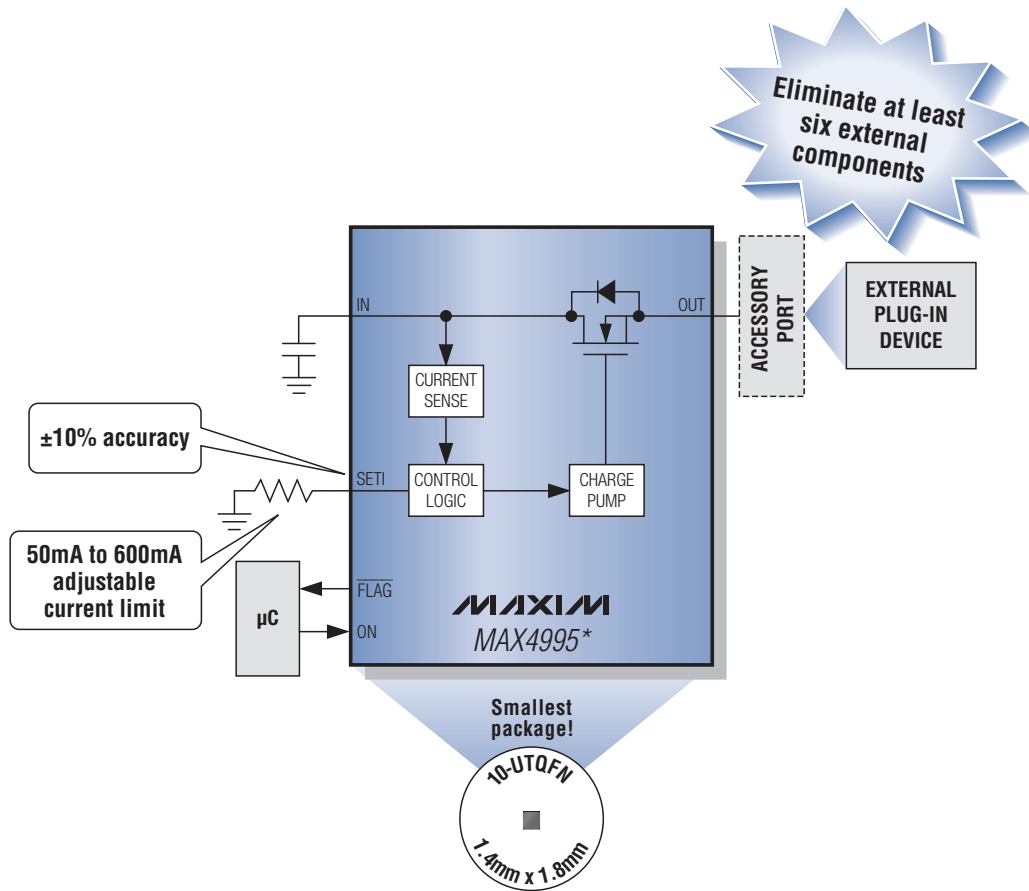
- Integrates n-channel MOSFET, charge pump, and ESD diodes
- Eliminates up to 12 discrete components

Part	Overvoltage Trip Level (V)	Undervoltage Trip Level (V)	R _{ON} (Ω)	CD+/CD- Capacitance (pF)	Overcurrent Mode	Package (mm x mm)
MAX4987AE	6.15	2.55	0.1	3	Autoretry	8-TDFN (2 x 3)
MAX4987BE*		4.20				

*Future product—contact factory for availability. Specifications are preliminary.

†Human Body Model.

Smallest, most-accurate current limiters offer maximum flexibility



Part	Current-Limit Trip Level (mA)	Current-Limit Type	Input-Voltage Range (V)	R _{ON} (Ω)	No-Load Flag	Overcurrent Flag	Overcurrent Mode	Package (mm x mm)
MAX4995A*/B*	50 to 600	Adjustable	1.7 to 5.5	0.2			Autoretry (MAX4995A)	10-UTQFN (1.4 x 1.8), 8-TDFN (2 x 2)
MAX4914B	100	Fixed	2.3 to 5.5				0.7	
MAX4915A/B	200			Autoretry (MAX4915A)	6-µDFN (2 x 2), 5-SOT23			
MAX4917A/B	300			Autoretry (MAX4917A)				
MAX4826/27*	50			0.7	6-µDFN (1 x 1.5)			
MAX4828*/29	100			0.7				
MAX4830/31*	50			1.4				

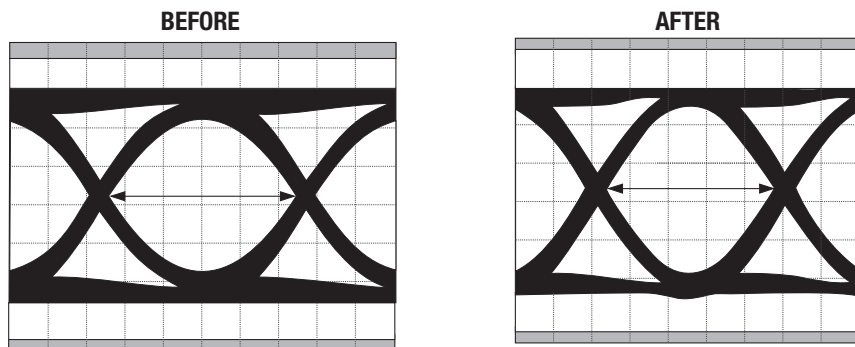
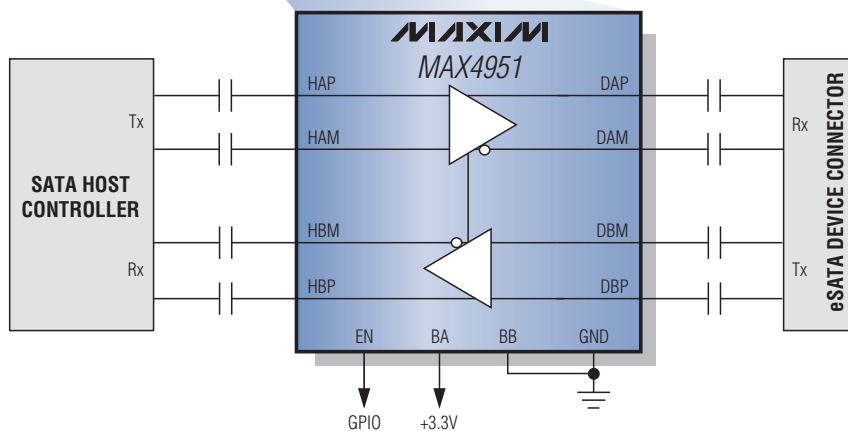
Additional current limiters are available—contact the factory for unlisted options.

*Future product—contact factory for availability. Specifications are preliminary.

SATA redriver supports next-generation data rates and minimizes jitter effects

Ideal for enterprise and computing applications

Extends signal integrity up to 2m



Improves signal quality

- Reduces total system jitter by squaring the signal
- Integrated out-of-band (OOB) detection protects against noise

Saves board space

- 3.3V single-supply operation eliminates need for LDO
- 4mm x 4mm TQFN is 2x smaller than the competition

Part	Redriver		Equalization		Interface and Speed	Power Supply (V)	Power-Save Mode	Total Jitter (ps, max)	Package (mm x mm)
	Input	Output	Input	Output					
MAX4951					SATA 1.0, 2.0	3.3	✓	16.8	20-TQFN (4 x 4)
MAX4950*	✓	✓	✓	✓	PCIe® 1.0, 2.0				

PCIe is a registered trademark of PCI-SIG Corp.

*Future product—contact factory for availability. Specifications are preliminary.

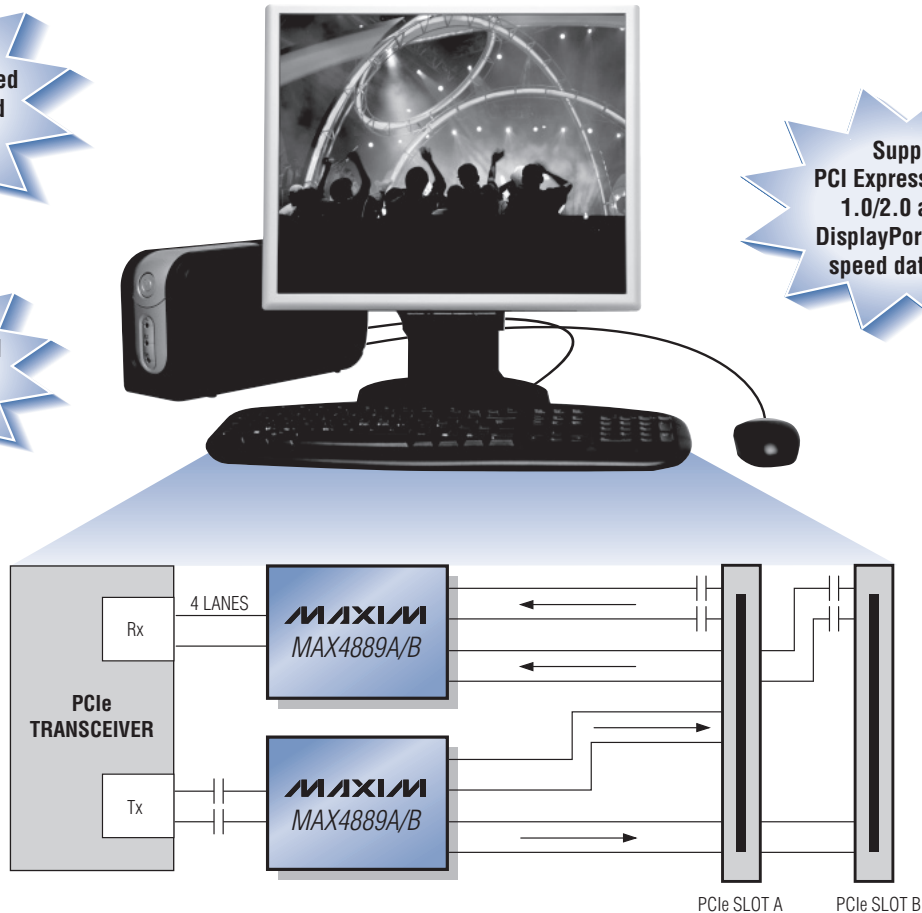
High-speed passive switches minimize jitter and improve signal integrity

Optimal jitter and eye performance: > 10% margin over the competition

High-performance switches are optimized for performance and provide easy board layout

Industry-standard pinouts for easy design-in

Support PCI Express® (PCIe) 1.0/2.0 and/or DisplayPort™ high-speed data rates



Let Maxim's high-speed switches inspire your next-generation designs

Part	Speed	Channels	3.3V Supply	Application	Package (mm x mm)	Price† (\$)
MAX4888/A	PCIe 1.0, 2.0	2	✓	PCIe, SATA/SAS	42-TQFN (3.5 x 9)	1.05
MAX4889/A	PCIe 1.0, 2.0	4				1.15
MAX4889B/C	PCIe 2.0 to 8Gbps	4				1.50
MAX4928A/B	PCIe 1.0, 2.0; DisplayPort	6		DisplayPort	56-TQFN (5 x 11)	1.50

PCI Express is a registered trademark of PCI-SIG Corp.

DisplayPort is a trademark of Video Electronics Standards Association (VESA).

†1000-up recommended resale. Prices provided are for design guidance and are FOB USA. International prices will differ due to local duties, taxes, and exchange rates. Not all packages are offered in 1k increments, and some may require minimum order quantities.

High-bandwidth analog switches for KVM and Gigabit LAN in blade server systems

Gigabit Ethernet/LAN

MAX4890E/MAX4892E
32-pin TQFN is half the size of the competition, with $\pm 15\text{kV}$ ESD protection†

Plug in a notebook PC for direct data access

Video

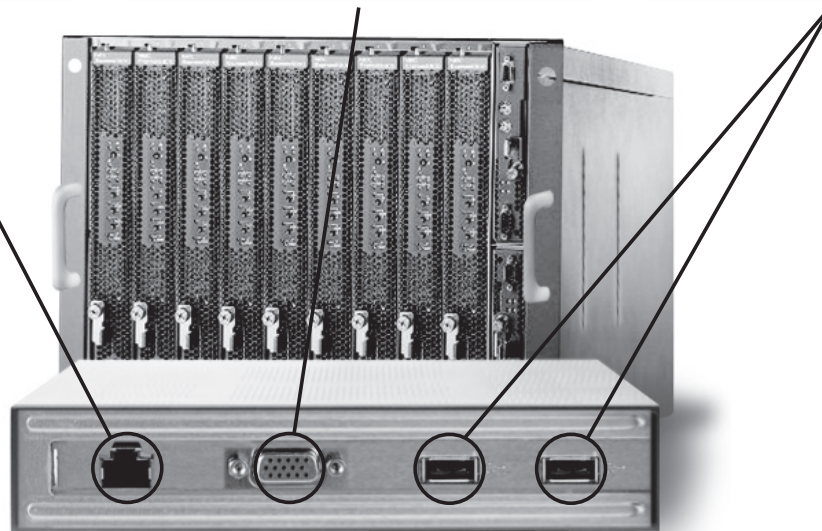
Integrated H/V sync, RGB, and DDC functions reduce BOM and cost

Continuously monitor on-board instrumentation

USB

Highly integrated muxes meet USB 2.0 specifications and include ESD protection

Switch and access data at individual blade terminals



Featured data-management switches and multiplexers

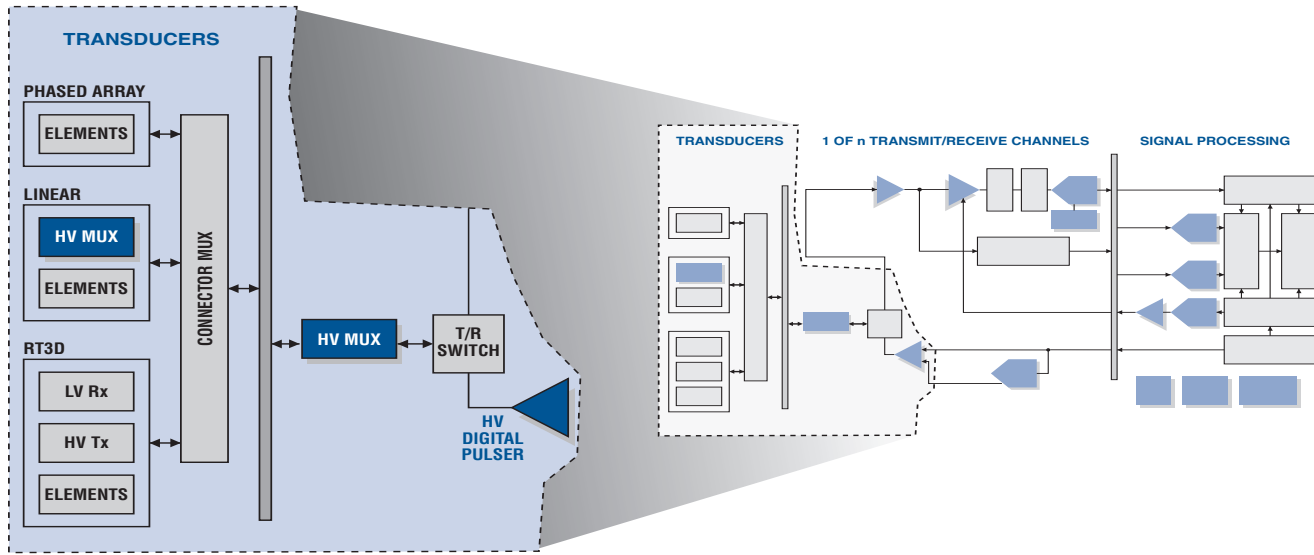
Part	Description
Gigabit Ethernet/LAN	
MAX4890/MAX4892	10/100/1000 Base-T Ethernet LAN switches
MAX4890E/MAX4892E/MAX4927E	1000 Base-T, $\pm 15\text{kV}$ ESD-protected LAN switches
Video	
MAX4885	1:2/2:1 integrated VGA mux with 8:1 configuration capability
MAX4886	2:1/1:2 TMDS® HDMI™/DVI™ switch
MAX4887	RGB triple video switch
MAX4929E	2:1/1:2 HDMI control switch
USB	
MAX4899AE/MAX4899E	Fault-tolerant, Hi-Speed USB 3:1/4:1 muxes
MAX4999	Hi-Speed USB 8:1 mux
MAX4906EF/MAX4906F/MAX4907/MAX4907F	Hi-Speed USB switches



TMDS is a registered trademark of Silicon Image, Inc.
HDMI is a trademark of HDMI Licensing, LLC.
DVI is a trademark of Digital Display Working Group (DDWG).
†Human Body Model.

High-voltage ultrasound pulsers and switches enhance ultrasound images

Provide superior performance and design flexibility



Improvements over competitive solutions

Dual, high-voltage, 1.3A/2A digital pulsers
**(MAX4806*/MAX4807*/MAX4808*,
 MAX4810*/MAX4811*/MAX4812*)**

- Greater isolation between high-voltage pins increases reliability
- Integrated active clamps minimize 2nd-harmonic distortion and system power consumption
- Capacitive architecture eliminates large, costly floating regulators
- 2x greater output-voltage range than the competition
- Multiple V_{PP}/V_{NN} supplies on each chip enable 5-level pulser in single package

8-channel, high-voltage multiplexers
(MAX4800/MAX4801/MAX4802)

- Lower maximum switch-off leakage: 4 μ A and 10 μ A vs. 10 μ A and 15 μ A
- Higher logic-output drive currents: 1mA vs. 0.45mA
- No restrictions on supply-voltage power-up sequences or rise times
- Pin-compatible switches with faster SPI™ interface: 10MHz at $V_{DD} = 2.7V$, 20MHz at $V_{DD} = 4.5V$
- Ultra-small, 5.35mm x 6mm, 26-pin CSBGA package saves board space

For more information on Maxim's industry-leading ultrasound solutions, visit:
www.maxim-ic.com/Ultrasound

SPI is a trademark of Motorola, Inc.

*Future product—contact factory for availability. Specifications are preliminary.

Our failure rate is *still* absolutely ridiculous

One failure in over 2 billion hours

Maxim ad
25 years ago

**THE
FAILURE
RATE
OF OUR
CMOS ANALOG
PARTS
IS
ABSOLUTELY
RIDICULOUS.***

*In fact, it's so ridiculous that we had the "Big Eight" accounting firm, Coopers and Lybrand, audit and certify that product reliability data. Complete documentation is on file.

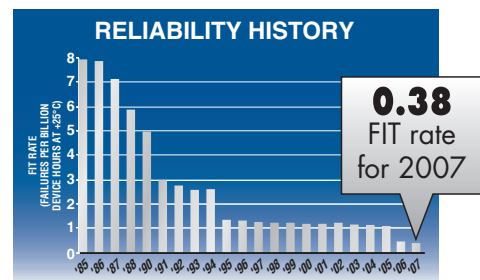
**Would you believe a mere
nine failures per billion hours?**

In commercial parts?
No. You probably wouldn't.
Frankly, even Maxim was a little surprised.
We were confident we knew how to make better CMOS analog parts. But nine failures in a billion hours?
That's ridiculous.
It means our second-source analog circuits are at least ten times more reliable than those made by the original manufacturer. Or almost twice as reliable as most digital parts made in Japan.
Better yet, we're not just talking about a few isolated parts. Our complete line of A to D converters, operational amplifiers, counters/display drivers, power supply circuits, timers and filters is that good.
How do we do it?
It's not easy. We improve their designs, build them better, guarantee additional specifications and test them to an extent that commercial analog parts have never been tested before. Every part we ship is completely electrically tested to datasheet parameters at elevated temperature. Subjected to 150°C biased burn-in. Then tested to datasheet parameters again at room temperature.
That's already more testing than anybody else does, but we do even more.
Every assembly lot is additionally qualified through extensive QA sample testing. Like 192 hours of burn-in at 150°C (equivalent to 1000 hours of life testing at 125°C), 96 hours of pressure pot humidity testing. And, again, electrical testing to datasheet parameters at three temperatures.
When we're done, you get commercial CMOS analog parts with military (or better) reliability. All at commercial prices.
And there's absolutely nothing ridiculous about that.
For product information and sample parts, contact the Authorized Maxim Representative or Distributor in your area.
Or for more information about the company that's making these ridiculous claims, send us the coupon.
Maxim Integrated Products, 510 N. Pastoria Avenue, Sunnyvale, CA 94086, (408) 737-7600.

MAXIM

See our reliability tools at www.maxim-ic.com/qa

- Reliability reports on every product
- AEC-Q100 reports
- ISO 9001:2000 and ISO/TS 16949:2002 certificates
- Online reliability calculators (includes FIT rate, PPM with confidence interval, and LTPD calculators)



www.maxim-ic.com/ridiculous

Mux & Switch-24 US 7/08

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