



# +3.3V, 10.7Gbps 1:16 Deserializer with LVDS Outputs

**MAX3950**

## General Description

The MAX3950 deserializer is ideal for converting 10Gbps serial data to 16-bit-wide, 622Mbps parallel data in SDH/SONET and DWDM applications. Operating from a single +3.3V supply, this device accepts CML serial clock and data inputs and delivers low-voltage differential-signal (LVDS) clock and data outputs for interfacing with high-speed digital circuitry.

The MAX3950 is available in the extended temperature range (-40°C to +85°C) in a 68-pin QFN package. The typical power dissipation is 900mW.

## Applications

- SONET/OC-192 SDH/STM-64 Transmission Systems
- Add/Drop Multiplexers
- Broadband Digital Cross-Connects

## Features

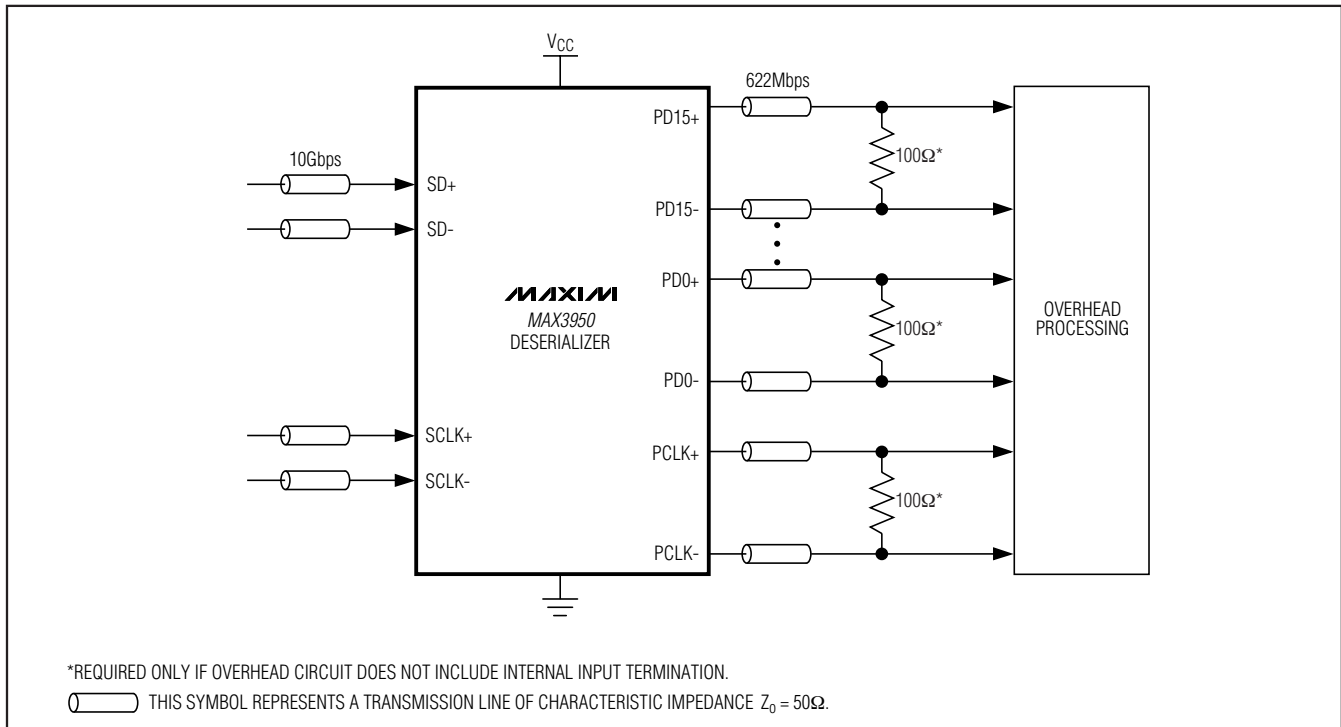
- ◆ Supports Serial Data Rates Up to 10.7Gbps
- ◆ 10Gbps/10.7Gbps Serial to 622Mbps/667Mbps Parallel Conversion
- ◆ Single +3.3V Supply
- ◆ 900mW Operating Power
- ◆ CML Serial Clock and Data Inputs
- ◆ LVDS Parallel Clock and Data Outputs
- ◆ -40°C to +85°C Operating Temperature

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX3950EGK	-40°C to +85°C	68 QFN

Pin Configuration appears at the end of data sheet.

## Typical Application Circuit



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## ABSOLUTE MAXIMUM RATINGS

Positive Supply Voltage ( $V_{CC}$ ).....-0.5V to +5.0V  
 CML Input Voltage Level.....( $V_{CC} - 0.8V$ ) to ( $V_{CC} + 0.5V$ )  
 LVDS Output Voltage Level.....-0.5V to ( $V_{CC} + 0.5V$ )  
 Continuous Power Dissipation ( $T_A = +85^\circ\text{C}$ )  
 68-Lead QFN (derate 43.5mW/ $^\circ\text{C}$  above +85 $^\circ\text{C}$ ) .....2800mW

Operating Temperature Range .....-40 $^\circ\text{C}$  to +85 $^\circ\text{C}$   
 Storage Temperature Range .....-55 $^\circ\text{C}$  to +150 $^\circ\text{C}$   
 Lead Temperature (soldering, 10s) .....+300 $^\circ\text{C}$

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.

## DC ELECTRICAL CHARACTERISTICS

( $V_{CC} = +3.0V$  to +3.6V, differential loads = 100 $\Omega \pm 1\%$ ,  $T_A = -40^\circ\text{C}$  to +85 $^\circ\text{C}$ , unless otherwise noted. Typical values are at  $V_{CC} = +3.3V$ ,  $T_A = +25^\circ\text{C}$ .)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current	$I_{CC}$			270	350	mA
<b>CML INPUTS (<math>SD_{\pm}</math>, <math>SCLK_{\pm}</math>)</b>						
Differential Input Voltage Swing	$V_{ID}$		400		1200	mV <sub>P-P</sub>
Single-Ended Input Voltage Range	$V_{IS}$	Figure 1	$V_{CC} - 0.6$		$V_{CC} + 0.3$	V
Input Termination to $V_{CC}$	$R_{IN}$		42.5	50	57.5	$\Omega$
<b>LVDS OUTPUT SPECIFICATION (<math>PD[15.0]_{\pm}</math>, <math>PCLK_{\pm}</math>)</b>						
Output High Voltage	$V_{OH}$				1.375	V
Output Low Voltage	$V_{OL}$		1.025			V
Differential Output Voltage	$ V_{OD} $	Figure 2	150		250	mV
Change in Magnitude of Differential Output for Complementary States	$\Delta V_{OD} $				25	mV
Offset Output Voltage			1.15		1.25	V
Change in Magnitude of Output Offset Voltage for Complementary States	$\Delta V_{OS} $				25	mV
Differential Output Impedance			80		120	$\Omega$
Output Current		Short together			12	mA
		Short to ground			24	

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## AC ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = +3.0V to +3.6V, differential loads = 100Ω ±1%, T<sub>A</sub> = -40°C to +85°C, unless otherwise noted. Typical values are at V<sub>CC</sub> = +3.3V, T<sub>A</sub> = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Serial Input Data Rate				10		Gbps
Serial Data Setup Time	t <sub>SU</sub>		25			ps
Serial Data Hold Time	t <sub>H</sub>		25			ps
Parallel Output Data Rate				622		Mbps
Parallel Output Clock Frequency				622		MHz
Parallel Clock-to-Q Delay	t <sub>CLK-Q</sub>	(Note 2)	-200		+200	ps
LVDS Output Rise/Fall Time		20% to 80%			300	ps
LVDS Differential Skew	t <sub>SKEW1</sub>	Any differential pair			65	ps
LVDS Channel-to-Channel Skew	t <sub>SKEW2</sub>	PD[15..0]±		200		ps
Input Return Loss	S <sub>11</sub>	100kHz ≤ f ≤ 5GHz		17		dB
		5GHz ≤ f ≤ 10GHz		14		
		10GHz ≤ f ≤ 15GHz		11		

**Note 1:** AC specifications are guaranteed by design and characterization.

**Note 2:** Relative to the falling edge of PCLK+. See Figure 3.

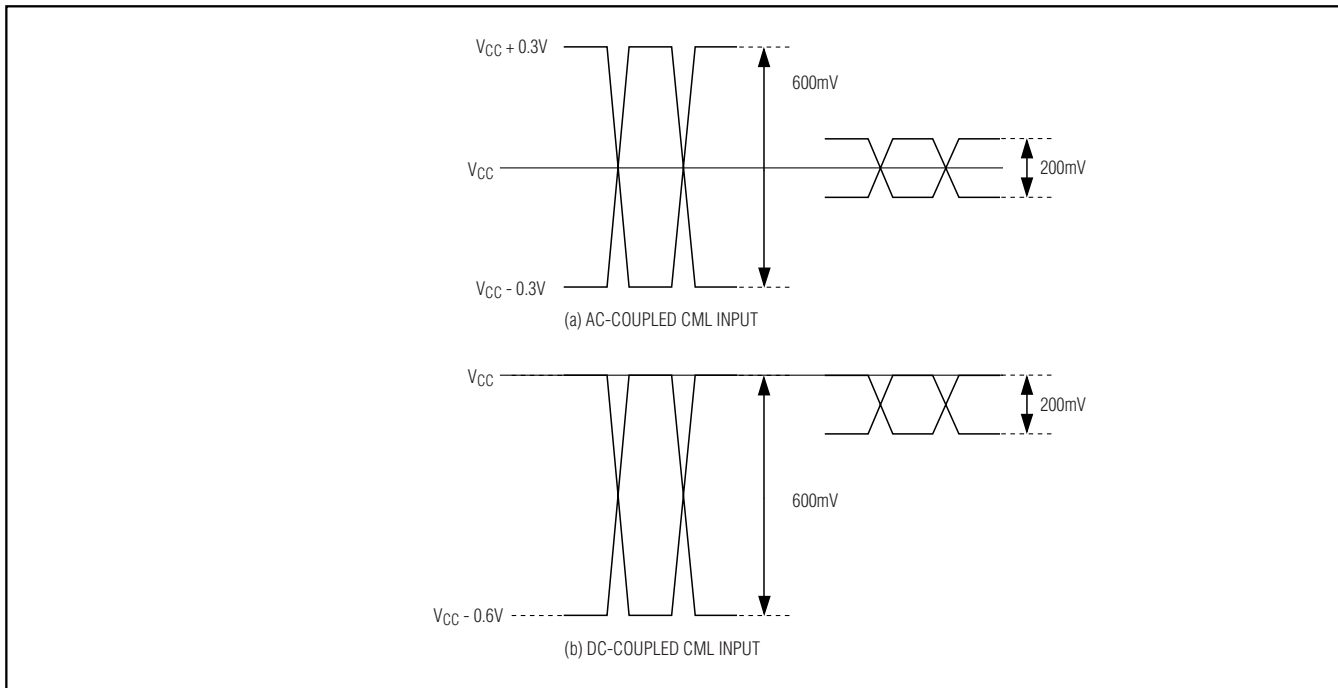


Figure 1. Input Amplitude

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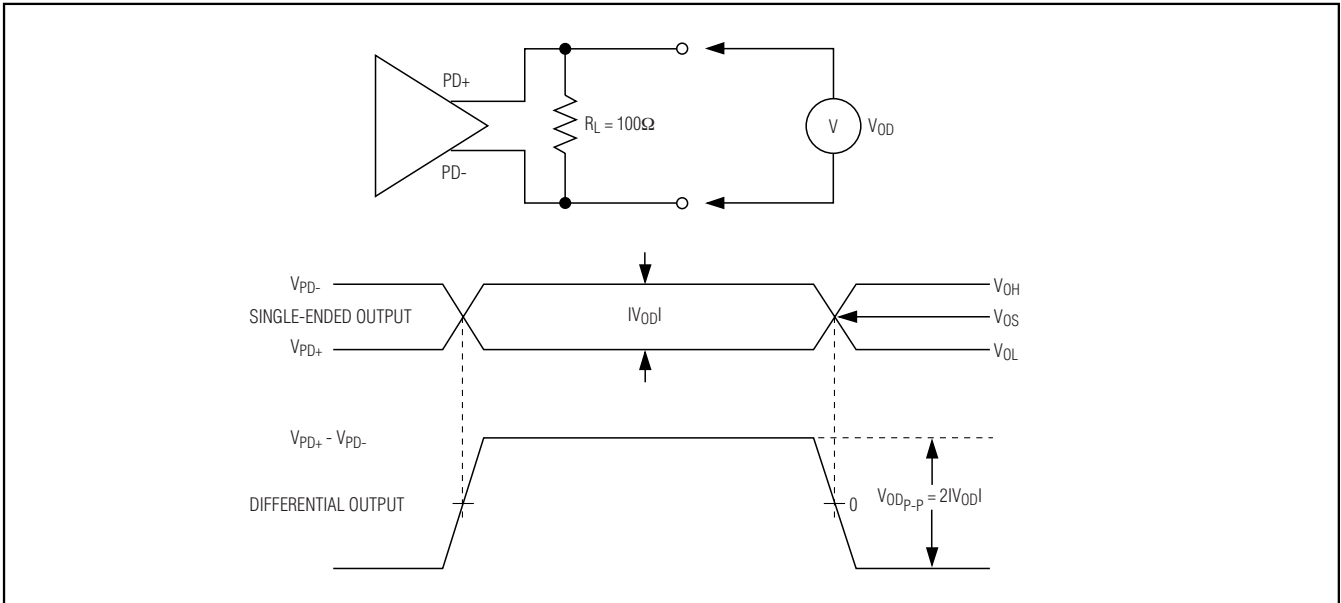


Figure 2. Driver Output Levels

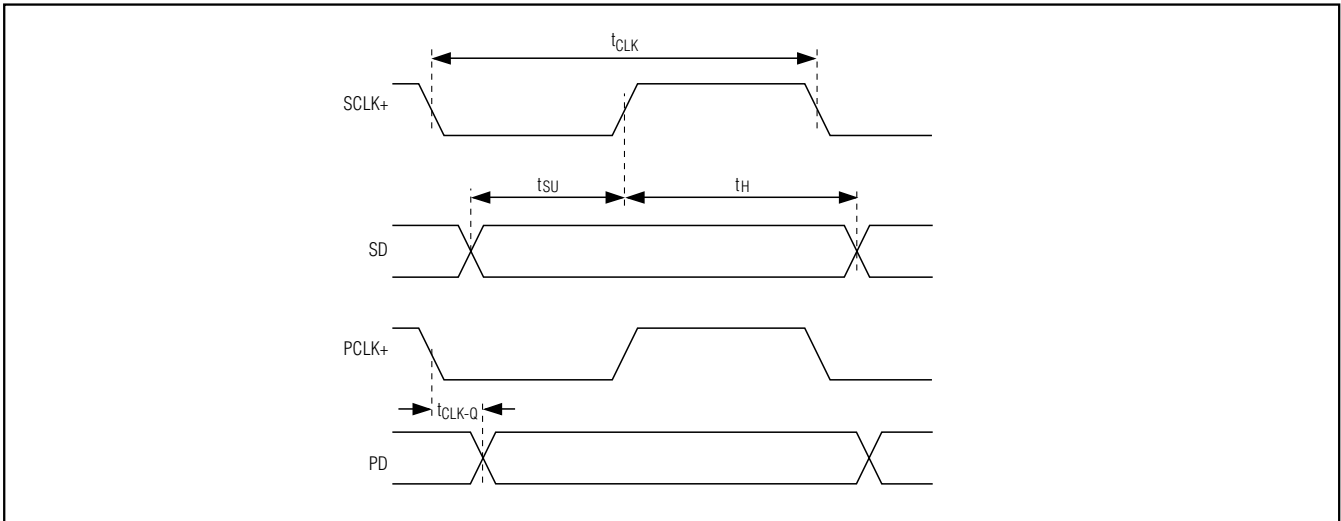


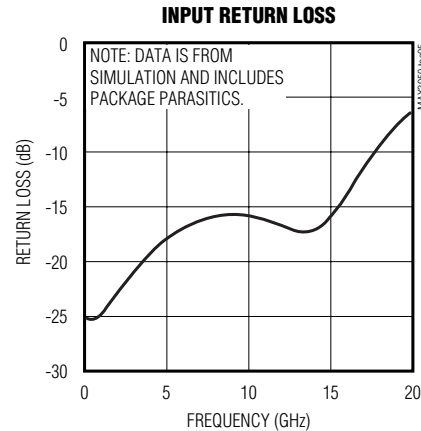
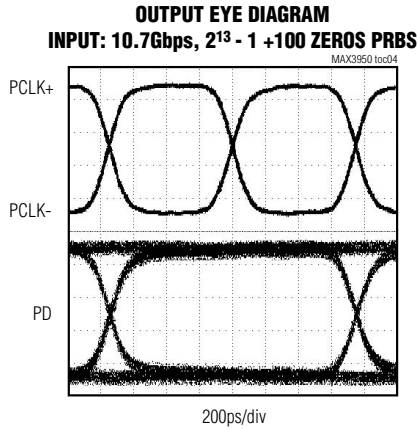
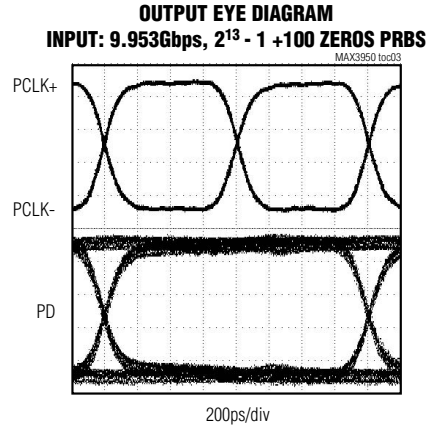
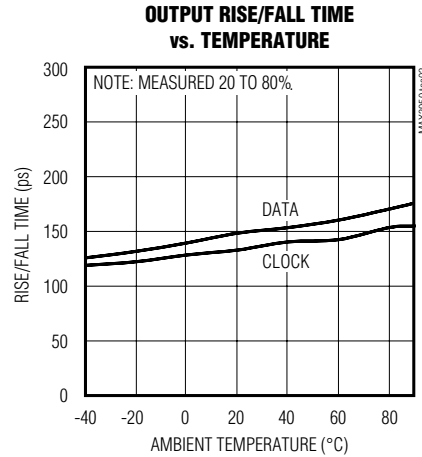
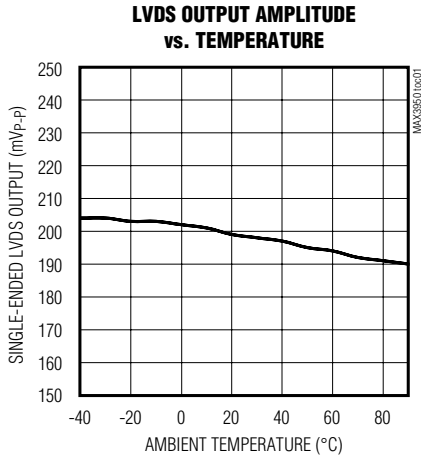
Figure 3. Timing Parameters

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## Typical Operating Characteristics

(T<sub>A</sub> = +25°C, unless otherwise noted.)

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## Pin Description

PIN	NAME	FUNCTION
1, 2, 5, 13, 16, 17, 18, 26, 33-36, 42, 51, 52, 53, 60, 68	GND	Ground
6, 9, 12, 25, 31, 32, 37, 43, 50, 54, 55, 61	VCC	Positive Power Supply
7	SD+	Positive Data Input. 9.953Gbps serial data stream, CML.
8	SD-	Negative Data Input. 9.953Gbps serial data stream, CML.
10	SCLK+	Positive Serial Clock Input. 9.953GHz, CML.
11	SCLK-	Negative Serial Clock Input. 9.953GHz, CML.
14	PCLK-	Negative Parallel Clock Output, 622.08MHz, LVDS.

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## Pin Description (continued)

PIN	NAME	FUNCTION
15	PCLK+	Positive Parallel Clock Output, 622.08MHz, LVDS.
19, 21, 23, 27, 29, 38, 40, 44, 46, 48, 56, 58, 62, 64, 66, 3	PD0- to PD15-	Negative Parallel Data Output, 622.08Mbps, LVDS.
20, 22, 24, 28, 30, 39, 41, 45, 47, 49, 57, 59, 63, 65, 67, 4	PD0+ to PD15+	Positive Parallel Data Output, 622.08Mbps, LVDS.
EP	Exposed Pad	Ground. This must be soldered to the circuit board ground for proper thermal and electrical operation. See <i>Layout Considerations</i> .
CP	Corner Pins	N.C. Not Connected. Ensure that the solder mask is located below them so that unintentional connections do not occur.

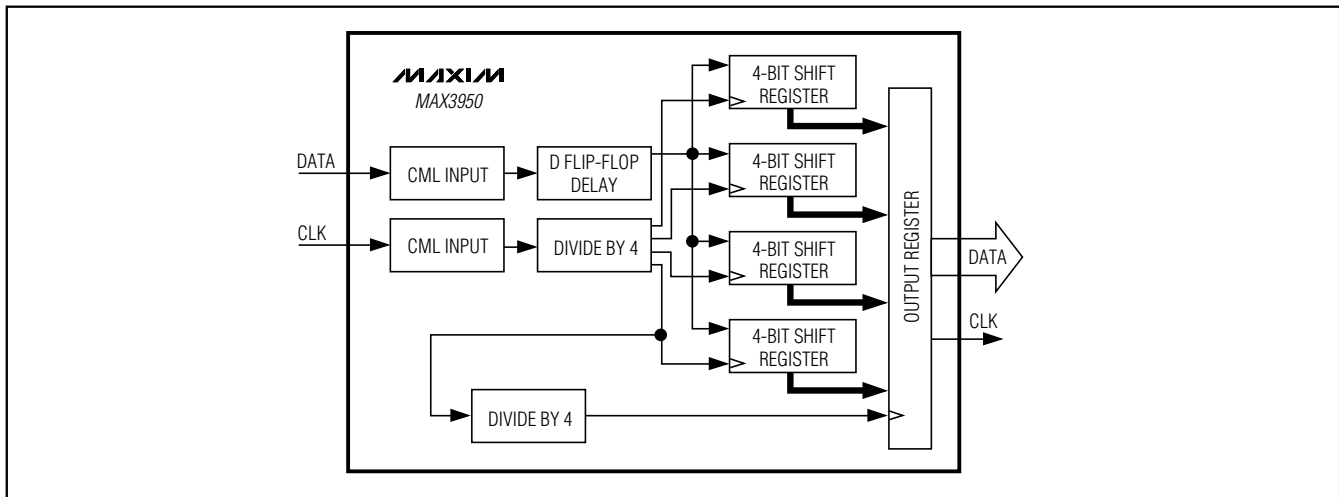


Figure 4. Functional Block Diagram

### Detailed Description

The MAX3950 deserializer implements a shift-register-based demultiplexer to convert 9.953Gbps serial data to 16-bit-wide, 622.08Mbps parallel data (Figure 4). The allocation of the serial input bits to the parallel LVDS outputs is displayed in Figure 5.

### Applications Information

#### Low-Voltage Differential-Signal Outputs

The MAX3950 features LVDS outputs for interfacing with high-speed digital circuitry. This LVDS implementation is based on the IEEE 1596.3 LVDS reduced-range link specification and is compatible with OIF 1999.102.

Note that the PCLK polarity on the MAX3950 is inverted relative to OIF 1999.102, so that PCLK+ is equivalent to RXCLK\_N and PCLK- is equivalent to RXCLK\_P.

The MAX3950 uses 300mV<sub>P-P</sub> to 500mV<sub>P-P</sub> differential low-voltage swings to achieve fast transition times, minimize power dissipation, and improve noise immunity. The parallel clock and data LVDS outputs (PCLK+, PCLK-, PD<sub>+</sub>, PD<sub>-</sub>) require 100Ω differential DC termination between the inverting and noninverting outputs for proper operation. Do not terminate these outputs to ground. For more information on interfacing with the LVDS outputs, refer to Maxim Application Note *HFAN-1.0: Interfacing Between CML, PECL, and LVDS*.

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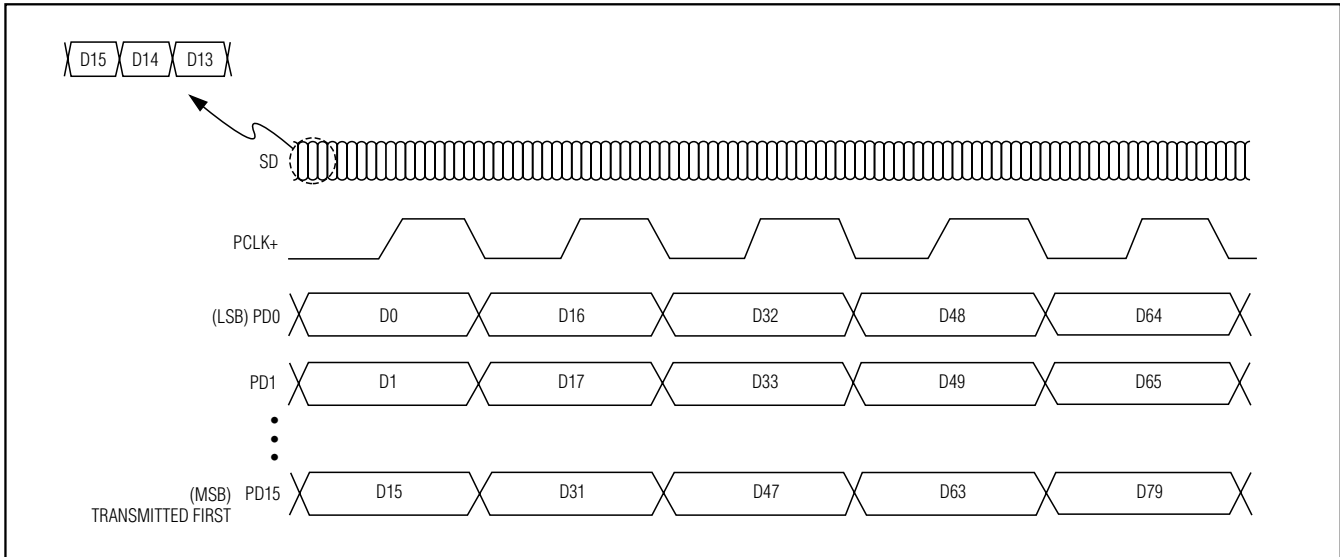


Figure 5. Timing Diagram

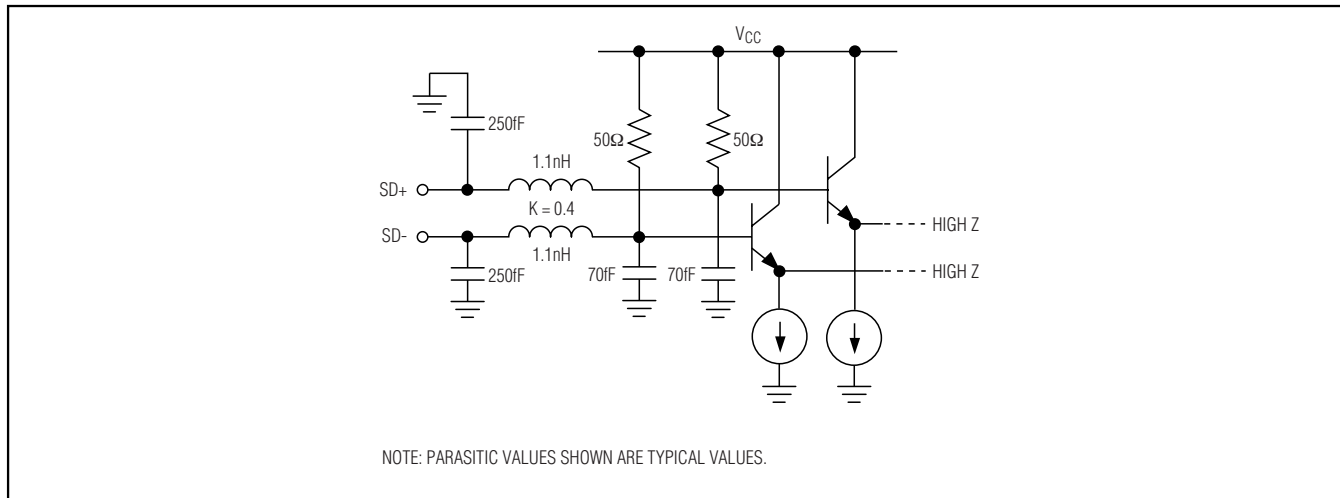


Figure 6. CML Input Model

## Current Mode Logic (CML) Inputs

The differential serial inputs to the MAX3950 are CML and have an input impedance of 50Ω on each of the complementary inputs. For more information on interfacing with the CML inputs, refer to Maxim Application Note HFAN-1.0: *Interfacing Between CML, PECL, and LVDS*.

## Interface Models

Figures 6 and 7 show the typical input/output models for the MAX3950 deserializer.

## Layout Considerations

For best performance, use good high-frequency layout techniques. Filter voltage supplies, keep ground connections short, and use multiple vias where possible. Use controlled-impedance transmission lines to interface with the MAX3950's high-speed inputs and outputs. Place power-supply decoupling as close to VCC as possible. To reduce feedthrough, isolate the input signals from the output signals.

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## Chip Information

TRANSISTOR COUNT: 4800

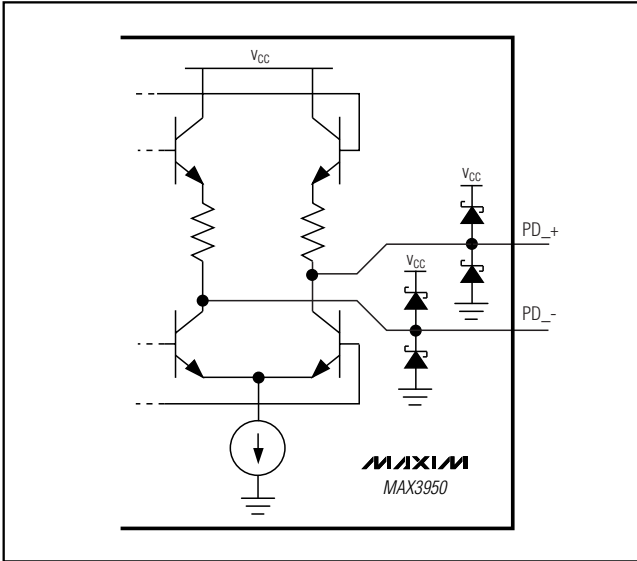
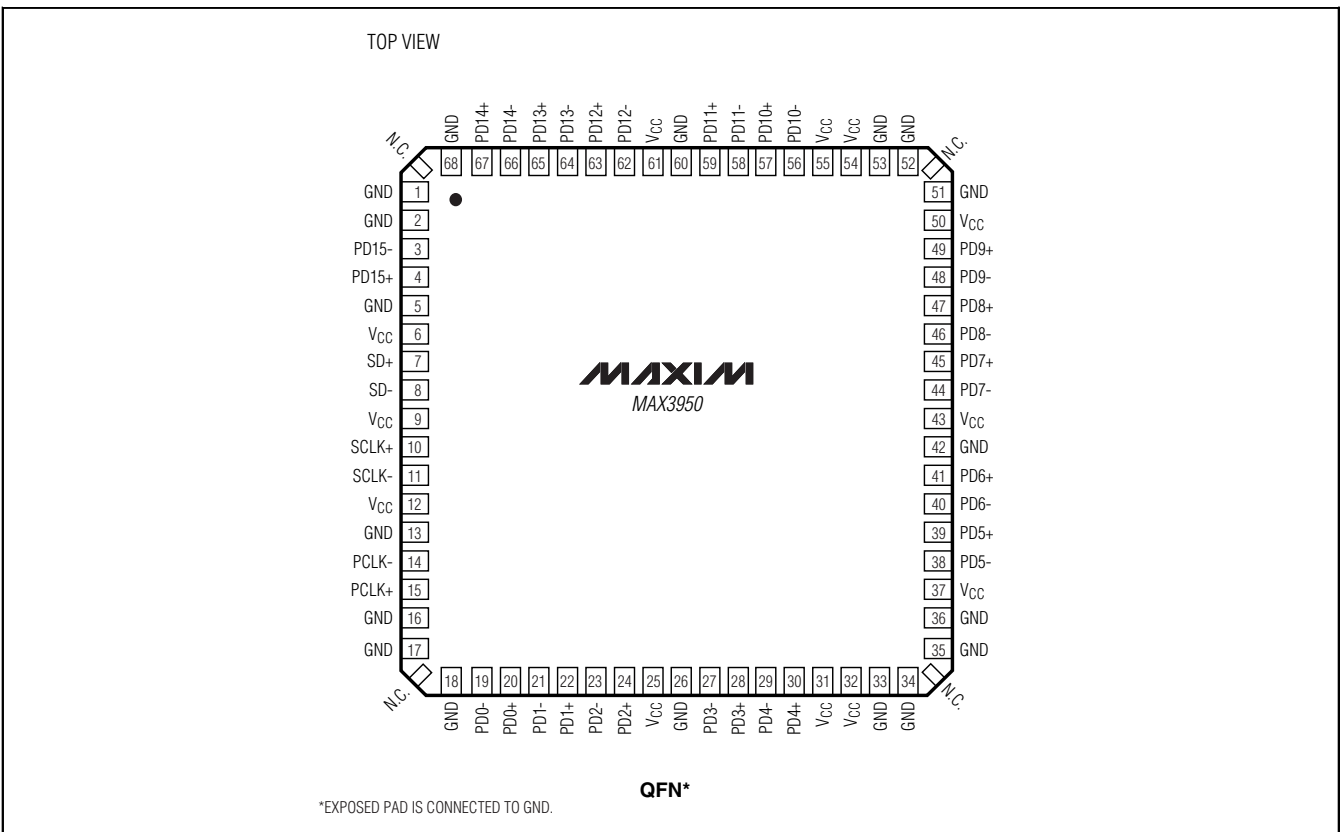


Figure 7. LVDS Output Model

## Pin Configuration



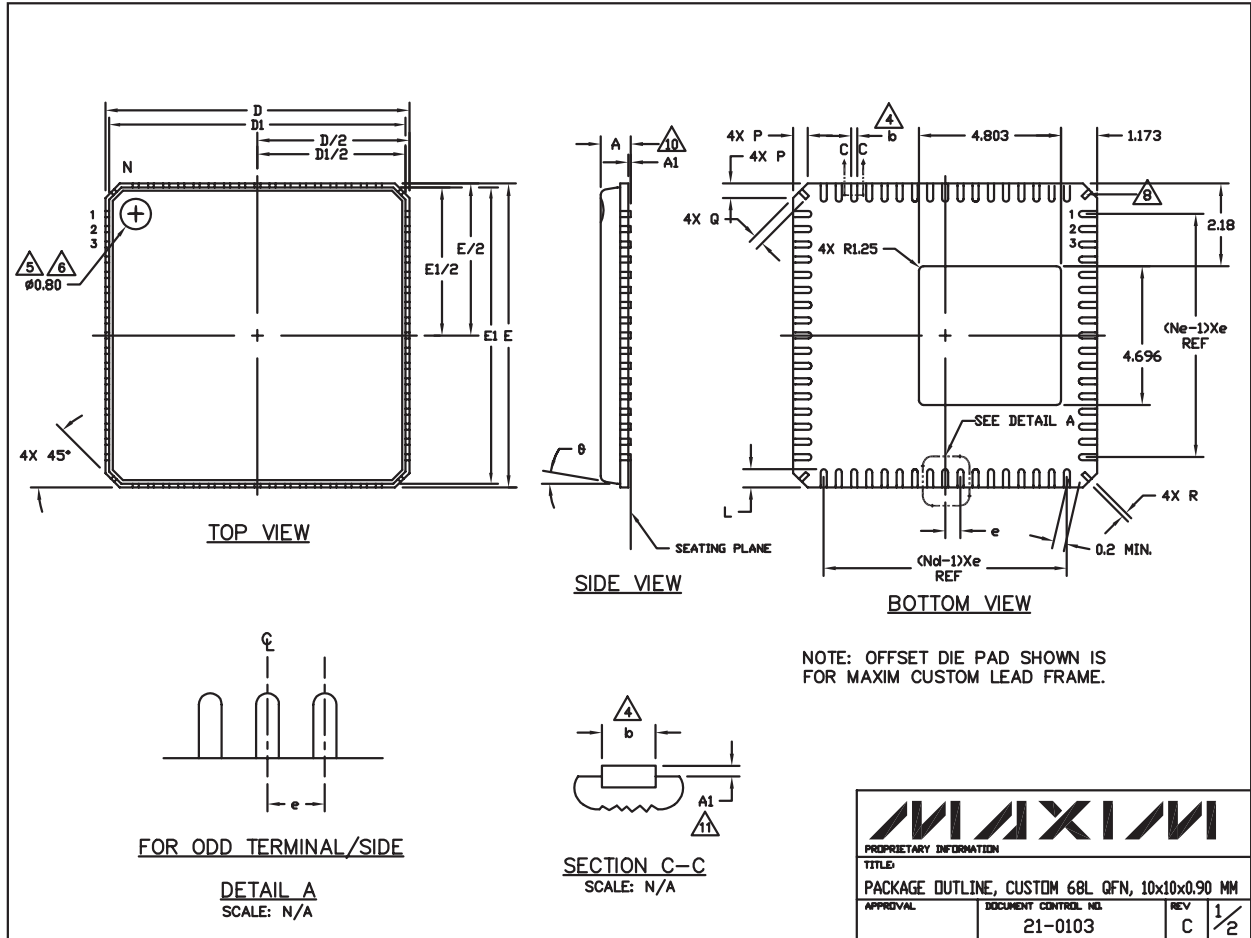


# +3.3V, 10.7Gbps 1:16 Deserializer with LVDS Outputs

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

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## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

### NOTES:

1. DIE THICKNESS ALLOWABLE IS .012 INCHES MAXIMUM.
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
3. N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20mm AND 0.25mm FROM TERMINAL.
5. THE PIN #1 IDENTIFIER MUST BE LOCATED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. THE SHAPES SHOWN AT FOUR CORNERS ARE CONNECTED TO DIE PAD.
9. PACKAGE WARPAGE MAX 0.10mm.
10. APPLIED FOR EXPOSED PAD AND TERMINALS.
11. APPLIED ONLY FOR TERMINALS.
12. CUSTOM LEAD FRAME WITH OFFSET DIE PAD: REFER TO MAXIM 24-0718 (G6800-1F).

S W L	COMMON DIMENSIONS			N <sub>O</sub> <sub>T</sub> E
	MIN.	NOM.	MAX.	
A	—	0.90	1.00	
A1	0.00	0.01	0.05	11
b	0.18	0.23	0.30	4
D	10.00BSC			
D1	9.75BSC			
E	10.00BSC			
E1	9.75BSC			
N	68			3
Nd	17			3
Ne	17			3
Ⓢ	0.50 BSC			
L	0.50	0.60	0.75	
Ⓟ				12°
P	0.24	0.42	0.60	
Q	0.30	0.40	0.65	
R	0.13	0.17	0.23	

<b>MAXIM</b>			
<small>PROPRIETARY INFORMATION</small>			
<small>TITLE</small>			
PACKAGE OUTLINE, CUSTOM 68L QFN, 10x10x0.90 MM			
<small>APPROVAL</small>	<small>DOCUMENT CONTROL NO.</small>	<small>REV</small>	<small>2/2</small>
	21-0103	C	

### Revision History

Rev 0; 11/00: Initial data sheet release.

Rev 1; 12/02: Page 6, Pin Configuration: Corner Pins changed from Ground to N.C.; page 8, Pin Configuration: Changed GND corner pins to N.C.

Rev 2; 7/06: Page 1: Removed future products from Typical Application Circuit.

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## MAX3950

### Part Number Table

**Notes:**

1. See the [MAX3950 QuickView Data Sheet](#) for further information on this product family or download the [MAX3950 full data sheet](#) (PDF, 392kB).
2. Other options and links for purchasing parts are listed at: <http://www.maxim-ic.com/sales>.
3. [Didn't Find What You Need?](#) Ask our applications engineers. Expert assistance in finding parts, usually within one business day.
4. Part number suffixes: T or T&R = tape and reel; + = RoHS/lead-free; # = RoHS/lead-exempt. More: See [full data sheet](#) or [Part Naming Conventions](#).
5. \* Some packages have variations, listed on the drawing. "PkgCode/Variation" tells which variation the product uses.

Part Number	Free Sample	Buy Direct	Package: TYPE PINS SIZE DRAWING CODE/VAR *	Temp	RoHS/Lead-Free? Materials Analysis
MAX3950EGK-TD	<input type="checkbox"/>	<input type="checkbox"/>		-40C to +85C	RoHS/Lead-Free: <a href="#">No</a>
MAX3950EGK-D	<input type="checkbox"/>	<input type="checkbox"/>	QFN;68 pin;10x10x0.9mm Dwg: <a href="#">21-0103D</a> (PDF) Use pkgcode/variation: G6800-1F*	-40C to +85C	RoHS/Lead-Free: <a href="#">No</a> <a href="#">Materials Analysis</a>

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