19-4775; Rev 1; 4/99

EVALUATION KIT AVAILABLE

+3.3V, 622Mbps, SDH/SONET 4:1 Serializer with Clock Synthesis and LVDS Inputs

General Description

The MAX3693 serializer is ideal for converting 4-bit-wide, 155Mbps parallel data to 622Mbps serial data in ATM and SDH/SONET applications. Operating from a single +3.3V supply, this device accepts low-voltage differential-signal (LVDS) clock and data inputs for interfacing with high-speed digital circuitry, and delivers a 3.3V PECL serial-data output. A fully integrated PLL synthesizes an internal 622Mbps serial clock from a 155.52MHz, 77.76MHz, 51.84MHz, or 38.88MHz reference clock.

The MAX3693 is available in the extended temperature range (-40°C to +85°C), in a 32-pin TQFP package.

Features

- **Single +3.3V Supply**
- **155Mbps (4-bit-wide) Parallel to 622Mbps Serial Conversion**
- **Clock Synthesis for 622Mbps**
- **215mW Power**
- **Multiple Clock Reference Frequencies (155.52MHz, 77.76MHz, 51.84MHz, 38.88MHz)**
- **LVDS Parallel Clock and Data Inputs**
- **Differential 3.3V PECL Serial-Data Output**

Applications

622Mbps SDH/SONET Transmission Systems

622Mbps ATM/SONET Access Nodes

Add/Drop Multiplexers

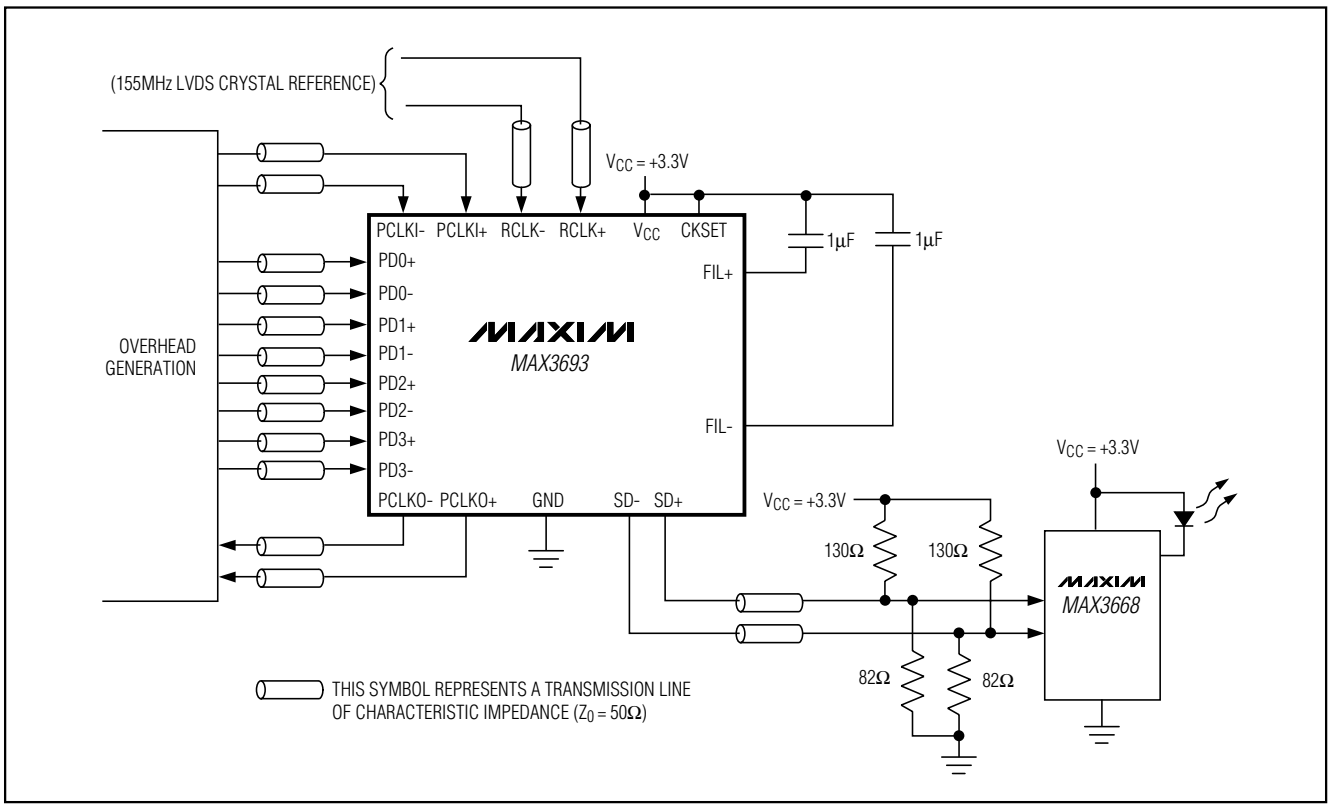
Digital Cross Connects

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX3693ECJ	-40°C to +85°C	32 TQFP

Pin Configuration appears at end of data sheet.

Typical Operating Circuit



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ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)
- V_{CC} .....-0.5V to +5V
- All Inputs, FIL+, FIL-, PCLKO+, PCLKO- .....-0.5V to (V_{CC} + 0.5V)

Output Current
- LVDS Outputs (PCLKO±).....10mA
- PECL Outputs (SD±).....50mA

Continuous Power Dissipation (T_A = +85°C)
- TQFP (derate 10.20mW/°C above +85°C).....663mW

Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-60°C to +160°C
Lead Temperature (soldering, 10sec) .....+300°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} = +3V to +3.6V, differential LVDS loads = 100Ω ±1%, PECL loads = 50Ω ±1% to (V_{CC} - 2V), T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.3V, T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current	I_{CC}	PECL outputs unterminated	38	65	100	mA
PECL OUTPUTS (SD±)						
Output High Voltage	V_{OH}	T_A = 0°C to +85°C	V_{CC} - 1.025		V_{CC} - 0.88	V
		T_A = -40°C	V_{CC} - 1.085		V_{CC} - 0.88	
Output Low Voltage	V_{OL}	T_A = 0°C to +85°C	V_{CC} - 1.81		V_{CC} - 1.62	V
		T_A = -40°C	V_{CC} -1.83		V_{CC} - 1.555	
LVDS INPUTS AND OUTPUTS (PCLKI±, RCLK±, PCLKO±, PD_±)						
Input Voltage Range	V_I	Differential input voltage = 100mV	0		2.4	V
Differential Input Threshold	V_{IDTH}	Common-mode voltage = 50mV	-100		100	mV
Threshold Hysteresis	V_{HYST}			60		mV
Differential Input Resistance	R_{IN}		85	100	115	Ω
Output High Voltage	V_{OH}				1.475	V
Output Low Voltage	V_{OL}		0.925			V
Differential Output Voltage	$\|V_{OD}\|$		250		400	mV
Change in Magnitude of Differential Output Voltage for Complementary States	$\Delta\|V_{OD}\|$				±25	mV
Output Offset Voltage	V_{OS}		1.125		1.275	V
Change in Magnitude of Output Offset Voltage for Complementary States	ΔV_{OS}				±25	mV
Single-Ended Output Resistance	R_O		40	95	140	Ω
Change in Magnitude of Single-Ended Output Resistance for Complementary Outputs	ΔR_O			±2.5	±10	%
PROGRAMMING INPUT (CKSET)						
CKSET Input Current	I_{CKSET}	CKSET = 0 or V_{CC}			±500	µA

AC ELECTRICAL CHARACTERISTICS

(V_{CC} = +3V to +3.6V, differential LVDS load = 100Ω ±1%, PECL loads = 50Ω ±1% to (V_{CC} - 2V), T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.3V, T_A = +25°C.) (Note 1)

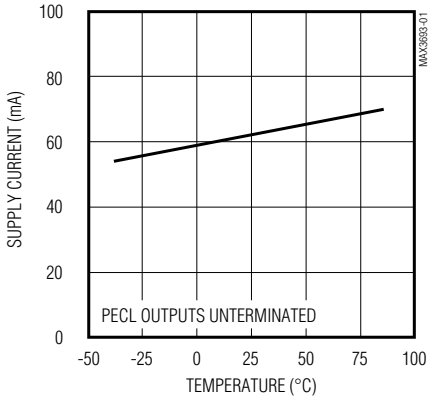
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Serial Clock Rate	f_{SCLK}			622.08		MHz
Parallel Data-Setup Time	t_{SU}	T_A = +25°C	200			ps
Parallel Data-Hold Time	t_H		600			ps
PCLKO to PCLKI Skew	t_{SKEW}		0		+4.0	ns
Output Random Jitter	Φ_0				11	ps_{RMS}
PECL Differential Output Rise/Fall Time	t_R, t_F			200		ps

Note 1: AC characteristics guaranteed by design and characterization.

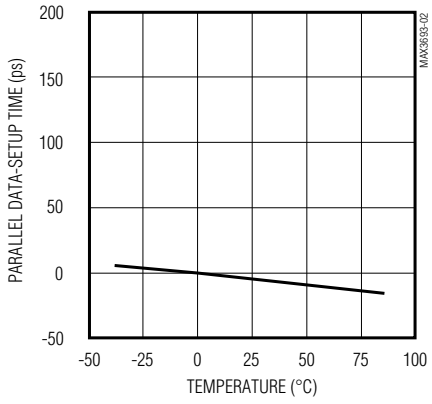
Typical Operating Characteristics

(V_{CC} = +3.3V, differential LVDS loads = 100Ω ±1%, PECL loads = 50Ω ±1% to (V_{CC} - 2V), T_A = +25°C, unless otherwise noted.)

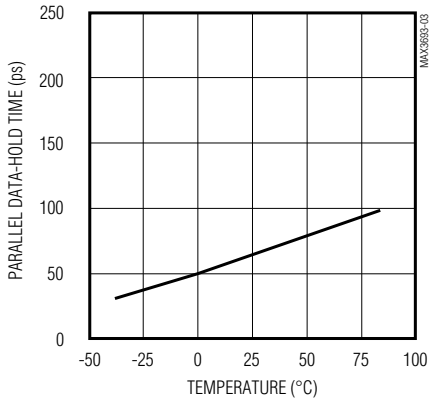
SUPPLY CURRENT vs. TEMPERATURE



PARALLEL DATA-SETUP TIME vs. TEMPERATURE



PARALLEL DATA-HOLD TIME vs. TEMPERATURE

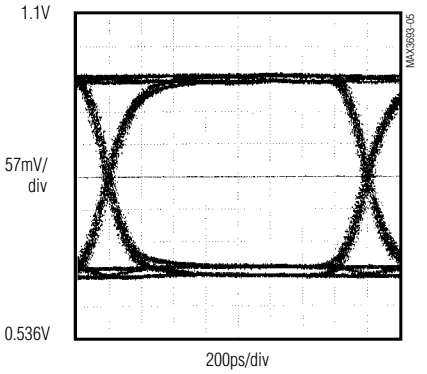


+3.3V, 622Mbps, SDH/SONET 4:1 Serializer with Clock Synthesis and LVDS Inputs

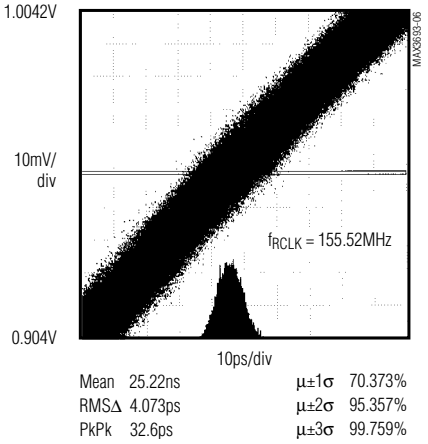
Typical Operating Characteristics (continued)

(V_{CC} = +3.3V, differential LVDS loads = 100Ω ±1%, PECL loads = 50Ω ±1% to (V_{CC} - 2V), T_A = +25°C, unless otherwise noted.)

SERIAL-DATA OUTPUT EYE DIAGRAM



SERIAL-DATA OUTPUT JITTER



Mean	25.22ns	μ±1σ	70.373%
RMSΔ	4.073ps	μ±2σ	95.357%
PkPk	32.6ps	μ±3σ	99.759%

Pin Description

PIN	NAME	FUNCTION
1, 3, 5, 7	PD0+ to PD3+	Noninverting LVDS Parallel Data Inputs. Data is clocked in on the PCLKI signal's positive transition.
2, 4, 6, 8	PD0- to PD3-	Inverting LVDS Parallel Data Inputs. Data is clocked in on the PCLKI signal's positive transition.
9, 17, 18, 19, 24, 25, 32	GND	Ground
10	PCLKO-	Inverting LVDS Parallel-Clock Output. Use positive transition of PCLKO to clock the overhead management circuit.
11	PCLKO+	Noninverting LVDS Parallel-Clock Output. Use positive transition of PCLKO to clock the overhead management circuit.
12, 13, 16, 21, 28, 29	V_{CC}	+3.3V Supply Voltage
14	SD-	Inverting PECL Serial-Data Output
15	SD+	Noninverting PECL Serial-Data Output
20	CKSET	Reference Clock Rate Programming Pin. CKSET = V_{CC}: Reference Clock Rate = 155.52MHz CKSET = Open: Reference Clock Rate = 77.76MHz CKSET = 20kΩ to GND: Reference Clock Rate = 51.84MHz CKSET = GND Reference Clock Rate = 38.88MHz
22	FIL-	Filter Capacitor Input. See *Typical Operating Circuit* for external-component connections.
23	FIL+	Filter Capacitor Input. See *Typical Operating Circuit* for external-component connections.
26	RCLK+	Noninverting LVDS Reference Clock Input. Connect an LVDS-compatible crystal reference clock to the RCLK inputs.
27	RCLK-	Inverting LVDS Reference Clock Input. Connect an LVDS-compatible crystal reference clock to the RCLK inputs.
30	PCLKI+	Noninverting LVDS Parallel Clock Input. Connect the incoming parallel-data-clock signal to the PCLKI inputs. Note that data is updated on the positive transition of the PCLKI signal.
31	PCLKI-	Inverting LVDS Parallel Clock Input. Connect the incoming parallel-data-clock signal to the PCLKI inputs. Note that data is updated on the positive transition of the PCLKI signal.

+3.3V, 622Mbps, SDH/SONET 4:1 Serializer with Clock Synthesis and LVDS Inputs

Detailed Description

The MAX3693 serializer comprises a 4-bit parallel input register, a 4-bit shift register, control and timing logic, a PECL output buffer, LVDS input/output buffers, and a frequency-synthesizing PLL (consisting of a phase/frequency detector, loop filter/amplifier, voltage-controlled oscillator, and prescaler). This device converts 4-bit-wide, 155Mbps data to 622Mbps serial data (Figure 1).

The PLL synthesizes an internal 622Mbps reference used to clock the output shift register. This clock is generated by locking onto the external 155.52MHz, 77.76MHz, 51.84MHz, or 38.88MHz reference-clock signal (RCLK).

The incoming parallel data is clocked into the MAX3693 on the rising transition of the parallel-clock-input signal (PCLKI). The control and timing logic ensure proper operation if the parallel-input register is latched within a window of time that is defined with respect to the parallel-clock-output signal (PCLKO). PCLKO is the synthesized 622Mbps internal serial-clock signal divided by four. The allowable PCLKO-to-PCLKI skew is 0 to +4ns. This defines a timing window at about the PCLKO rising edge, during which a PCLKI rising edge may occur (Figure 2).

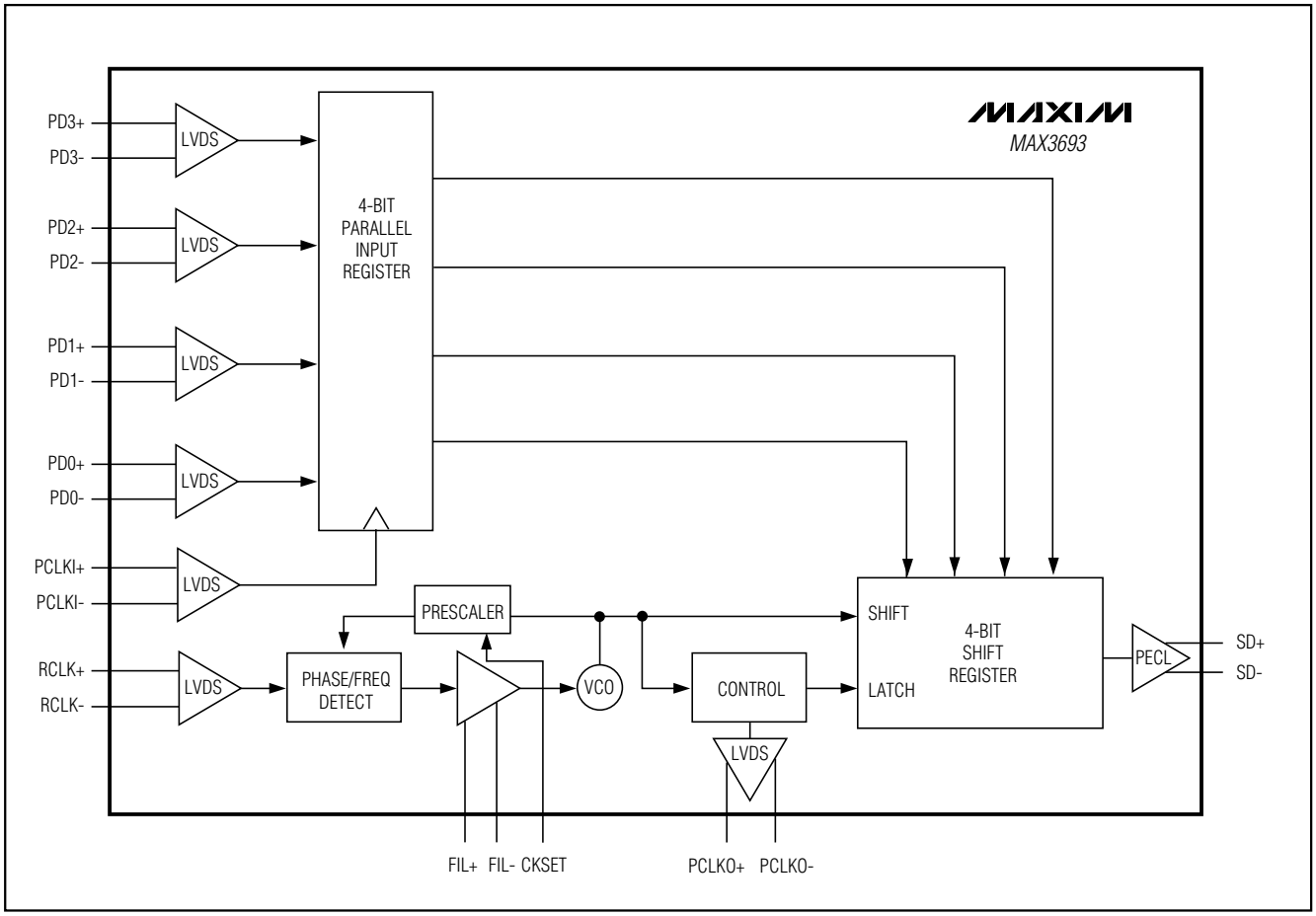


Figure 1. Functional Diagram

+3.3V, 622Mbps, SDH/SONET 4:1 Serializer with Clock Synthesis and LVDS Inputs

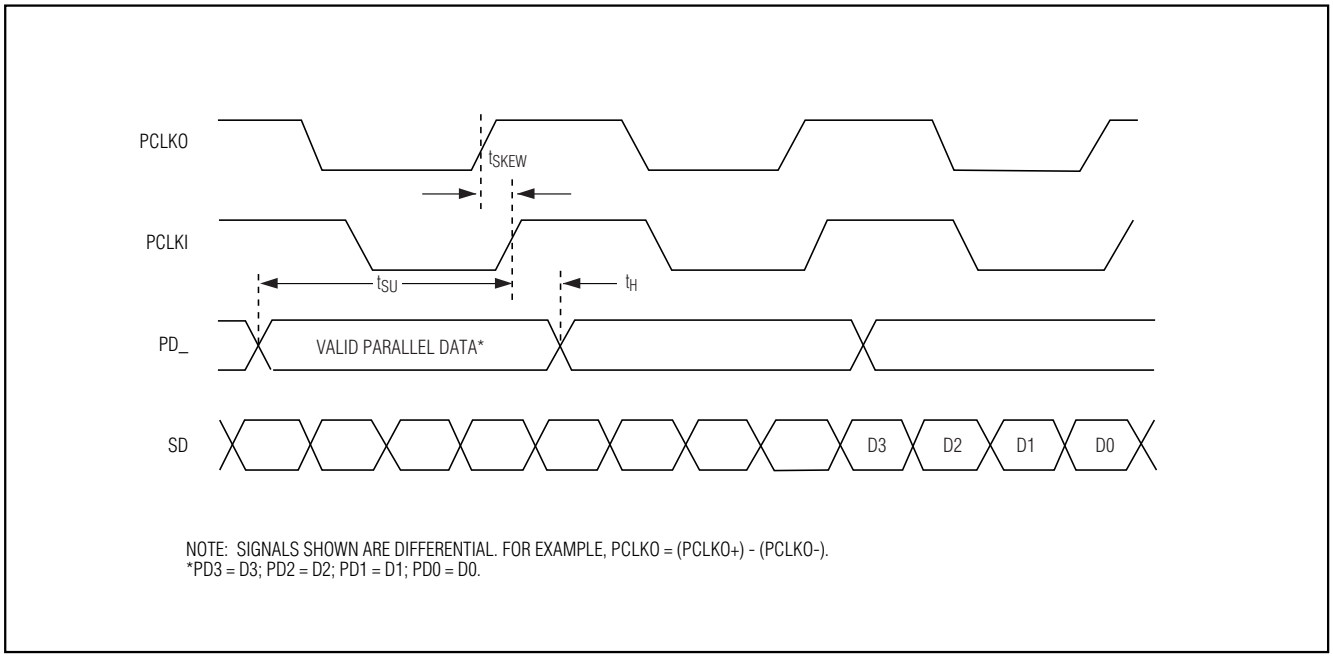


Figure 2. Timing Diagram

Low-Voltage Differential-Signal (LVDS) Inputs and Outputs

The MAX3693 features LVDS inputs and outputs for interfacing with high-speed digital circuitry. The LVDS standard is based on the IEEE 1596.3 LVDS specification. This technology uses 250mV to 400mV differential low-voltage swings to achieve fast transition times, minimized power dissipation, and noise immunity.

For proper operation, the parallel-clock LVDS outputs (PCLKO+, PCLKO-) require 100Ω differential DC termination between the inverting and noninverting outputs. Do not terminate these outputs to ground.

The parallel data and parallel clock LVDS inputs (PD_+, PD_-, PCLKI+, PCLKI-, RCLK+, RCLK-) are internally terminated with 100Ω differential input resistance, and therefore do not require external termination.

PECL Outputs

The serial-data PECL outputs (SD+, SD-) require 50Ω DC termination to (V_{CC} - 2V) (see the *Alternative PECL-Output Termination* section).

+3.3V, 622Mbps, SDH/SONET 4:1 Serializer with Clock Synthesis and LVDS Inputs

Applications Information

Alternative PECL-Output Termination

Figure 3 shows alternative PECL output-termination methods. Use Thevenin-equivalent termination when a (V_{CC} - 2V) termination voltage is not available. If AC coupling is necessary, be sure that the coupling capacitor is placed following the 50Ω or Thevenin-equivalent DC termination.

Layout Techniques

For best performance, use good high-frequency layout techniques. Filter voltage supplies and keep ground connections short. Use multiple vias where possible. Also, use controlled-impedance transmission lines to interface with the MAX3693 clock and data inputs and outputs.

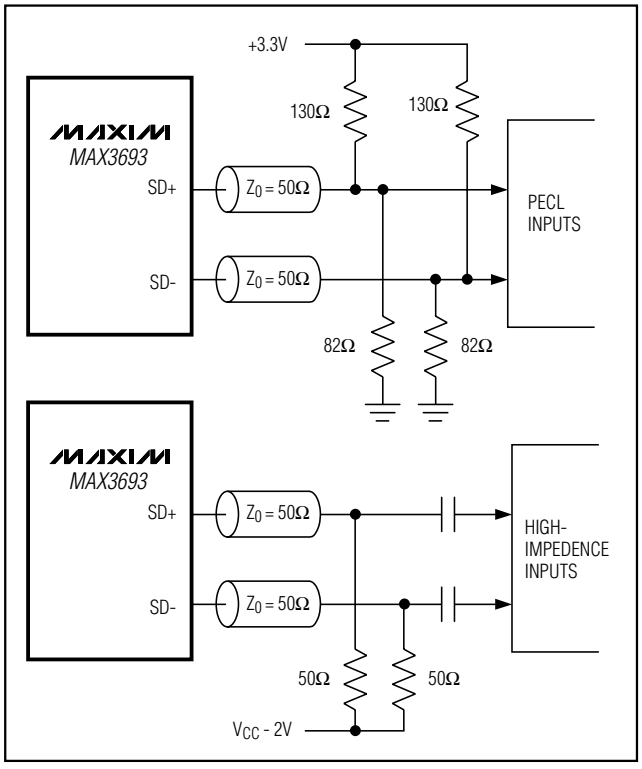
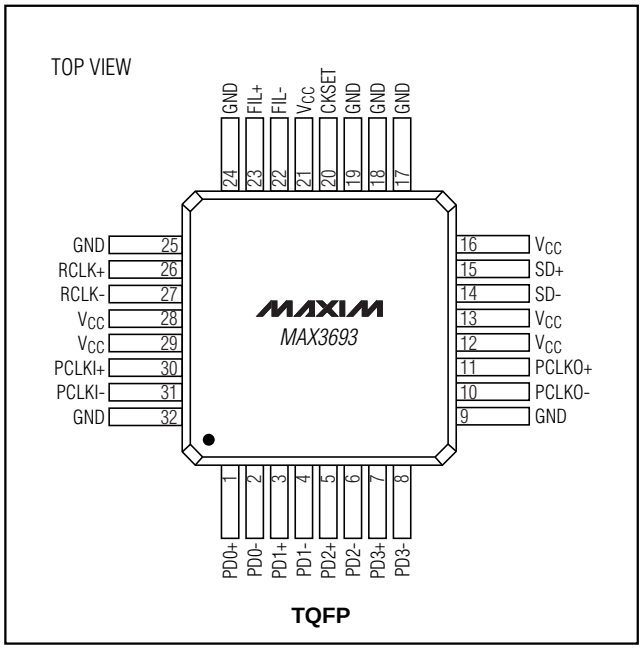


Figure 3. Alternative PECL-Output Termination

Pin Configuration



Chip Information

TRANSISTOR COUNT: 2925

+3.3V, 622Mbps, SDH/SONET 4:1 Serializer with Clock Synthesis and LVDS Inputs

Package Information