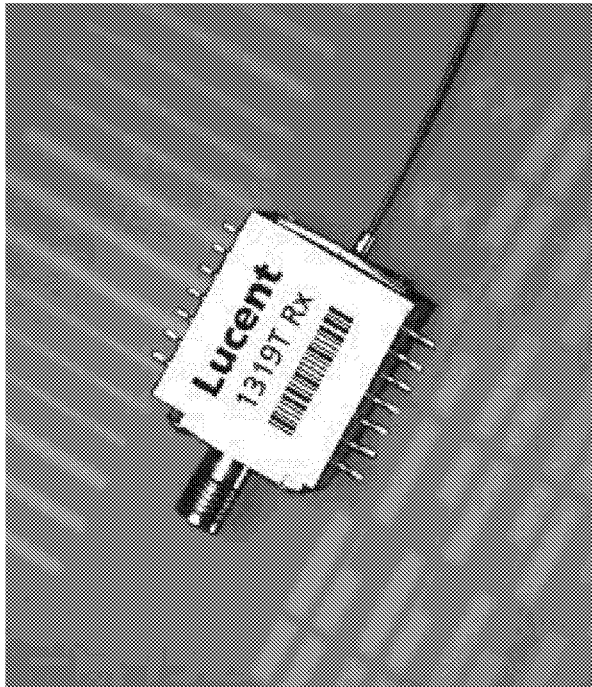


## 1319T OC-192/STM-64 Lightwave Receiver



The 1319T 10 Gbits/s Receiver is manufactured in a compact, 14-pin butterfly-lead package with a single-mode optical fiber pigtail and a precision microwave coaxial connector for data access.

### Features

- High data rate capability: 10 Gbits/s
- APD or PIN photodetector
- Fully operational through the 1.3  $\mu\text{m}$  to 1.55  $\mu\text{m}$  wavelength range
- Typical sensitivity:
  - With PIN,  $-18$  dBm
  - With APD,  $-26$  dBm
- 23 dB typical dynamic range
- Single-mode fiber pigtail with FC/PC or SC optical connector
- Operating case temperature range:  
0  $^{\circ}\text{C}$  to 65  $^{\circ}\text{C}$
- 50  $\Omega$  ac-coupled data output
- Compact butterfly package with precision microwave *K Connector*\* for data output

### Applications

- Line terminal equipment
- High-speed networks up to 10 Gbits/s
- SONET OC-192 and SDH STM-64 telecommunications applications
- Extended-reach datacom and telecom applications
- Digital video

\* *K Connector* is a registered trademark of Wiltron Corporation.

## 1319T OC-192/STM-64 Lightwave Receiver

### Description

#### Receiver Operation

The 1319T 10 Gbits/s fiber-optic receiver consists of a high-speed photodetector (APD or PIN) and a wide-band linear preamp in a pigtailed butterfly-lead metal package. It is designed for use in single-mode, high-speed telecommunication applications at the SONET OC-192 and the ITU-T SDH STM-64 data rate of 9.95328 Gbits/s.

At 10 Gbits/s, the typical room temperature sensitivity measured at a BER of  $3 \times 10^{-11}$  is  $-26$  dBm for the APD version of the receiver and  $-18$  dBm for the PIN version of the receiver. The operating case temperature range for the receiver is  $0^\circ\text{C}$  to  $65^\circ\text{C}$ .

The receiver is manufactured in a compact, 14-pin butterfly-lead package with a single-mode optical fiber pigtail and a precision microwave coaxial connector for data access. The fiber pigtail is internally beveled for low return loss and is available with *ST*<sup>®</sup>, *SC*, or *FC-PC* optical connectors.

The received data is ac-coupled ( $0.033 \mu\text{F}$  capacitor) through a precision microwave coaxial *K Connector* manufactured by Wiltron Corp. This connector is mechanically and electrically compatible with standard SMA and 3.5 mm coaxial connectors but provides a lower return loss than the standard connectors. Other coaxial connectors will be available in the future.

The receiver requires  $+5\text{ V}$  and  $-5\text{ V}$  power supplies for operation. The photodiode also requires a separate bias voltage: for the PIN, a nominal bias of  $+5\text{ V}$  at less than  $1\text{ mA}$  is required; for the APD, a nominal bias of approximately  $+35\text{ V}$  is required. The APD bias supply should be temperature compensated to match the  $0.2\%/\text{C}$  gain vs. temperature performance of the APD photodiode. The APD version of the receiver includes a  $3\text{ k}\Omega$  thermistor which can be used to monitor receiver case temperature and also as the feedback element for a temperature-compensated bias supply for the APD.

The 700B power module available from the Lucent Technologies Power Systems Division is a dc-dc converter that converts  $+5\text{ Vdc}$  to an adjustable high-voltage output in the range required for the APD bias. The 700B uses the thermistor in the 1319T to provide a temperature-compensated output. Contact your local Lucent sales office for pricing and delivery.

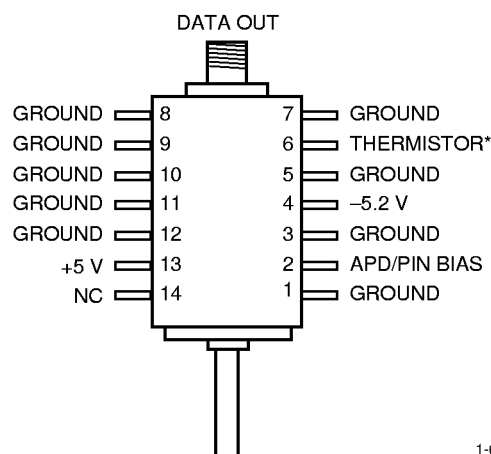
Also available from Maxim Integrated Products, Sunnyvale, CA are the MAX1771 and MAX774 dc-dc switching converter ICs which can be used to build a high-voltage APD bias supply.

### Pin Information

Table 1. Pin Descriptions

Pin	Name
1	Ground
2	Photodiode bias
3	Ground
4	VEE ( $-5.2\text{ V}$ )
5	Ground
6	Thermistor*
7	Ground
8	Ground
9	Ground
10	Ground
11	Ground
12	Ground
13	Vcc ( $5\text{ V}$ )
14	No connect
CASE	Ground

\* The thermistor is not available in the PIN version of the receiver. In 1319P-Type receivers, this pin will be open circuit internally.



1-635.b

\* No connection for PIN versions (not connected internally).

Figure 1. Pin Diagram

## Handling Precautions

### Mounting and Connections

The pigtail consists of a 41 in.  $\pm$  13 in. (1041 mm  $\pm$  330 mm), 8  $\mu$ m core, single-mode fiber. The 1319P PIN receiver pigtails have a 900  $\mu$ m OD jacket diameter.

The 1319T APD models have a 1200  $\mu$ m OD jacket diameter. Both models of the receiver are available with FC/PC or SC optical connectors. Other connector options may be available. Contact your Lucent sales office for availability and ordering information.

The fiber bending radius during operation and storage is 1.5 in. (38 mm) minimum.

### Electrostatic Discharge

**CAUTION: This device is susceptible to damage as a result of electrostatic discharge (ESD). Take proper precautions during both handling and testing. Follow guidelines such as JEDEC Publication No. 108-A.**

Although protection circuitry is designed into the device, take proper precautions to avoid exposure to ESD. Lucent employs a human-body model (HBM) for ESD-susceptibility testing and protection design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 k $\Omega$ , capacitance = 100 pF) is widely used and, therefore, can be used for comparison purposes.

The HBM ESD withstand voltage established for the 1319-Type receiver is  $\pm$ 500 V.

### Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations section of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Supply Voltage:				
Positive Supply	VCC	0	5.8	V
Negative Supply	VEE	0	-5.8	V
Photodiode Supply Current:				
Forward*	—	—	20	mA
Reverse	—	—	2	mA
Optical Input Power:†				
APD	P <sub>MAX</sub>	—	2	dBm
PIN	P <sub>MAX</sub>	—	5	dBm
Operating Case Temperature	T <sub>C</sub>	0	65	°C
Storage Temperature	T <sub>C</sub>	-40	85	°C
Lead Soldering Temperature	—	—	250	°C
Lead Soldering Time	—	—	10	s

\* Device is normally reverse biased. Forward biasing the photodiode may compromise device performance and reliability.

† Under biased conditions. Unbiased, the maximum input optical power for both devices is +8 dBm.

## 1319T OC-192/STM-64 Lightwave Receiver

### Qualification Tests

The 1319-Type receiver has successfully passed the following qualification tests and meets the intent of Bellcore TR-NWT-000468.

Test	Conditions	Sample Size	Failure Criteria
Physical Dimensions	MIL-STD-883C-2016	90	Visual
External Visual	MIL-STD-883C-2009.8	90	Visual
Impact Shock	1500 G, 5 hits, 6 axis, MIL-STD-883C-2002.3	11	Electrical/Optical
Variable Frequency Vibration	20 G, 10 Hz to 2 kHz, 4 cycles, 3 directions, 4 min./cycle, MIL-STD-883C-2007.1	11	Electrical/Optical
Solderability	MIL-STD-883C-2003.5	100%	Visual
Temperature Cycle	-10 °C to +60 °C, 2000 cycles, MIL-STD-883C-1010.7	15	Electrical/Optical
High Temperature, High Humidity with Bias	60 °C, 95% relative humidity, rated bias, 4000 hours	4	Electrical/Optical
High Temperature with Bias	60 °C ambient, rated bias, 4000 hours, MIL-STD-883C-1005.5	—	Electrical/Optical
Electrostatic Discharge	Human-body model (to determine class)	3	Electrical/Optical
Power Cycling	1500 cycles (30 min. on/off) MIL-STD-1006	3	Electrical/Optical

### Optical Characteristics

T<sub>A</sub> = 25 °C.

Parameter	Symbol	Min	Typ	Max	Unit
Optical Wavelength for Rated Sensitivity	$\lambda$	1.2	—	1.6	$\mu\text{m}$
Sensitivity (10 Gbits/s, 2 <sup>23</sup> - 1 PRBS, 3 x 10 <sup>-11</sup> BER):					
APD Version	P <sub>LOW</sub>	-22	-24	—	dBm
PIN Version	P <sub>LOW</sub>	-15	-18	—	dBm
Maximum Optical Input Power (10 Gbits/s 2 <sup>23</sup> - 1 PRBS, 3 x 10 <sup>-11</sup> BER):					
APD Version	P <sub>HIGH</sub>	-4	—	—	dBm
PIN Version	P <sub>HIGH</sub>	0	—	—	dBm
Optical Return Loss	—	-27	-30	—	dBm
Responsivity of APD, $\lambda = 1.55 \mu\text{m}$ , M = 10	R <sub>APD</sub>	—	7.5	—	A/W
Responsivity of PIN, $\lambda = 1.55 \mu\text{m}$ , M = 1	R <sub>PIN</sub>	—	0.85	—	A/W
APD Gain 12 Voltage	V <sub>12</sub>	20	—	35	V
APD Breakdown Voltage	V <sub>BRK</sub>	—	—	40	V
Total Dark Current	I <sub>DK</sub>	—	0.3	—	$\mu\text{A}$
Temperature Coefficient of Gain 12 Voltage	—	—	0.2	—	%/°C

Optical Characteristics (continued)

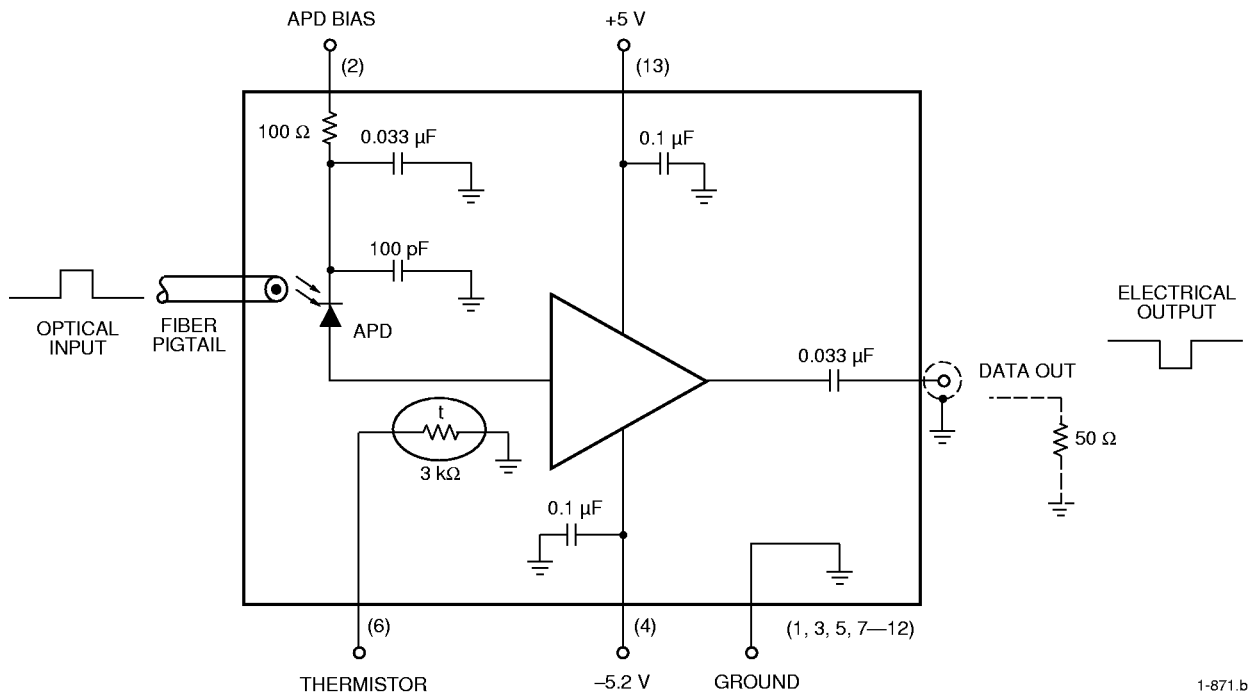


Figure 2. 1319-Type High-Speed Lightwave Receiver Schematic

Electrical Characteristics

Table 2. 1319 Receiver Thermistor Resistance (R) vs. Temperature (T)

T (°C)	R (Ω)	T (°C)	R (Ω)	T (°C)	R (Ω)	T (°C)	R (Ω)
0	9796	20	3748	40	1598	60	746.3
2	8851	22	3426	42	1475	62	694.7
4	8006	24	3155	44	1363	64	647.1
6	7252	26	2872	46	1260	66	603.3
8	6576	28	2633	48	1167	68	562.8
10	5971	30	2417	50	1081	70	525.5
12	5427	32	2221	52	1002	72	490.9
14	4939	34	2042	54	929.6	74	459.0
16	4500	36	1880	56	863.3	76	429.5
18	4105	38	1733	58	802.3	78	402.2

1319T OC-192/STM-64 Lightwave Receiver

Electrical Characteristics (continued)

Table 3. Electrical Characteristics

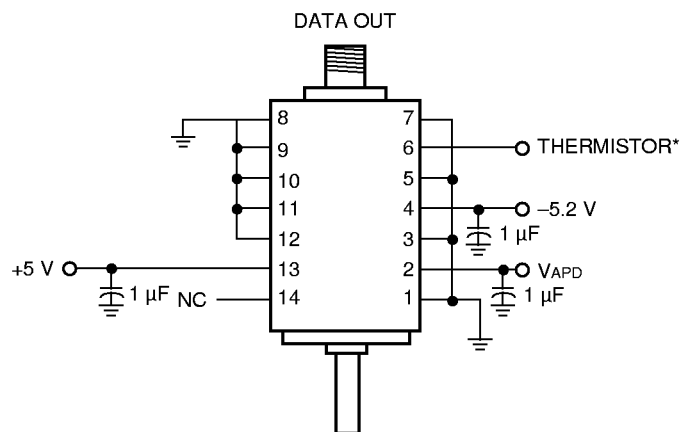
T<sub>A</sub> = 25 °C.

Parameter	Symbol	Min	Typ	Max	Unit
dc Power Supply Voltages:					
Positive Supply	V <sub>CC</sub>	4.75	5.0	5.25	V
Negative Supply	V <sub>EE</sub>	-5.46	-5.2	-4.94	V
APD Bias*	V <sub>APD</sub>	20	—	50	V
PIN Bias	V <sub>PIN</sub>	—	5	10	V
dc Power Supply Currents:					
Positive Supply	I <sub>CC</sub>	—	75	100	mA
Negative Supply	I <sub>EE</sub>	—	20	30	mA
APD Bias	I <sub>APD</sub>	—	—	2	mA
PIN Bias	I <sub>PIN</sub>	—	—	2	mA
Power Dissipation	P <sub>DISS</sub>	—	0.6	0.96	W
Transimpedance†:	T <sub>Z</sub>				
I <sub>PH</sub> ≤ 100 μA		—	1000	—	Ω
I <sub>PH</sub> ≤ 500 μA		—	750	—	Ω
I <sub>PH</sub> ≤ 1000 μA		—	675	—	Ω
I <sub>PH</sub> ≤ 1500 μA		—	650	—	Ω
I <sub>PH</sub> ≤ 2000 μA		—	550	—	Ω
Average Equivalent Input Noise Spectral Density	—	—	10	—	pA/√Hz
Summed Equivalent Noise Power	—	—	950	—	nArms
Feedback Resistor Value	R <sub>F</sub>	—	500	—	Ω
Low-frequency Cutoff	f <sub>L</sub>	—	100	—	kHz
Bandwidth	BW	—	8	—	GHz
Rolloff (3 dB + 5 GHz)	—	—	-20	—	dB
Peaking:					
0 GHz—5 GHz	—	—	2	—	dB
5 GHz—10 GHz	—	—	3	—	dB
Group Delay Deviation:					
0 GHz—5 GHz	—	—	±50	—	ps
5 GHz—10 GHz	—	—	±100	—	ps
Output Return Loss:	S <sub>22</sub>				
0 GHz—3 GHz		—	< -15	—	dB
3 GHz—10 GHz		—	< -10	—	dB

\* The gain = 12 APD bias voltage at 25 °C is supplied with each device. For optimum performance, V<sub>APD</sub> must be set within 50 mV of the specified value. V<sub>APD</sub> needs to be temperature compensated to maintain constant gain over the operating temperature. The nominal compensation is 0.18%/°C.

† Transimpedance,  $T_Z = \frac{V_{PP}}{I_{PH(AVG)}}$ , where I<sub>PH(AVG)</sub> is the average photodiode current.

### Recommended Circuit Diagram



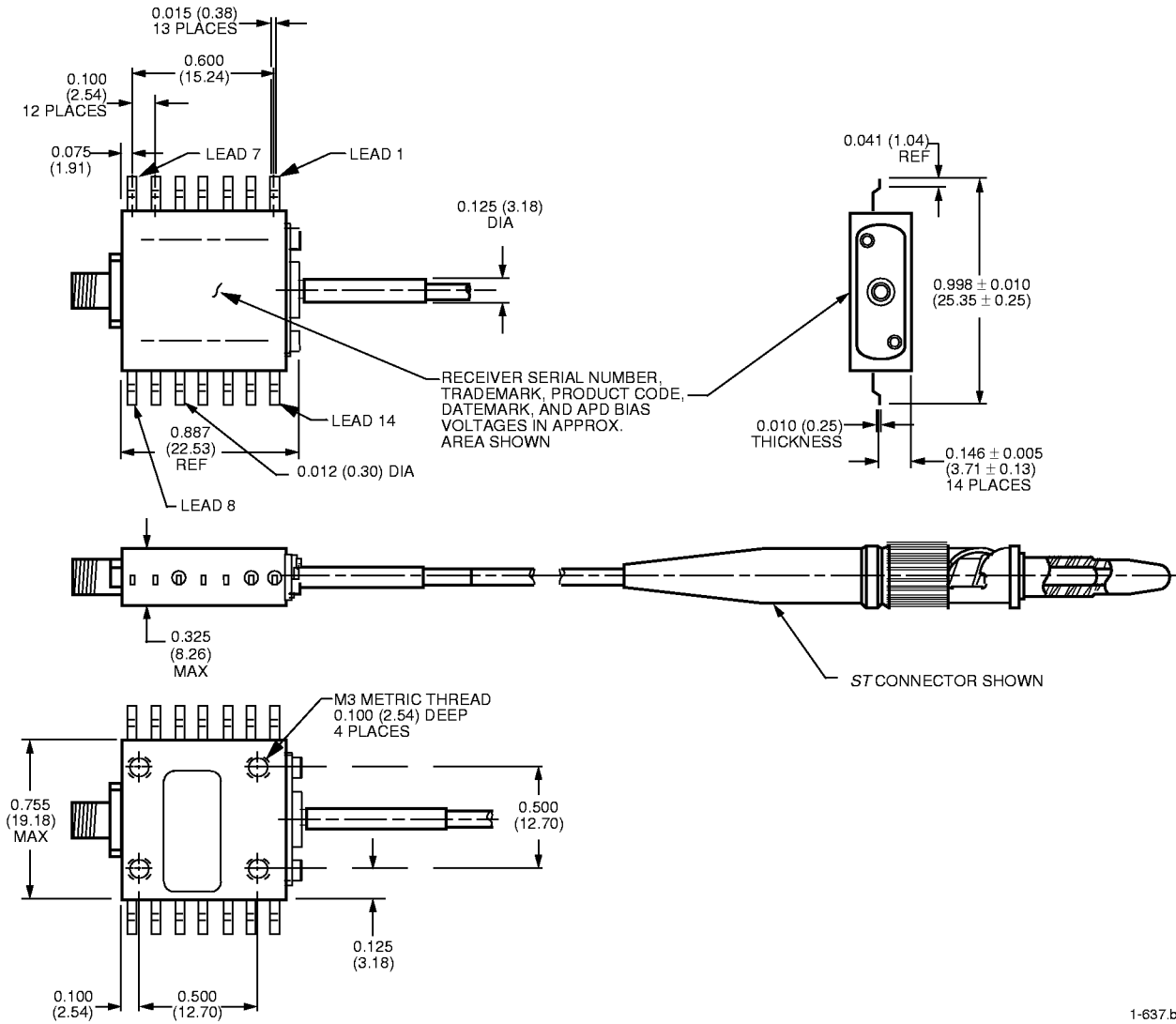
\* APD version only.

1-636.b

Figure 3. Circuit Diagram

Outline Diagram

Dimensions are in inches and (millimeters).



1-637.b



## Ordering Information

Description	Product Code	Photodiode	Connector	Comcode
1319T-Type OC-192/ STM-64 Lightwave Receiver	1319TA	APD	FC-PC	107913519
	1319TC	APD	SC	107913535
	1319TP	PIN	FC-PC	107913543
	1319TS	PIN	SC	107913568

## Related Product Information

Product Code	Description	Document Number
290EM-Type Laser Module	10 Gbits/s Laser Module with Integrated Electro-Absorptive Modulator	PS97-009LWP
D2500P-Type Laser Module	Wavelength Selectable, Isolated DFB Laser Module with PMF Fiber	DS96-144LWP
2410/2420-Type Modulator	LiNbO <sub>3</sub> Dual-Output Electro-Optic Modulator	PN94-075LWP
26xx-Type Modulator	LiNbO <sub>3</sub> SLIM-PAC Electro-Optic Modulator	DS96-135LWP
1712-Type EDFA	Erbium-Doped Fiber Amplifier (980 nm Pump Laser)	DS96-086LWP
1713-Type EDFA	Erbium-Doped Fiber Amplifier (1480 nm Pump Laser)	DS96-134LWP
1718-Type EDFA	Fiber Amplifier Gain Block (980 nm Pump Laser)	DS95-233LWP
700B	Power Module (High-Voltage Output dc-dc Converter)	DS95-182EPS