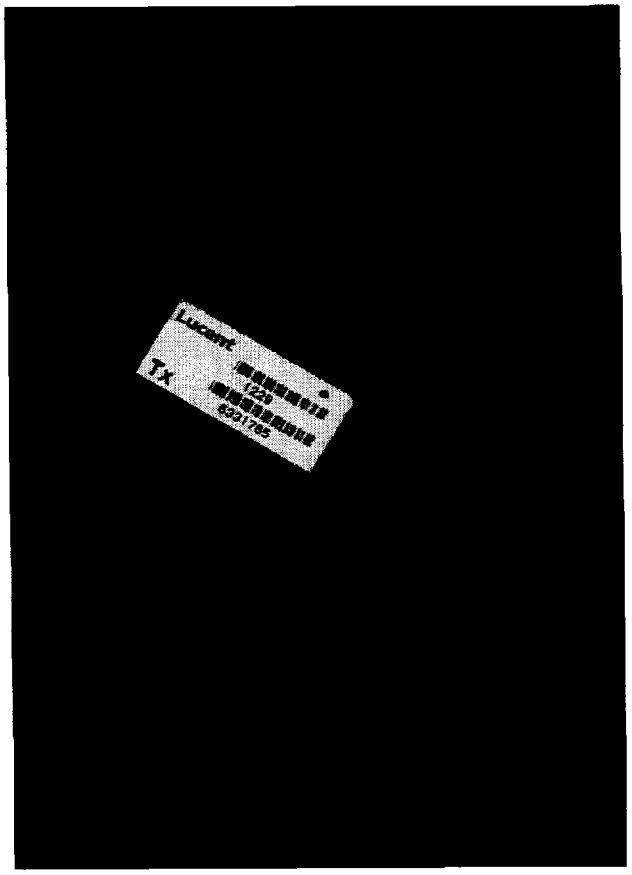
Data Sheet
February 1997

microelectronics group

Lucent Technologies
Bell Labs Innovations

1229-Type *ASTROTEC*® Uncooled DFB Laser Transmitter



The 1229-Type is manufactured in a 20-pin DIP with a single-mode fiber pigtail.

Features

- 1.3 µm wavelength and 1.55 µm wavelength versions
- SONET/SDH OC-3/STM-1 and OC-12/STM-4 long-reach compliant
- NRZ data rates to 650 Mbits/s
- Uncooled laser with automatic control of optical output power over case temperature range
- Requires single 5 V power supply
- ECL or PECL differential or single-ended data inputs
- Transmit disable input
- Uses reliable InGaAsP MQW DFB laser
- Uses low-power CMOS technology
- Operating case temperature range of –40 °C to +85 °C (+70 °C for 1550 nm version)
- Adheres to Lucent Technologies Microelectronics Group's Reliability and Qualification Program standards for built-in quality

Applications

- Telecommunications
  - — Inter- and intraoffice SONET/ITU-T SDH
  - — Subscriber loop
  - — Metropolitan area networks
- Data communication
  - — High-speed data links
  - — Single-mode FDDI
  - — ATM

Description

The 1229-Type *ASTROTEC* Lightwave Transmitter is designed for use in transmission systems and medium- to high-speed data communication applications. Used in intraoffice and long-reach applications, the transmitter operates at SONET OC-1, OC-3, and OC-12 rates, as well as at ITU-T synchronous digital hierarchy (SDH) rates of STM-1 and STM-4.

The transmitter meets all present Bellcore GR-253-CORE requirements and the ITU-T G.957 and G.958 recommendations. The transmitter is also ideally suited for extended distance data and networking communications applications.

Description (continued)

The transmitter requires a single power supply (+5 V or –5 V) and operates over data rates of 1 Mbit/s to 650 Mbits/s (NRZ). Automatic power control circuitry provides nearly constant optical output power over the operating case temperature range. The automatic power control circuitry also compensates for laser aging.

Manufactured in a 20-pin DIP, the transmitter uses a hermetic, InGaAsP MQW laser and a single CMOS driver IC. The low power consumption circuit provides modulation, automatic optical output power control, and data reference. The module can be driven by either ac- or dc-coupled data in single-ended or differential configurations. (See Recommended User Interfaces section for typical connection schemes).

Output voltages proportional to the laser bias and backface monitor currents are available for transmitter performance monitoring. The transmitter optical output can be disabled by a logic-level input.

Functional Overview

Transmitter Circuit Description and Operation

Figure 1 shows a simplified schematic of the transmitter; pin information is listed in Table 1. The laser within the 1229 transmitter is driven by a single CMOS integrated circuit, which provides the input data signal reference level, automatic temperature-compensated laser bias, and modulation current control. The laser bias current can be obtained by measuring the voltage developed across pins 2 and 4 of the transmitter. Dividing this voltage by 10 Ω will yield the value of the laser bias current. This value will increase or decrease in response to operating temperature, power supply voltage, data pattern, and laser aging.

The voltage measured across pins 17 and 19 of the transmitter is a programmed output (nominally 100 mV) that will remain constant over the lifetime of the transmitter. When the laser has reached its end-of-life condition, as determined by an inability of the transmitter to maintain the nominal output power, the voltage across pins 17 and 19 will begin to decrease proportionally to the decrease in output power.

Table 1. Pin Descriptions

Pin Number	Name
1	No user connection
2	Laser bias monitor (+)*
3	No user connection
4	Laser bias monitor (–)*
5	V_{EE}
6	Vcc
7	Transmitter disable
8	Vcc
9	Vcc
10	No user connection
11	Case ground
12	Vcc
13	Case ground (RF ground)
14	V_{EE}
15	$\overline{\text{DATA}}$
16	DATA
17	Laser backface monitor (–)*
18	Vcc
19	Laser backface monitor (+)*
20	No user connection

* Laser backface and bias monitor functions are customer-use options that are not required for normal operations of the transmitter. They are normally used during manufacture and for diagnostics.

Functional Overview (continued)

Transmitter Circuit Description and Operation (continued)

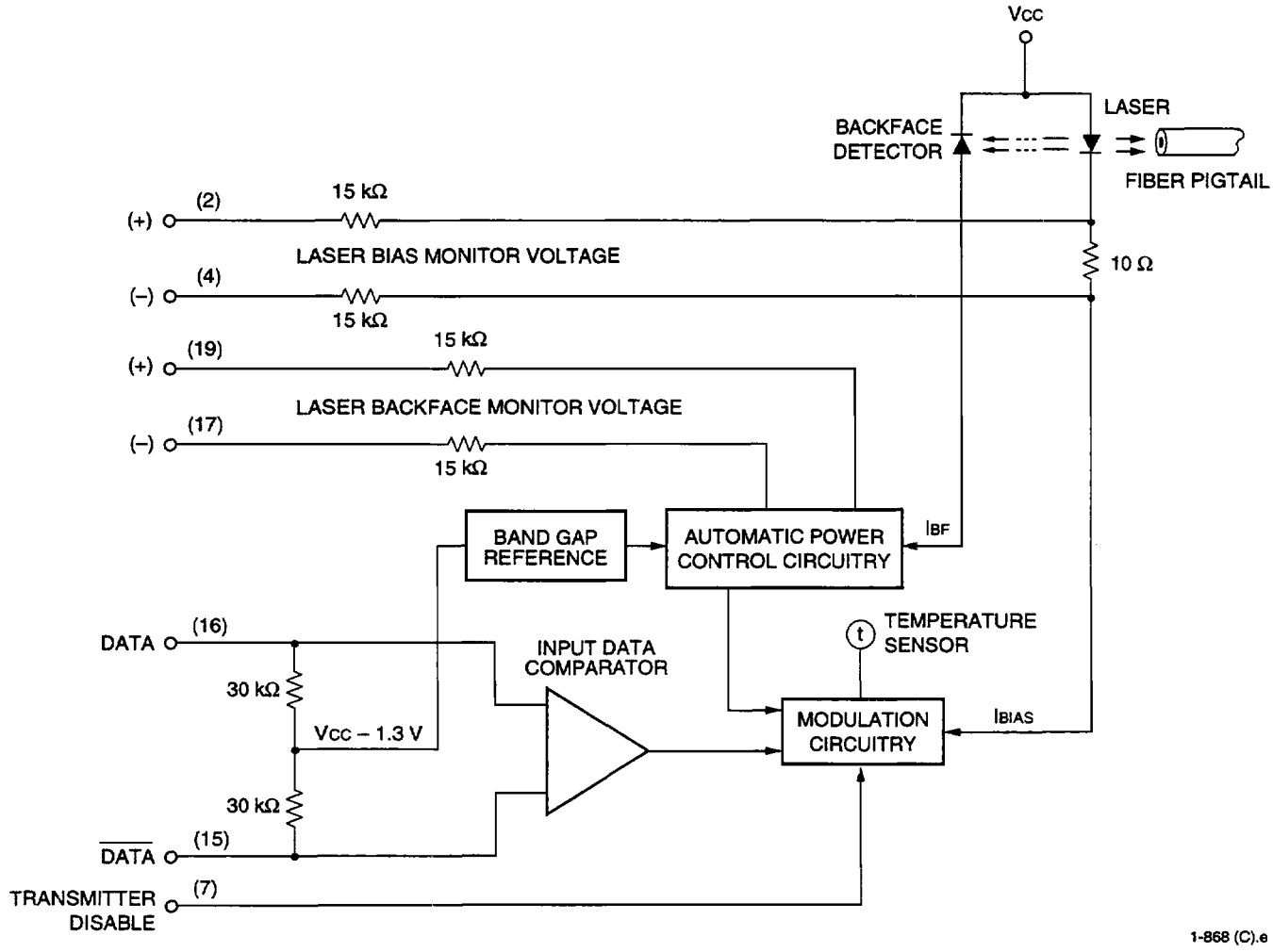


Figure 1. Simplified Transmitter Schematic

Input Data

Data enters the transmitter through a comparator. These ECL inputs have internal high-impedance pull-down resistors to a voltage reference that is 1.3 V below Vcc. This configuration allows the transmitter to be driven from either a single-ended or a differential input signal. At higher data rates (i.e., 622 Mbits/s), it is recommended that the transmitter be driven with a differential input signal from a 50 Ω source. When driven single-ended, the input signal voltage should be centered around Vcc – 1.3 V to eliminate pulse-width distortion. With a single-ended input, either input can be used. The unused input should be bypassed to ground with a small-value capacitor (0.01 µF) to enhance noise immunity.

For differential input data or a single-ended input using the DATA input, the optical output signal will follow the input data—an input logic high turns the laser diode on and an input logic low turns the laser diode off. However, if single-ended data is applied to the $\overline{\text{DATA}}$ input, the optical signal will be the complement of the data input signal.

Minimum Data Rate

Because the modulation and bias control circuitry are internally corrected for the input data pattern, the 1229 transmitter cannot be used in burst-mode type applications. The minimum data rate (pseudorandom data, 50% average duty cycle) for the 1229 transmitter is approximately 1 Mbit/s.

Functional Overview (continued)

Input Data (continued)

Minimum Data Rate (continued)

Since most applications operate at very high data rates, high-frequency design techniques need to be used to ensure optimum performance from the transmitter and interfacing circuitry. Input signal paths should be kept as short and as straight as possible; differential signal lines should be equal in length, and controlled-impedance stripline or microstrip construction should always be used when laying out the printed-wiring board traces for the data lines. The Recommended User Interfaces section of this data sheet shows several methods of interfacing to the 1229 transmitter.

Power Supply

The 1229 transmitter is configured for operation from either a single +5 V power supply or a single –5 V power supply. For positive power supply operation, connect Vcc to the +5 V power supply and connect VEE to ground or circuit common. For operation from a –5 V power supply, connect Vcc to ground and connect VEE to the –5 V power supply. Whichever option is chosen, the Vcc or VEE connection to the transmitter should be well filtered to prevent power supply noise from interfering with transmitter operation.

Transmitter Specifications

Optical Output Power

During manufacture, the optical output power of every transmitter is tuned to the typical value specified in Table 3. The tuning is performed at room ambient temperature (typically 25 °C) using a nominal power supply voltage of 5 Vdc and a 50% average duty cycle input signal. The minimum and maximum values listed in Table 3 reflect the worst-case limits that the transmitter is expected to operate within over its lifetime and over allowed power supply and operating temperature range.

Every transmitter shipped receives a final test which includes a SONET/SDH eye-mask test at either the OC-3/STM-1 data rate of 155.52 Mbits/s or OC-12/STM-4 data rate of 622.08 Mbits/s, depending on code. The eye-mask test examines the optical output pulse shape characteristics. These characteristics include rise time, fall time, pulse overshoot, pulse undershoot, and ringing, all of which need to be controlled to prevent excessive degradation of the receiver sensitivity.

Connector Options

The standard optical fiber pigtail is an 8 µm core, single-mode fiber having a 0.036 in. (914 µm) *Hytrel** outer jacket diameter. The standard length is 39 in. ± 4 in. (1 m ± 10 cm) and can be terminated with either an *ST*®, SC, or FC-PC optical connector. Other connector options may be available on special order. Please contact your Lucent Technologies Account Manager for ordering information.

Handling Precautions

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 (Dec. 1988).

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 kΩ, capacitance = 100 pF) is widely used and, therefore, can be used for comparison purposes. The HBM ESD withstand voltage established for the 1229 transmitter is ±1000 V.

Transmitter Processing

The 1229 transmitter can withstand normal wave soldering processes. The complete transmitter module is not hermetically sealed; therefore, it should not be immersed in or sprayed with any cleaning solution or solvents. The process cap and fiber pigtail jacket deformation temperature is 85 °C. The transmitter pins can be wave soldered at 250 °C for 10 seconds.

* *Hytrel* is a registered trademark of E. I. du Pont de Nemours and Company.

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 sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Supply Voltage*	—	—	5.5	V
Operating Case Temperature Range†‡	T_C	–40	85	°C
Storage Case Temperature Range	T_{stg}	–40	85	°C
Lead Soldering Temperature/Time	—	—	250/10	°C/s
Relative Humidity (noncondensing)	RH	—	85	%
Minimum Fiber Bend Radius	—	1.25 (31.8)	—	in. (mm)

* With V_{EE} connected to –5 V, V_{CC} must be at 0 V; with V_{CC} connected to +5 V, V_{EE} must be at 0 V.
† The device is capable of a cold start at –40 °C; specifications are met after a warm-up time determined by the system thermal design.
‡ The maximum operating case temperature for the 1550 nm version is +70 °C.

Characteristics

Minimum and maximum values specified over operating case temperature range at 50% duty cycle data signal. Typical values are measured at room temperature unless otherwise noted.

Table 2. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
dc Power Supply Voltage[1]	V	4.75	5.0	5.50	V
dc Power Supply Current Drain[2]	I_{TOTAL}	—	70	130	mA
Input Data Voltage[3]:					
Low	V_{IL}	–1.81	—	–1.47	V
High	V_{IH}	–1.16	—	–0.88	V
Input Transition Time[4]	t_I	—	t/4	—	ns
Transmitter Disable Voltage[5]	V_D	V_{CC} – 2.0	—	V_{CC}	V
Transmitter Enable Voltage	V_{EN}	V_{EE}	—	V_{EE} + 0.8	V
Output Disable Time[6]	t_D	—	—	0.20	µs
Output Enable Time[7]	t_{EN}	—	—	2.00	µs
Laser Bias Voltage (T_A = 25 °C)[8, 9]	V_B	0.01	0.06	0.70	V
Laser Monitor Voltage (50% duty cycle)	V_{BF}	0.01	0.050	0.20	V

1. With V_{EE} connected to –5 V, V_{CC} must be at 0 V; with V_{CC} connected to +5 V, V_{EE} must be at 0 V.
2. For [–40 °C < T_{CASE} < –10 °C], I_{TOTAL} = 250 mA maximum.
3. Input measured from V_{CC} with 50 Ω load to (V_{CC} – 2) V. 10K, 10K H, and 100K ECL compatible.
4. Between 10% and 90% (50% duty cycle) where t is the bit period in ns.
5. The transmitter is normally enabled and only requires an external voltage to disable.
6. Time measured from rising edge of disable signal until optical output (laser diode) has turned off.
7. Time measured from falling edge of enable signal until optical output has stabilized at nominal output power level.
8. The laser bias current is obtained by dividing the bias voltage by the internal 10 Ω current-sensing resistor. (See Figure 1.) When measuring this voltage or using it in conjunction with alarm circuits, use a high input impedance device.
9. For the 1550 nm version, V_B (typ) = 0.12 V, V_B (max) = 0.75 V.

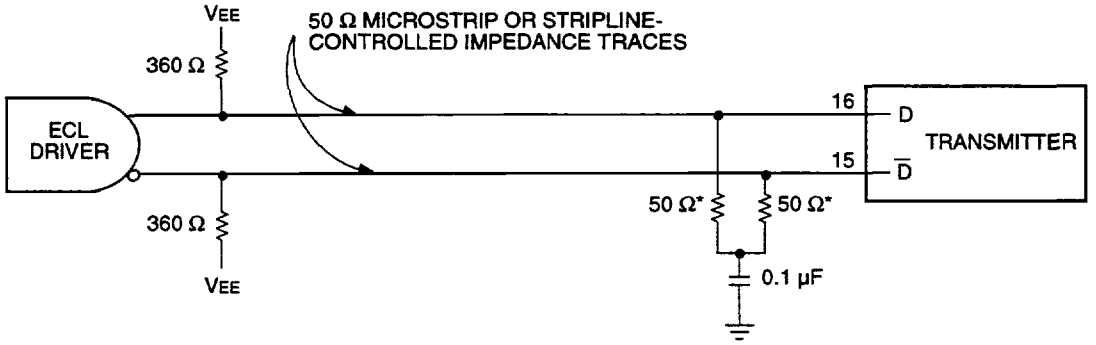
Characteristics (continued)

Table 3. Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Average Power Output[1]					
155 Mbits/s Codes	P_T	–5	–2	0	dBm
622 Mbits/s Codes	P_T	–3	0	2	dBm
Center Wavelength Range					
@ 1310 nm	λ_T	1280	—	1335	nm
@ 1550 nm	λ_T	1480	—	1580	nm
Spectral Width[2]	$\Delta\lambda 20$	—	—	1	nm
Wavelength Shift with Temperature					
@ 1310 nm	—	—	0.1	—	nm/°C
@ 1550 nm	—	—	0.1	—	nm/°C
Side-mode Suppression Ratio[3]	SSR	30	—	—	dB
Extinction Ratio[4]	r_e	10	—	—	dB
Optical Rise and Fall Times[5]	t_R, t_F	—	0.5	—	ns
Eye Mask of Optical Output [6, 7]	—	Meets SONET and ITU-T			

1. Output power definitions and measurement per ITU-T Recommendation G.957 and G.958.
2. Full spectral width measured 20 dB down from the maximum of the central wavelength peak under fully modulated conditions.
3. Ratio of the average output power in the dominant longitudinal mode to the optical power in the most significant side mode under fully modulated conditions.
4. Ratio of logic 1 output power to logic 0 output under fully modulated conditions.
5. Between 10% and 90% while modulated with a 50% duty cycle square wave.
6. GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria.*
7. ITU-T Recommendation G.957, *Optical Interfaces for Equipment and Systems Relating to the Synchronous Digital Hierarchy.*

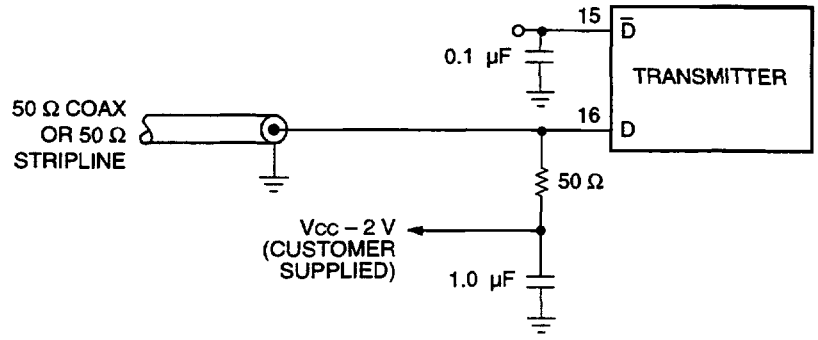
Recommended User Interfaces



*Locate components as close to DATA/$\overline{\text{DATA}}$ inputs as possible.

Figure 2. dc-Coupled Differential Input

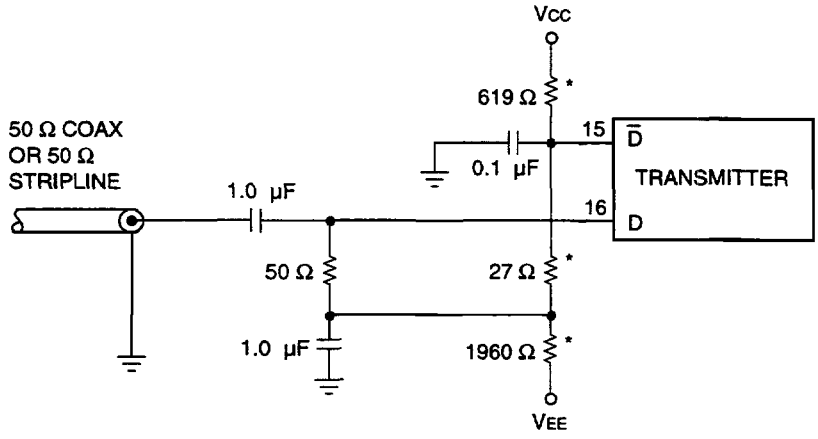
Recommended User Interfaces (continued)



Note: Input can also be connected to DATA; unused input pin remains unconnected.

1-497 (C).a

Figure 3. dc-Coupled, Single-Ended Input



* These networks introduce a slight offset between D and $\overline{D}$, which turns the laser transmitter off when there is no data present at the inputs.

1-498 (C).b

Figure 4. ac-Coupled, Single-Ended Input

Qualification and Reliability

To help ensure high product reliability and customer satisfaction, Lucent is committed to an intensive quality program that starts in the design phase and proceeds through the manufacturing process. Optoelectronic modules are qualified to Lucent internal standards as well as other appropriate industry standards using MIL-STD-883 test methods and procedures, and using sampling techniques consistent with Bellcore requirements. Except for the laser module, the 1229 transmitter is identical to the 1227 *ASTROTEC* transmitter family of devices, which has been subjected to an extensive and rigorous set of qualification tests. The table of qualification tests below lists each of the stresses, the sample size, and the failure criteria for each stress that this 1227 transmitter has undergone. The 1227 transmitter successfully passed each of these stresses without failure. The DFB laser module used in the 1229 transmitter has been separately qualified to a similar set of requirements consistent with Bellcore practices. This qualification program fully meets the intent of Bellcore reliability practices TR-NWT-000468 and TA-TSY-000983.

In addition, Lucent Technologies Microelectronics Group Optoelectronics Unit design, development, and manufacturing facilities have been certified to be in full compliance with the latest ISO-9001 Quality System Standards.

Table 4. Qualification Tests

The 1229-type transmitter has successfully passed the following tests and meets the intent of Bellcore TR-NWT-000468 and TA-TSSY-000983.

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	1500G, 5 hits, 6 dir., MIL-STD-883C-2002, Condition B	11	Electrical/Optical
Variable Frequency Vibration	20G, 20 Hz to 2 kHz, 4 cycles, 3 directions, 4 min./cycle, MIL-STD-883C-2007.1	11	Electrical/Optical
Solderability	MIL-STD-883C-2003.6	3 (60 leads)	Visual
Lead Integrity	MIL-STD-883C-2004.5	3 (60 leads)	Visual
Solvent Resistance	MIL-STD-883C-2015.7	5	Visual
Temperature Cycle	T_A = –40 °C to +85 °C, 500 cycles, MIL-STD-883C-1010.7	11	Electrical/Optical
High Temperature, High Humidity, with Bias	T_A = 85 °C, 85% relative humidity, rated bias, 2,000 hours	11	Electrical/Optical
High Temperature with Bias	T_A = 85 °C, rated bias, 5,000 hours, MIL-STD-883C-1005.5	25	Electrical/Optical
Low Temperature with Bias	T_A = –40 °C, rated bias, 2,000 hours, MIL-STD-883C-1005.5	25	Electrical/Optical
Internal Visual	MIL-STD-883C-2014	10	Visual
Electrostatic Discharge	Human-body model (to determine class)	3	Electrical/Optical
Fiber Pull	1 kg, 10 s, 3 times	11	Optical
Low-temperature Storage	T_A = –40 °C, 2,000 hours	11	Electrical/Optical
Voltage Stress	Maximum rated voltage	10	Electrical/Optical
Flammability	Fiber cable meets *UL**-listed OFN	—	—
Power Cycling	MIL-STD-883C-1006	5	Electrical/Optical

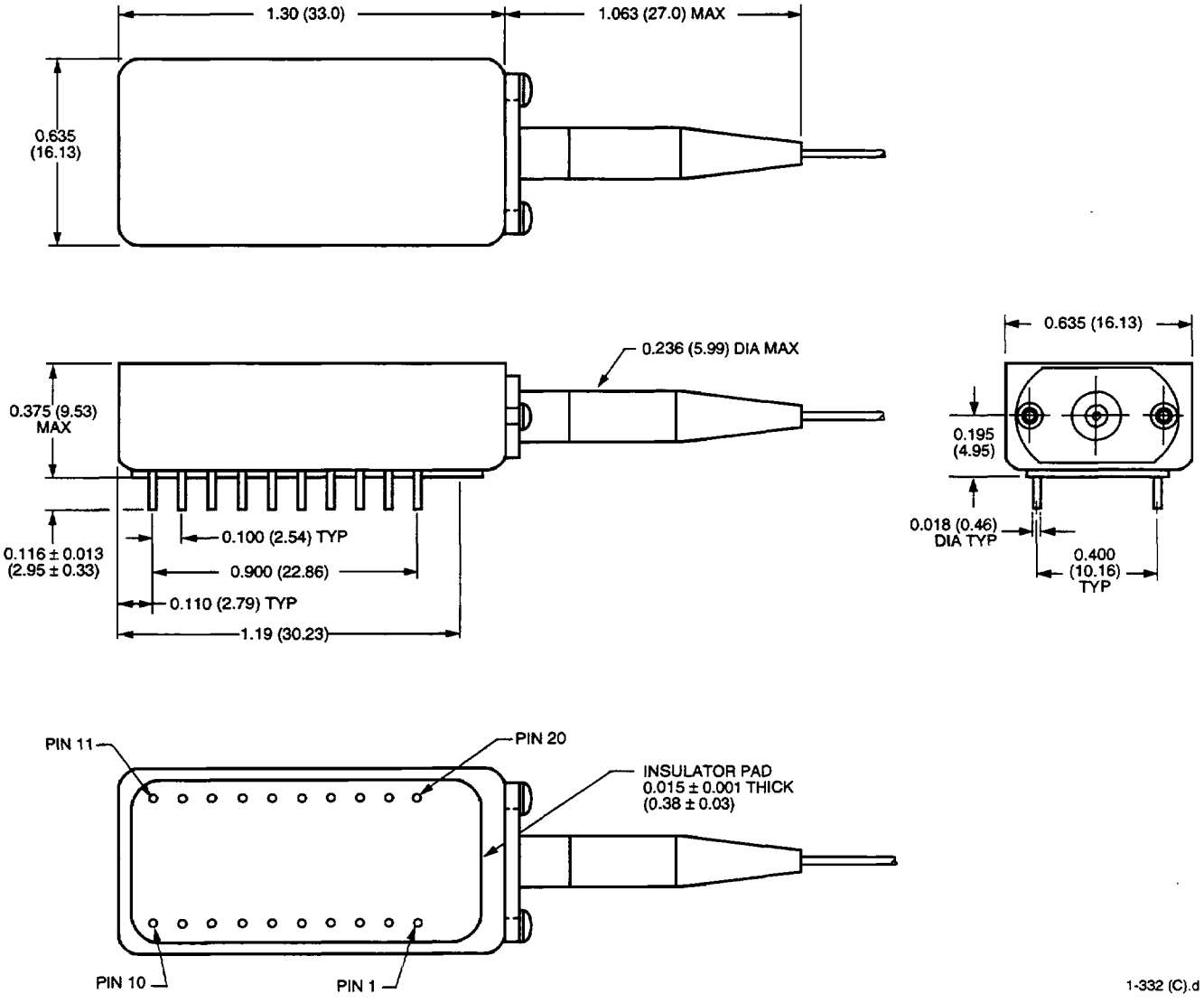
* *UL* is a registered trademark of Underwriters Laboratories, Inc.

Outline Diagram

Dimensions are in inches and (millimeters).

Unless noted otherwise, tolerances are ±0.005 in. (±0.127 mm).

Weight = 0.9 oz. (25 g).



Ordering Information

Data Rate (Mbits/s)	Transmitter Model	Center Wavelength (nm)	Optical Connector*	Comcode
155	1229TB5	1550	*ST*	107873861
155	1229FB5	1550	FC	107873853
155	1229CB5	1550	SC	107873846
622	1229TA5	1550	*ST*	107841512
622	1229FA5	1550	FC	107841538
622	1229CA5	1550	SC	107841520
622	1229TA	1310	*ST*	107579039
622	1229FA	1310	FC	107645467
622	1229CA	1310	SC	107645459

* The connectors listed are for standard product. Other connectors are available on special order.

Laser Safety Information

Class I Laser Product

The 1229-type transmitter is a Class 1 laser product per CDRH, 21 CFR 1040 Laser Safety requirements.
The 1229-type transmitter has been certified with the FDA under accession number 8720009.
The 1229-type transmitter is a Class 1 laser product per IEC 825-1:1993.

CAUTION: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.

This product complies with 21 CFR 1040.10 and 1040.11.
8.8 µm single-mode pigtail with connector
Wavelength = 1.3 µm
Maximum Power = 10 mW

Because of size constraints, laser safety labeling is shipped with the device.
Product is not shipped with power supply.

Notice

**Unterminated optical connectors may emit laser radiation.
Do not view with optical instruments.**

Notes

For additional information, contact your Microelectronics Group Account Manager or the following:

OPTOELECTRONICS BUSINESS UNIT: Optoelectronics Center, 9999 Hamilton Blvd., Breinigsville, PA 18031-9359
610-391-2520, FAX 610-391-2535

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