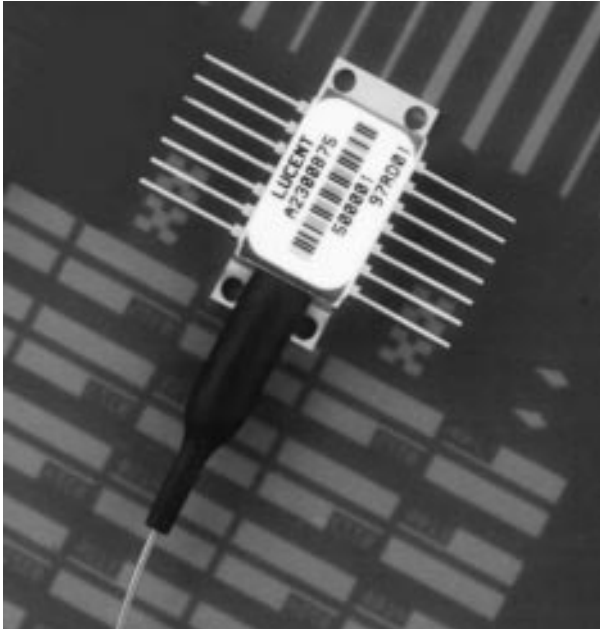
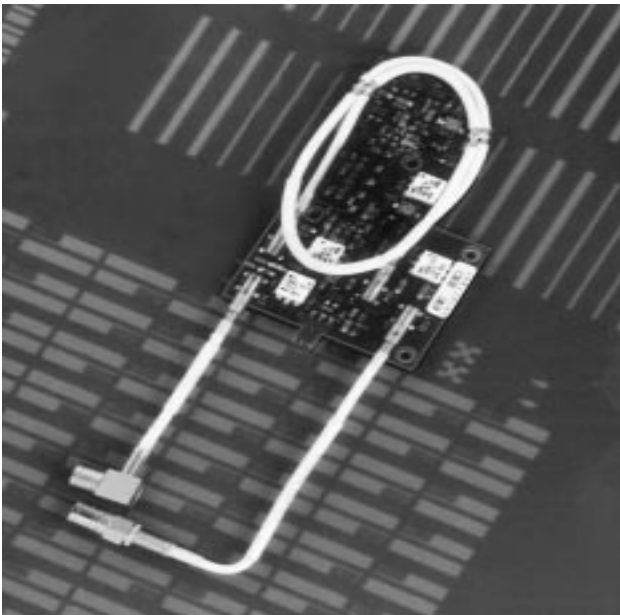




## A2300-Type Laser 2000 Analog DFB Laser Module



The A2300-Type, Isolated, Cooled, Analog DFB Laser Module provides enhanced performance in analog transmission systems, with a variety of product options.



A separate predistortion board provides both CSO and CTB correction enhancements to the A2300-Type Laser Module performance, for 110 NTSC as well as 42 CENELEC channels.

### Features

- High-performance, multiquantum-well (MQW), distributed-feedback (DFB), semiconductor laser.
- 14-pin, hermetic, butterfly-type package provides internal isolation and thermoelectric cooling/heating functions.
- Stable, accurate, PIN photodetector for laser back-facet optical output power monitoring/control.
- Operation at the low dispersion, 1310 nm wavelength.
- Stable performance over the wide temperature range of  $-20^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ .
- Multiple product options available:
  - Stand-alone or predistorted.
  - 77/110 NTSC or 42 CENELEC test channel loading.
  - Simulated system testing available in a variety of fiber link budget losses.
- $25\ \Omega$  resistive-matched or  $75\ \Omega$  transformer-matched input impedances.

### Applications

- Video surveillance
- CATV
- Wireless/personal communications networks and systems

## **Description**

The Laser 2000, A2300-Type Analog DFB Laser Module contains a high-performance, Indium Gallium Arsenide Phosphide, multi-quantum-well, distributed-feedback laser chip designed for 1310 nm, single-mode fiber-optic applications. The module is an industry-standard, 14-pin butterfly-type, hermetic, metal/ceramic package and houses the laser chip as well as an integral thermoelectric cooling/heating device, a thermistor, an integral optical isolator, and a laser back-facet optical monitor. The module is equipped with a 900  $\mu\text{m}$  *Hytrel*<sup>\*</sup> jacketed, 8.8  $\mu\text{m}$  core, single-mode fiber; several standard fiber-optic connector options are also available.

The integral thermoelectric cooler (TEC) provides stable thermal characteristics for the laser chip, as well as the optical isolator and back-facet monitor photodiode. The TEC allows for heating and cooling of these internal optical components and can maintain their temperature at a constant 25 °C over the entire ambient operating temperature range of -20 °C to +65 °C. The thermistor monitors the internal module temperature and provides feedback control for the TEC. This gives the A2300-type laser 2000 superior, stable optical characteristics.

When used in a fiber-optic system, reflected light entering the laser module is attenuated a minimum of 40 dB by the optical isolator. The internal PIN photodiode monitors the optical power emitted from the rear facet of the laser diode, and when used in conjunction with exterior module circuitry, it can monitor and control the optical output power launched into the fiber.

Lucent Technologies offers two different pinout types and RF drive impedance. The first is the Optoelectronics unit standard analog isolated laser module (ILM) pinout, which has an input impedance of 75  $\Omega$ . The 75  $\Omega$  input impedance eliminates the need for external matching circuits and is achieved using an

RF transformer internal to the package. This allows the RF drive level into the laser to be typically 4 dB less than if resistive matching were used. The second pinout type has a resistive input impedance of 25  $\Omega$  and matches the pinout of the optoelectronic industry's standard 2.5 Gbits/s package.

Lucent Technologies analog laser modules feature the ability to have enhanced performance and value through the addition of the Optoelectronics unit's exclusive predistortion board. The separate predistortion board provides both CSO and CTB correction enhancements to the laser module performance, for 110 NTSC as well as 42 CENELEC channels. While maintaining extremely low electrical power dissipation and low insertion loss, the predistortion board allows 1000 MHz of RF bandwidth.

Every A2300-type laser 2000 module is tested to meet the customer's analog performance specifications, over the specified fiber link budget loss and test channel plan. This measurement method ensures proper system performance of the product. Lucent Technologies Optoelectronics unit components and products are qualified to the rigorous requirements of *Telcordia Technologies*<sup>†</sup> Standards, ensuring that the optoelectronic performance will meet the needs of the application over the lifetime of the product.

\* *Hytrel* is a registered trademark of E.I. DuPont de Nemours and Company.

† *Telcordia Technologies* is a trademark of Bell Communications Research, Inc.

## Pin Information

### Type 2

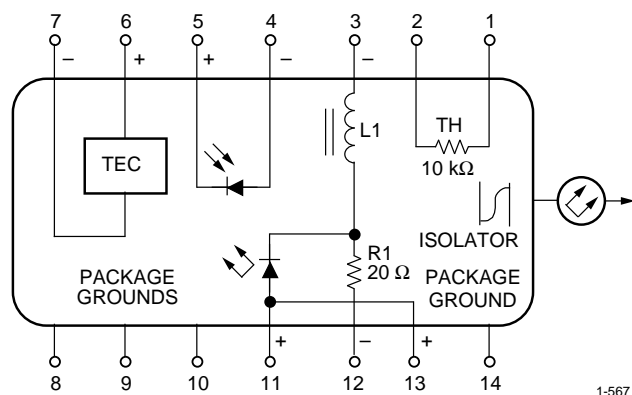


Figure 1. Circuit Schematic (Top View)  
Industry-Standard (2.5 Gbits/s) Pinout,  
25  $\Omega$  Resistive Input Impedance

Table 1. Type 2 Pin Descriptions

Pin	Connection
1	Thermistor.
2	Thermistor.
3	Laser (dc Bias) Cathode (-).
4	Back-facet Monitor Anode (-).
5	Back-facet Monitor Cathode (+).
6	Thermoelectric Cooler (+).*
7	Thermoelectric Cooler (-).*
8	Case Ground.†
9	Case Ground.†
10	Case Ground.†
11	Laser Anode (+).‡
12	RF Input; 25 $\Omega$ (-).§
13	Laser Anode (+).‡
14	Case Ground.†

\* A positive current through the thermoelectric cooler cools the laser.

† Pins 8—10 and 14 must be grounded to RF ground.

‡ Both leads should be grounded for optimum performance.

§ For proper operation, pin 12 (RF input) must be dc decoupled.

■ Benefits:

- Pinout allows drop-in replacement for industry-competitive modules.

### Type 3

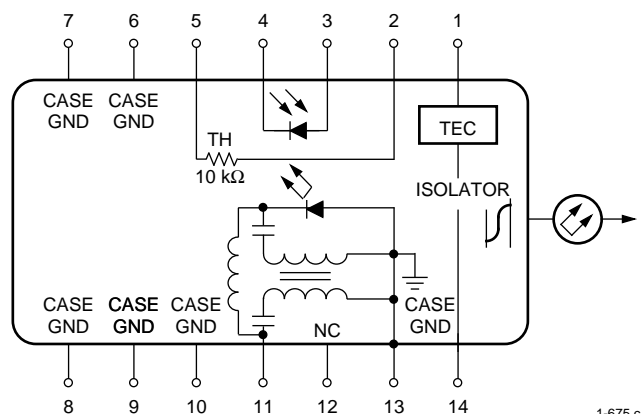


Figure 2. Circuit Schematic (Top View)  
Lucent Technologies Standard Pinout,  
75  $\Omega$  Transformer-Matched Input  
Impedance

Table 2. Type 3 Pin Descriptions

Pin	Connection
1	Thermoelectric Cooler (+).*
2	Thermistor.
3	Back-facet Monitor Anode (-).
4	Back-facet Monitor Cathode (+).
5	Thermistor.
6	Case Ground.†
7	Case Ground.†
8	Case Ground.†
9	Case Ground.†
10	Case Ground.†
11	Laser (dc Bias) Cathode (-) and RF Input; 75 $\Omega$ Input.
12	No Connect.
13	Laser Anode (+), Case Ground.†
14	Thermoelectric Cooler (-).*

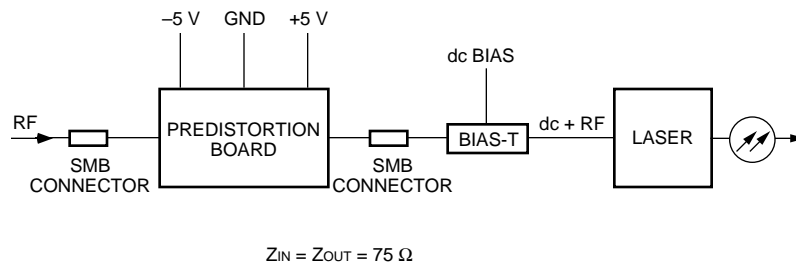
\* A positive current through the thermoelectric cooler cools the laser.

† Pins 6—10 and 13 must be grounded to RF ground.

■ Benefits:

- Transformer allows for 4.0 dB reduction in required RF drive per channel.
- No impedance matching circuitry required between output of hybrid amplifier and Lucent laser.

## Predistortion Function Information



1-831

**Figure 3. Laser and Predistortion PCB Solution Block Diagram**

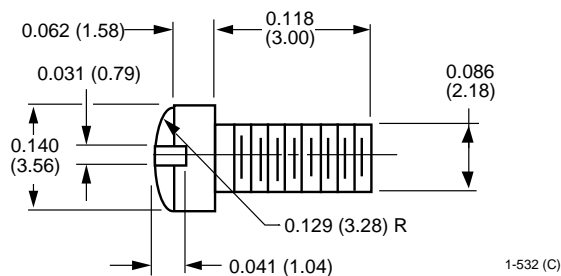
- Benefits:
  - Preselected laser matched to separate predistortion board optimizes customer system-level performance.
  - Lucent Technologies provides predistortion circuitry, no customer design required.
  - Compatible with Type 3.
  - CSO and CTB distortion enhancements.

## Handling Precautions

### Mounting Instructions for Laser Module

The minimum fiber bend radius is 1.25 in. To avoid degradation in performance, mount the module on the board as follows:

1. Place the bottom flange of the module on a flat heat sink at least 0.5 in. x 1.180 in. (12.7 mm x 30 mm) in size. The surface finish of the heat sink should be better than 32  $\mu\text{m}$ . (0.8  $\mu\text{m}$ ), and the surface flatness must be better than 0.001 in. (25.4  $\mu\text{m}$ ). The use of thermal conductive grease is optional; however, thermal performance can be improved by up to 5% if conductive grease is applied between the bottom flange and the heat sink.
2. Mount four #2-56 screws with Fillister heads (M2-3 mm) (see Figure 4) at the four screw-hole locations (see Outline Diagram, page 7). The Fillister head diameter must not exceed 0.140 in. (3.55 mm). Do not apply more than 1 in.-lb. of torque to the screws.



Note: Dimensions are in inches and (millimeters).

Figure 4. Fillister Head Screw

## 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
Laser Reverse Voltage	—	—	2	V
Laser dc Forward Current	—	—	150	mA
Predistortion Board dc Supply Voltage:				
Positive	—	—	+7	V
Negative	—	—	-7	V
RF Modulation per Channel (75 $\Omega$ )	—	—	0	dBm
Operating Temperature Range	T <sub>A</sub>	-20	65	°C
Storage Case Temperature Range	T <sub>stg</sub>	-40	85*	°C

\* 2000 hours maximum.

## Power Sequencing

Adopt the following sequence for turn-on as a matter of good practice to avoid the possibility of damage to the laser module from power supply switching transients.

1. All ground connections.
2. Most negative supply.
3. Most positive supply.
4. All remaining connections.

Reverse the above order for the proper turn-off sequence.

## Electrostatic Discharge

**CAUTION: This device is susceptible to damage as a result of electrostatic discharge. Take proper precautions during both handling and testing. Follow guidelines such as JEDEC Publication No. 108-A (Dec. 1988).**

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 threshold presented here was obtained using these circuit parameters:

Parameter	Value	Unit
Human-body Model	400	V

## Characteristics

Minimum and maximum values are testing requirements. Typical values are for informational purposes only and are not part of the testing requirements. Each device is provided with recommended operating conditions to achieve specified performance.  $T_L = 25\text{ }^\circ\text{C}$ , unless noted otherwise. Predisortion board supply voltage is  $\pm 5\text{ V}$ ,  $\pm 10\%$ .

**Table 3. Electrical Characteristics**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Laser Forward Voltage	$V_{LF}$	At rated power	—	1.3	1.8	V
Operating Current	$I_{OP}$	—	—	50	100	mA
Threshold Current	$I_{TC}$	*	—	10	40	mA
Monitor Reverse-bias Voltage	$V_{MON}$	—	3	—	10	V
Monitor Current	$I_{MON}$	At $I_{OP}$	0.2	—	2.0	mA
Monitor Dark Current	$I_D$	$I_F = 0, V_{MON} = 5\text{ V}$	—	—	0.10	$\mu\text{A}$
Thermistor Current	$I_{TH}$	—	10	—	100	$\mu\text{A}$
Thermistor Resistance	$R_{TH}$	$T_L = 25\text{ }^\circ\text{C}, I_{TH} \leq 0.1\text{ mA}$	9.5	—	10.5	$\text{k}\Omega$
Thermistor Thermal Characteristic	$\Delta R_{TH}/\Delta T_L$	$-20\text{ }^\circ\text{C} \leq T_L \leq 65\text{ }^\circ\text{C}^\dagger$	—	-4.4	—	$\%/^\circ\text{C}$
Thermistor Temperature Coefficient	B	—	3700	3900	4100	K
TEC Current	$I_{TEC}$	$\Delta T = 40\text{ }^\circ\text{C}$	—	—	1.0	A
TEC Voltage	$V_{TEC}$	$\Delta T = 40\text{ }^\circ\text{C}$	—	—	1.8	V
TEC Cooling Capacity	$\Delta T$	—	40	—	—	$^\circ\text{C}$

\* The laser threshold current is the current at which the first derivative of the laser light vs. forward current is at one-half of its maximum.

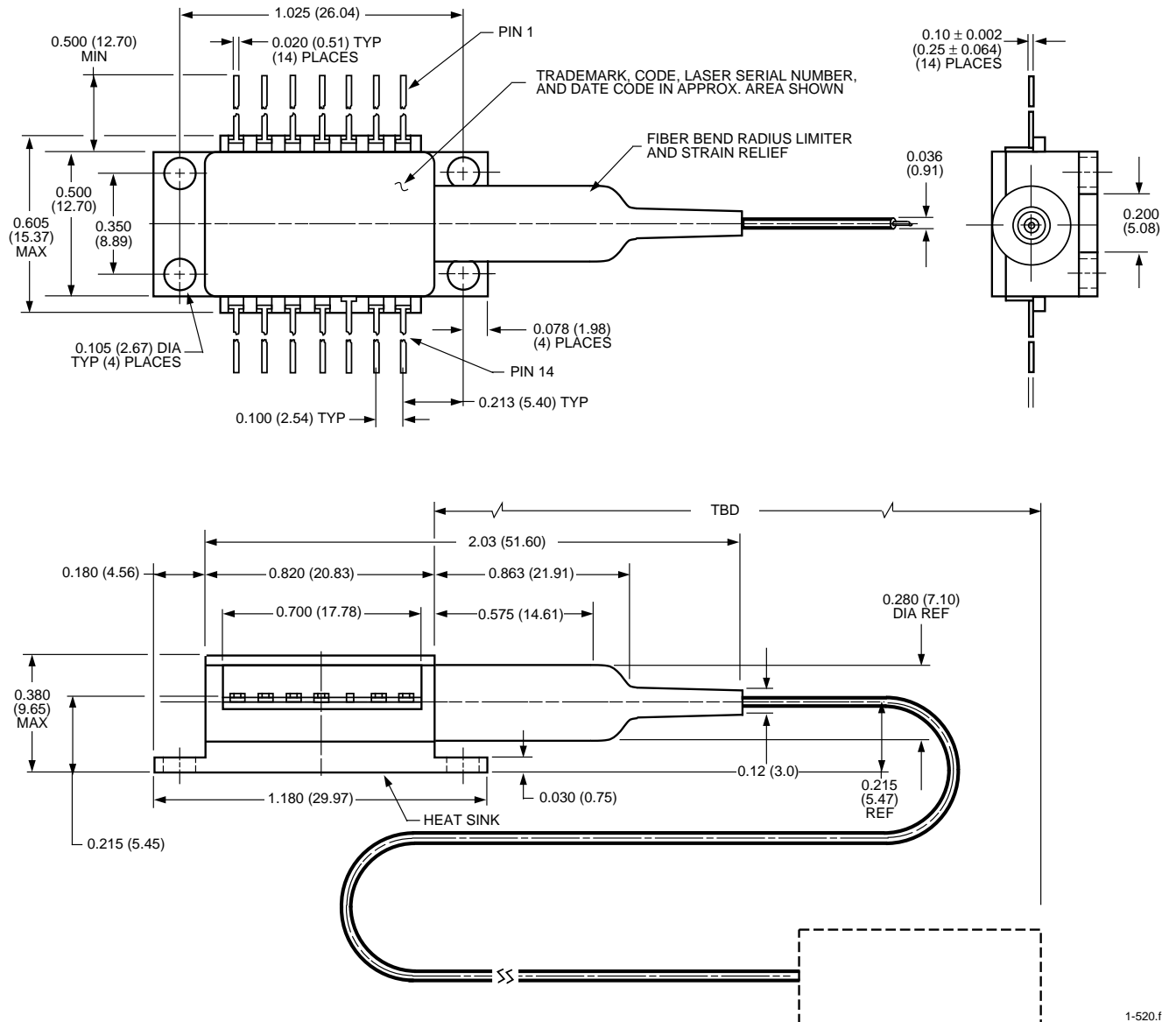
† The thermistor thermal characteristic will be monotonic.

**Table 4. Optical Characteristics**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Optical Output Power	$P_O$	—	3.0	—	20.0	mW
Center Wavelength	$\lambda_C$	—	1290	1310	1330	nm
Optical Isolation	—	$-20\text{ }^\circ\text{C}$ to $+65\text{ }^\circ\text{C}$	40	45	—	dB
Side-mode Suppression Ratio	SMSR	Modulated	30	—	—	dB

## Outline Diagram

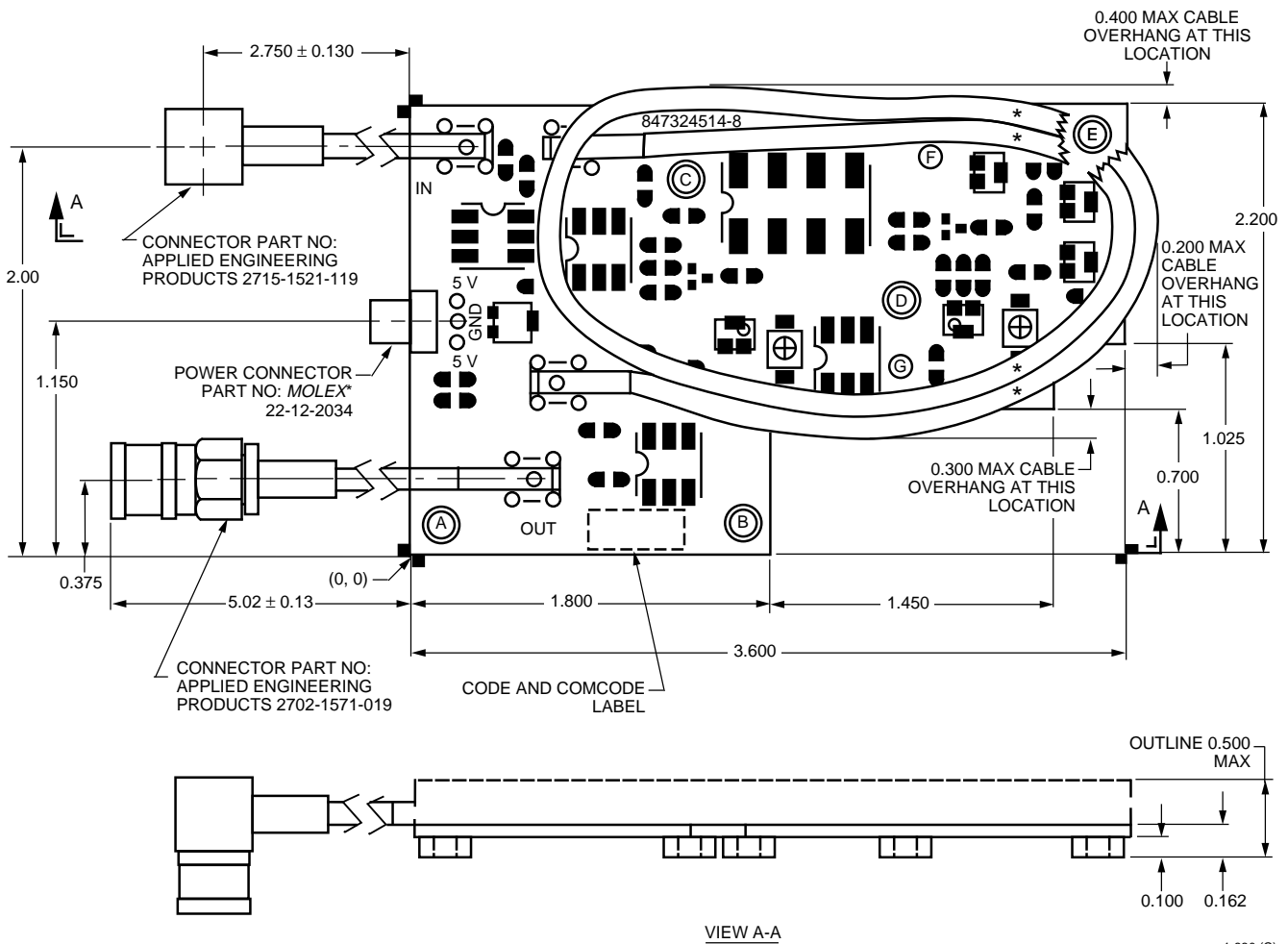
Dimensions are in inches and (millimeters).



1-520.f

**Predistortion Board**

Dimensions are in inches. Tolerances are  $\pm 0.005$  in. unless noted otherwise.



\* Molex is a registered trademark of Molex, Inc.

- Notes: Mating connectors from Applied Engineering Products:  
 PWB mounted straight—2709-1511-001  
 PWB mounted right angle—2710-1511-000  
 Cable connector—2701-1571-019

Centerline hole position from (0,0). All holes are unplated.

Designation	Inner Diameter	X	Y
A	0.116	0.150	0.150
B	0.116	1.650	0.150
C	0.116	1.380	1.850
D	0.116	2.450	1.250
E	0.116	3.450	2.050
F	—	2.600	1.955
G	—	2.450	0.925

A spacer is inserted in holes A, B, C, D, and E. The diameter listed is the inner diameter of the spacer.

## Laser Safety Information

### Class IIIb Laser Product

FDA/CDRH Class IIIb laser product. All versions are Class IIIb laser products per CDRH, 21 CFR 1040 Laser Safety requirements. All versions are Class 3B laser products per IEC\* 60825-1:1993. The device has been certified with the FDA under accession number 8720010.

This product complies with 21 CFR 1040.10 and 1040.11.

8.8/125  $\mu\text{m}$  single-mode fiber pigtail and connector

Wavelength = 1.3  $\mu\text{m}$

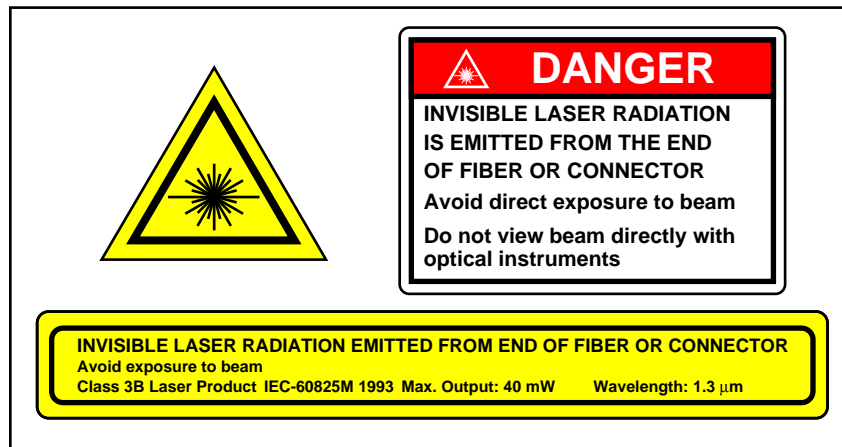
Maximum power = 40 mW

Because of size constraints, laser safety labeling (including an FDA Class IIIb label) is not affixed to the module but attached to the outside of the shipping carton.

Product is not shipped with power supply.

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

\* IEC is a registered trademark of The International Electrotechnical Commission.



## Ordering Information

Table 5. Analog Product Availability

Tested Loss*	Optical Power (mW)	Channel Capacity	CNR (dBc)	CSO (dBc)	CTB (dBc)	RF Drive (dBm/Channel)	Package Configuration†	L2000 Part Number†	Comcode
<b>Stand-Alone Short-Haul Lasers</b>									
7 dB: (7f)	2.5— 6.5	77 NTSC	43	-61	-67	< -21	75 Ω/Stand-alone	A2303D75	108116740
	2.5— 6.5	77 NTSC	43	-61	-67	< -21	75 Ω/Stand-alone	A2303R3S	108406695
	<6.0	77 NTSC	51	-62	-67	< -12	75 Ω/Stand-alone	A2312D3S	108263849
	<6.0	77 NTSC	51	-62	-67	< -12	75 Ω/Stand-alone	A2312R3S	108235706
	4.0— 6.5	77 NTSC	51	-63	-67	< -12	75 Ω/Stand-alone	A2307D75	108116732
	4.0— 6.5	77 NTSC	51	-63	-67	< -12	75 Ω/Stand-alone	A2307R3S	108406703
	3.0— 6.0	42 CEN-ELEC	50	-62	-67	< -6.5	25 Ω/Stand-alone	A2311D2S	108332040
<b>Stand-Alone Long-Haul Lasers</b>									
11 dB: (9f + 2p)	>4	77 NTSC	48	-61	-67	< -9.3	75 Ω/Stand-alone	A2315D75	108116716
	>9	77 NTSC	48	-61	-67	< -9.3	75 Ω/Stand-alone	A2316R3S	108028010
	>9	77 NTSC	50	-62	-67	< -9.3	75 Ω/Stand-alone	A2332D3S	108309618
	>9	77 NTSC	50	-62	-67	< -9.3	75 Ω/Stand-alone	A2332R3S	108406711
	6—10	42 CEN-ELEC	50	-62	-67	< -6.5	25 Ω/Stand-alone	A2350D2S	108332057
	>10	42 CEN-ELEC	50	-62	-67	< -6.5	25 Ω/Stand-alone	A2351B2S	108161365
	>10	42 CEN-ELEC	51	-63	-67	< -6.5	25 Ω/Stand-alone	A2341B2S	108148776
<b>Predistorted Short-Haul Lasers</b>									
11 dB: (9f + 2p)	6—8	42 CEN-ELEC	49	-63	-67	< -6.5	75 Ω/Discrete Pre-D	A2313B3P	108075326
	8—10	42 CEN-ELEC	50	-63	-67	< -6.5	75 Ω/Discrete Pre-D	A2336B3P	108161373

\* 7 dB, all fiber; 9 dB includes 2 dB passive loss; 11 dB includes 2 dB passive loss; 13 dB includes 4 dB passive loss.

† Type 2: industry-standard pinout (2.5 Gbits/s type) and a 25 Ω input impedance (resistive). Type 3: Lucent pinout and a 75 Ω input impedance (transformer matched).

Note: Some codes do not conform to the standard ADN configuration scheme. An ADN that ends with D75 denotes a stand-alone module, Type-3 pinout.

**Ordering Information** (continued)

**Table 5. Analog Product Availability** (continued)

Tested Loss*	Optical Power (mW)	Channel Capacity	CNR (dBc)	CSO (dBc)	CTB (dBc)	RF Drive (dBm/Channel)	Package Configuration†	L2000 Part Number†	Comcode
<b>Predistorted Long-Haul Lasers</b>									
11 dB: (9f + 2p)	>10	77 NTSC	52	-61	-67	< -9.3	75 Ω/Discrete Pre-D	A2352R3P	108066739
	>6	77 NTSC	52	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2334D7P	108116724
	>6	77 NTSC	52	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2334R3P	108216417
	>8	77 NTSC	51	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2335D7P	108116682
	6—10	42 CEN-ELEC	52	-63	-67	< -8.0	75 Ω/Discrete Pre-D	A2343B3P	108168220
	10—12	42 CEN-ELEC	52	-63	-67	< -8.0	75 Ω/Discrete Pre-D	A2354B3P	108132390
	13—15	42 CEN-ELEC	52	-63	-67	< -6.0	75 Ω/Discrete Pre-D	A2357B3P	108230541
13 dB: (9f + 4p)	>13	77 NTSC	50	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2361D3P	108387879
	>13	77 NTSC	50	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2361R3P	108406729
	>16	77 NTSC	50	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2362D3P	108357658
	>16	77 NTSC	50	-62	-67	< -9.3	75 Ω/Discrete Pre-D	A2362R3P	108406737
	>8	77 NTSC	52	-63	-69	< -9.3	75 Ω/Discrete Pre-D	A2365R3P	108028044
	>8	110 NTSC	51	-63	-69	< -9.3	75 Ω/Discrete Pre-D	A2366R3P	108028390
	16—18	42 CEN-ELEC	52	-63	-67	< -6.0	75 Ω/Discrete Pre-D	A2363R3P	108341116
	16—18	42 CEN-ELEC	52	-63	-67	< -6.0	75 Ω/Discrete Pre-D	A2363B3P	108230558

\* 7 dB, all fiber; 9 dB includes 2 dB passive loss; 11 dB includes 2 dB passive loss; 13 dB includes 4 dB passive loss.

† Type 2: industry-standard pinout (2.5 Gbits/s type) and a 25 Ω input impedance (resistive). Type 3: Lucent pinout and a 75 Ω input impedance (transformer matched).

Note: Some codes do not conform to the standard ADN configuration scheme. An ADN that ends with D75 denotes a stand-alone module, Type-3 pinout.

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