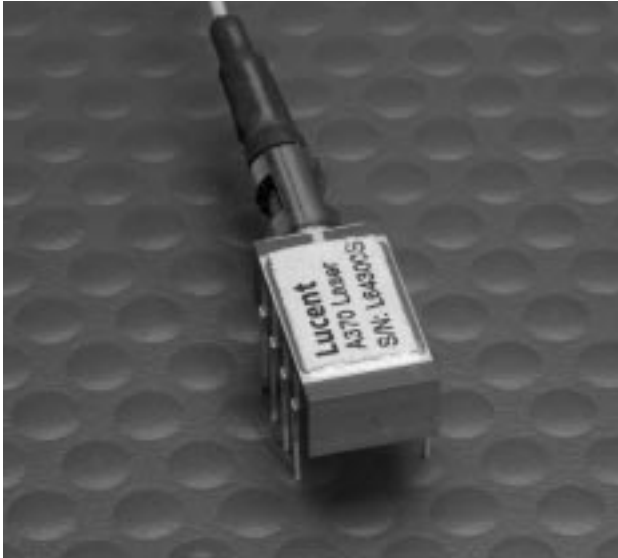




## A370-Type Analog Uncooled Laser Module



The low-profile A370-Type Analog Laser Module is ideally suited for CATV applications, particularly in systems where long spans and superior reliability are the critical considerations.

### Features

- Eight-pin package suitable for CATV applications
- Frequency range up to 1.0 GHz
- MQW F-P 1.3  $\mu\text{m}$  laser with single-mode fiber pigtail
- Wide operating temperature range:  
–40 °C to +85 °C
- No TEC required
- High output power: typically 1.0 mW power coupled into single-mode fiber
- Hermetically sealed active components
- Internal back-facet monitor
- Qualification program: *Telcordia Technologies*\* TA-983

### Applications

- Narrowband video
- Downstream telephony and data
- Return path systems
- Analog and digital modulation systems
- Telecommunications

### Benefits

- Easily board mounted
- Requires no lead bending
- No additional heat sinks required
- Pin compatible with industry-standard, 14-pin laser module
- High output power allows for longer system spans, more fiber splits, and greater tolerance of fiber and connector quality

\* *Telcordia Technologies* is a trademark of Telcordia Technologies, Inc.

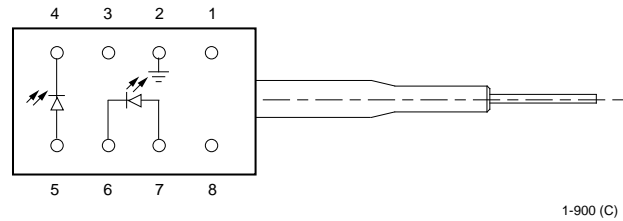
**Description**

The A370-Type Uncooled Laser Module consists of a laser diode coupled to a single-mode fiber pigtail. The device is available in a standard, 8-pin configuration (see Figure 1 and/or Table 1) and is ideal for CATV applications.

The module includes a multiquantum-well Fabry-Perot (MQW F-P) laser and an InGaAs PIN photodiode back-facet monitor in an epoxy-free, hermetically sealed package.

The device characteristics listed in this document are met at 1.0 mW output power. Higher- or lower-power operation is possible. Under conditions of a fixed photodiode current, the change in optical output is typically  $\pm 0.5$  dB over an operating temperature range of  $-40$  °C to  $+85$  °C.

This device incorporates the new Laser 2000 manufacturing process from the Optoelectronics unit of Lucent Technologies Microelectronics Group. Laser 2000 is a low-cost platform that targets high-volume manufacturing and tight product distributions on all optical sub-assemblies. This platform incorporates an advanced optical design that is produced on the Optoelectronic unit's highly automated production lines. The Laser 2000 platform is qualified for the central office and uncontrolled environments, and can be used for applications requiring high performance and low cost.



**Figure 1. A370-Type Analog Uncooled Laser Module Schematic, Top View**

**Table 1. Pin Descriptions**

| Pin Number | Connection          |
|------------|---------------------|
| 1          | NC                  |
| 2          | Case ground         |
| 3          | NC                  |
| 4          | Photodiode cathode  |
| 5          | Photodiode anode    |
| 6          | Laser diode cathode |
| 7          | Laser diode anode   |
| 8          | NC                  |

**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     |
|---|-----------------------|-------|-----------|----------|
| Maximum Peak Laser Drive Current or<br>Maximum Fiber Power* | $I_{OP}$<br>$P_{MAX}$ | —     | 150<br>10 | mA<br>mW |
| Peak Reverse Laser Voltage:                                 |                       |       |           |          |
| Laser   | $V_{RL}$              | —     | 2         | V        |
| Monitor   | $V_{RD}$              | —     | 20        | V        |
| Monitor Forward Current                                     | $I_{FD}$              | —     | 2         | mA       |
| Operating Case Temperature Range                            | $T_C$                 | $-40$ | 85        | °C       |
| Storage Case Temperature Range                              | $T_{stg}$             | $-40$ | 85        | °C       |
| Lead Soldering Temperature/Time                             | —                     | —     | 260/10    | °C/s     |
| Relative Humidity (noncondensing)                           | RH                    | —     | 85        | %        |

\* Rating varies with temperature.

## 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.

## Electro/Optical Characteristics

**Table 2. Electro/Optical Characteristics** (over operating temperature range unless otherwise noted)

| Parameter                          | Symbol           | Test Conditions                                 | Min  | Typ | Max  | Unit  |
|------------------------------------|------------------|---|------|-----|------|-------|
| Operating Temperature Range        | T                | —   | -40  | —   | 85   | °C    |
| Optical Output Power*              | P <sub>F</sub>   | CW, nominal                                     | —    | 1   | —    | mW    |
| Threshold Current                  | I <sub>TH</sub>  | T = 25 °C                                       | 4.5  | 9   | 15   | mA    |
|                                    |                  | T = full range                                  | 1    | —   | 45   | mA    |
| Drive Current Above Threshold      | I <sub>MOD</sub> | CW, P <sub>F</sub> = 1.0 mW, T = 25 °C          | 20   | 30  | 40   | mA    |
|                                    |                  | CW, I <sub>MON</sub> = constant, T = full range | 15   | —   | 70   | mA    |
| Slope Efficiency                   | SE               | CW, P <sub>F</sub> = 1.0 mW, T = 25 °C          | 25   | —   | 50   | μW/mA |
| Center Wavelength                  | λ <sub>c</sub>   | P <sub>F</sub> = 1.0 mW, CW                     | 1270 | —   | 1350 | nm    |
| RMS Spectral Width                 | Δλ               | P <sub>F</sub> = 1.0 mW                         | —    | 2   | 3    | nm    |
| Tracking Error                     | TE               | I <sub>MON</sub> = constant, CW                 | —    | 0.5 | ±1   | dB    |
| Forward Voltage                    | V <sub>F</sub>   | CW  | —    | 1.1 | 1.6  | V     |
| Input Impedance                    | R                | —   | 3    | —   | 8    | Ω     |
| Monitor Current                    | I <sub>MON</sub> | V <sub>R</sub> <sup>†</sup> = 5 V               | 400  | —   | 1200 | μA    |
| Monitor Dark Current               | I <sub>D</sub>   | V <sub>R</sub> <sup>†</sup> = 5 V               | —    | 10  | 200  | nA    |
| Wavelength Temperature Coefficient | —                | —   | —    | 0.4 | 0.5  | nm/°C |

\* See Table 5 for more information.

† V<sub>R</sub> = reverse voltage.

**Electro/Optical Characteristics** (continued)

**Analog Operation**

The A370 Series Laser Module has the capability of being used in a wide variety of analog operations. These may include several channels of pure video signals, or a mix of video signals with digital data channels riding on analog carriers. It is difficult to prepare a single battery of testing conditions that will satisfy all applications. The following table contains a set of testing conditions that Lucent believes will give a broad indication of the performance of the A370 Series Laser Module. Please contact your local Field Application Engineer if different testing conditions and parametric limits are required.

The distortion characteristics are measured using a two-tone test. The frequencies are 13 MHz and 19 MHz. The second-order distortion components are measured at  $f_1 + f_2 = 32$  MHz and  $f_1 - f_2 = 6$  MHz. All third-order distortion components are measured in the frequency range of 5 MHz—200 MHz, and they meet the required level. All measurements are made with SC-SPC connectors on the laser module pigtailed.

**Table 3. Analog Characteristics**

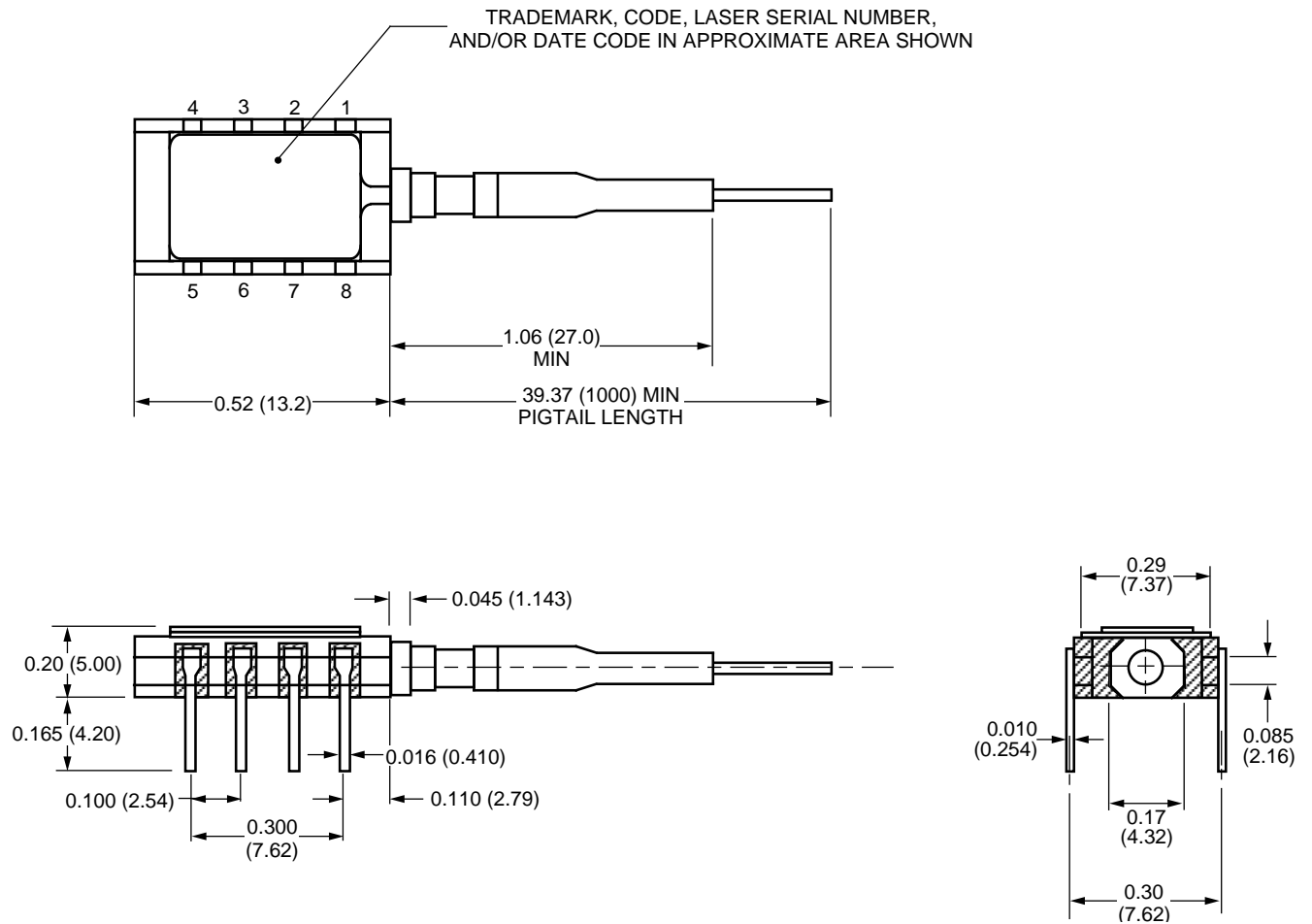
| Parameter                    | Symbol           | Test Conditions  | Min | Typ                     | Max                     | Unit       |
|------------------------------|------------------|--|-----|-------------------------|-------------------------|------------|
| Output Power*                | P <sub>o</sub>   | CW, T = -40 °C to +85 °C   | —   | 1.0                     | —                       | mW         |
| Relative Intensity Noise     | RIN              | CW,<br>Freq. = 5 MHz to 300 MHz;<br>no fiber loss, T = -40 °C to +85 °C  | —   | -140                    | -130                    | dB/Hz      |
| Modulation Bandwidth         | BW               | -3 dB,<br>T = -40 °C to +85 °C   | 1.0 | —                       | —                       | GHz        |
| Second-order Distortions     | —                | T = 25 °C, OMI = 0.2;<br>Two-tone test: f <sub>1</sub> = 13 MHz,<br>f <sub>2</sub> = 19 MHz; 20 km of fiber,<br>(7 dB loss) plus connector loss,<br>f <sub>1</sub> ± f <sub>2</sub>                | —   | -48<br>-50 <sup>†</sup> | -40<br>-45 <sup>†</sup> | dBc<br>dBc |
| Third-order Distortions      | —                | T = 25 °C, OMI = 0.2;<br>Two-tone test: f <sub>1</sub> = 13 MHz,<br>f <sub>2</sub> = 19 MHz; 20 km of fiber<br>(7 dB loss), plus connector loss,<br>all peaks from 5 MHz—50 MHz<br>meet this level | —   | -60<br>-60 <sup>†</sup> | -50<br>-50 <sup>†</sup> | dBc<br>dBc |
| RF Bandpass Flatness         | B <sub>F</sub> F | Peak to valley: 5 MHz to 200 MHz   | —   | —                       | 1.0                     | dB         |
| Spurious Noise               | N <sub>SP</sub>  | T = 25 °C, OMI = 0.2;<br>ref. to one-tone: 5 MHz to 50 MHz,<br>20 km of fiber, (7 dB loss) plus<br>connector loss  | —   | -58<br>-58 <sup>†</sup> | -54<br>-54 <sup>†</sup> | dBc<br>dBc |
| Spurious Noise (carrier off) | N' <sub>SP</sub> | T = 25 °C  | —   | -45<br>-45 <sup>†</sup> | -37<br>-40 <sup>†</sup> | dBc<br>dBc |

\* See Table 5 for more information.

† Premium performance.

### Outline Diagram

Dimensions are in inches and (millimeters).



1-899.f

## Qualification Information

The A370-Type Laser Module has passed the following qualification tests and meets the intent of *Telcordia Technologies* TR-NWT-000468 for interoffice environments and TA-TSY-000983 for outside plant environments.

**Table 4. A371-Type Laser Module Qualification Test Plan**

| Qualification Test         | Conditions                   | Sample Size | Reference   |
|----------------------------|------------------------------|-------------|---|
| Mechanical Shock           | 500 G                        | 11          | MIL-STD-883<br>Method 2002                        |
| Vibration                  | 20 g, 20 Hz—2,000 Hz         | 11          | MIL-STD-883<br>Method 2007                        |
| Solderability              | —                            | 11          | MIL-STD-883<br>Method 2007                        |
| Thermal Shock              | Delta T = 100 °C             | 11          | MIL-STD-883<br>Method 2003                        |
| Fiber Pull                 | 1 kg; 3 times                | 11          | <i>Telcordia Technologies</i> 983                 |
| Accelerated (Biased) Aging | 85 °C, 5,000 hrs.            | 25          | <i>Telcordia Technologies</i> 983<br>Section 5.18 |
| High-temperature Storage   | 85 °C, 2,000 hrs.            | 11          | <i>Telcordia Technologies</i> 983                 |
| Temperature Cycling        | 500 cycles                   | 11          | <i>Telcordia Technologies</i> 983<br>Section 5.20 |
| Cyclic Moisture Resistance | 10 cycles                    | 11          | <i>Telcordia Technologies</i> 983<br>Section 5.23 |
| Damp Heat                  | 40 °C, 95% RH,<br>1,344 hrs. | 11          | MIL-STD-202<br>Method 103                         |
| Internal Moisture          | <5,000 ppm water vapor       | 11          | MIL-STD-883<br>Method 1018                        |
| Flammability               | —                            | —           | TR357<br>Sec. 4.4.2.5                             |
| ESD Threshold              | —                            | 6           | <i>Telcordia Technologies</i> 983<br>Section 5.22 |

## 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 classified with the FDA under accession number 8720010.

This product complies with 21 CFR 1040.10 and 1040.11.

8.3  $\mu\text{m}$  single-mode pigtail or connector

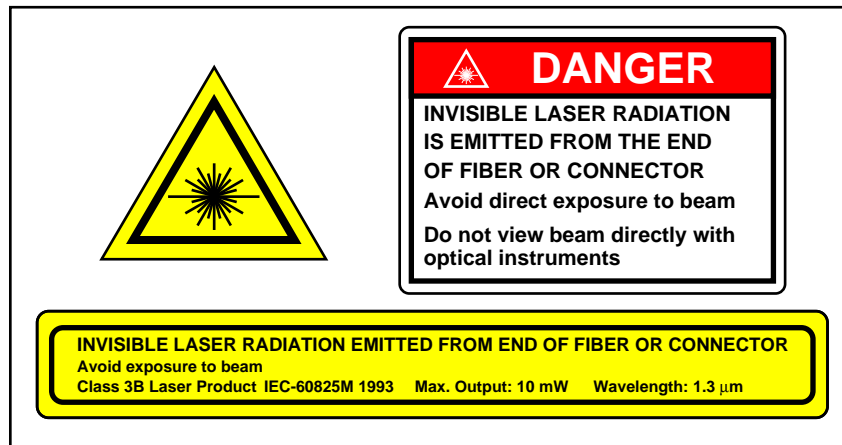
Wavelength = 1.3  $\mu\text{m}$

Maximum power = 10 mW

Because of size constraints, laser safety labeling 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. Ordering Information**

| Code     | Comcode   | Pfiber | Connector | Performance Option |
|----------|-----------|--------|-----------|--------------------|
| A370-10A | 108009150 | 1.0 mW | SC-PC     | Standard           |
| A370-10F | 108013954 | 1.0 mW | FC-PC     | Standard           |
| A370-10B | 108024183 | 1.0 mW | SC-APC    | Standard           |
| A370-10G | 108061839 | 1.0 mW | FC-APC    | Standard           |
| A370-10N | 108013962 | 1.0 mW | none      | Standard           |
| A370-11A | 108225384 | 1.0 mW | SC-PC     | Premium            |
| A370-11F | 108225392 | 1.0 mW | FC-PC     | Premium            |

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