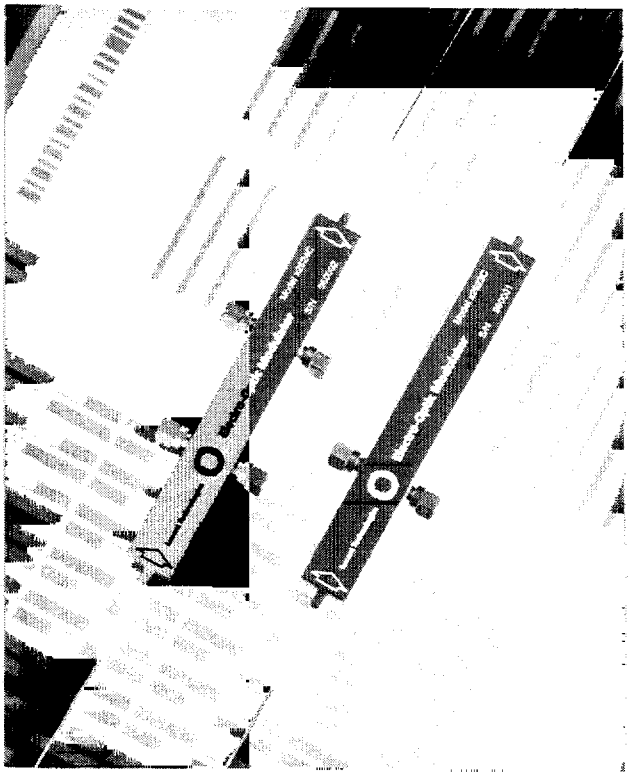
Advance Data Sheet
July 1996

microelectronics group

Lucent Technologies
Bell Labs Innovations

Lithium Niobate SLIM-PAC Electro-Optic Modulator



Offered in a new, low-profile hermetic package, the Lithium Niobate SLIM-PAC Modulator features a patented dual-drive configuration that allows for no chirp dispersion penalty. At 2.5 Gbits/s, transmission distances of 800 km can be achieved.

Features

- Slim, hermetic package
- Excellent long-term bias stability
- Low modulation voltages
- Patented dual-drive technology
- Patented Ti-diffusion process
- 1.3 μm and 1.55 μm wavelengths
- Ti-$LiNbO_3$ technology
- Angled interfaces for minimal optical reflections
- 43 Ω design for minimal electrical reflections
- Bandwidths up to 16 GHz
- Operational over a temperature range of 0 °C to 65 °C

Benefits

- Adjustable chirp for long distances at high bit rate
- Configurable to customer specifications

Applications

- Digital high-speed telecommunications
  — SONET: OC-1 through OC-192
  — SDH: STM-16, STM-64
- Analog and digital cellular communication
- Analog CATV
- Military radar remoting

Description

Lucent Technologies Microelectronics Group's SLIM-PAC Electro-Optic Modulator is designed for long-wavelength, single-mode external amplitude modulation applications. It employs an integrated Mach-Zehnder configuration to convert single polarization CW light from a semiconductor (DFB) or solid-state (frequency-optimized Nd:YAG) laser into a time-varying optical output signal. Using the source in the CW mode eliminates the need for demanding, high-speed performance from the laser and reduces its cost.

Microelectronics Group's patented dual-drive configuration and Ti-diffusion process are standard features on all modulator devices. With this design advantage, balanced drive voltage produces zero-chirp modulation operation. In addition, the redesigned package is now hermetic to protect the $LiNbO_3$ die from the environment. Novel processing techniques now make it possible to achieve 20-year operation with little drift in the dc-bias point. The qualification of the SLIM-PAC modulator to Bellcore 468 (TR-NWT-000468, Issue 1, December 1991) will be completed in December 1996.

Other standard features include Panda-type polarization-maintaining fiber (PMF) as the optical input fiber and single-mode SBJ fiber for the output fiber. Modulators are available with either rotary mechanical splice or FC-type connectors that are keyed to the axis of polarization.

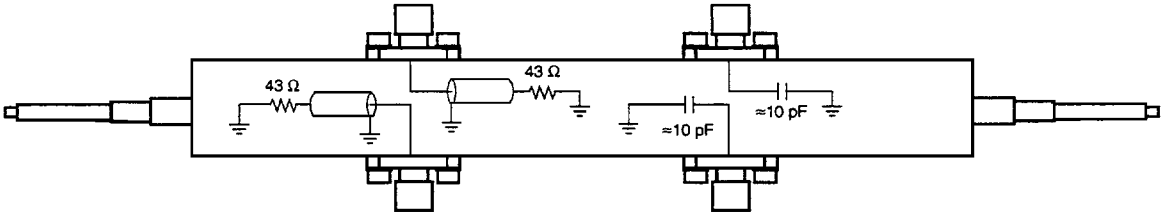


Figure 1. Equivalent Circuit (2624-Type)

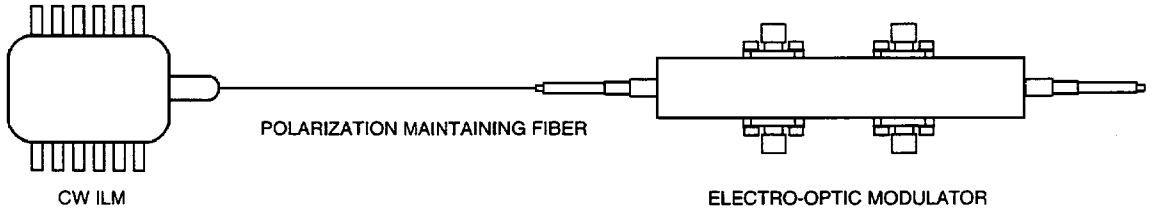


Figure 2. Typical Interconnection

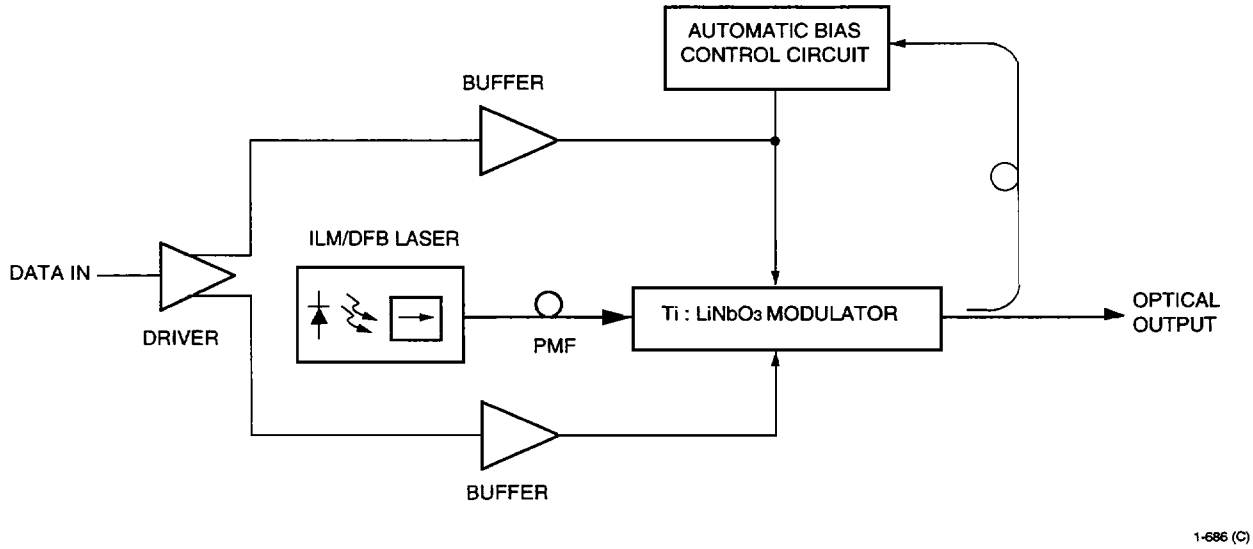


Figure 3. Typical Circuit Schematic

Description (continued)

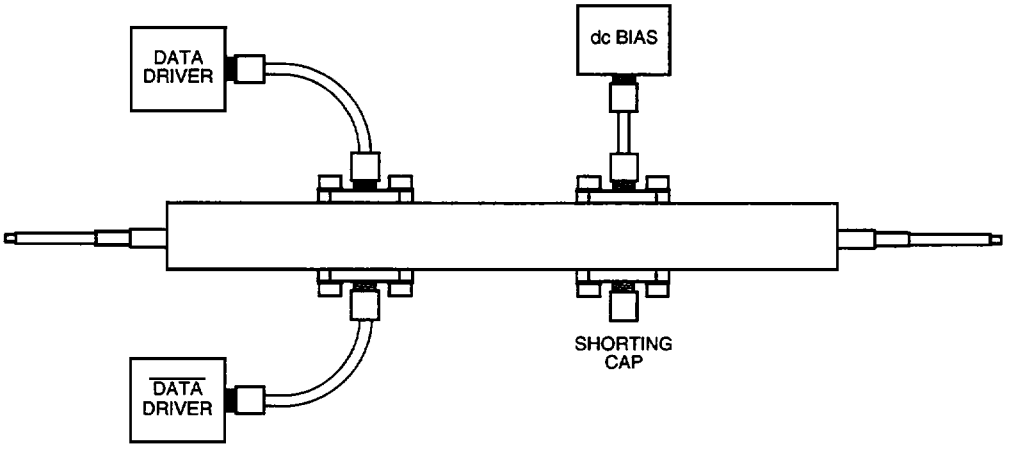


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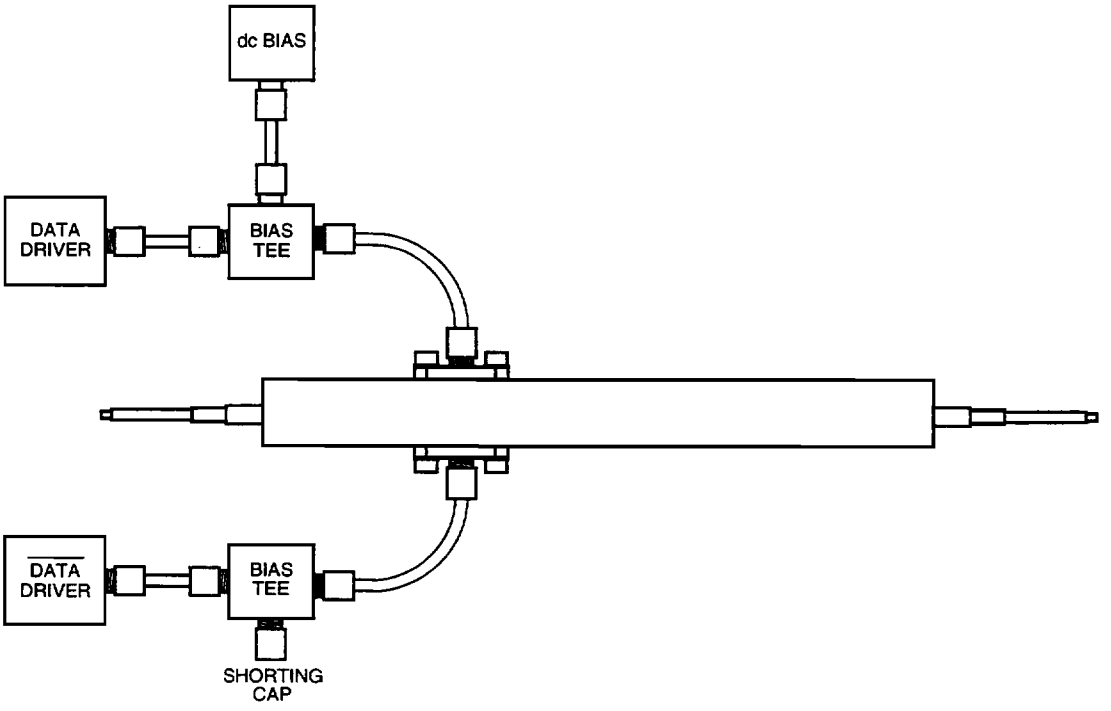
Figure 4. Recommended Operating Circuit Diagram for the 2624-Type SLIM-PAC Modulators



1-689(C).a

Figure 5. Recommended Operating Circuit Diagram for the 2623-Type SLIM-PAC Modulators

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

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T_{stg}	–40	70	°C
Optical Input Power (at 1.5 μm and 1.3 μm)	P_{IN}	—	100	mW
RF Voltage (peak to peak)	V_{RF}	—	20	V
dc Voltage	Vdc	–20	20	V
Operating Temperature	T_{OP}	0	65	°C

Optical/Electrical Characteristics (Nominal)

Device Code	Wavelength (μm)	Bandwidth* (GHz)	Switching Voltage† (V)	Extinct. Ratio (dB)	Impedance (Ω)	Insertion Loss (dB)	Electrical Return Loss (dB)	Optical Return Loss (dB)
2613	1.3	≥8	≤4.5	≥20	43	≤4.0	≥15	≥40
2614	1.3	≥16	≤9.0	≥20	43	≤4.0	≥15	≥40
2623	1.55	≥8	≤6.0	≥20	43	≤4.0	≥15	≥40
2624	1.55	≥16	≤12.0	≥20	43	≤4.0	≥15	≥40

* Bandwidth stated is electrical-optical-electrical as determined by the frequency response of the received RF electrical power (after the photodiode) and measured relative to the RF electrical power used to drive the modulator. This response is referenced to the value at 130 MHz.

† The switching voltage listed is the $V\pi$ voltage as tested at 1 GHz. The total voltage swing is approximately the same regardless of whether the modulator is used in a single- or dual-drive operation. However, driving the modulator differentially requires only half the voltage on each driver. (A 4.0 V swing required in a single-sided operation requires only a 2.0 V swing on each output of a differential driver.)

Optical/Electrical Characteristics

(continued)

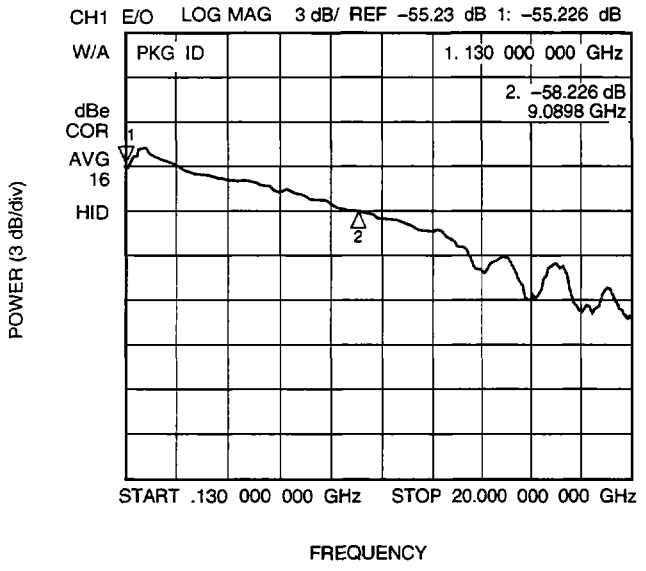


Figure 6. Typical Lithium Niobate Modulator Frequency of Response at 8 GHz 1-898 (C)

Electrical Signal Input

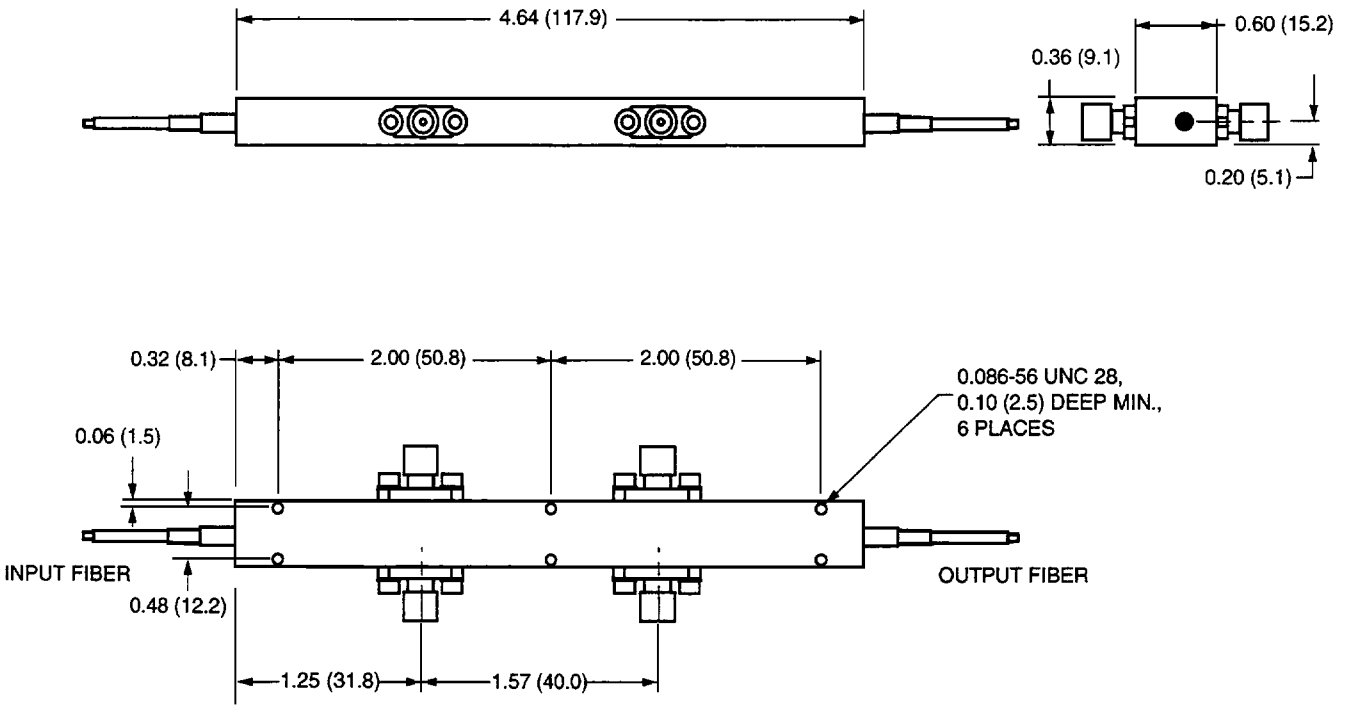
Electrical signal input is made through SMA coaxial connectors. The standard device includes an internal termination network. Care must be taken not to exceed the recommended 8 in-lb. of torque when making connection to these inputs. High-frequency coaxial cable is recommended.

Packaging

The SLIM-PAC hermetic package design incorporates a laser-sealed lid and soldered fibers. The minimum bend radius for the fiber is 1.5 in. These model devices are designed to NEBS (inside plant) standards. To prevent warping, use only the two center screws to mount the device.

Outline Diagram (2624-Type)

Dimensions are in inches and (millimeters).



1-889 (C)

Ordering Information

Table 1. Device Information

Description*	Part Number	Optical Connector Type	Comcode
High-Speed Electro-Optic Modulators	2613AA	Rotary	107683641
	2614AA	Rotary	107792301
	2623AA	Rotary	107683682
	2624AA	Rotary	107683708
	2613C	FC	107683658
	2614C	FC	107792285
	2623C	FC	107683690
	2624C	FC	107683716

* Bias and drive circuitry information available on request. Higher operating speeds and custom designs are available.

Table 2. Related Product Information

Description	Part Number	Document Number
1.3 μm Isolated DFB Laser Module	246-Type	DS96-143LWP
1.5 μm Isolated DFB Laser Module (with PMF)	246-P	DS96-144LWP
1.5 μm Isolated DFB Laser Module	246-Type	DS94-186LWP
High-Speed Lightwave Receiver	1319-Type	DS95-116LWP
1.5 μm Erbium-Doped Fiber Amp. (980 nm pumps(s))	1712-Type	DS96-086LWP
1.5 μm Erbium-Doped Fiber Amp. (1480 nm pumps(s))	1713-Type	DS96-134LWP
Dual-Output $LiNbO_3$ Modulators	2410C, 2420C	PN94-075LWP

Table 3. Related Literature

Title	Document Number
Lithium Niobate Modulator	TN94-017LWP
The Relationship Between Chirp and Voltage for the Mach-Zehnder Lithium Niobate Modulators	TN95-009LWP

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

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DS96-135LWP (Replaces DS95-223LWP)

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