Shelf for Headend Office

Physical Description of Headend Shelf

The Laser Link II shelf, shown with independently ordered modules in Figure 3-1 and Figure 3-2, fits into a 5U (8.75 inches) high by 19 inches wide area and is about 20 inches deep. The Laser Link II shelf mounts into a 19-inch rack that conforms to the ANSI*/EIA-310-C standard. The shelf is designed to accommodate up to seven plug-in modules. The plug-in slots accept the Laser Link II transmitters, receivers, and amplifiers. This flexibility allows for customized modular arrangements. Table 3-1 provides the specifications for the Laser Link II shelf.

Table 3-1. Laser Link II Shelf Specifications

Dimensions (H x W x L)	8.75" X 19" X 20"
Number of slots	7
Operating temperature	0°C to 49°C
Relative humidity	20% to 55% noncondensing
Nominal power requirement	115 VAC or 230 VAC, 50 to 60 Hz
Voltage output	24 VDC
Current output	8 A maximum
Weight	17 lbs

* Registered trademark of American National Standards Institute

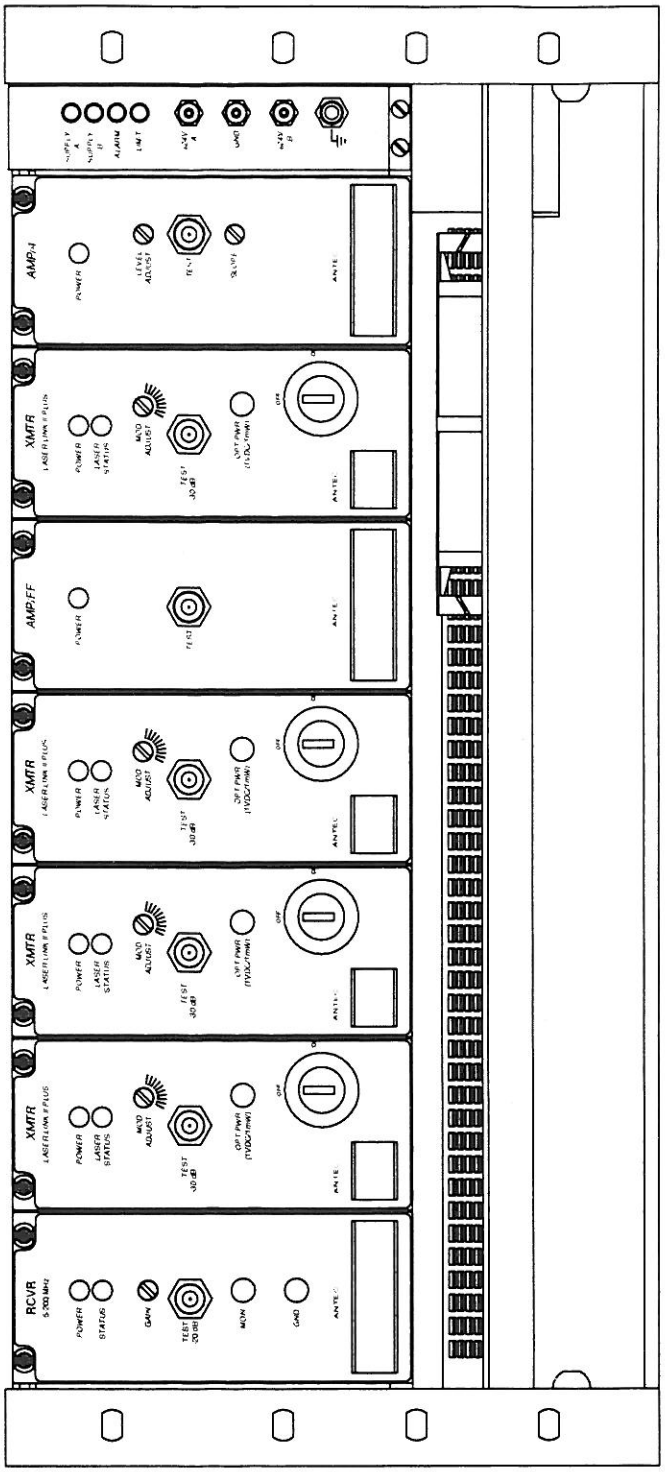

Figure 3-1. Laser Link II Shelf (Front View)

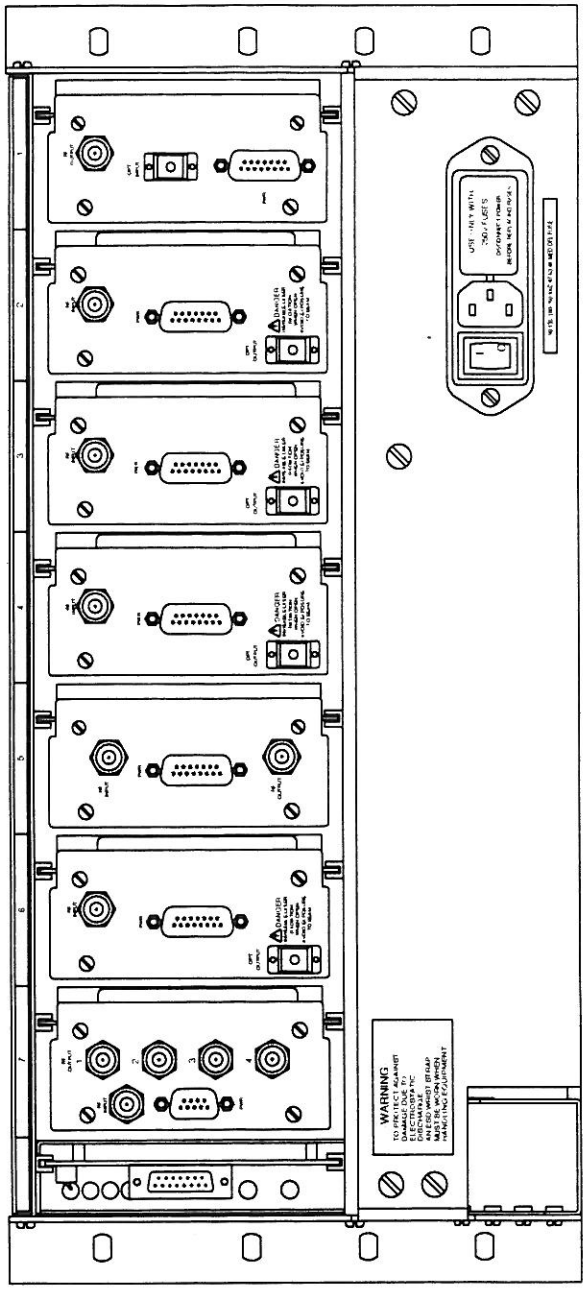

Figure 3-2. Laser Link II Shelf (Rear View)

Shelf Power Configurations

The Laser Link II shelf may be ordered with or without a power supply.

- The customer may order the shelf with supply A pre-equipped (mounted) and may also order a redundant power supply (ED8C830-32G2,3) that can be mounted near the shelf. If the power supply is ordered, the customer then wires the power supply output to terminal block TB1 of the power distribution board, as shown in Figure 3-3. For each power supply, a nominal power source of 115 VAC or 230 VAC, 50 to 60 Hz, must interface with the IEC connector on the power supply.
- The customer may order the shelf with supply A pre-equipped (mounted), but **not** order a redundant power supply B. If redundant power is desired, then the customer's choice of power supply should be wired to terminal block TB1, as shown in Figure 3-3. When using the redundant supply B, the ENABLE switch on the user panel should be enabled. If redundant power is not desired, then terminal block TB1 need not be wired to a power supply.
- The customer may order the shelf without any power supplies. The standard power supply voltages should be applied to the 6-pin Molex connector located on the power distribution board (see Figure 3-4).

On the power distribution board shown in Figure 3-3, F2 is the fuse for the +24 V from power supply A and F1 is the fuse for the +24 V from power supply B. F1 and F2 can only be replaced with 15 A snap-in auto fuses. The power distribution board contains the following connectors:

- One 6-pin Molex connector for shelf power supply.
- Seven 15-pin connectors (J1, J2, J3, J4, J5A, J6A, and J7A) for distributing power to the transmitter, receiver, and feedforward amplifier modules.
- Three 9-pin connectors (J5B, J6B, and J7B) for distributing power to the quad amplifier modules.
- A terminal block (TB1) is provided to allow connection points for the +24 V redundant B-supply and for the alarm relay contacts N-O (normally open), N-C (normally closed), and COM (common). There is a contact transfer in the relay when a general operational alarm (GOALN) exists.
- A 25-pin telemetry connector (J9) that contains the shelf alarm, module alarms, and power supply voltages and ground.

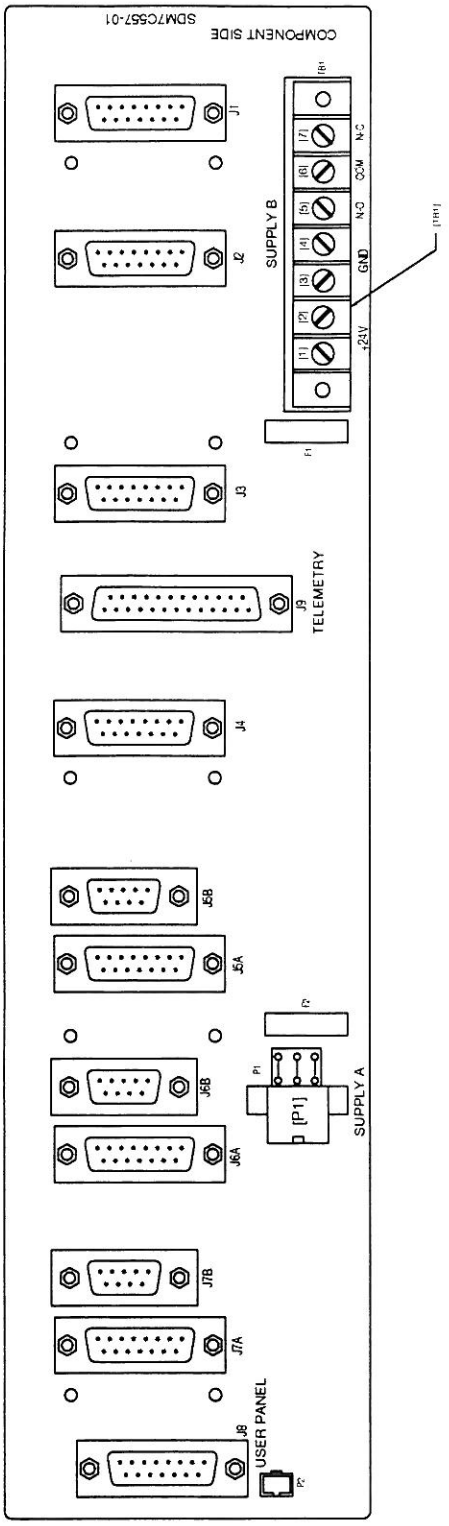

Figure 3-3. Power Distribution Board

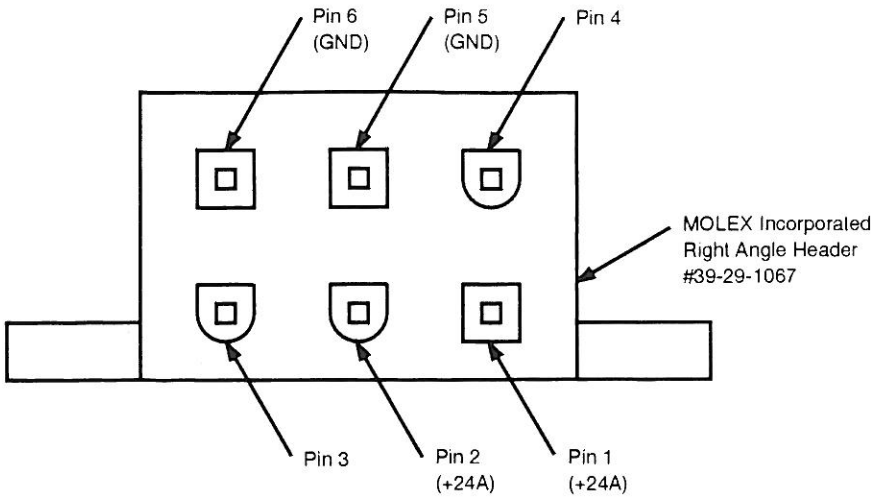

Figure 3-4. Power Supply Voltages to 6-pin Molex Connector

Functional Description of Headend Shelf

The shelf provides a framework where Laser Link II modules can be interconnected. The shelf supplies power to the modules and provides shelf alarms and status indicators. Figure 3-5 shows the front and rear views of the user panel.

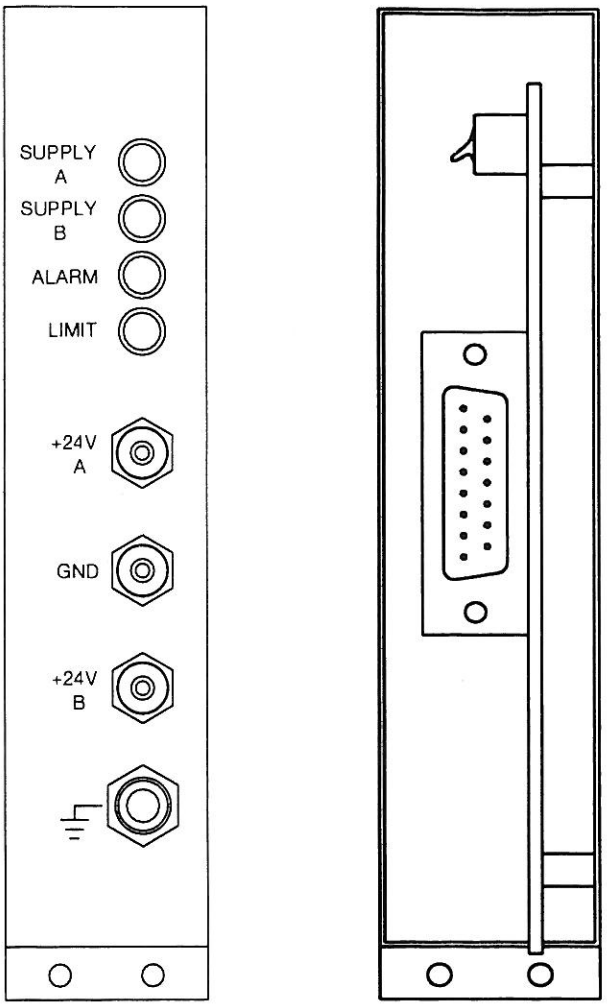

Figure 3-5. User Panel

The shelf may be backed up with a redundant power supply. If the shelf is equipped with redundant power, then the LED enable switch (shown in Figure 3-5) should be in the "up" position. If the shelf is not equipped with redundant power, then the LED enable switch should be in the "down" position.

If the shelf is equipped with redundant power:

- SUPPLY A LED indicator will be green during normal operation and red when power supply A fails.
- SUPPLY B LED indicator will be green during normal operation and red when power supply B fails.
- ALARM LED indicator will be extinguished during normal operation and red when there is a general operational alarm. The general operational alarm could be caused by the failure of power supply A or B, or by the alarm condition of a module. The general operational alarm can be reported to a remote location.

If the shelf is **not** equipped with redundant power:

- SUPPLY A LED indicator will be green during normal operation and extinguished when power supply A fails.
- SUPPLY B LED indicator will be extinguished.
- ALARM LED indicator will be green during normal operation and red when there is a general operational alarm that is initiated when power supply A falls below +21.5 VDC. The ALARM LED will be extinguished when power supply A fails completely.

The Laser Link II shelf is designed so that the user panel can indicate excess power dissipation in the shelf. For example, during normal operation, the LIMIT LED will be extinguished. However, should any combination of plug-in modules installed in the shelf exceed the recommended power dissipation capability of the shelf, the LIMIT LED will be amber. The illuminated LIMIT LED indicates that the shelf power dissipation limit has been exceeded.

The +24V A, +24V B, and GND jacks are test points on the user panel that facilitate the measurement of power supply voltages. The electrostatic discharge (ESD) jack should be used for plugging in an ESD wrist strap before handling the modules.

The Laser Link II system has module and shelf level alarms (also known as vital signs) that are available on the power distribution board for connection to remote telemetry. The Laser Link II transmitter, receiver, and amplifier modules are capable of producing alarms which are reported at the telemetry connector by logic signals. Table 3-2 provides a summary of vital sign logic signals grouped by module type. For all module types, the redundant power alarm (RPAN) is active when the primary power supply fails and the optional redundant power supply is providing power. This alarm causes the POWER LED to turn from green to red. For the transmitter module, the laser temperature / bias alarm (LSRTBN), when active, indicates an abnormal laser diode temperature or an abnormal laser diode bias current. This alarm causes the LASER STATUS LED to turn from green to red. For the receiver module, the low received optical power (OPTSTAT) alarm

occurs when the received optical power is below a preset value. This alarm causes the STATUS LED to turn from green to red.

The vital signs, general operational alarm, and the +24 V supply voltage(s) are brought out to the telemetry connector (J9) on the power distribution board. Table 3-3 provides the pinout and interconnect information for the telemetry connector (J9). The designation VS4-1 indicates that it is vital sign #1 for slot location 4. VS4-1 allows for the monitoring of the redundant power alarm for the module in slot location 4.

Table 3-2. Summary of Plug-In Module Alarms

Transmitter		
Vital Signs	**Description**	**Logic**
#1	Redundant Power Alarm (RPAN)	+5 V = Alarm 0 V = Normal
#2	No Connection	
#3	Laser Temperature/Bias Alarm (LSRTBN)	+5 V = Alarm 0 V = Normal
Receiver		
Vital Signs	**Description**	**Logic**
#1	Redundant Power Alarm (RPAN)	+5 V = Alarm 0 V = Normal
#2	Low Received Optical Power (OPTSTAT)	+5 V = Alarm 0 V = Normal
#3	No Connection	
AMP/4 or AMP/FF		
Alarm Signal	**Description**	**Logic**
#1	Redundant Power Alarm (RPAN)	+5 V = Alarm 0 V = Normal
#2	No Connection	
#2	No Connection	

* This is the logic sense for current product. Early transmitters (equipped with lasers having 2.4 mm diameter pigtails) had the opposite logic sense.

Table 3-3. Pinout and Interconnect Information for Telemetry Connector

Pin#	J1	J2	J3	J4	J5A	J6A	J7A	J8	J5B	J6B	J7B	J9
1	PSGND	PSGND	PSGND	PSGND	PSGND	PSGND	PSGND	N-O	GOALN	GOALN	GOALN	+24A
2	NC	NC	NC	NC	NC	NC	NC	COM-MON	VS5-1	VS6-1	VS7-1	VS4-1
3	NC	NC	NC	NC	NC	NC	NC	N-C	+24A	+24A	+24A	GOALN
4	GOALN	GOALN	GOALN	GOALN	GOALN	GOALN	GOALN	GOALN	+24B	+24B	+24B	VS5-1
5	VS1-1	VS2-1	VS3-1	VS4-1	VS5-1	VS6-1	VS7-1	NC	GND	GND	GND	VS5-3
6	+24A	+24A	+24A	+24A	+24A	+24A	+24A	+24A	VS5-3	VS6-3	VS7-3	VS5-2
7	+24AB	+24B	+24B	+24B	+24B	+24B	+24B	+24B	LIM	LIM	LIM	VS6-1
8	GND	GND	GND	GND	GND	GND	GND	GND	+24A	+24A	+24A	VS6-3
9	NC	NC	NC	NC	NC	NC	NC	NC	GND	GND	GND	VS6-2
10	NC	NC	NC	NC	NC	NC	NC	NC				VS7-1
11	VS1-2	VS2-2	VS3-2	VS4-2	VS5-2	VS6-2	VS7-2	EXTALM				VS7-3
12	VS1-3	VS2-3	VS3-3	VS4-3	VS5-3	VS6-3	VS7-3	10V-REF				VS7-2
13	LIM	LIM	LIM	LIM	LIM	LIM	LIM	LIM				GND
14	+24A	+24A	+24A	+24A	+24A	+24A	+24A	+24A				+24B
15	GND	GND	GND	GND	GND	GND	GND	GND				VS4-3
16												VS4-2
17												VS3-1
18												VS3-3
19												VS3-2
20												VS2-1
21												VS2-3
22												VS2-2
23												VS1-1
24												VS1-3
25												VS1-2

Headend Shelf Installation Procedures

The Laser Link II shelf is shipped assembled except for the power cords and extender brackets. Should you notice any shipping damage while unpacking, report it to the carrier before proceeding. Follow these procedures to install the shelf:

WARNING:
Never view any unterminated optical connector with optical instruments other than indirect image-converting devices such as the FIND-R-SCOPE, since viewing optics tends to collimate the energy from an optical connector and, hence, increases the potential risk for injury.*

1. Determine the position in the cabinet where the Laser Link II shelf is to be installed. There should be 2 inches of clearance above the shelf for ventilation purposes.
2. While two people support the shelf, position the shelf into the determined location.
3. Screw the shelf into the cabinet from the front.
4. Install the two extender brackets as shown in Figure 3-6. Note that the screws are inserted from inside of the shelf through the bracket and into the shelf side panel. The screws that fasten the extender brackets to the shelf side plates should be put in first. Do not tighten the screws at this time.

* Registered trademark of F.J.W. Industries, Inc.

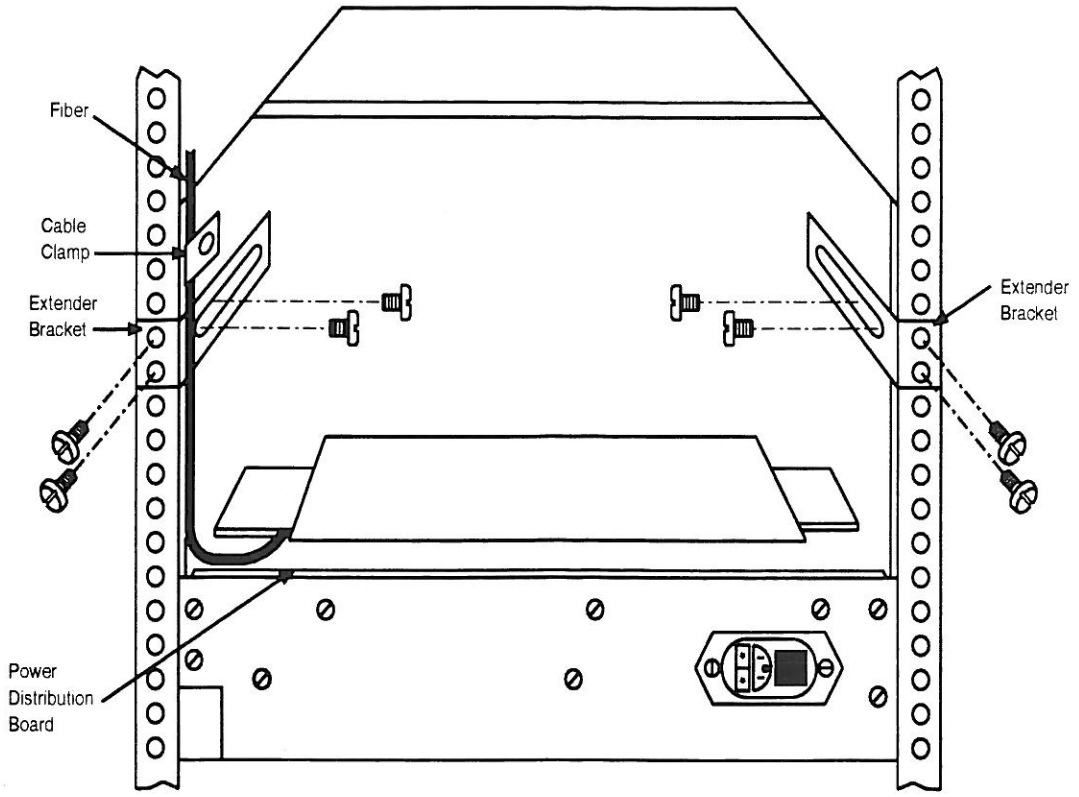

Figure 3-6. Rear Shelf Support Installation

5. Push the extender bracket forward until it contacts the rear upright of the cabinet.
6. Screw and tighten the extender bracket to the cabinet upright.
7. Tighten the screws holding the extender mounting brackets to the side plates.
8. Prepare the incoming fiber cable and provide strain relief for the cables with a cable clamp (see Figure 3-6). The cable clamps are not provided with the shelf.
9. Connect the power cord to the shelf and to the power source.
10. Turn the shelf power switch on, and the shelf is ready for operation.
11. If the shelf is equipped with a supply B, then put the ALARM LED enable switch in the ON or up position. If the shelf is not equipped with a supply B, then put the ALARM LED enable switch in the OFF or down position.

12. If the shelf is equipped with a supply B, verify that SUPPLY A and B LEDs are both green. If the shelf is not equipped with a supply B, verify that the SUPPLY A LED is green, and the SUPPLY B LED is extinguished.
13. Verify that the ALARM and LIMIT LEDs are extinguished.
14. Measure the voltages of the +24A and +24B test points for future reference.

Modules for Headend Office

The Laser Link II shelf in the headend office can be equipped with transmitter, receiver, and amplifier modules. The physical description, functional description, and the installation procedures of the Laser Link II modules for the headend office are provided.

Transmitter Modules for Headend Office

There are two different types of transmitter (XMTR) modules that may be used in the headend office. They are the EAW1C and EAW5.

Physical Description of Headend Transmitter Modules

The front and rear views of the EAW1C transmitter module are shown in Figure 3-7. The only visual difference between the EAW1C and EAW5 is that while the EAW1C is labeled LASER LINK II PLUS, the EAW5 is labeled LASER LINK II PLUS - HP. The HP indicates that it is the high power transmitter. The transmitters have POWER and LASER STATUS LEDs on the front panel, a radio frequency (RF) modulation adjustment potentiometer, and jacks to monitor the output optical power and the RF input signal. The input (RF INPUT), output (OPT OUTPUT), and power (PWR) connectors are in the rear of the modules. OPT OUTPUT interfaces with an SC-type connector.

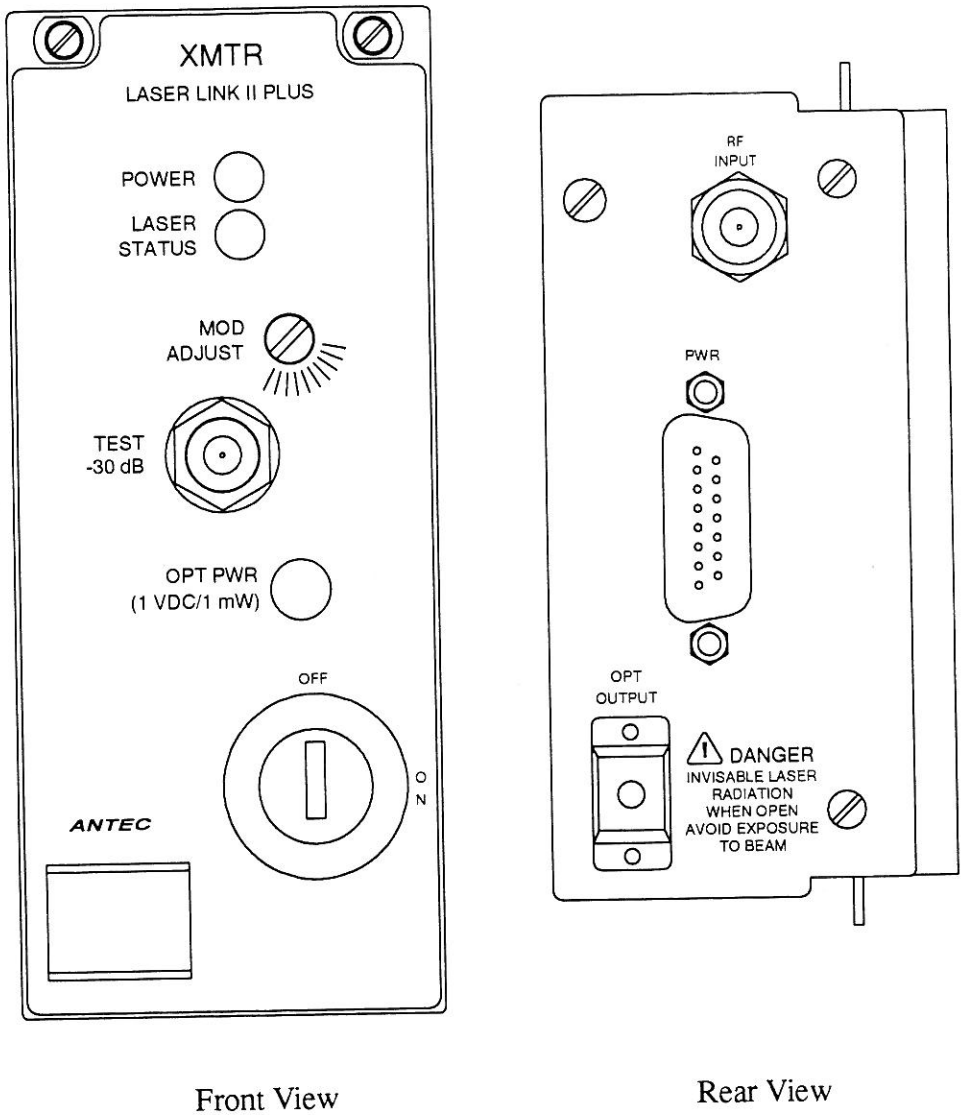

Figure 3-7. Transmitter Module (EAW1C) Front and Rear Views

Functional Description of Headend Transmitter Modules

The transmitter modules (EAW1C and EAW5) convert an RF signal into an intensity-modulated optical signal that feeds into a fiber optic cable. The transmitter modules may receive the RF input from an amplifier module or from another

source that can provide a minimum RF input level of 32 dBmV per channel. While the optical power output of the EAW1C transmitter is typically 9 mW, the minimum optical power output of the EAW5 high power transmitter module is 12 mW.

Figure 3-8 shows a block diagram of the EAW1C transmitter module. The RF input signal passes through the MOD ADJUST attenuator that provides a 10 dB adjustment range. The RF signal may be monitored at the -30 dB test point available in the front panel of the transmitter module. The signal at the test point is 30 dB below the RF signal. The RF signal is amplified prior to conversion into an optical signal. The optical output power can be monitored with a voltmeter. The OPT PWR jack in the front of the module is calibrated to measure 1 volt for each milliwatt of transmitted optical power.

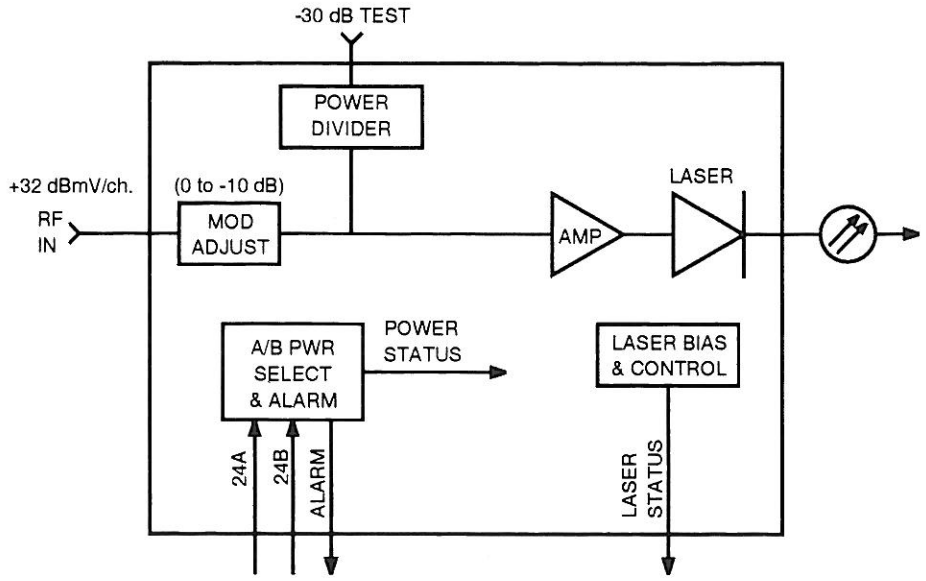

Figure 3-8. Transmitter Module (EAW1C) Block Diagram

Temperature control is an important factor in maintaining the longevity and performance consistency of the laser. A stable, high-gain temperature control circuit in the transmitter assures that over the full range of ambient temperatures there will be a quick and reliable convergence to a stabilized specific temperature. Board-monitoring circuitry continuously measures the operation of the closed-loop temperature control system. Abnormal variations in the operational characteristics of this system will result in activating the shelf-level general operational alarm and LASER STATUS faceplate LED indicator.

The A/B power select circuit is an integral part of each transmitter module. In the event of a failure in the primary power supply, an optional redundant power supply wired to the Laser Link II power distribution board will provide power to the module automatically. The POWER indicator on the faceplate displays the status of power in the module. The POWER LED is green during normal operations and red when the +24B supply is selected upon failure of the +24A supply. In case of no power to the module, the POWER LED is extinguished.

In addition to the faceplate power indicator, the Laser Link II transmitter modules provide power alarm and status conditions to the Laser Link II user panel. The user panel receives this information from the transmitter modules in the shelf through the shelf general operational alarm GOALN. The ALARM LED on the shelf will turn red if a power alarm is detected.

Table 3-4 provides the specifications for the EAW1C transmitter module, and Table 3-5 provides the specifications for the EAW5 transmitter module.

Table 3-4. Laser Link II Transmitter Module EAW1C Specifications

Specification	Min.	Typical	Max.	Units	Notes
Optical					
Optical power		9		mW	
Optical connector return loss			-50	dB	
Wavelength		1310		nm	
RF Input/Output					
Impedance		75		ohms	
Return loss		16		dB	
Input level	32			dBmV/ch.	
Modulation adjustment	+2/–8			dB	
Frequency response	50-750			MHz	
Ripple (peak to valley) 50-550 50-750			 ±1.0 ±1.5	 dB	
Test point attenuation		30		dB	
Carrier-to-noise	51	52.5		dB	1, 2
Composite second order			–60	dBc	3
Composite triple beat			–65	dBc	3
Power					
Supply voltage		24		VDC	
Current drain		0.5	1.0	amps	
Physical					
Operating temperature	0		49	°C	4
Relative humidity	20		55	%	
Pigtail length (single mode)	28			ft	
Optical connector		SC			
Weight		2.76		lbs	
Mounting		LL II			4
Dimensions (H x W x L)		5.25x2.25x11.5		inches	

Notes:

1. Tested with 8 dB of fiber (0.35 dB/km) and a receiver with $8\frac{pA}{\sqrt{Hz}}$ of front-end noise. Optical connector return loss ≤ -50 dB.

Table 3-4. Laser Link II Transmitter Module EAW1C Specifications (Contd)

2. An available version of the EAW1C is tested with 11 dB of optical loss that is comprised of 8 dB of fiber (0.35 dB/km) in series with a -3 dB (2-way) optical splitter.
3. 77 analog channels, 50-550 MHz. Assumes no significant contribution from the receiver.
4. Laser Link II shelf.

Table 3-5. Laser Link II High Power Transmitter Module EAW5 Specifications

Specification	Min.	Typical	Max.	Units	Notes
Optical					
Optical power	12			mW	
Optical connector return loss			-50	dB	
Wavelength		1310		nm	
RF Input/Output					
Impedance		75		ohms	
Return loss		16		dB	
Input level	32			dBmV/ch.	
Modulation adjustment	+2/–8			dB	
Frequency response	50-750			MHz	
Ripple (peak to valley) 50-550 50-750			 ±1.0 ±1.5	 dB	
Test point attenuation		30		dB	
Carrier-to-noise	52			dB	1
Composite second order			–60	dBc	2
Composite triple beat			–65	dBc	2
Power					
Supply voltage		24		VDC	
Current drain		0.72	1.0	amps	
Physical					
Operating temperature	0		49	°C	3
Relative humidity	20		55	%	
Pigtail length (single mode)	28			ft	
Optical connector		SC			
Weight		2.76		lbs	
Mounting		LL II			3
Dimensions (H x W x L)		5.25x2.25x11.5		inches	

Notes:

1. Tested with 11 dB of optical loss that is comprised of 8 dB of fiber (0.35 dB/km) in series with a -3 dB (2-way) optical splitter, and a receiver with $8\frac{pA}{\sqrt{Hz}}$ of front-end noise. Optical connector return loss ≤ -50 dB.

Table 3-5. Laser Link II High Power Transmitter Module EAW5 Specifications (Contd)

2. 77 analog channels, 50-550 MHz. Assumes no significant contribution from the receiver.
3. Laser Link II shelf.

Installation Procedures of Headend Transmitter Modules

WARNING:
Never view any unterminated optical connector with optical instruments other than indirect image-converting devices such as the FIND-R-SCOPE, since viewing optics tends to collimate the energy from an optical connector and, hence, increases the potential risk for injury.

The transmitter module is shipped assembled except for the 15-pin male-to-female shielded cable assembly and keys for the ON/OFF switch. Should you notice any shipping damage while unpacking, report it to the carrier before proceeding. Verify that the 15-pin D-type shielded cable assembly and the keys are in the carton. The transmitter module may be placed in slots one through seven of the shelf. Follow these procedures to install the transmitter:

1. Wear an electrostatic discharge (ESD) wrist strap that is connected to an earth ground.
2. Open the front cover of the Laser Link II shelf by turning the front panel latch handles counterclockwise.
3. Remove the module from the shipping package and insert it into an empty slot. The transmitter is shipped with fiber pigtail connected to a keyed bulkhead mounted adapter on the rear cover plate. If you have an SC-type connector that reaches the shelf, simply insert the SC-type connector into the keyed adapter, and then go to Step 8. If the SC-type connector (and the fiber pigtail) of the transmitter module need to be extended to a local distribution or interconnect panel, then follow Steps 4 through 7.
4. Remove the nine screws that attach the top cover to the module. Four screws are accessed from each side of the module, and one screw is accessed from the rear plate.
5. Remove the top cover from the module.

NOTE:
The fiber is connected to the circuitry. Slowly separate the cover from the base unit to prevent the application of tension to the fiber.

6. Detach the SC-type connector from the adapter. Uncoil enough fiber from within the module to reach the adapter location that is external to the shelf. This location can be up to 25 feet from the transmitter. The fiber shall be routed externally through the access hole located in the cover (see Figure 3-9). Route the fiber through the protective grommet. Ensure that the minimum bend radius is 1 inch because sharp bends will degrade system performance. Ensure that at least one coil of fiber is left on the fiber management clips, for strain relief.

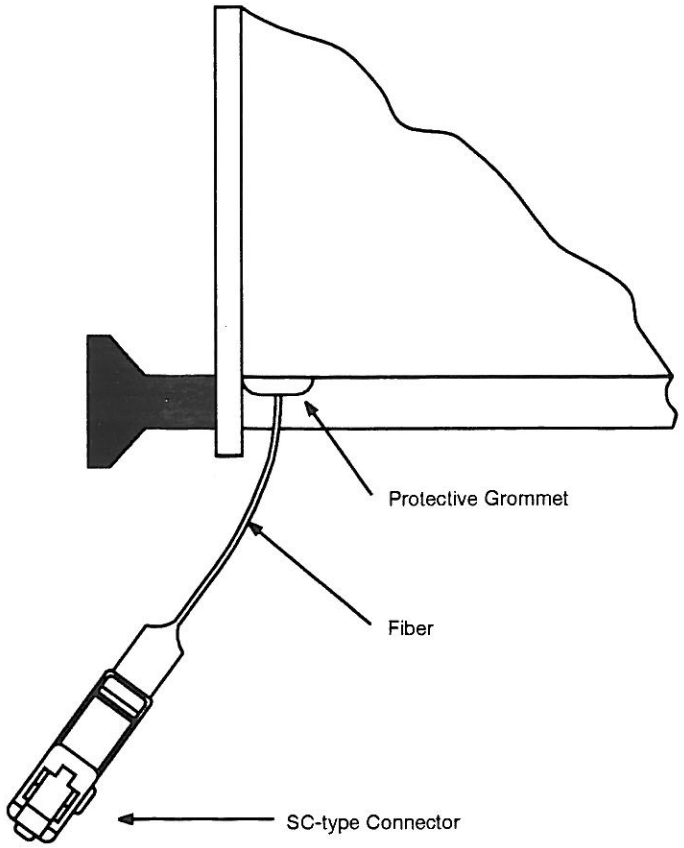

Figure 3-9. Routing Fiber from Module

7. Reassemble the top cover to the base of the module by reinstalling the ten screws.
8. Screw the module into the shelf, using the two captive screws provided with the module.

9. In the rear of the shelf, connect the 15-pin D-type shielded cable assembly between the module connector PWR and the power distribution board. Make sure the cable is secured at both ends by screwing the connector in place.
10. Verify that the shelf power is on. Turn unit key switch to the ON position.
11. Verify that the POWER and LASER STATUS LEDs are green before proceeding. While the temperature control circuit in the transmitter module is converging to a stable temperature, the LASER STATUS LED will be red. The time it takes for the LASER STATUS LED to turn from red to green will depend on the temperature in the room.
12. Measure the optical power at the optical connector, using an optical power meter, and record this value. Measure the voltage at the OPT PWR jack with respect to the ground that is available in the user panel. The OPT PWR jack is calibrated to measure 1 volt for each milliwatt of transmitted optical power.
13. Turn the key switch to the OFF position. Connect the XMTR pigtail to the outgoing fiber.
14. Turn the key switch to the ON position.
15. Interconnect the 75-ohm coaxial cable to the RF INPUT port per system requirements, while being careful not to overtorque the nut.
16. Remove the ESD wrist strap.

Receiver Module for Headend Office

The EAW31 is the receiver (RCVR) module used in the headend office. The physical description, functional description, and installation procedures of this module are provided.

Physical Description of Headend Receiver Module

Figure 3-10 shows the front and rear views of the EAW31 receiver module. The EAW31 has POWER and STATUS LEDs on the front panel, a gain adjustment potentiometer, and jacks to monitor the optical input power and the RF output signal. The input (OPT INPUT), output (RF OUTPUT), and power (PWR) connectors are in the rear of the module. OPT INPUT interfaces with an SC-type connector.