



Adder[™] 882 System

Instruction Manual

Telecast Fiber Systems, Inc.
102 Grove Street
Worcester, MA 01605
Tel: 508-754-4858
Fax: 508-752-1520
www.telecast-fiber.com

Table of Contents

Introduction	1
Unpacking	2
Installation	3
Rack Mounted Installation	3
Fiber Optic Installation	3
Audio Setup	4
Procedure	4
Optical Connections	6
Electrical Connections	6
Input Power Fuse	8
Operating Details	9
Battery Charging	9
Powering Up	9
Theory of Operation	10
Digital I/O	12
Optical	15
Preventive Maintenance	16
Accessory List	16
Troubleshooting	16
Specifications	18
Warranty	20

List of Figures

Figure 1.	Rear Panel of the Adder 882	1
Figure 2.	Block Diagram of a One Fiber System	2
Figure 3.	Possible Optical Configurations	2
Figure 4.	Installing the Rack Mount Adapters	3
Figure 5.	Audio Setup Controls	5
Figure 6.	Main Circuit Board	5
Figure 7.	ST Optical Connectors on the Rear Panel	6
Figure 8.	XLR Connectors on the Rear Panel	7
Figure 9.	RS-422 D Connectors on the Rear Panel	8
Figure 10.	Power Connector and Fuse Locations	8
Figure 11.	Front Panel	9
Figure 12.	Electronics Block Diagram	10
Figure 13.	Audio Input Buffer Circuit	11
Figure 14.	Audio Output Buffer Circuit	11
Figure 15.	Digital I/O Connectors 1, 3, 5 and 7	13
Figure 16.	Digital I/O Connectors 2, 4, 6 and 8	14
Figure 17.	Battery Charger Block Diagram	15

List of Tables

Table 1.	Maximum Fiber Lengths	3
Table 2.	Audio Inputs	4
Table 3.	Input and Output Cable Connections	6
Table 4.	Digital Cable Connections	7
Table 5.	Power Connections	8
Table 6.	Adder 882 Main Circuits	17
Table 7.	Troubleshooting Chart	18

Introduction

The Telecast Adder™ 882 System consists of two Adder 882 fiber optic multiplexer/demultiplexers that simultaneously send and receive up to eight audio signals, eight digital datas, and four remote relay closures in each direction. These signals are transmitted on optical fibers. Audio inputs are set up by internal DIP switches that set amplifier gain to accept either mic or line levels. Audio outputs are always at line levels. Digital inputs and outputs are RS-422 and RS-232 compatible signals. Four of the digital connectors also provide contact closure input and output. The other four connectors alternatively provide SONY CCU compatible interfaces. All connections are made via the rear panel. See Figure 1.

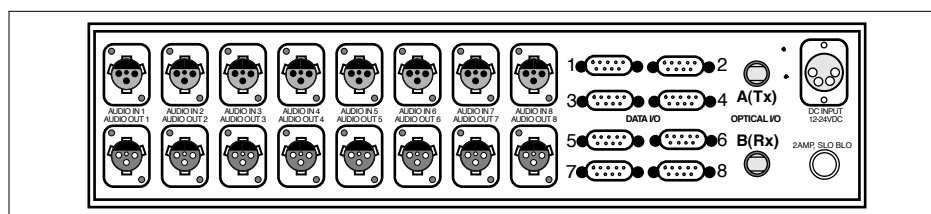


Figure 1. Rear Panel of the Adder 882

Within an Adder 882 unit, the audio signals are first digitized and then multiplexed with the digital data and control signals. The combined electrical signal is converted to an optical signal, launched into the optical fiber and sent to a second Adder 882. This second unit receives the optical signal, converts it into an electrical data stream, demultiplexes the signals and restores the audio signals to analog levels.

An internal Ni-Cad battery provides backup in the event of line power loss.

The Adder 882 is available with several optical options and configurations.

- Standard connection with bidirectional signals carried on two optical fibers at either 850, 1300, or 1550 nm.
- One fiber connection with optically combined bidirectional signals at 850/1300 nm or 1300/1550 nm as shown in Figure 2.

In a standard two fiber system, *identical* Adder 882 units are used at each location. The units both transmit at 850 nm on ST connector **A** and receive the 850 nm signal on ST connector **B**. They are connected by the two fibers so that the optical output of each box is connected to the optical input of the other. In both one and two fiber systems, the input of channel 1 on one unit becomes the output of channel 1 on the other unit, and vice versa.

In a one fiber system, the two Adder 882 units are *not identical* and are configured before shipment. They must be used as a pair. The units are connected by a single fiber that is wavelength division multiplexed (WDM). One unit transmits from the **A** ST connector at a wavelength of 1300 nm and also receives at 850 nm on the same connector. The other unit transmits from the **A** ST connector at 850 nm and similarly receives at 1300 nm on the same connector.

Figure 3 illustrates available optical configurations of the ADDER 882.

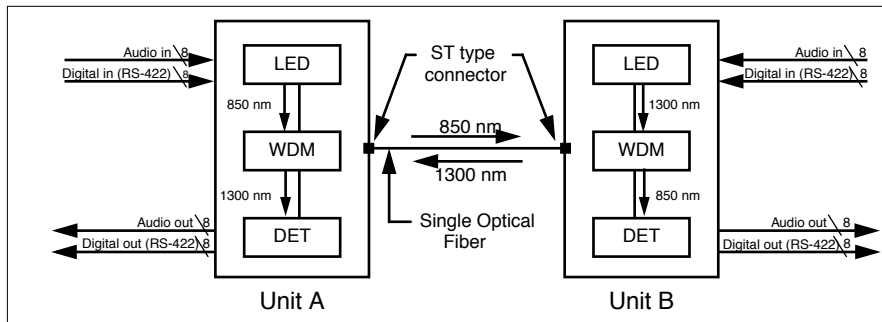


Figure 2. Block Diagram of a One Fiber System

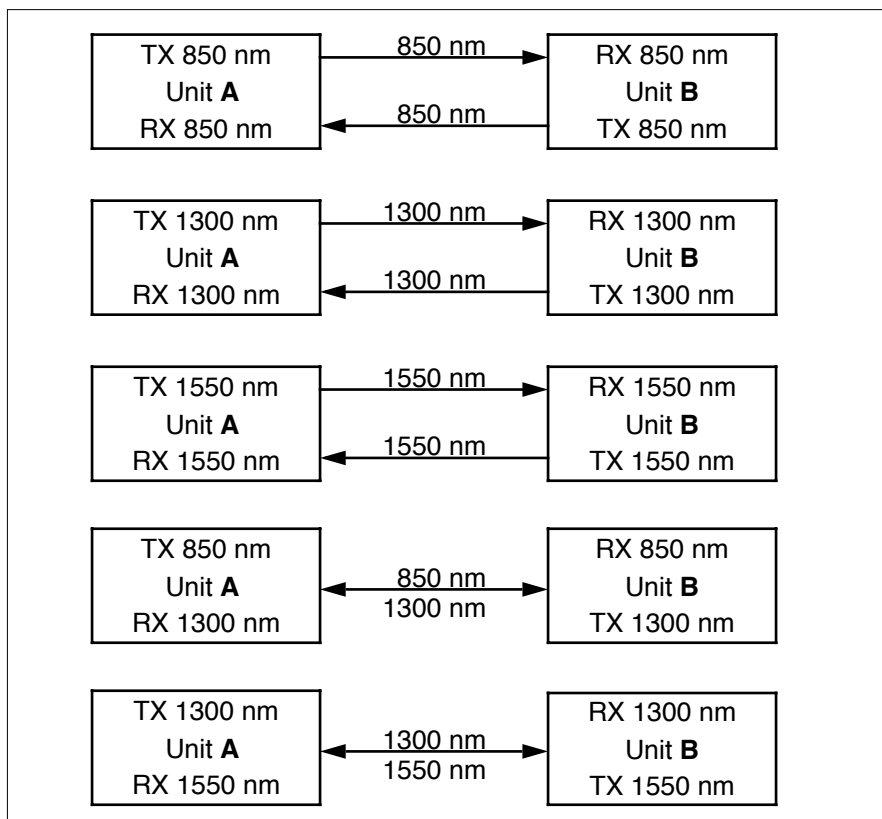


Figure 3. Possible Optical Configurations

Unpacking

The Adder 882 System consists of:

- Two Adder 882 multiplexer/demultiplexer units
- Two external power supplies (AC/DC adapters)
- Rack mount hardware kits
- Plastic or metal covers for optical connectors

Installation

Inspect the units for mechanical damage. Inspect all electrical connectors for bent or damaged pins and latches. Report any damage to the carrier and to Telecast Fiber Systems, Inc.

Leave the protective plastic caps on the optical connectors until it is time to attach the fiber(s) to the units. Store the caps in the plastic bag packed with this manual. Place the caps back on the connectors whenever the fibers are left disconnected.

Rack Mounted Installation

Units are shipped ready for bench use. To rack mount the units, mounting adapters must be attached. Each adapter is held in place by two #10 flat head screws (see Figure 4).

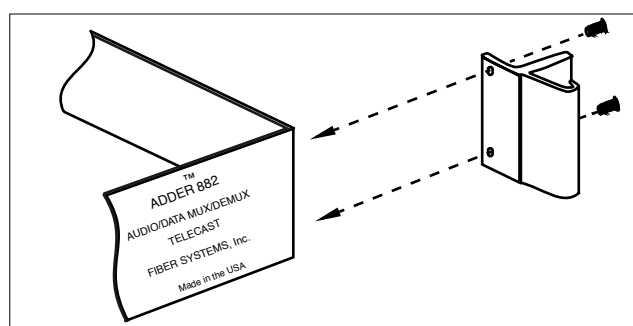


Figure 4. Installing the Rack Mount Adapters

Place the units in their intended locations before attaching any cables or wires. This will prevent accidental damage to the cables or their connectors.

Fiber Optic Installation

The installer is responsible for providing the fiber optic cable runs which are available from Telecast Fiber Systems, Inc. Refer to the Accessory List on page 16 of this manual for the cable and other items required for system installation. Be sure that the fiber core diameters are compatible with the intended installation distances as shown in Table 1.

Table 1. Maximum Fiber Lengths

Fiber core diameter	Maximum fiber length
50 microns	5 km (3 mi)
62.5 microns	3 km (2 mi)
8 microns (single mode)	10 km (6 mi)

The system units have been configured at the factory for the fiber type with which they are going to be used.

Mark or tag the optical fibers when they are pulled, carefully avoiding the fiber tip, so that their identity is known at both ends. If there is confusion about the identity of the two fibers, illuminate the end of one fiber with a flashlight and look for the light at the other end.

WARNING Do NOT use the Adder 882 optical output for this purpose. Never look directly into the end of the optical fiber while either end of the system is operating. Eye damage is possible.

Inspect the fiber ends and clean them with clean, dry compressed air or with Kim-Wipes that have been wet with isopropyl alcohol. Fingerprints or other dirt on the optical connector end surfaces will reduce the received optical signal level.

Audio Setup

The setup switches for line or microphone inputs levels are inside the Adder 882. Setup steps are *not* required if all inputs are at the factory default 600 Ω, 0 dB gain, line level. Setup *is* required if microphone inputs are used, if 5 kΩ input impedance is required, or if the optional 10 dB boost/cut is desired on line inputs.

Procedure

1. Determine which inputs will be connected to microphones and for which line I/O the 10 dB boost/cut is to be used.
2. Copy Table 2 and fill in the required I/O characteristics. Recopy the original table for use with other hookups.
3. *With the power switch off*, take off the top cover of the unit by removing the #4 flat head screw at each corner.

In Figure 5, **A** refers to the odd numbered channel and **B** refers to the even numbered channel of the pair.

Table 2. Audio Inputs

UNIT A SWITCH SETTING	Channel Number							
	1	2	3	4	5	6	7	8
MIC IN (0 or +40 db gain)								
LINE IN (0 or +10 db gain)								
INPUT IMPEDANCE (600 Ω or 5 kΩ)								
LINE OUT (0 or -10 db gain)								
UNIT B SWITCH SETTING	1	2	3	4	5	6	7	8
MIC IN (0 or +40 db gain)								
LINE IN (0 or +10 db gain)								
INPUT IMPEDANCE (600 Ω or 5 kΩ)								
LINE OUT (0 or -10 db gain)								

4. With the rear of the unit facing you (connector end), move the slide switches shown in Figures 5 and 6 to match the settings in Table 2. The controls are arranged in pairs.

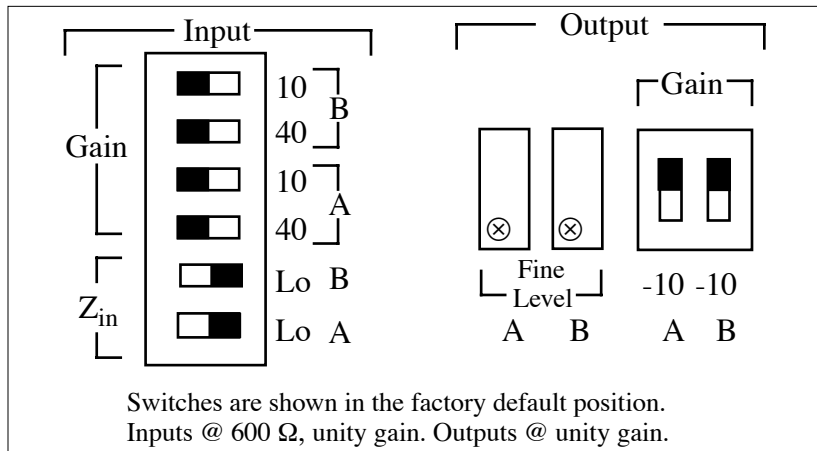


Figure 5. Audio Setup Controls

5. Replace the top cover and gently reinstall the screws.

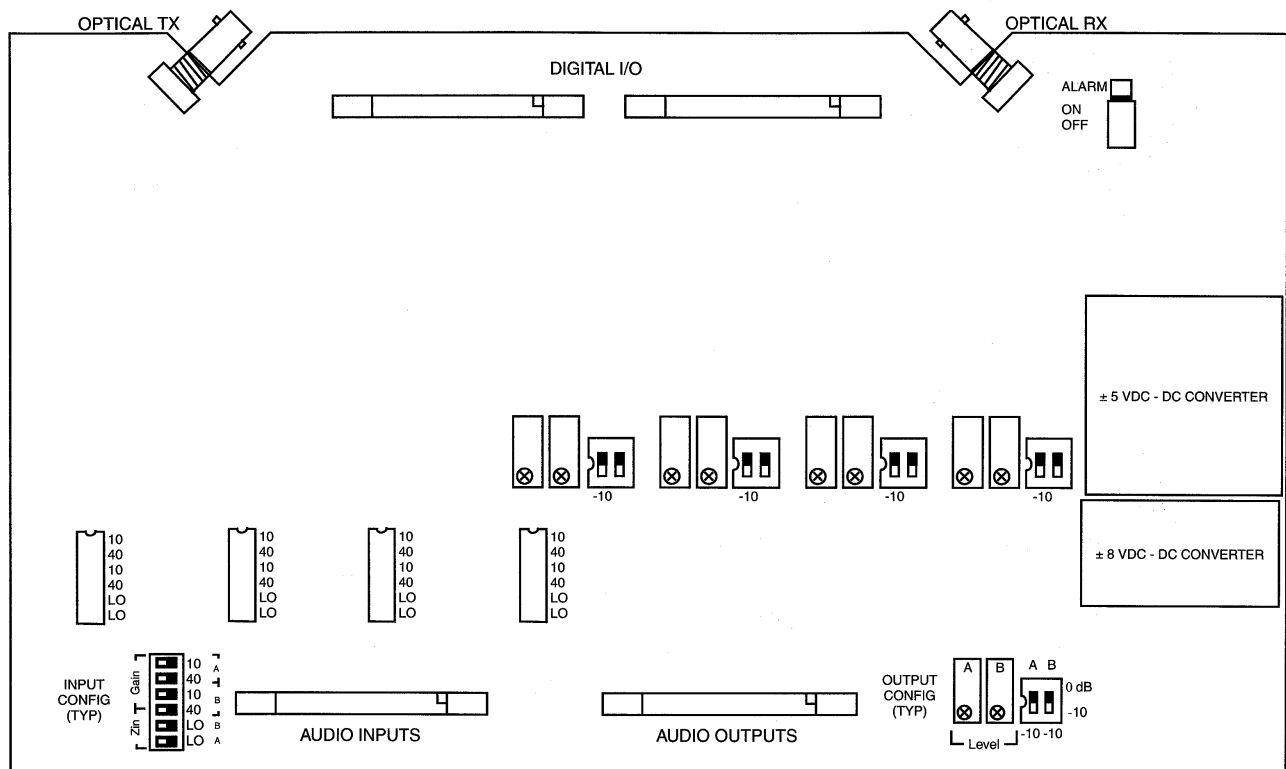


Figure 6. Main Circuit Board

Optical Connections

Refer to Figure 7 before beginning the optical connections.

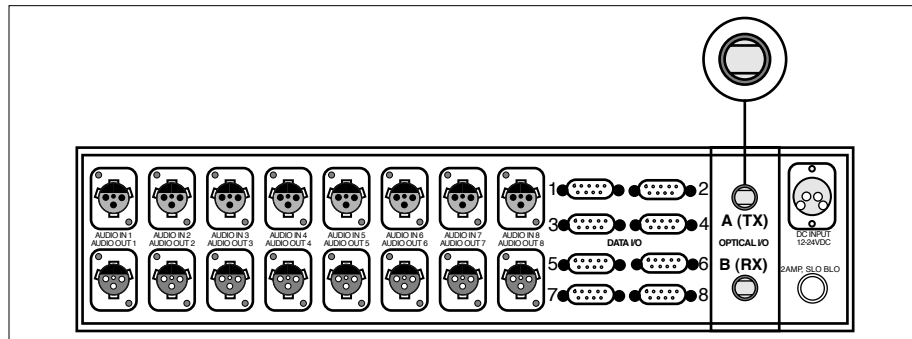


Figure 7. ST Optical Connectors on the Rear Panel

WARNING Never look directly into the end of the optical fiber while either end of the system is operating. Eye damage is possible.

The Adder 882 is compatible with industry standard ST type connectors. It may be used with installed backbone cables or with dedicated cables.

Assembled cables and connectors are available from Telecast Fiber Systems, Inc. For custom cable fabrication, use type ST connectors such as Telecast part number CONN-ST-QC.

Always follow the connector manufacturer's directions when fastening a connector to the cable. A Quick-crimp kit, part number CKIT-ST-QC, is available from Telecast.

On a two fiber system, connect the cables so that transmitter ST **A** at one end connects to receiver ST **B** at the other end.

On a one fiber system, connect the fiber optic cable to the ST **A** at each end.

Electrical Connections

Audio

Input and output audio connections use 3-pin XLR connectors with industry standard wire locations. Table 3 and Figure 8 show these connections.

Table 3. Input and Output Cable Connections

Pin	Signal
1	Ground
2	Balanced I/O (-)
3	Balanced I/O (+)

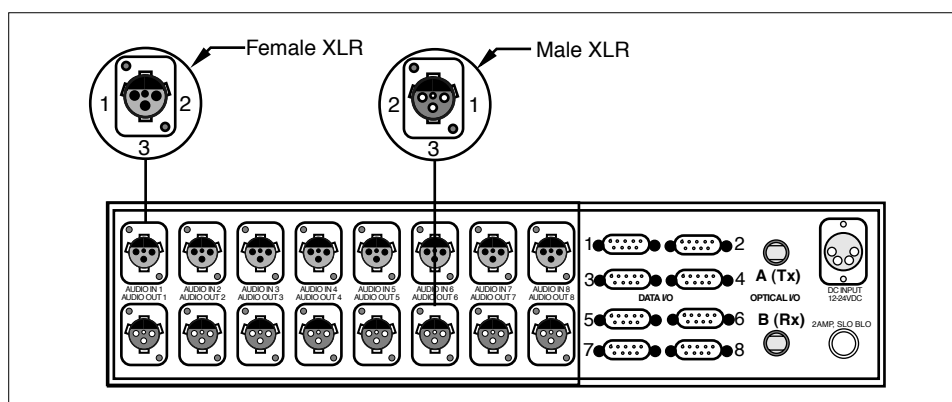


Figure 8. XLR Connectors on the Rear Panel

The audio *input* connector is Switchcraft E3FST-AU. The audio *output* connector is Switchcraft E3MST-AU.

Digital

Digital signal connections are made via the 9-pin D connectors described in Table 4 and illustrated in Figure 9. A 110 Ω terminating resistor placed across the balanced inputs may be needed if cable lengths using 110 Ω twisted pairs are in excess of 6 feet. The serial communications protocol can be RS-232 at one end and RS-422 at the other, if desired.

Contact closure input is activated by connecting it to ground. Contact closure output is an isolated dry contact.

If SONY CCU interface operation is selected, RS-422 and RS-232 functions are not available at that connector.

Table 4. Digital Cable Connections

Pin Number	Connectors 1, 3, 5, 7 (Left)	Connectors 2,4,6,8 (Right)	
		Serial Com.	CCU
1	RS-422 in (-)	RS-422 in (-)	No connection
2	Contact out	No connection	CCU I/O Jumper to pin 6
3	Ground	Ground	Ground
4	RS-232 out	RS-232 out	No connection
5	RS-422 out (-)	RS-422 out (-)	Jumper to pin 8
6	RS-422 in (+) RS-232 in	RS-422 in (+) RS-232 in	CCU I/O Jumper to pin 2
7	Contact out	No connection	No connection
8	Contact in	No connection	Jumper to pin 5
9	RS-422 out (+)	RS-422 out (+)	No connection

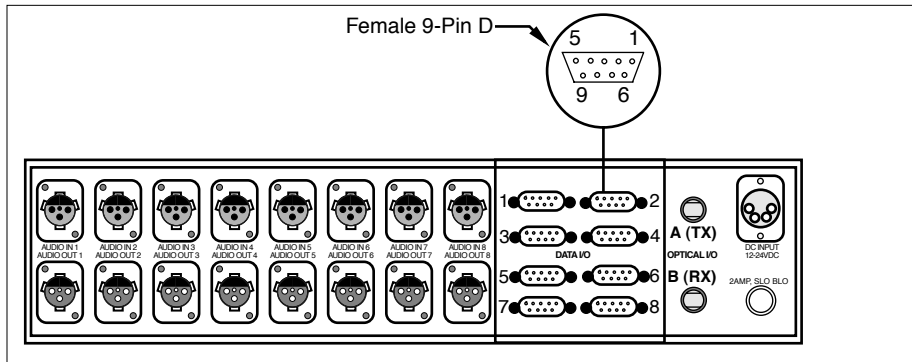


Figure 9. RS-422 D Connectors on the Rear Panel

The digital I/O connector is AMP 747905-2.

Power Connector

When using the standard Telecast power supply, connect the 4-pin XLR connector to the Adder 882 and plug the supply into a 120 VAC line. See Figure 10.

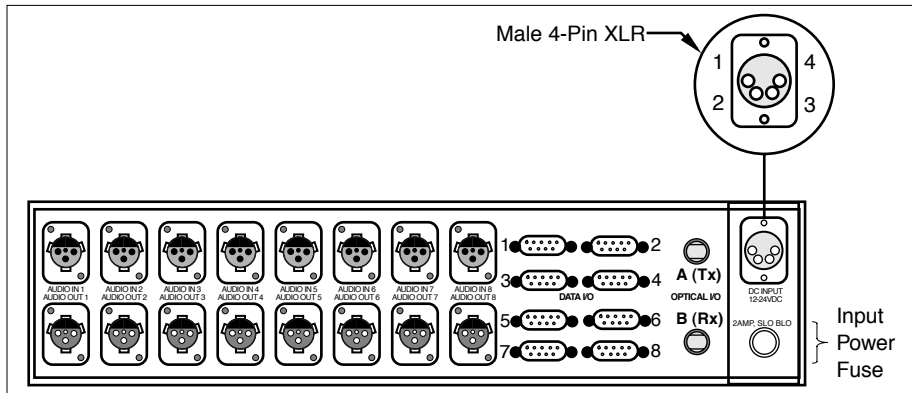


Figure 10. Power Connector and Fuse Locations

Any power supply used with the Adder 882 must supply 1.5 amperes continuous current. Use the wiring connections shown in Table 5. The power connector is Switchcraft D4M.

Table 5. Power Connections

Pin	Signal
1	Ground
2	Not used
3	Not used
4	+12 to 24 VDC (Abs. Max. 30 VDC)

Input Power Fuse

The 2 ampere time delay power fuse is accessible from the rear panel (see Figure 10). Be sure to use the same fuse type if replacement is required.

Operating Details

Battery Charging

Charge the internal UPS batteries at a minimum 13.8 VDC for 16 hours (40 mA trickle charge) by attaching each unit to its external power supply. This will permit battery operation for up to 20 minutes during line power losses.

Indicators

The three LEDs on the front panel are shown in Figure 11.

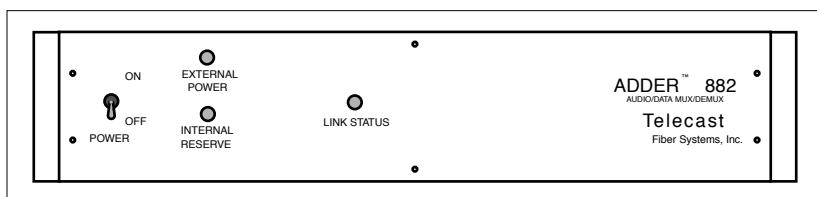


Figure 11. Front Panel

- **EXTERNAL POWER** . When this green LED is illuminated, an external supply of between 12 and 24 VDC is connected.
- **INTERNAL RESERVE** . This LED is illuminated green when the power is on and the internal battery is adequately charged. This LED lights after one half hour of charge. There may be a few minutes of reserve after the indicators extinguish. This LED is illuminated red when the internal battery is discharging.
- **LINK STATUS** . This red LED is on when the fiber optic link is *not* properly attached, or the system units are *not* communicating properly. This indicator is meaningful only if one of the other two LEDs is on.
- **AUDIBLE ALARM** . An audible alarm has been incorporated into the Adder 882 in addition to the LED indicators on the front panel. This alarm alerts the user that the internal batteries are discharging. A defeat switch for the audible alarm is located inside the unit on the main circuit board.

Powering Up

Note: A locking switch is provided to prevent inadvertent power turn off. Never try to move the front panel switch without first pulling on the switch lever to disengage its lock.

With power OFF at both units, check all electrical and optical connections as described in *Installation* on page 3. Firmly seat and latch all connectors. To operate the power switch:

1. Pull the lever away from the panel.
2. Move it *up* for power ON, or *down* for power OFF.

The power switches at both units must be on for the system to achieve normal function.

3. Switch on the power to both Adder 882 units.

Verify that the green **EXTERNAL POWER** LEDs are illuminated, and that the red **LINK STATUS** LEDs do not light. If you do not get this result, refer to the Troubleshooting Chart on page 16.

Theory of Operation

The Adder 882 circuit block diagram is shown in Figure 12. The unit has two basic functions: multiplexing signals onto an optical fiber, and demultiplexing signals from an optical fiber. The Adder 882 accepts up to eight audio inputs, eight digital inputs and four remote relay closures and time division multiplexes them onto a single optical fiber.

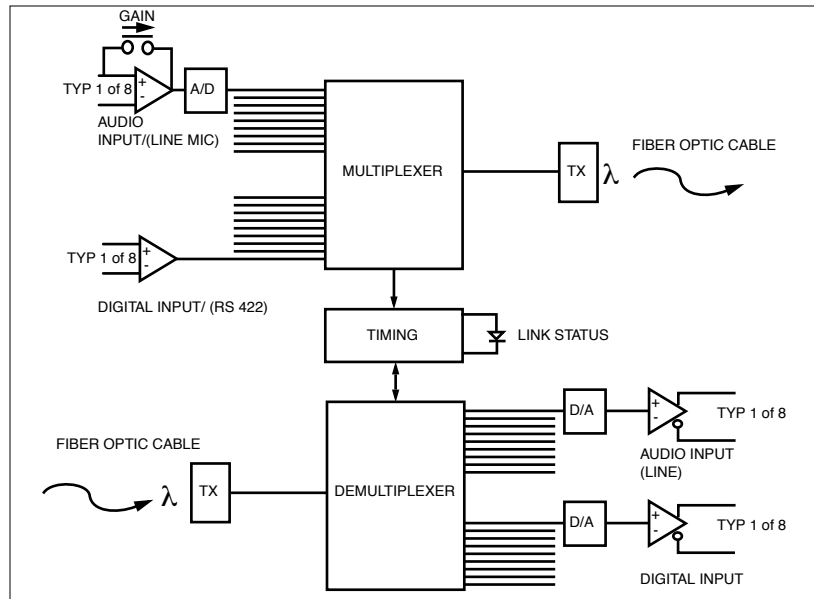


Figure 12. Electronics Block Diagram

All signals on the optical fiber are digital and, therefore, relatively insensitive to transmission level variations. As a demultiplexer, the unit separates the multiplexed signals it receives from the optical fiber and converts the audio information back into analog signals.

There is a one-to-one correspondence between inputs and outputs at opposite ends of the system. Audio inputs and outputs are on separate sets of eight XLR connectors located on the rear panel. Refer to Figure 1 on page 1.

For details on setting up the audio circuits refer to *Audio Setup* on page 4. Inputs can be set to have a balanced 600 Ω or 5 k Ω buffer circuit that is shown in Figure 13.

The audio input buffer circuit shown in Figure 13 can accept two signal levels:

- **LINE** input, factory default. Set the input buffer to unity gain. The gain of the input can optionally be set to +10 dB, and the output to -10 dB. This provides a lower noise floor, but decreases the clipping level from +18 dBm to +8 dBm.
- **MICROPHONE** input. Set the input buffer to a gain of 40 dB.

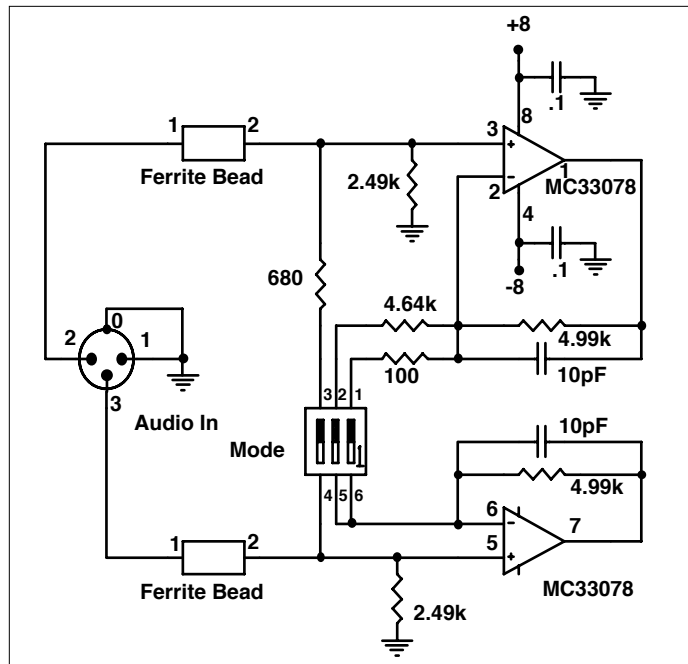


Figure 13. Audio Input Buffer Circuit

The audio output circuit is shown in Figure 14. The output impedance is 30 Ω, balanced.

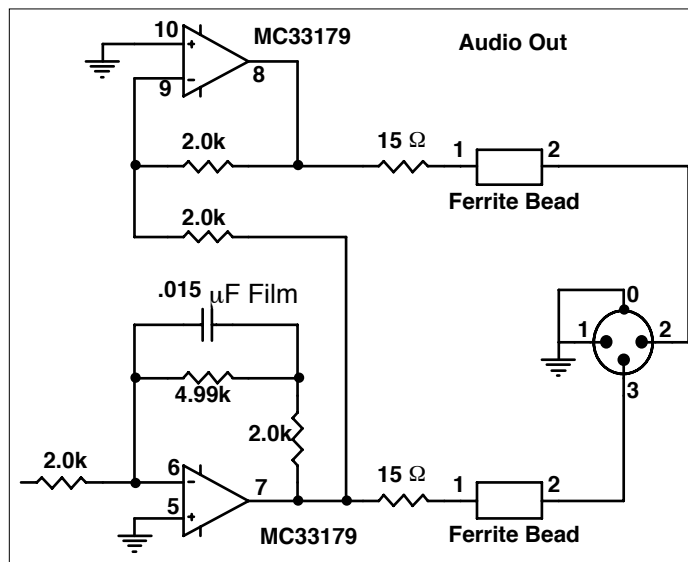


Figure 14. Audio Output Buffer Circuit

Digital I/O

The digital input buffer circuits shown in Figures 15 and 16 accept and drive industry standard RS-422, RS-423, and RS-232 signal levels. These circuits may be used to convert from one signal format to another.

The digital output circuit shown in Figure 15 can be configured by the user to provide SONY CCU compatible I/O; contact closure circuits are not provided on connectors 2, 4, 6, and 8. Refer to Table 4, "Digital Cable Connections," on page 7 for instructions on selecting the CCU capability. When this option is selected, the RS-422 and RS-232 serial communications for that connector are not available.

The circuits in Figure 15 also provide contact closure inputs and outputs. The contact closure inputs are made by connecting pin 8 to ground (pin 3). This may be accomplished with a TTL output referenced to pin 3 as ground. The output contact closure is an SPST-NO relay and is not ground referenced.

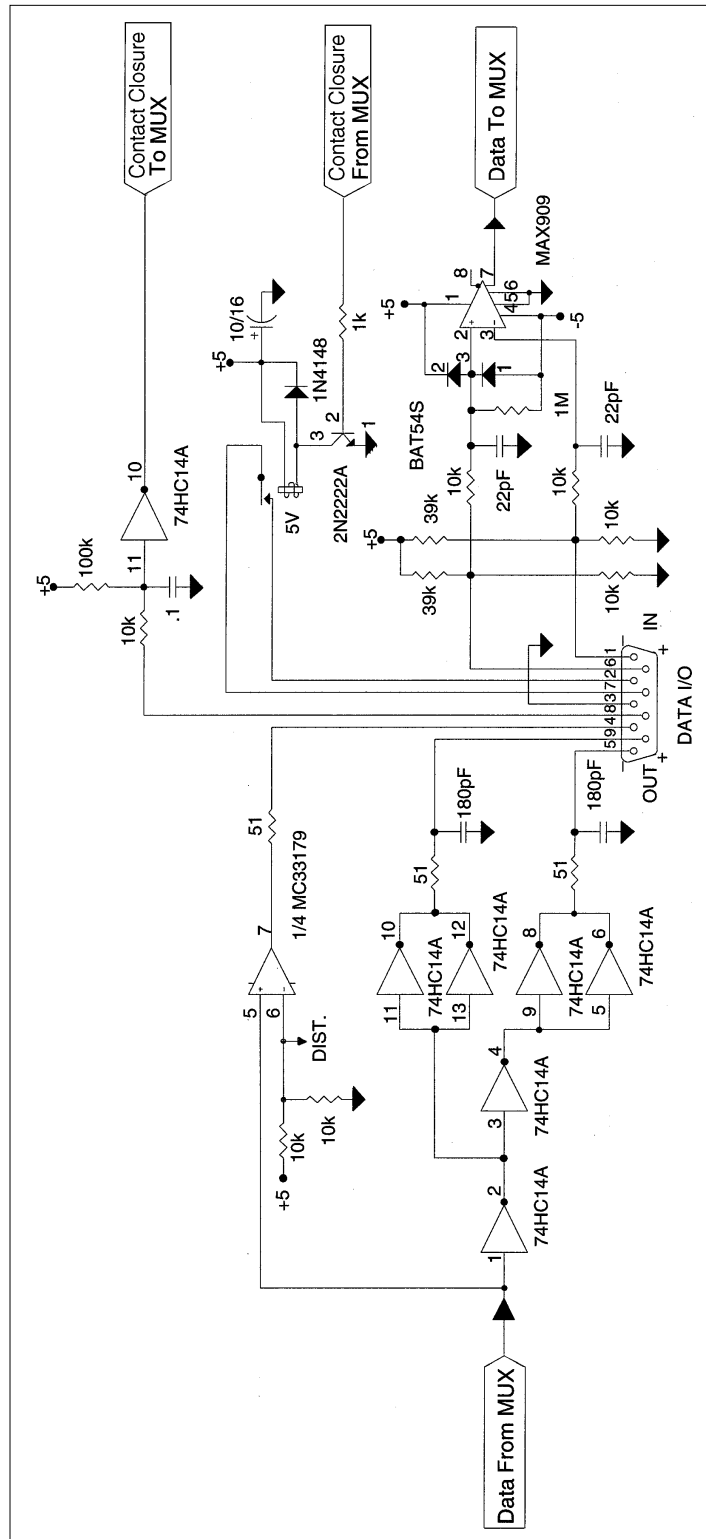


Figure 15. Digital I/O Connectors 1, 3, 5 and 7

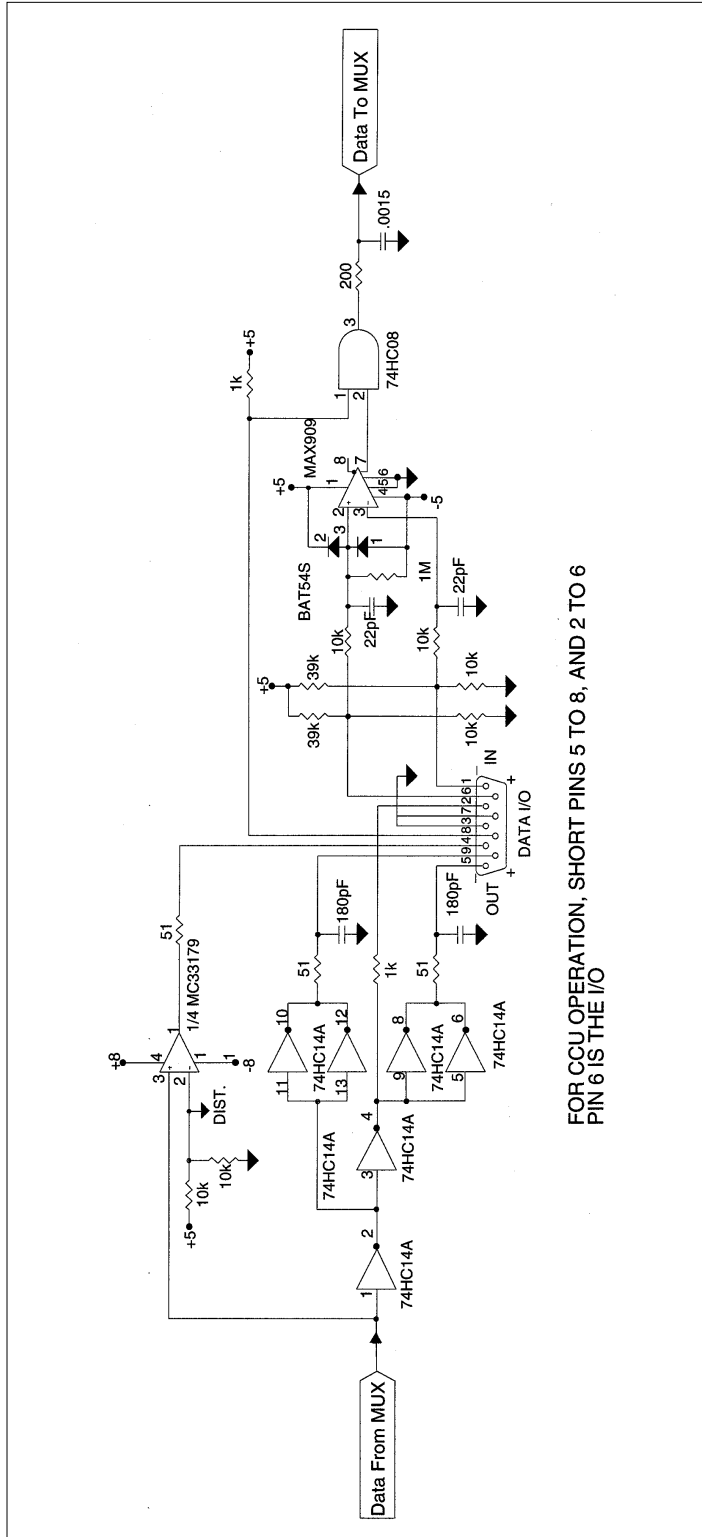


Figure 16. Digital I/O Connectors 2, 4, 6 and 8

Optical

The optical output is generated from a high power LED coupled to an optical fiber. User connections are made at a bulkhead type ST connector at the rear panel. The transmission fiber must be matched to the fiber pigtail type specified at the time of manufacture. The input uses a *pin* diode and amplifier to convert the optical signal back into an electrical signal. The optional single-fiber system uses a wavelength division multiplexer to combine and then to separate the two colors used. The main circuits in the Adder 882 are described in Table 6. The basic setup is illustrated in Figure 2 on page 2.

Table 6. Adder 882 Main Circuits

A/D	High speed analog to digital converters located in each audio channel.
Multiplexer	Sequentially presents eight RS-422 digital inputs and eight digitized audio signals from the A/D converters to the optical output driver and four to remote relay closures.
Demultiplexer	Takes sequential digital signals from the <i>pin</i> diode and separates them into 20 separate lines: eight to the D/A converters, eight to the RS-422 transmitters and four to remote relay closures.
D/A	High speed digital to analog converters located in each audio channel convert the digitized signal back to analog audio.
Battery charger	The battery charger (Figure 17) is active whenever an Adder 882 unit is receiving DC power between 13.8 and 24 VDC. Charging current is limited to a trickle level at any voltage input. Full charge takes 16 hours.

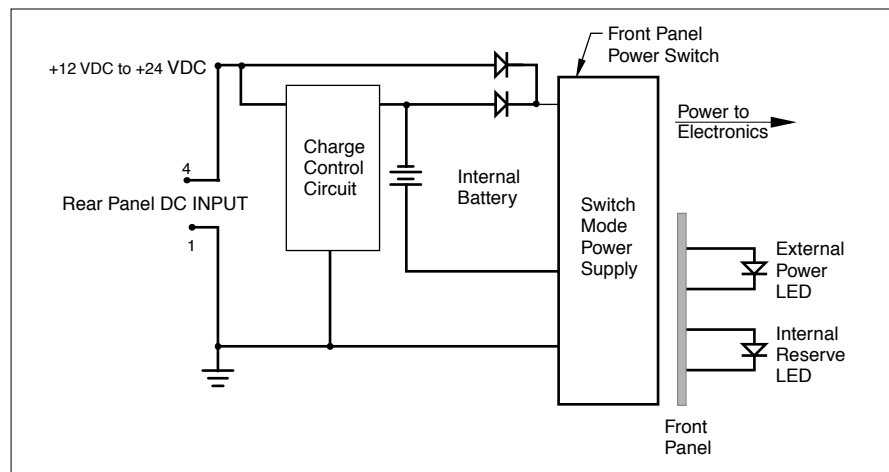


Figure 17. Battery Charger Block Diagram

Preventive Maintenance

Carry out the following procedures every two years:

- Replace the internal Ni-Cad battery pack.
- Verify the adequacy of optical power at the far end of each optical fiber. Use an optical power meter such as the one in the Accessory List.

Accessory List

The following accessories are available from Telecast:

- Optical power meter kit
- Cable repair kit
- Loop-back cable to localize signals during installation test
- Replacement Ni-Cad battery pack
- Quick-crimp kit to attach ST connectors to fiber optic cable
- Prefabricated cables built to custom lengths

Troubleshooting

Refer to the troubleshooting chart on the following page. If you are unable to resolve the problems with your Adder 882 System, call Telecast Fiber Systems, Inc. at 508-754-4858 and ask for our service department.

To return a unit for repair, obtain a return material authorization (RMA) number from Telecast service.

Table 7. Troubleshooting Chart

Symptoms	Possible Cause	Corrective Action
No operation, indicators all <i>off</i>	No power	Make sure the power switches of both units are <i>on</i> , and their external supplies are delivering between 13.8 to 24 VDC.
No operation INTERNAL RESERVE LED <i>off</i>	Battery depleted and either power switch <i>off</i>	Make sure the power switches of both units are <i>on</i> . Recharge battery.
Normal operation INTERNAL RESERVE LED <i>red</i>	Internal battery depleted	The light should go back on after 1/2 hour of use with the AC power adapter. If it does not go on, replace the battery.
No operation LINK STATUS LED <i>on</i>	Optical communications failure	Check for broken or disconnected fibers or that the Adder 882 unit at the other end is not operational. On a one fiber system, refer to Figure 2 on page 2.
Very low signal output on one audio channel	Microphone on input with 0 dB selected	Move internal slide switch to 40 dB setting.
Signal distorted on one channel	Line input with 40 dB selected	Move internal slide switch to 0 dB setting.
Internal reserve battery fails quickly	Reserve battery is not charged	Connect to power source of 13.8 to 24 VDC for 16 hours.
System goes dead as soon as external power is removed	Reserve battery dead or disconnected	Check the battery connection. Replace the battery if necessary.

Specifications

Audio Characteristics

Input Signal Levels

600 Ω balanced (low Z_{in})

Unity gain +18 dBm peak

+10 dB +8 dBm peak

+40 dB -22 dBm peak

5 k Ω balanced (high Z_{in})

Unity gain +16 dBV peak

+10 dB +6 dBV peak

+40 dB -24 dBV peak

30 Ω , balanced output into 600 Ω s

Unity gain +18 dBm peak

+10 dB +8 dBm peak

Frequency response @ +8 dBm, from DC to 25 kHz \pm 0.2 dB

Output Signal Level

30 Ω , balanced output into 600 Ω s

Unity gain +18 dBm peak

+10 dB +8 dBm peak

Frequency response @ +8 dBm, from DC to 25 kHz \pm 0.2 dB

Total Harmonic Distortion

From 20 Hz to 20 kHz (@ +8 dBm) <0.05%

1 kHz (@ +18 dBm) <0.0085%

Intermodulation Distortion (SMPTE Method)

60 Hz + 3 kHz, mixed 4:1 @ +8 dBm <0.04%

Signal to Noise Ratio (unweighted)

20 Hz to 20 kHz, AVG (ref to +18 dBm) >95 dB

Digital Characteristics

Serial Communications

Data Interface	Signal Level	Data Rate
RS-422	Balanced TTL levels	0-150 kBits/sec*
RS-423	TTL levels	0-150 kBits/sec*
RS-232	$\pm 8 V_{p-p}$	0-38.4 kBits/sec
Sony CCU**	RM-M7, RM-P3 or compatible	0-20 kBits/sec
Jitter	1.12 μ secs	

*Higher rates possible dependent on user system jitter tolerance.

** Request Telecast Application Note for more information.

Contact Closure

Input	TTL "1" or open circuit	Remote contact open
	TTL "0" or shorted to circuit ground	Remote contact closed
Output (Form 1A SPST-NO isolated contacts)		
	Voltage	200 VDC
	Switched current	500 mA
	Carry current	1.2 A
	Contact resistance	200 m Ω

Optical Characteristics

System Margin Data (1-fiber/2-fiber)

Operating Wavelength	850 nm	1300 nm	1550 nm
TX Output into cable	-16*/-18 dBm	-15/-13 dBm	-15/-13 dBm
RX Sensitivity	-24*/-26 dBm	-28/-30 dBm	-28/-30 dBm

*62.5 μ m fiber only.

Power Requirements

Voltage	12 to 24 VDC
Current	1.5 amperes, maximum @ 13.8 VDC

Note: Although the units will operate at 12 VDC, 13.8 VDC is required to charge the internal reserve battery.

Caution: Absolute maximum voltage is 30 VDC. Equipment damage may occur at higher voltages.

Warranty

LIMITED WARRANTY STATEMENT

Telecast Fiber Systems, Inc. ("Telecast") expressly warrants to Buyer that the Products supplied shall be free from defects in materials and workmanship for a period of 12 months following the date the Products are delivered to Buyer (the "Warranty Period"). Telecast's liability under this limited warranty shall be limited, at its option, to providing refund of purchase price for Products, or replacing or repairing Products shown to be defective either in materials or workmanship. Buyer's sole and exclusive remedy for breach of warranty shall be such refund, replacement or repair.

A claim of defect in materials or workmanship in any Product shall be allowed only when it is submitted in writing to Telecast Fiber Systems, Inc. within seven days after discovery of the defect, and in any event within the Warranty Period. No claim shall be allowed in respect of any Product which has been altered, neglected, damaged or stored in any manner which adversely affects it. In order to obtain service under the terms of this warranty, Distributor's customer or Distributor must notify Telecast of the defect prior to the expiration of the applicable warranty period and obtain a Return Authorization Number from Telecast. In no event may products be returned to Telecast or to Distributor for warranty service without having obtained from Telecast a Return Authorization Number.

This limited warranty applies only to new and unused Products delivered to Buyers located within the United States of America, or to international Buyers if sold through an authorized Distributor organization, and shall not extend to any equipment not manufactured by Telecast Fiber Systems, Inc., even though such equipment may be sold or operated with the Products. In addition, this limited warranty shall be void and of no further force or effect whatsoever if the Product is repaired or modified by any person other than an authorized representative of Telecast Fiber Systems, Inc. without the consent of Telecast Fiber Systems, Inc. This warranty shall not apply to any defect, failure or damage caused by improper use or inadequate maintenance and care. Nor shall this warranty apply to any damage caused in whole or in part by attempts by personnel other than Telecast's personnel, as approved in advance in accordance with the foregoing provisions, to open, install, repair, or service the Product; nor to damage resulting from improper connection with incompatible equipment; nor to damage to a unit which has been modified by personnel other than Telecast personnel.

Products returned to Telecast for warranty service shall be shipped, freight prepaid to Telecast. Telecast will return the repaired product or ship a replacement, freight prepaid, to either Distributor or Distributor's customer, as requested by Distributor's customer, at a location within the United States or, at Telecast's option, to Distributor's location in the case of international sales.

This limited warranty shall also apply to Products that replace defective Products and Products that have been repaired by authorized representatives of Telecast Fiber Systems, Inc., but only for the original Warranty Period. The Warranty Period shall not be extended by reason of defect, or any period of time during which the Product is not available to Buyer because of defects or repairs, without the express written consent of Telecast Fiber Systems, Inc.

EXCEPT FOR THE EXPRESS LIMITED WARRANTY AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP CONTAINED HEREIN, TELECAST FIBER SYSTEMS, INC. MAKES NO WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, AND ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND OTHER WARRANTIES OF WHATEVER KIND ARE HEREBY DISCLAIMED BY TELECAST FIBER SYSTEMS, INC. THIS LIMITED WARRANTY SETS FORTH EXCLUSIVELY ALL OF TELECAST FIBER SYSTEMS, INC.'S LIABILITY IN CONTRACT OR OTHERWISE IN THE EVENT OF A DEFECTIVE PRODUCT.

WITHOUT LIMITATION ON THE FOREGOING, TELECAST FIBER SYSTEMS, INC. EXPRESSLY DISCLAIMS ANY LIABILITY WHATSOEVER FOR ANY DAMAGES INCURRED DIRECTLY OR INDIRECTLY IN CONNECTION WITH THE SALE OR USE OF, OR OTHERWISE IN CONNECTION WITH, THE PRODUCT, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS AND SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER CAUSED BY NEGLIGENCE OR OTHERWISE, REGARDLESS WHETHER TELECAST HAS BEEN GIVEN ADVANCE NOTICE OF THE POSSIBILITY THEREOF.

THIS WARRANTY IS GIVEN BY TELECAST IN LIEU OF ANY OTHER WARRANTY EXPRESSED OR IMPLIED.