ARTEL VIDEO SYSTEMS

DigiLink 2701

Single Channel ASI or SDI Fiber Optic Video Transmission System Installation and Operation Guide

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NOTICE

Artel Video Systems, Inc.
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WARNINGS

The optical transmission system on some optical transmitter models is a Class I laser product only when installed in accordance with the procedures of this manual. Laser radiation is restricted to the optical cable, thus preventing human access. User modification to the system may alter the product classification and create a radiation hazard.

DO NOT, UNDER ANY CIRCUMSTANCES, stare directly into a fiber optic connector. Although the light used in most fiber optic transmissions is not visible to the naked eye, potentially harmful levels of optical laser radiation may be present at the optical output ports and unconnected receive fiber ends. Prior to applying system power, connect fiber cables to either another DigiLink unit or to an optical power meter.

The DigiLink 2701 Single Channel Fiber Optic Video Transmission System contains components that can be damaged by electrical static discharge if covers are removed. Ensure that you connect an approved anti-static wrist strap to your wrist and then connect it to an electrical ground before installing or removing covers from the unit.

CAUTION

This manual is intended for use by trained service personnel. The use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous exposure to optical radiation.

SAFETY LISTING

UL listed, file # E171306

cUL approved, file #E171306

EN 60 950: International Safety Standards

NETWORK EQUIPMENT-BUILDING SYSTEMS (NEBS)

This product is NEBS-compliant. Contact factory for details.

FEDERAL COMMUNICATIONS COMMISSIONS NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions in this manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user must correct the interference at the user's own expense.

Compliance with applicable regulations depends on the use of shielded I/O cables. The user is responsible for procuring the appropriate cables.

CANADIAN EMISSIONS REQUIREMENTS

Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur la matériel brouilleur: "Appareils Numériques", NMB-003 édictée par le Ministère des Communications.

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus", ICES-003 of the Department of Communications.

INTERNATIONAL EMC REQUIREMENTS

This equipment has been tested and found to comply with the limits of the following international standards.

EN55 022	Radiated & Conducted Emissions
CISPR 22	Class A
EN50 082-1	Immunity
IEC 801-2	ESD
IEC 801-3	Immunity
IEC 801-4	EFT

Declaration of Conformity

We,

Artel Video Systems, Inc.

Located at
237 Cedar Hill Street
Marlborough, MA 01752

declare under our sole responsibility that the following DigiLink 2701 Single Channel Fiber Optic Video Transmission System products:

DL2701E, DL2701E-48
DL2701D, DL2701D-48

to which this declaration relates, are in conformity with the following standards and other normative documents:

Product Safety: EN 60 950
EMC: EN55 022, EN 50 082-1
NEBS: GR-63, GR-1089

The aforementioned products follow the provisions of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Name: Chester J. Gapinski
Title: Chief Operating Officer
Date: October, 2001

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About This Guide

This guide provides you with instructions for installing, configuring, and operating the DigiLink 2701 single channel fiber optic video transmission system.

Audience

This guide is intended for the following trained and qualified service personnel who are responsible for installing and operating the DigiLink 2701:

- System installer
- Hardware technician
- System operator

How to Use This Manual

This manual contains the following:

Section	Provides
Chapter 1, "Introduction"	An overview of the DigiLink 2701 system, including encoder and decoder features and capabilities
Chapter 2, "Unpacking and Installing"	• Procedures for unpacking and installing DigiLink 2701 devices as standalone, rack-mount, or wall-mount units • Configuration quick start tables for the DigiLink 2701 encoders and decoders
Chapter 3, "Configuring and Cabling an Encoder"	Descriptions of the encoder front and rear panel components, and instructions for setting the switches and cabling the ports and connectors
Chapter 4, "Configuring and Cabling a Decoder"	Descriptions of the decoder front and rear panel components, and instructions for setting the switches and cabling the ports and connectors
Chapter 5, "Replacement Procedures"	Replacement procedures for the external fan and fiber optic cartridge
Appendix A, "Fiber Optic Cables"	Reference material for selecting fiber cables
Index	An alphabetical listing of topics in this manual

Symbols and Conventions

This manual uses the following symbols and conventions.

Caution

A caution means that a specific action you take or fail to take could cause harm to the equipment or to the data transmission.

Warning

A warning describes an action you take or fail to take that could result in death, serious physical injury, or destruction of property.

Note: Important related information, reminders, and recommendations.

Italics—used for emphasis, for indicating the first occurrence of a new term, and for book titles

1. Numbered list—where the order of the items is important

- Bulleted list—where the items are of equal importance and their order is unimportant

Contacting Customer Service

To contact Artel Customer Service, call:

- 1-800-225-0228 for calls made within the continental US
- (508) 303-8200 for calls made outside the continental US

When requesting assistance, please be ready to provide the following information:

- Your name and telephone number
- Product model and serial number
- Brief description of the problem
- List of symptoms
- Steps you have already taken to try to resolve the problem

If the product is damaged

If any portion of the unit is damaged, forward an immediate request to the delivering carrier to perform an inspection of the product and to prepare a damage report. Save the container and all packing materials until the contents are verified.

Concurrently, report the nature and extent of the damage to Artel Customer Service so that action can be initiated to either repair or replace the damaged items.

Do not return any items to Artel until you obtain instructions from Customer Service.

Report the problem or deficiency to Customer Service along with the model number and serial number. Upon receipt of this information, Artel will provide you with service instructions, or a *Return Authorization Number* and shipping information.

Chapter 1

1 Introduction

This chapter provides an introduction to the DigiLink 2701 single channel fiber optic ASI or SDI video transmission system (hereafter referred to as DL2701). DL2701 products include several models of encoders and decoders.

This chapter contains the following sections:

Product Overview

A DL2701 transmission system performs transmission of broadcast-quality digital video. The encoders and decoders are able to receive and transmit either SDI or DVB/ASI 270 Mb/s video (MPEG) and provide elastic store to reduce jitter.

ASI and SDI Operation

When a DL2701 encoder or decoder is processing an ASI or SDI signal, it is a data-transparent 270 Mb/s transport system. It can transmit/receive:

- SDI: standard 270 Mbit/s serial digital interface signal that complies with SMPTE 259M-C 4:2:2 component signal formats (such as D1 tape) and with ITU 601
- SDI: SMPTE 305M
- ASI: standard 270 Mbit/s asynchronous serial interface signal that complies with EN 50083-9

Note: The DL2701 encoder does not embed analog audio or digital data into its SDI transmission. However, it can transmit embedded data transparently.

Transport/Reception Mechanisms

The encoder can transmit its output signal via two mechanisms:

- A fiber optic link over distances up to 120 km (74.5 miles)
- An electrical (coaxial cable) link over distances up to 250 m (820 ft)

DL2701 encoders operate with 1330 nm or 1550 nm laser cartridges or ITU-standard notched lasers for dense wavelength division multiplexing (DWDM) applications. All encoders have a compartment on the rear panel in which you can install a laser cartridge. The available laser cartridge models and their wavelengths are listed in Table 1-2 on page 1-5.

The DL2701 decoders have a built-in optical receiver with an optical input port that allow them to receive optically transmitted signals. For signal output, the decoders have three ASI/SDI output ports; two for normal signal distribution and a third for local monitoring of the output.

Optical Transport

The optical transmitter in a DL2701 encoder laser cartridge converts a high-speed bit stream output to pulses of laser light and couples them into a single mode optical fiber. The optical output is transmitted through an FC-PC female connector.

Laser diode optical output power and bias current are monitored continuously. Alarms will be generated if the laser bias current increases beyond a preset limit (indicating that the laser diode is degrading) or if the optical output power decreases by 1.25 dB or more below its initial value.

DL2701 optical systems are intended for 9/125 μm single mode fiber cable plants, but you can use it over short distances with multimode fiber if sufficient modal bandwidth is maintained. The output power launched into the multimode fibers is the same as the power launched into a singlemode fiber.

The maximum usable transmission distance between an encoder and decoder (assuming premium grade optical fiber) is:

- 61.5 km (38 mi) for 9 μm single mode fiber with a 1310 nm laser
- 120 km (74.5 mi) for 9 μm single mode fiber with a standard 1550 nm laser or a DWDM notched laser
- 136 km (85 mi)) for 9 μm single mode fiber with a high-power 1550 nm laser
- 2.7 km (1.7 mi) for 62.5 μm graded-index multimode fiber
- 4.4 km (2.7 mi) for 50 μm graded-index multimode fiber

Longer distances are possible by adding optical amplifiers (EDFA's).

Laser Cartridges

All DL2701 encoders require a laser cartridge. By installing a laser cartridge, you can:

- Customize the encoder's wavelength
- Configure up to sixteen DL2701 encoder transmissions on different notched wavelengths and optically multiplex them via the Artel MegaWav system onto a single fiber pathway—this is *dense wavelength division multiplexing* (DWDM)

Table 1-2 lists the 19 laser cartridge types available from Artel. This group includes standard 1310 nm and 1550 nm lasers, a special high-power 1550 nm laser, and 16 ITU-standard notched wavelengths for DWDM. DL2701 encoders have a front panel display used to display the wavelength or ITU channel of the installed cartridge.

Product Models

DL2701

DL2701 encoders and decoders are available with either an on-board AC or DC power supply.

Table 1-1. DL2701 Models

Model	Power Supply	Description
DL2701E	AC	Encoder with AC power supply
DL2701E-48	DC	Encoder with DC power supply
DL2701D	AC	Decoder with AC power supply
DL2701-48	DC	Decoder with DC power supply

Laser Cartridges

Listed below are the various wavelengths available for use with the DL2701.

Table 1-2. Laser Cartridge Models

Model Number	Wavelength (nm)	ITU Channel Number	ITU Frequency (GHz)
WL13	1310 (± 30)		
WL15	1550 (± 30)		
WL15+4	1550 @ +4dBm		
WL51	1536.61	51	195,100
WL49	1538.19	49	194,900
WL47	1539.77	47	194,700
WL45	1541.35	45	194,500
WL43	1542.94	43	194,300
WL41	1544.52	41	194,100

Model Number	Wavelength (nm)	ITU Channel Number	ITU Frequency (GHz)
WL39	1546.12	39	193,900
WL37	1547.71	37	193,700
WL35	1549.31	35	193,500
WL33	1550.92	33	193,300
WL31	1552.52	31	193,100
WL29	1554.13	29	192,900
WL27	1555.74	27	192,700
WL25	1557.36	25	192,500
WL23	1558.98	23	192,300
WL21	1560.61	21	192,100

The TX port on the WL13 is labeled 1310, the TX port on the WL15 and WL15+4 cartridges are labeled 1550, and the TX port on the DWDM lasers is labeled with the laser's wavelength, as listed above. For example, the port on a 31 ITU DWDM laser is labeled 1552.52 nm.

DL2701 Functional Description

Figure 1-1 illustrates both the DL2701 encoder and decoder block diagram.

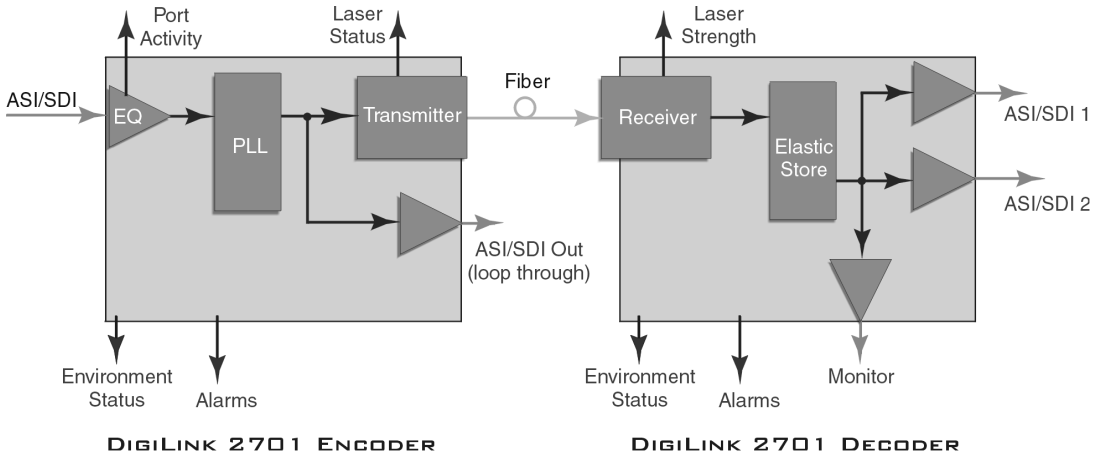

Figure 1-1. DL2701 Encoder/Decoder Block Diagram

Where to Go NextChapter 2 provides configuration quick start and installation information for the DigiLink 2701 encoders and decoders.

2

Chapter 2

Unpacking and Installing

This chapter provides encoder and decoder configuration quick start tables. It also describes how to unpack DL2701 encoders and decoders and install them as free-standing, rack-mount, or wall-mount units.

This chapter contains the following sections:

Site Requirements

Before you select an installation site for the DL2701, read the electrical, environmental, and physical requirements specified in the product specification sheet shipped with the unit.

Warning

Never stare directly into a fiber optic connector.

Although the light used in most fiber optic transmissions is not visible to the naked eye, potentially harmful levels of radiation may be present at the optical output ports and unconnected transmit fiber ends.

Failure to observe this warning could result in personal injury.

Warning

Do not remove the DL2701 cover.

There are electrical shock hazards present in the unit if the cover is removed, and there are no operator-serviceable components beneath it.

Failure to observe this caution could result in injury and damage to equipment. The warranty is voided if you break the warranty seals.

Required Tools and Equipment

To install the DL2701 as a rack-mounted or wall-mount unit, you need:

- A screwdriver
- Four screws

Unpacking the Unit

1. Remove the unit from the shipping carton. Set aside the packing material in case you need to repackage the unit later.
2. Check the configuration of the unit against the items listed on the packing slip. If you find any discrepancies, report them in accordance with the instruction on Contacting Customer Service (page -xxi).

Shipment Contents

The DL2701 shipment contains the following items:

- One DL2701 unit
- 2 three-pin screw wire clamp connectors
- One copy of this manual
- Product specification sheet
- AC power cord (if the unit is an AC unit)

Installing the Unit

The DL2701 can be placed on a flat surface as a free-standing unit or rack-mounted in a standard 48.26 cm (19 inch) wide equipment cabinet. As you position the DL2701 for installation, keep in mind that all cables will connect to the back of the unit.

Refer to the product specification sheet shipped with the unit for environmental specifications.

Cooling Considerations

The DL2701 uses forced air convection cooling as the primary means of cooling the device. Cool ambient air is drawn through the unit by a single axial fan integral to the unit. Note that it is important the location of the device be well ventilated or provided with forced air within the environment to avoid re-circulation of air through the unit.

Figure 2-1shows the position of the fan and ventilation openings. Care must be taken not to obscure these items with cables, mounting hardware, or other articles that may restrict airflow through the unit. In general, allow 3 inches of clearance around the sides and rear of the unit.

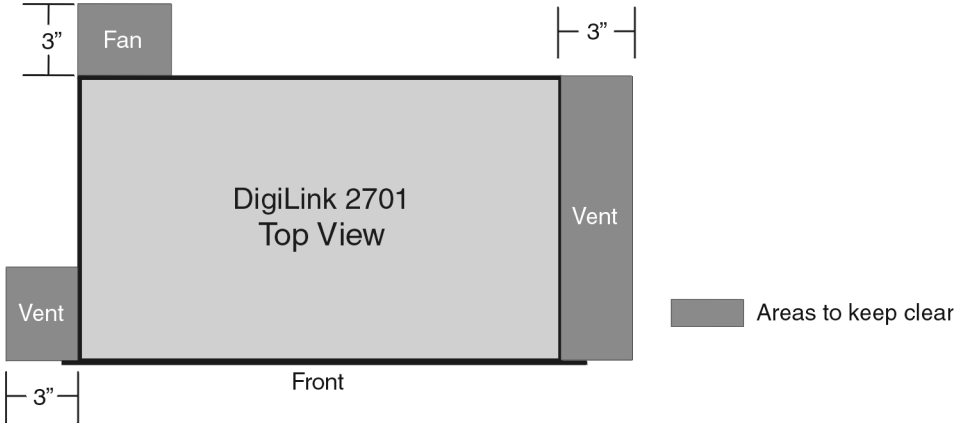

Figure 2-1. Device Ventilation/Cooling

Heat Load

The maximum power dissipation of a DL2701 is <25 W, which is equivalent to approximately 85 BTU/hour. When sizing the cooling requirements for a rack, the total heat output of the equipment in the rack should be used. For example, the total heat output of sixteen (16) DL2701 units installed in a single rack would be about 1360 BTU/hour.

Vertical Spacing

The DL2701 is housed in an enclosure that is 1 RU in height. In general, it is permissible to mount units without leaving a space between adjacent units. However, in racks with poor ventilation (low air flow) or operating temperatures, heat density considerations may make it necessary to leave a 1 RU space between units. Operation in an environment (within the equipment rack) of over 40 degrees Celsius for extended periods of time is not recommended.

Installing the DigiLink as a Free-standing Unit

To install the DL2701 as a free-standing unit, position the unit on the selected flat surface. Be sure to allow for adequate ventilation as described in Cooling Considerations (page 2-4).

Wall-mounting the Unit

To install the DL2701 as a wall-mounted unit:

1. Remove the three screws securing the mounting brackets to the unit.
2. Rotate the mounting brackets 90° to position the flange parallel to the top of the unit.
3. Replace the three screws to secure the mounting brackets to the unit.
4. Attach the unit to the wall.

Rack-mounting the Unit

Before you rack-mount the unit, determine if you want to flush-mount or mid-mount the chassis into the cabinet. Flush-mounting sets the front edge of the unit even with the front edge of the rack. Mid-mounting causes the front edge of the unit to protrude from the front of the rack.

The DL2701 flush-mounted brackets are factory pre-installed for a flush-mount installation.

To mid-mount the chassis:

1. Remove the three screws securing each mounting bracket to the unit.
2. Rotate the mounting brackets 180° so the flanges are facing the rear of the unit.
3. Replace the three screws to secure each mounting bracket to the unit.

Once the mounting brackets are in position, you are ready to install the unit.

To install the DL2701 into a rack:

1. Raise the unit to the appropriate installation height.
2. Align the screw holes on the mounting brackets with the screw holes on the equipment rack.
3. Install the screws through the mounting brackets on the unit into the mounting brackets on the rack. The unit requires two screws for each side of the chassis.

Quick Start Configurations

The following tables provide the basic video cabling and switch settings required to pass video streams between a pair of DL2701 devices (encoder and decoder). These settings are meant as quick start references only—see Chapter 3 and Chapter 4 for more details.

Table 2-1. Encoder Quick Start Configuration

Item	Description	Location	Connection/Setting
ASI/SDI INPUT	BNC Connector	Rear panel	Connect a coax cable between the SDI INPUT connector and the source device. See also Cabling the ASI/SDI INPUT Port (page 3-6).
OPTICAL OUTPUT	FC-PC female optical connector	Rear of laser cartridge	Connect a fiber optic cable between the OPTICAL OUTPUT connector and the destination device. See also Cabling the Optical Output Port (page 3-6).
AUDIBLE ALARM/ LASER OFF	3-position switch	Front panel	Set this switch to either of the following positions to activate the laser: • Aud. Alarm ON • Aud. Alarm OFF See also Setting the AUDIBLE ALARM/LASER OFF Switch (page 3-12).

Table 2-2. Decoder Quick Start Configuration

Item	Description	Location	Connection
OPTICAL INPUT	FC-PC female optical connector	Rear panel	Connect a fiber optic cable between the OPTICAL INPUT connector and the source device. See also Cabling the OPTICAL INPUT Port (page 4-6).
ASI/SDI OUTPUT	BNC Connector	Rear panel	Connect a coax cable between the ASI/SDI OUTPUT connector and the destination device. See also Cabling the ASI/SDI Output Port Locations (page 4-7).

Proceed to the next section for information pertaining to connecting a power source to a DL2701 device.

Power Connection

DL2701 products are available with either an AC or DC power supply. Before you install the AC or DC power cord, refer to the product specification sheet for a complete understanding of the system's electrical and environmental specifications.

AC Connection

The AC connector is located on the encoder's rear panel and requires a three-prong IEC 320-C13 115/230 VAC power cord.

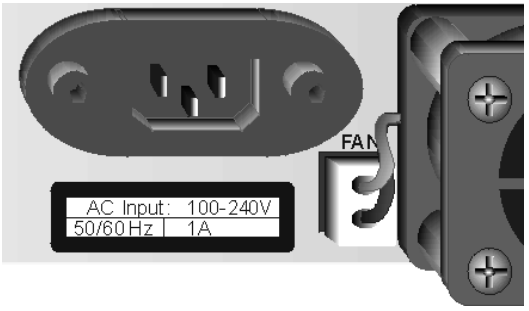

Figure 2-2. AC Connector

To connect an AC power cord to a power source:

1. Make sure that the POWER switch is in the 0 (OFF) position.
2. Plug the AC power cord into the power receptacle at the rear of the unit.
3. Plug the power cord into a three-wire grounding receptacle.

DC Connection

The DC versions of the DL2701 encoders have a -48 VDC input connector terminal block.

Caution

When connecting a DC power supply, make sure that you are connecting the DL2701 to a -48 VDC (-38.4 ... -57.6 VDC) source that is isolated from any AC power and is reliably grounded to earth.

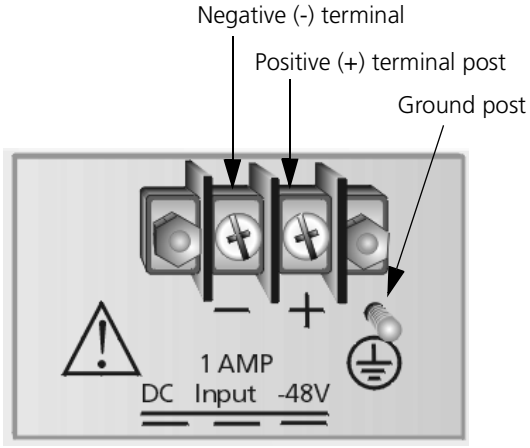

Figure 2-3. DC Power Supply Terminal Block

To connect a DC-powered encoder to a power source:

1. Locate the terminal block assembly on the rear of the unit and remove the clip-on protective cover (not shown).
2. Loosen the two terminal post screws (**3**) marked **-** and **+**.
3. Install the DC power source cables and tighten the screws to secure the connectors to the terminal block. Ensure the spade connector terminations are positioned under the screw heads.

Caution

Before installing the spade connectors, make sure that the polarity of the DC connections is correct. Reversed polarity can blow the DC input fuse and may cause damage to the power supply.

4. Secure the ground cable to the ground post.
5. Reinstall the protective cover onto the DC terminal block.
6. Connect the other end of the power cable into an approved safety extra low voltage (SELV) energy output source.

Note: Each DL2701 product consumes less than 25 W from a nominal 48 VDC circuit. For sizing an external protection circuit, slow blow (time delay) fusing, such as a T1.0 fuse is recommended. If fast blow (fast-acting) fuses are used, a minimum fuse capacity of 2.5 A per device is recommended to prevent nuisance trips.

Where to Go Next

Once the DL2701 is installed securely into the equipment cabinet, proceed to Chapter 3 for information on configuring and cabling the encoder. Proceed to Chapter 4 for information on configuring and cabling the decoder.

3

Configuring and Cabling an Encoder

This chapter describes how to configure an encoder using the panel switches and cable ports. The major topics are:

Encoder Panel Views

Front Panel

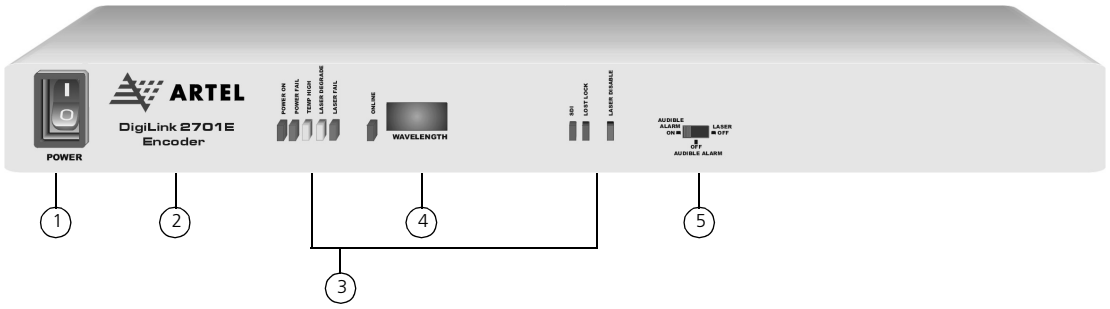

Figure 3-1. DL2701 Encoder Front Panel

Table 3-1. Encoder Front Panel Elements

Item	Panel Element	for details, see...
1	POWER switch	page 3-5
2	Encoder model	page 3-4
3	Device status LED indicators (9)	page 3-9
4	Laser wavelength display	page 3-11
5	AUDIBLE ALARM/LASER OFF Switch	page 3-12

Rear Panel

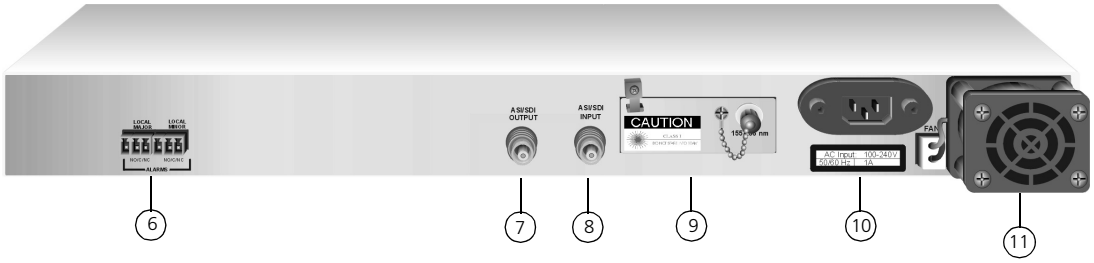

Figure 3-2. DL2701 Encoder Rear Panel

Table 3-2. Encoder Rear Panel Elements

Item	Panel Element		for details, see...
6	ALARM Relay Connector		page 3-13
7	ASI/SDI OUTPUT port		page 3-8
8	ASI/SDI INPUT port		page 3-6
9	Laser cartridge compartment (Optical Output)		page 3-6
10	Power connector		
		AC	page 2-8
		DC	page 2-9
11	External fan		
		Device cooling requirements	page 2-4
		Replacement	page 5-2

Chapter 3

Identifying the Unit

The text on the left side of the encoder's front panel, below the Artel logo (see item 2 on page 3-2) contains the model of the unit and type of device (encoder or decoder).

Figure 3-3 illustrates a sample that identifies the unit as a DigiLink 2701E, which is an encoder equipped with an AC power supply.

Figure 3-3. Encoder Model Identifier

Refer to Product Models (page 1-5) for a complete listing of DL2701 models.

Applying Power

Once external power has been connected to the encoder (see page 2-8), it can be powered up using the two-position POWER switch on the front panel.

Figure 3-4. Encoder POWER Switch

Toggle the POWER switch to the **1** (ON) position. As the encoder powers up, it initializes and turns on the LEDs briefly.

Once the encoder initializes, you can use the switches on the front and rear panels to configure the encoder and the LEDs to monitor its status.

For details on connecting the encoder to a power source, see Power Connection (page 2-8).

If you are using a DWDM laser cartridge:

A thermo-electric cooler in the laser transmitter controls its heating and cooling. When you power up the encoder, it disables laser output for approximately 10 seconds while the laser reaches its proper operating temperature. This feature prevents the unit from transmitting undesired wavelengths onto a network. During this 10 s period, the LASER DEGRADE and LASER FAIL LEDs will illuminate. These LEDs are indicators of major alarm conditions, but they *can* be ignored during this short warm-up period.

Establishing Video Inputs/Outputs

A DL2701 encoder is a data-transparent 270 Mb/s transport system. It can transmit/receive the signals described in ASI and SDI Operation (page 1-2).

The DL2701 encoder does not add audio or data to the input signal, and it does not perform any encoding on it. It amplifies the digital signal that it has received and transmits it as either an ASI or SDI output signal.

Cabling the ASI/SDI INPUT Port

Location

The ASI/SDI INPUT port is a BNC connector located on the rear panel of the encoder (item 8on page 3-3).

Purpose

The ASI/SDI INPUT port provides digital inputs for a DL2701 encoder.

Cabling the Optical Output Port

Location

The optical output port is an FC-PC female optical connector located on the rear of the installed laser cartridge and is labeled with the wavelength of the laser inside the cartridge. For a DL2701 encoder to work, you must install a laser cartridge of the desired wavelength and power. For additional laser cartridge information and cartridge installation instructions, refer to page B-3.

Figure 3-5. Optical Output (Laser Cartridge)

Purpose

The encoder uses the optical output port to transmit ASI or SDI signals optically over a single fiber cable whenever the signals are pulsed by the built-in laser. The port is designed to operate with a 9 μm single mode optical fiber cable.

Caution

When the OPTICAL OUTPUT port is not connected to a fiber cable, cover the connector with the protective plastic cap. The cap prevents degradation of optical performance that dirt and moisture can cause.

To install a fiber optic cable on the laser cartridge's optical output port:

1. Remove the protective plastic cap from the connector.
2. Use a fiber optic cable with a male FC-PC connector on it. Insert the cable connector into the optical connector and turn it until the keys mate.
3. Push in the connector and tighten it.

Note: Use care when moving or installing an encoder that has a fiber cable attached to the connector. To avoid sharp bends, kinks, or twists in the optical cables, remove the cable before moving an encoder.

Using a DWDM Laser Cartridge at Encoder Startup

DWDM laser cartridge's laser transmitter is designed with a thermo-electric cooler that controls laser heating and cooling. When you power up the encoder, it disables laser output (approximately 10 s) until the laser reaches proper operating temperature. This feature prevents undesired wavelengths from being transmitted into a network.

Note: During this 10 s period, the LASER DEGRADE and LASER FAIL LEDs will illuminate. Ignore these indicators during the short warm-up period

Cabling the ASI/SDI OUTPUT Port

Location

The ASI/SDI OUTPUT port is a BNC connector located on the encoder's rear panel (item 7 on page 3-3).

Purpose

The encoder uses the ASI/SDI OUTPUT port as an active loop-through of the input signal. This port can be used to monitor the signal coming into the encoder. It can also be used to pass the signal on to another encoder device or a digital switch.

Note: Since this is an *active* loop-through connection, its ASI or SDI output will be dropped if power to the device is removed.

The encoder can transmit an output signal up to 250 m (820 ft) over the ASI/SDI OUTPUT port. For best performance and repeatability, we recommend a high-quality coaxial cable (Belden type 8281 or equivalent).

Termination should be applied as appropriate on the destination end of the link.

Using Internal and External Display Capabilities

Interpreting Device Status LEDs

Location

The nine Device Status LEDs are located on the encoder's front panel (item 3 on page 3-2).

Purpose

The LEDs indicate the following:

- When the encoder power is on
- When an alarm condition has been detected
- When the encoder is enabled and is transmitting valid data
- When an SDI/ASI signal is being transmitted
- When a lost lock condition exists
- When AUDIO ALARM/LASER OFF switch (page 3-12) is set to LASER OFF

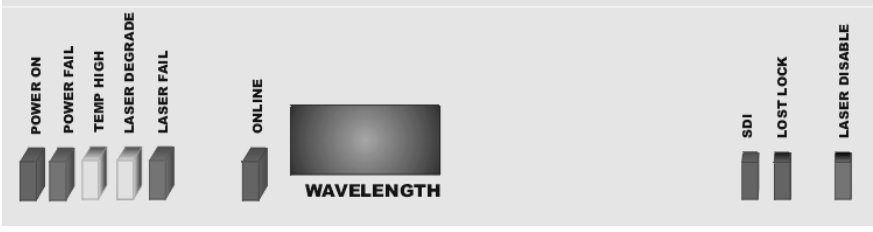

Figure 3-6. Device Status LEDs

Table 3-3 describes their indications and the recommended response.

Table 3-3. Device Status LEDs

Name	Color	State	Indication	Alarm Condition
POWER ON	Green	On	Main power is on	None
POWER FAIL	Red	On	DC system voltages are out of tolerance	Major—unit must be serviced.
TEMP HIGH	Yellow	On	Internal system temperature limit has been exceeded	Minor—possible causes: • Fan failure • Ambient temperature too high • Poor air circulation
LASER DEGRADE	Yellow	On	Bias current required to maintain the laser diode optical output power is beyond a preset limit.	Minor—transmitter is still functional, but laser diode may be nearing end of life. Laser repair is recommended.
LASER FAIL	Red	On	Laser diode optical output power has decreased by more than 1.25 dB below initial value.	Major—affects the functionality of the encoder. Laser must be repaired.
ONLINE	Green	On	Encoder enabled and transmitting valid data	None
		Off	Encoder not transmitting valid data	Major—possible causes: • Transmitter disabled • Encoder in a LOCK LOST condition
		Blinking	Laser diode optical output power has decreased by more than 1.25 dB below its initial value and may have failed completely	Major— affects the functionality of the encoder. Laser must be repaired.
SDI	Green	On	The encoder is transmitting an SDI signal.	None
Lost Lock	Yellow	On	The encoder does not detect a 270 Mb/s signal.	Minor
LASER DISABLE	Red	On	The AUDIBLE ALARM/LASER OFF switch has been set to LASER OFF.	Major alarm—place switch in one of the following settings: Audible Alarm On; Audible Alarm Off

Laser Wavelength Display

Location

The LASER WAVELENGTH display is located on the encoder's front panel (item 4 on page 3-2).

Purpose

The display shows a value or a channel number indicating the wavelength of the laser in the encoder.

- For a unit with a 1310 nm or 1550 nm laser cartridge installed, the display will show 1310 or 1550
- For a unit with a DWDM laser cartridge installed, the wavelength is represented by a channel number (see page 1-3 for details)
- For a unit with a high-power WL15+4 1550 nm laser, the display will show 155+
- If no cartridge is installed, the display will read NONE

Figure 3-7. Wavelength Display

Setting the AUDIBLE ALARM/LASER OFF Switch

Location

The three-position AUDIBLE ALARM ON/LASER OFF switch is located on the encoder's front panel (item 5 on page 3-2).

Purpose

The switch serves two purposes:

- To activate the encoder's internal alarm buzzer
- To disable the encoder's optical transmitter

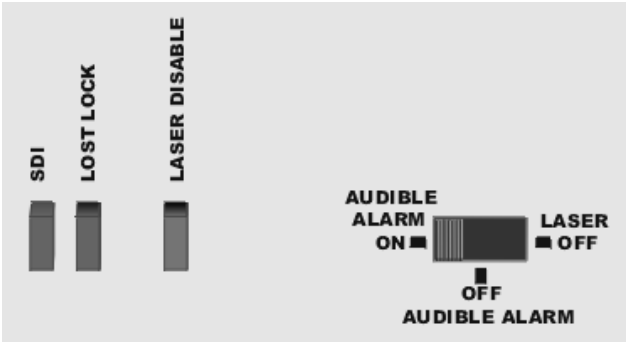

Figure 3-8. Audible Alarm/Laser Off Switch

Audible alarm control

The encoder has an internal buzzer that can be configured to sound whenever the encoder detects a major alarm condition.

- When the switch is in the ON position, the audible alarm buzzer will sound when a major alarm is detected
- When the switch is in the OFF position, the audible alarm buzzer does not sound when a major alarm is detected

Laser-disable control

When the switch is in the LASER OFF position, you disable the laser cartridge.

Note: We recommend that you always disable the optical transmitters before you perform routine maintenance or re-cable the encoder.

Setting the switch to LASER OFF generates a major alarm condition and illuminates the LASER DISABLE LED (page 3-10).

Wiring the ALARM Relay Connectors

Location

Two three-terminal alarm relay contact closures—one for LOCAL MAJOR alarms and one for LOCAL MINOR alarms—are located on the encoder's rear panel (item 8 on page 3-3).

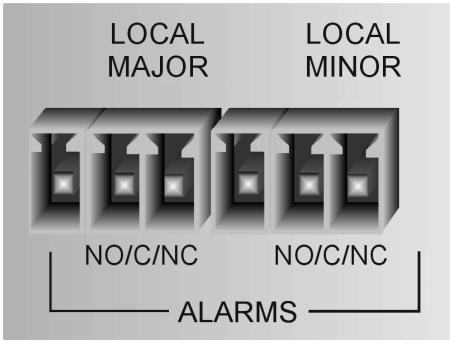

Figure 3-9. ALARM Relay Connectors

Purpose

These contact closures can be used to connect the encoder to an external coil device (such as a lamp or a horn), which can be activated when the encoder detects an alarm condition.

The ALARM relay connectors can be wired as normally closed (NC), in which case it will open when an alarm condition is sensed; or normally open (NO), in which case it will close when an alarm condition is sensed.

To connect an external coil to an alarm relay connector, use one of the three-pin removable screw wire clamp connectors shipped with the DL2701. The connectors accept #24 ... #18 gauge twisted-pair wire.

The alarm relay contact rating is 48 VAC or VDC @ 100 mA. All contact pairs are isolated from chassis ground and from each other. Maximum applied voltage from any contact to chassis ground must be less than 100 VDC. The contacts are not polarity-sensitive.

Where to Go Next

Chapter 4 describes DL2701 decoders.

4

Configuring and Cabling a Decoder

This chapter describes how to configure the decoder using the panel switches and cable ports. The major topics are:

Decoder Panel Views

Front Panel

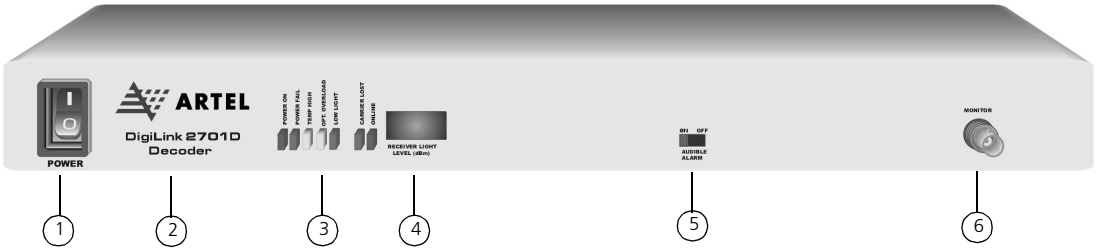

Figure 4-1. DL2701 Decoder Front Panel

Table 4-1. Decoder Front Panel Elements

Item	Panel Element	for details, see...
1	POWER switch	page 4-5
2	Decoder label	page 4-4
3	Device status LEDs (7)	page 4-8
4	RECEIVER LIGHT LEVEL window	page 4-10
5	AUDIBLE ALARM Switch	page 4-10
6	VIDEO MONITOR port	page 4-12

Rear Panel

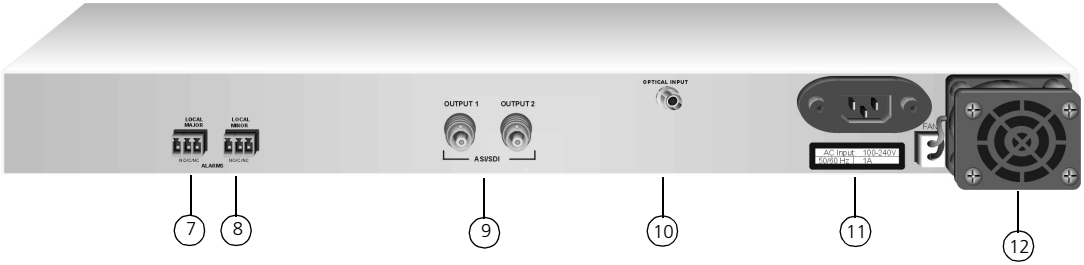

Figure 4-2. DL2701 Decoder Rear Panel

Table 4-2. Decoder Rear Panel Elements

Item		Panel Element	for details, see...
7	LOCAL MAJOR ALARM connector		page 4-11
8	LOCAL MINOR ALARM connector		page 4-11
9	ASI/SDI output ports 1 and 2		page 4-7
10	OPTICAL INPUT port		page 4-6
11	Power connector		
		AC	page 2-8
		DC	page 2-9
12	External fan		
		Device cooling requirements	page 2-4
		Replacement	page 5-2

Chapter 4

Identifying the Unit

The text on the left side of the decoder's front panel, below the Artel logo (see item 2 on page 4-2) contains the model of the unit and type of device (encoder or decoder).

Figure 4-3 illustrates a sample that identifies the unit as a DigiLink 2701D, which is a decoder equipped with an AC power supply.

Figure 4-3. Decoder Label

Refer to Product Models (page 1-5) for a complete listing of DL2701 models.

Applying Power

Once external power has been connected to the decoder, it can be powered up using the two-position POWER switch on the front panel (item 1 on page 4-2).

Figure 4-4. Decoder POWER Switch

Toggle the POWER switch to the **1** (ON) position. As the decoder powers up, it initializes and turns on the LEDs briefly.

Once the decoder initializes, you can use the switches on the front and rear panels to configure it and the LEDs to monitor its status.

For details on connecting the decoder to a power source, see Power Connection (page 2-8).

Establishing Video Inputs/Outputs

Input transmission media

The decoder receives a digital input signal optically via its OPTICAL INPUT port. It can transmit/receive the signals described in ASI and SDI Operation (page 1-2).

The DL2701 decoder also provides an elastic store function to reduce jitter and is completely data-format transparent. In DVB/ASI applications, the DL2701 transmits the full 270 Mb/s stream.

Cabling the OPTICAL INPUT Port

Location

The OPTICAL INPUT port is an FC-PC female optical connector on the decoder's rear panel (item 10 on page 4-3).

Purpose

The decoder uses its OPTICAL INPUT port to receive an ASI or SDI-formatted digital input signal via a fiber optic input cable. It is designed to operate with 9 μm single mode optical fiber cable. You can use 50 or 62.5 μm multimode fiber for short distance applications (less than 4 km).

Caution

When the OPTICAL OUTPUT port is not connected to a fiber cable, cover the connector with the protective plastic cap. The cap prevents degradation of optical performance that dirt and moisture can cause.

To connect a fiber optic cable to the OPTICAL INPUT port:

1. Remove the protective plastic cap from the connector.
2. Use a fiber optic cable with a male FC-PC connector on it. Insert the cable connector into the OPTICAL INPUT connector and turn it until the keys mate.
3. Push in the connector and tighten it.

Note: Use care when moving or installing a decoder that has a fiber cable attached to the connector. To avoid sharp bends, kinks, or twists in the optical cables, remove the cable before moving a decoder.

Cabling the ASI/SDI Output Port Locations

The two ASI/SDI output ports are BNC connectors located on the decoder's rear panel (item 9 on page 4-3). The output from each of these ASI/SDI ports is identical, providing signal redundancy.

Purpose

These ports transmit ASI or SDI-formatted digital output signals from a DL2701 decoder that has received an ASI or SDI optical input. The signals are transmitted over coaxial cables.

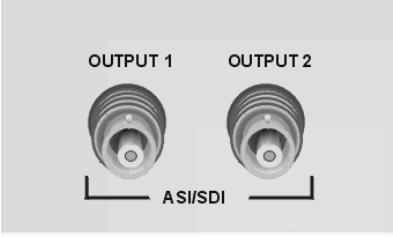

Figure 4-5. Decoder ASI/SDI Output Ports

Using Internal and External Display Capabilities

Internal mechanisms

The decoder provides three on-board mechanisms that provide status information and alarm conditions:

- LEDs (see page 4-8)
- The RECEIVER LIGHT LEVEL meter display (see page 4-10)
- An audio alarm (see page 4-10)

The LEDs on the front panel provide indications of system operating status and output status.

Optional external devices

Two relays (see page 4-11) are provided so that you can send major and/or minor alarm detection information to an external device. One relay provides major alarm status and the other provides minor alarm status information.

Interpreting the Device Status LEDs

Location

The decoder's front panel contains a group of seven light-emitting diode (LED) indicators used as *device status* LEDs.

The device status LEDs indicate:

- When the decoder power is on
- When an alarm condition has been detected
- When the decoder is enabled and transmitting valid data

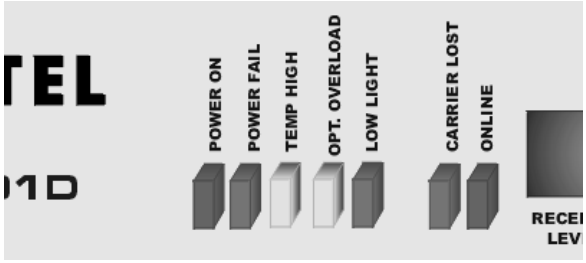

Figure 4-6. Device Status LEDs

Table 4-3 describes their indications and the recommended response.

Table 4-3. Device Status and LEDs

Name	Color	State	Indication	Alarm Condition
POWER ON	Green	On	Main power is on	None
POWER FAIL	Red	On	One or more of the DC system voltages is out of tolerance	Major—unit must be serviced
TEMP HIGH	Yellow	On	Internal system temperature limit has been exceeded	Minor—possible causes: • Fan failure • Ambient temperature too high • Poor air circulation
OPTICAL OVERLOAD	Yellow	On	Optical power level greater than -1.0 dBm	To reduce the optical power level, install an optical attenuator in series with the OPTICAL INPUT connector
LOW LIGHT	Red	On	Optical power level less than -32 dBm	Major—see the two notes below
CARRIER LOST	Red	On	Clock recovery circuit can not lock onto the incoming bit stream	Major—the bit rate is incorrect or not present
ONLINE	Green	On	Decoder is enabled and is transmitting valid data.	None
		Off	Decoder is not transmitting valid data	Major

Using the RECEIVE LIGHT LEVEL Display

The RECEIVER LIGHT LEVEL display shows the decoder's optical input power (in dBm). Valid power is in the range is 0 ... -40 dBm and is displayed in increments of 0.1 dBm.

Optimal operation is with the display between -10 and -30 dBm. The unit will operate normally from -1 to -32 dBm.

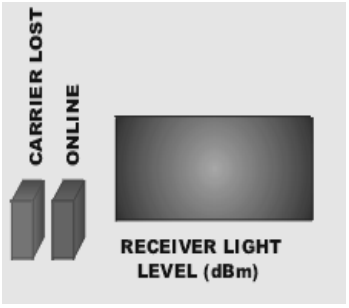

Figure 4-7. Receiver Light Meter

Configuring the AUDIBLE ALARM

Location

The two-position AUDIBLE ALARM switch is located on the decoder's front panel (item 5 on page 4-2).

Purpose

Use this switch to enable or disable the decoder's internal alarm buzzer. When enabled, the buzzer is activated when the decoder detects a major alarm condition.

- When the switch is in the ON position, the audible alarm buzzer will sound when a major alarm is detected
- When the switch is in the OFF position, the audible alarm buzzer does not sound when a major alarm is detected

Cabling the ALARM RELAY Connectors

Location

Two three-terminal ALARM RELAY contact closures for local alarm status are located on the decoder's rear panel.

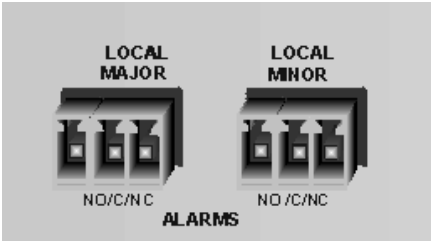

Figure 4-8. ALARM RELAY Connectors

Purpose

These relays can be used to connect the decoder to external loads, which can be activated when the decoder detects alarm conditions in itself. The two alarm relays convey status information about:

- Local major alarms
- Local minor alarms

The alarm relays can be wired as normally closed (NC) contacts, in which case it will open when an alarm condition is sensed; or normally open (NO), in which case it will close when an alarm condition is sensed. All alarm relays go to the alarm state if there is a total loss of system power.

To connect an external coil to an alarm relay connector, use one of the three-pin removable screw wire clamp connector shipped with the DL2701. The connector accepts #24 ... #18 gauge twisted-pair wire.

The relay contact rating is 48 VAC or VDC @ 100 mA. All relay contact pairs are isolated from chassis ground and from each other. Maximum applied voltage from any contact to chassis ground must be less than 100 VDC. The contacts are not polarity-sensitive.

Monitoring Output

Wiring the MONITOR Port

Location

The MONITOR port is a BNC connector on the decoder's front panel (item 6 on page 4-2).

Purpose

Use this port to connect an external device such as a waveform analyzer, a bit analyzer (for digital video), or a video monitor to the to the decoder.

Note: For accurate measurements, terminate the signal with 75 ohms.

5

Replacement Procedures

This chapter describes the following:

Replacing the External Fan

The DL2701 products have an external fan on its rear panel (item 12 on page 3-3) that remains *on* while the unit is under power. Refer to Cooling Considerations (page 2-4) for additional details on ensuring proper ventilation for the DL2701.

Replacing the external cooling fan requires a DL1K-FAN-ED replacement fan, which is available from your Artel customer service representative, and a Phillips screwdriver. This task should be performed by a qualified service person.

Note: The fan replacement procedure can be performed while the encoder is under power.

1. Remove the fan wire connector (1) from its receptacle on the rear of the unit. The connector is a pinch clip that needs to be pushed down for removal.

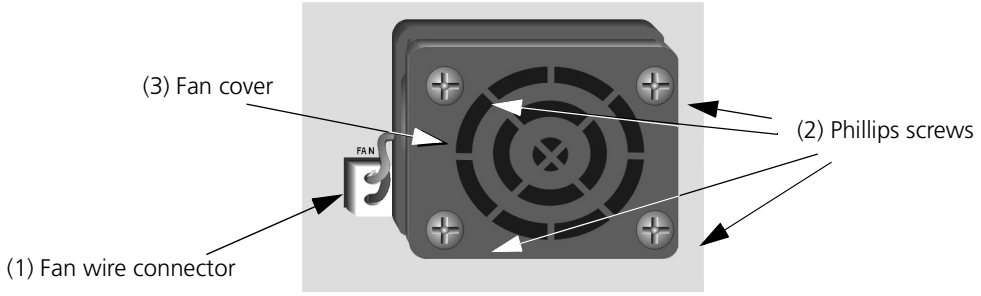

Figure 5-1. Fan Replacement

2. With the Phillips screwdriver, remove the four screws (2) that secure the fan to the unit. Set the screws aside for later use.
3. Remove the fan cover (3) and set it aside for use later.
4. Remove the fan.
5. Align the new DL1K-FAN-ED fan unit with the four screw holes in the chassis.
6. Replace the fan cover and reinsert the four Phillips screws.
7. Plug the new fan wire connector into the receptacle.

Installing a Laser Cartridge

Installing a laser cartridge into the DL2701 encoder does not require any tools and can be accomplished with the encoder under power.

To install a laser cartridge:

1. Locate the laser cartridge slot on the rear of the encoder, as shown in Figure 5-2.

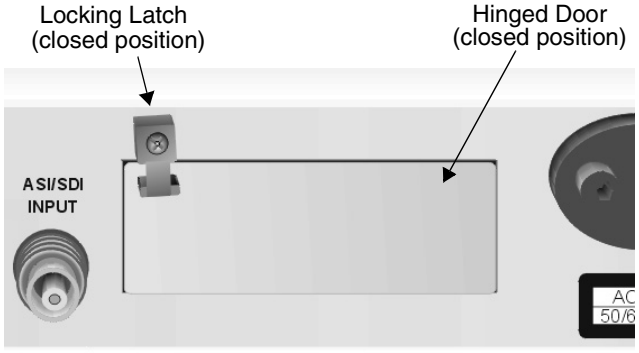

Figure 5-2. Laser Cartridge Slot on the Encoder Rear Panel

2. Swivel the locking latch 90^{o} clockwise to the open position.
3. Place the top of the card edge on the laser cartridge against the top of the slot with the cartridge body angled downward toward the hinged door, as shown in Figure 5-3.

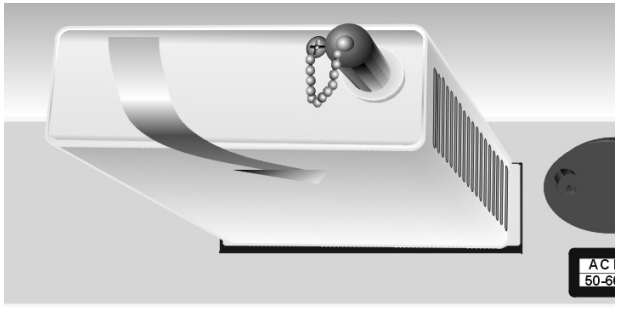

Figure 5-3. Installing a Laser Cartridge

4. As you slide the laser cartridge into the slot, rotate it until the card edge is aligned with the slot opening. The slot door in hinged at the top, and this rotating motion allows the cartridge to open the slot door as it is being inserted.
5. Push in the laser cartridge until the card edge is seated firmly into the encoder card edge connector.
6. Swivel the locking latch back to the closed position.
7. Attach the fiber optic cable from the source device as described on page 3-6.

Appendix A

A

Fiber Optic Cables

This appendix provides information on fiber optic cables, and describes how to select the proper cable for your network application.

This Appendix includes the following sections:

Fiber Optic Cable Properties

Bandwidth in optical fiber is limited by a phenomena known as *dispersion*. Because of dispersion, fiber bandwidth is inversely proportional to fiber length. There are two types of dispersion:

- Modal dispersion (below)
- Chromatic dispersion (page A-4)

In addition to dispersion information, this section includes information on:

- Modal bandwidth (page A-4)
- Signal attenuation (page A-5)

Modal dispersion

Modal dispersion is the spreading of light over time as it travels through the fiber. Dispersion is the main mechanism that limits the bandwidth or information-carrying capacity of a fiber. Dispersion limits fiber bandwidth, and therefore data rate.

Some of the light transmitted over a multimode fiber enters the core at a non-zero angle with respect to the axis of the fiber. The light rays repetitively reflect off the core and cladding boundary traveling in a zig-zag pattern along the length of the fiber.

The path length for the light rays (also called modes) is longer than the path length of a light ray traveling along the axis of the fiber. The longer path results in different propagation delays for components of a single light pulse. This phenomena is referred to as modal dispersion.

Note: Modal dispersion is not present in single mode fiber.

Figure A-1 illustrates modal dispersion in optical fibers.

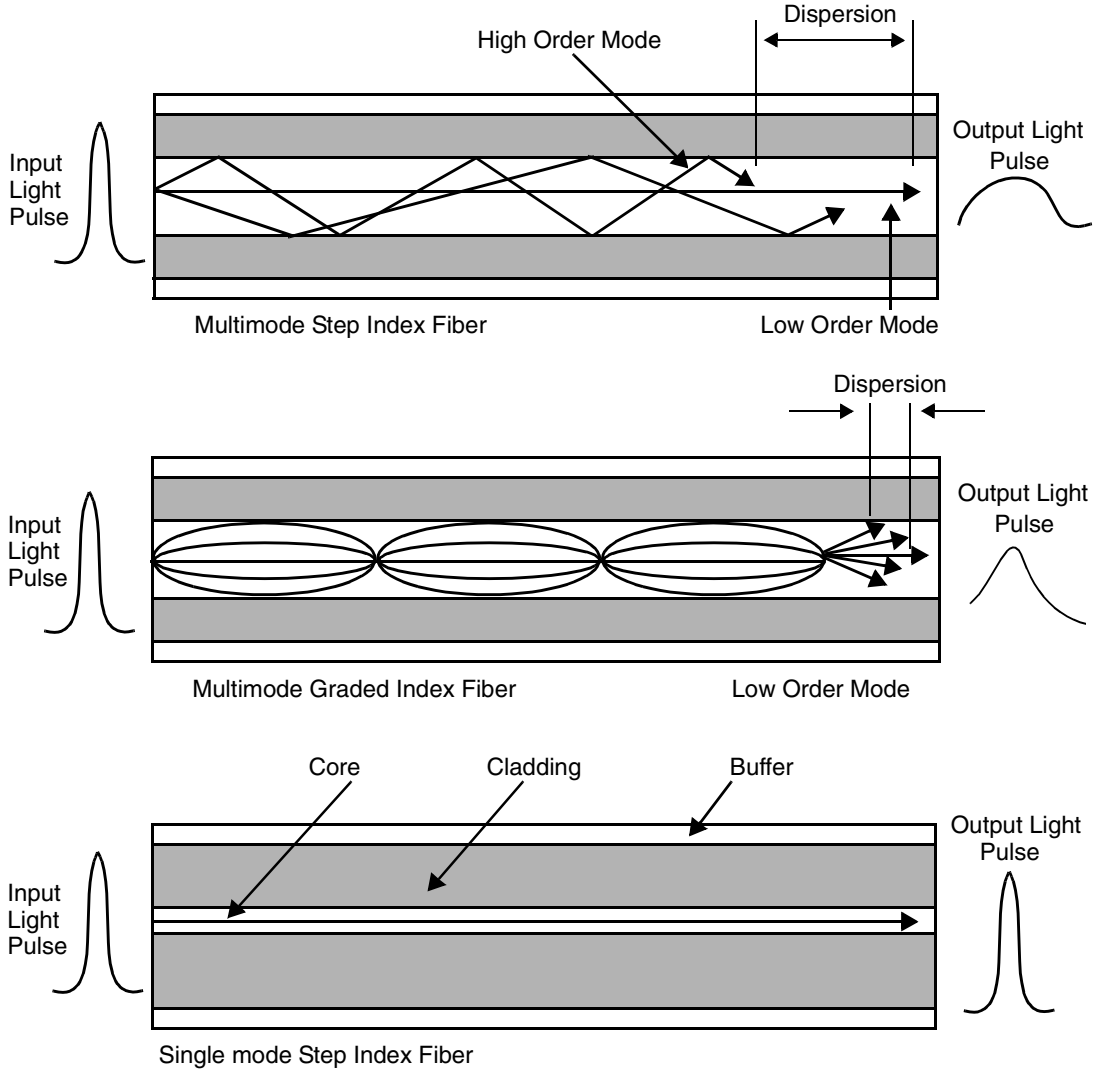

Figure A-1. Modal Dispersion in Optical Fibers

Chromatic dispersion

Chromatic dispersion occurs when optical energy is spread over a range of wavelengths (colors). Different wavelengths traveling the same path have different propagation velocities, which causes pulse spreading.

The propagation delay through the fiber core material is also a function of the light wavelength. The optical energy from LEDs and laser diodes tends to be distributed over a range of wavelengths, therefore its color is not pure. The different colors travel through the optical fiber at different speeds. This phenomena is referred to as chromatic dispersion.

Note: You only need to calculate chromatic dispersion for spans of singlemode fiber that are greater than 50 km.

You can reduce chromatic dispersion by:

- Operating at the zero dispersion wavelength of the optical fiber (1310 nm for silica glass)
- Using a light source with a narrow spectral width, such as a 1550 nm distributed feedback (DFB) laser diode. (All Artel 1550 nm and DWDM products are DFB type.)

Modal bandwidth

In general, the total fiber bandwidth is a function of both the modal and the chromatic bandwidth of the fiber. The chromatic bandwidth of an optical fiber is dependent upon the center wavelength and the spectral width of the emitting light source, as well as the material dispersion of the fiber (which is a function of wavelength).

Multimode fiber bandwidth is commonly rated in megahertz-kilometers (MHz-km). This rating refers only to the modal bandwidth (that is, the band limitations imposed by modal dispersion), and has been normalized to a 1 km length.

Note: Because all DL2701 optical transmitters are laser diodes with relatively narrow line widths, only the modal bandwidth of multimode fibers needs to be considered.

Signal attenuation

Unlike attenuation in copper cables, signal attenuation in an optical fiber does *not* increase with increasing modulation frequency. Rather, signal attenuation in an optical fiber is *constant* across the usable frequency range of the fiber.

Optical fiber signal attenuation is proportional to fiber length and depends on the wavelength (color) of the light being propagated.

In silica glass fibers, the dominant attenuation mechanism is Rayleigh scattering, which decreases gradually with increasing wavelength.

Attenuation rises dramatically above 1550 nm due to infrared absorption.

Fiber Optic Cable Types

An optical fiber consists of two concentric cylindrical glass regions. The inner region (the core) has a refractive index higher than the outer region (the cladding). As a result, light injected into the core at an angle within a cone-shaped zone (the numerical aperture) is totally reflected whenever it encounters the core and cladding boundary.

The light continues to be reflected down the length of the fiber by this total internal reflection. The cladding is usually surrounded by a third layer (the buffer), which protects the optical properties of the cladding and core. One or more buffered fibers are surrounded with various strength members and jacketing to form a fiber optic cable.

Fibers are usually classified by their refractive index profiles, core size, and numerical aperture. There are three main types of fibers:

- Step-index multimode fibers
- Graded-index multimode fibers
- Singlemode fibers

Step-Index multimode fiber cable

Step-index multimode fibers have core diameters in the 50 ... 1000 µm range. This large core size supports many modes of light propagation. Because the different paths give rise to modal dispersion, this type of cable is not recommended.

Graded-index multimode fiber cable

Graded-index fibers have a core index of refraction profile that changes gradually. The index is highest in the center and decreases until the core and cladding boundary is reached. Unlike step-index fibers, light is refracted as it traverses the index gradient, continually bending back towards the center.

Because light travels faster in glass with a lower refractive index, the light farther from the center axis travels faster. The rays following the longest paths have a faster average velocity, so that all modes tend to arrive at any point at nearly the same time. This reduces dispersion to provide a higher bandwidth fiber.

Table A-1 provides information on graded-index multimode fiber optic cable attenuation characteristics.

Table A-1. Graded-Index Multimode Fiber Optic Cable Characteristics

Fiber Geometry (core and cladding)	Fiber Grade	Maximum Attenuation (dB/km)		Typical Attenuation (dB/km)		Modal Bandwidth (MHz/km)	
		1310 nm	1550 nm	1310 nm	1550 nm	Min	Max
50/125 µm	Standard	1.5	1.0	1.0	0.5	400	800
	High	0.9	0.6	0.7	0.4	600	1200
	Premium	0.7	0.4	0.5	0.3	800	2000
62.5/125 µm	Standard	2.0	1.0	1.2	0.6	150	300
	High	1.0	0.7	0.8	0.5	400	800
	Premium	0.8	0.5	0.6	0.4	500	1000

Note: Ensure that any fiber cable longer than 4 km is single mode fiber optic cable. Single mode fiber cable has higher bandwidth and lower loss properties than multimode fiber cable.

Single Mode Fibers

Single mode fibers offer a method of limiting modal dispersion. These fibers have a core diameter small enough to allow only one mode to propagate. With dispersions of only tens of picoseconds/km, the fibers have exceptional bandwidths and low losses that make them suited to long distance, high speed telecommunications, and CATV.

Single mode fiber small core size makes them more difficult to splice. They generally require a laser light source to couple a sufficient amount of light into the small fiber core.

Table A-2 provides information on step-index single mode fiber optic cable characteristics.

Table A-2. Step-Index Single Mode Fiber Optic Cable Characteristics

Fiber Geometry (core and cladding)	Fiber Grade	Maximum Attenuation (dB/km)		Typical Attenuation (dB/km)	
		1310 nm	1550 nm	1310 nm	1550 nm
9/125 µm	Standard	1.0	0.6	0.7	0.4
	High	0.7	0.5	0.5	0.3
	Premium	0.5	0.25	0.4	0.2

Selecting Fiber Optic Cable

Two optical wavelengths have become standards for long distance high speed data transmission:

- 1310 nm—Provides the maximum data bandwidth due to the zero chromatic dispersion property of silica glass fibers at this wavelength.
- 1550 nm—Provides the lowest possible attenuation, which permits data transmission over the longest distance without repeaters.

For lower equipment cost and easier cable splicing, use multimode fiber for cable lengths under 4.4 km (2.7 mi). To support reliable transmission of the DL2701 digital data stream, ensure that the optical bandwidth and attenuation of the fiber is sufficient for DL2701 operation.

When purchasing fiber optic cable, the most important considerations are the following fiber transmission specifications:

- Maximum attenuation
- Minimum bandwidth
- Diameter of the fiber core and cladding

Secondary considerations in choosing fiber optic cable include:

- Rated pull strength
- Cable constructions
- Number of fibers packaged in a cable

Refer to your cable manufacturer's specifications for information regarding these cable characteristics.

Using Fiber Optic Cable

To ensure proper operation of the fiber optical cables, follow the precautions listed below.

- Do not exceed -25 dB maximum optical return loss in the optical fiber plant.
- When no fiber cable is connected, install the protective plastic cap.
- Before you connect fiber cable to equipment, ensure that you clean the fiber carefully (use an alcohol wipe and an oil-free canned air blast).
- Ensure that no dirt particles or other contamination is introduced into the optical connector. Failure to keep the optical connector free of contaminants may result in severely reduced optical output power and reduced range.

  If a dirt particle becomes imbedded in the optical connector, return the unit to Artel. Refer to page xxi for instructions on returning equipment for service.

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