Phoenix Digital

ROCKWELL ALLEN-BRADLEY ControlNet OPTICAL COMMUNICATION MODULES

INSTALLATION and USERS MANUAL

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PHOENIX DIGITAL CORPORATION

ROCKWELL ALLEN-BRADLEY ControlNet
OPTICAL COMMUNICATION MODULES

Users Manual

Notes: 1. This manual provides user information describing the operation and functionality of the following ControlNet fiber optic modules:

OCM-CTN-xx (Panelmount, Standalone and 1771 Plug-In... with Serial Numbers 7000 and above);
OLC-CTN-xx (1746 Plug-In);
OCX-CTN-xx (DIN Rail, Standalone and 1756 Plug-In).

2. All OCX modules (with the "-D" diagnostic option) are rated for use in Class I, Division 2 Groups A, B, C, and D hazardous locations. The following information is provided for hazardous location approval for OCX module applications:

"WARNING - Explosion Hazard - Do not disconnect while circuit is live unless area is known to be non-hazardous."

"WARNING - Explosion Hazard - Substitution of components may impair suitability for Class I, Division 2."

"This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only."

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ROCKWELL ALLEN-BRADLEY ControlNet
OPTICAL COMMUNICATION MODULES USERS MANUAL

TABLE OF CONTENTS

CHAPTER 1

DESCRIPTION AND SPECIFICATION

1.1 INTRODUCTION

Phoenix Digital's family of Rockwell Allen-Bradley ControlNet™ fiber optic modules provide the most advanced, comprehensive, state-of-the-art fiber optic communication capabilities on the market today. Phoenix Digital's ControlNet fiber optic modules are available as Panelmount, Standalone and DIN Rail, Standalone modules with integral 120/220 VAC, 24 VDC, or 125 VDC power supplies (Optical Communication Modules... OCM-P and OCX-R), 1771 plug-in modules (Optical Communication Modules... OCMs), 1746 plug-in modules (Optical Link Couplers... OLCs), and 1756 plug-in modules (Optical ControlLogix Modules... OCXs). These fiber optic modules translate hardwire networks into an optical network medium, transparent to the communication protocol and configurable for distribution by the user in ring, bus, star, tree, or point-to-point network installations. Fiber optic network options include features not found in even the most expensive communication network installations; on-line diagnostic monitoring with high speed self healing communication recovery around points of failure (Fault Tolerant), fault tracking for dual, redundant network configurations, in-line signal strength monitoring with annunciation of impending communication failures (Fault Predictive), interactive diagnostics to locate fault and impending fault conditions (accessible by the user program), and wavelength selection for matching fiber media characteristics to enable communication over extended distances. Phoenix Digital makes all of this possible through application of its patented self-healing communication switch and advanced optical measurement technologies.

The following table provides correspondence between Phoenix Digital fiber optic module Model Numbers and Allen-Bradley networks. The user should check the Model Number label located on the side of the fiber optic module cover to verify network interface compatibility.

PRODUCT MODEL #	NETWORK COMPATIBILITY
OCM-CTN-(1)-(2)-(3)-(4)-(5)-(6)-(7)	ControlNet Communications (1771 Plug-In and Panelmount, Standalone modules)
OCX*-CTN-(1)-(2)-(3)-(4)-(5)-(6)-(7)	ControlNet Communications (1756 Plug-In and DIN Rail, Standalone modules)
OLC-CTN-(1)-(3)-(4)-(6)-(7)	ControlNet Communications (1746 Plug-In modules)
OCM-CBL-TF-(8)	Interconnect Cable for ControlNet Fault Tracking (3ft/0.9 meter length)

(1)	"85"	=	850 nanometer wavelength selection
	"13"	=	1300 nanometer wavelength selection
	"15"	=	1550 nanometer wavelength selection
(2)	"P"	=	Panelmount, Standalone Enclosure (OCM modules only)
	"R"	=	DIN Rail, Sandalone Enclosure (OCX modules only)
	blank	=	1771, 1746, or 1756 Plug-In Module
(3)	"D"	=	Interactive Diagnostics (Required for OCX CL I, DIV 2)
	blank	=	No Diagnostics
(4)	"ST"	=	ST Fiber Optic Connector Style
	"SMA"	=	SMA Fiber Optic Connector Style (Available with 850nm wavelength only.)
(5)	"24V"	=	24 VDC Operation
	"ACV"	=	120/220 VAC, 50/60 Hz Operation
	"125V"	=	125 VDC Operation
(6)	"SM"	=	Singlemode Fiber Compatibility (Available with 1300 nm or 1550 nm Wavelengths, and ST connector options only.)
	blank	=	Multimode Fiber Compatibility
(7)	"EXT"	=	Extended Capacity Operation (Required for networks with 28 or more OCM/OLC/OCX-CTN modules.)
(8)	"10"	=	10 foot/3 meter length
	blank	=	3 foot/0.9 meter length

* OCX modules are rated for use in Class I, Div 2 hazardous locations, when the "-D" diagnostic option is included.

PRODUCT MODEL NUMBER DEFINITION

TABLE 1

A summary of selected fiber optic features is given below:

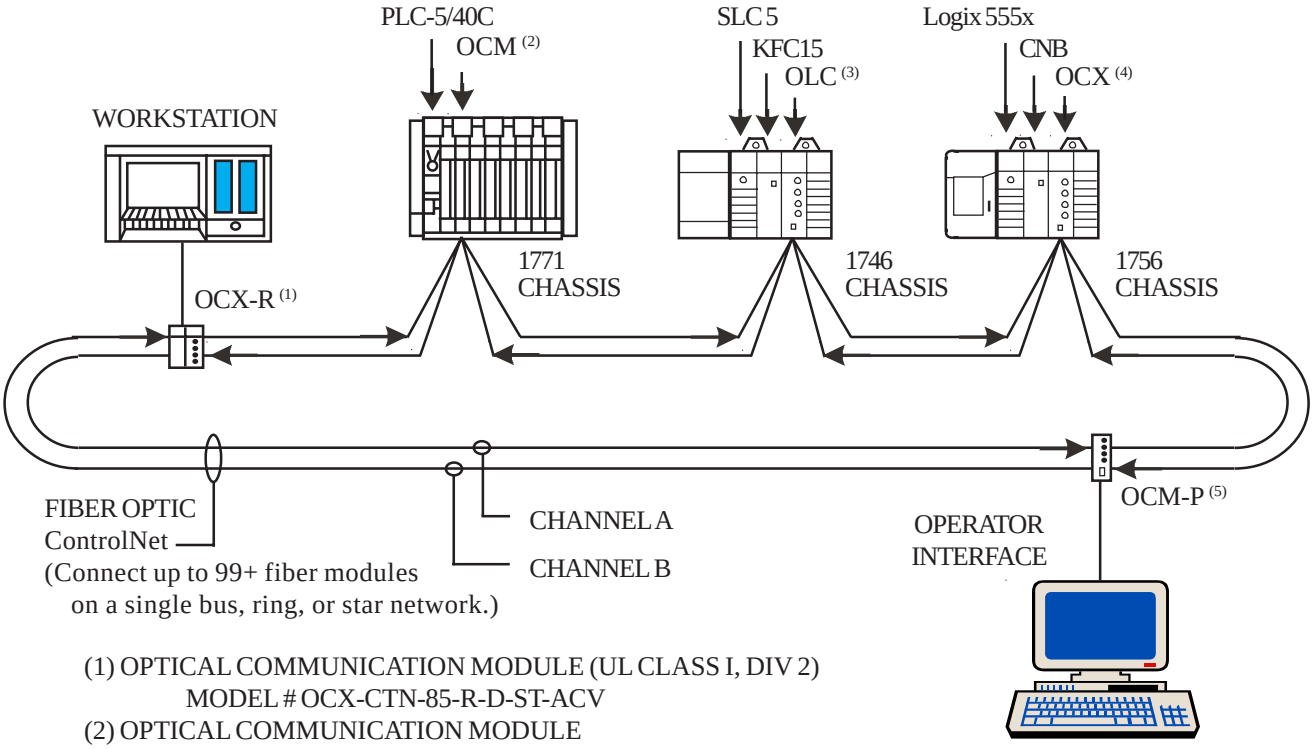
- Supports a wide range of Communication Distances (beyond 6 miles/10 kilometers between nodes using multimode fiber, beyond 16 miles/25 kilometers between nodes using singlemode fiber).
- Fault Tolerant Communication: Provides On-line Diagnostic Monitoring and High Speed, Self-Healing Communication Recovery.
- Fault Tracking: Provides Fault Tracking in Dual Redundant Fiber Optic Module Network Configurations, for Multipoint Media Fault Management.
- Fault Predictive Communication: Provides In-line Optical Signal Strength Monitoring and Annunciation of Impending Communication Failures.
- Interactive Diagnostics (User Program Accessible): Locates and Traps Fault and Impending Fault Conditions Throughout the Network.
- Selectable Wavelengths: 850 nanometer, 1300 nanometer (multimode and singlemode), and 1550 nanometer (multimode and singlemode).
- UL Class I, Division 2 Rating on all 1756 Plug-In and DIN Rail, Standalone Modules.
- Easy to see, visual indication of Communication Diagnostic Status.

1.2 PRODUCT DESCRIPTION

1.2.1 FAULT TOLERANT, SELF-HEALING COMMUNICATION

Phoenix Digital's Fault Tolerant, Self-Healing Communication technology provides diagnostic monitoring of the communication signal waveforms at each node on the network, and ultra-high speed detection, isolation, and correction of points of communication failure anywhere on the network grid. Phoenix Digital's fiber optic modules will self heal around communication failures in ring, bus, star, tree, or point-to-point network configurations. Figure 1 illustrates Examples of Typical Fiber Optic Module Network Configurations.

ControlNet DUAL MEDIA RING CONFIGURATION (FAULT TOLERANT)



(1) OPTICAL COMMUNICATION MODULE (UL CLASS I, DIV 2)
MODEL # OCX-CTN-85-R-D-ST-ACV
(2) OPTICAL COMMUNICATION MODULE
MODEL # OCM-CTN-85-D-ST
(3) OPTICAL LINK COUPLER
MODEL # OLC-CTN-85-D-ST
(4) OPTICAL ControlLogix MODULE (UL CLASS I, DIV 2)
MODEL # OCX-CTN-85-D-ST
(5) OPTICAL COMMUNICATION MODULE
MODEL # OCM-CTN-85-P-D-ST-ACV

EXAMPLE OF A TYPICAL OCM/OLC/OCX NETWORK CONFIGURATION

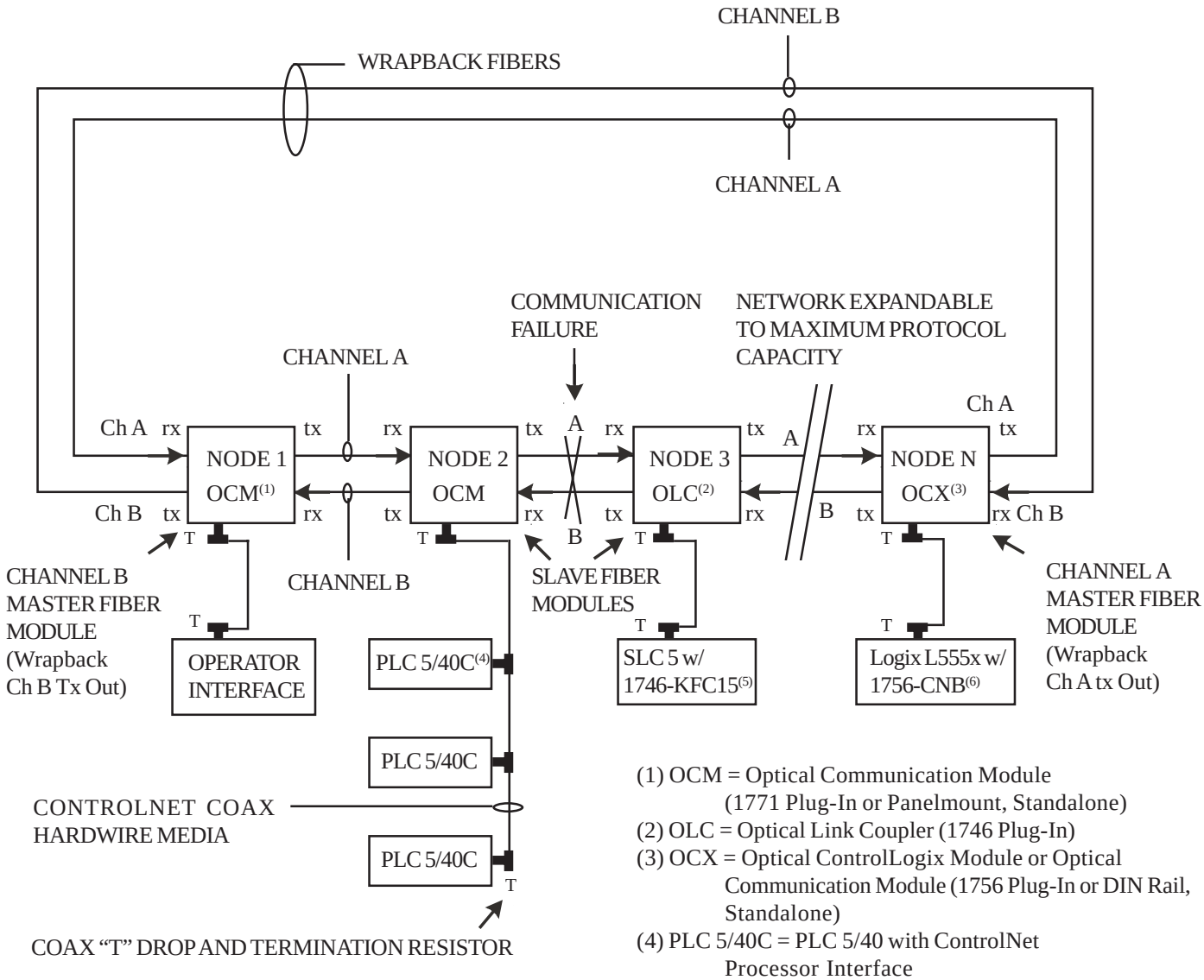
FIGURE 1

The ultra-high speed, self-healing communication technology on each fiber optic module will automatically redirect network traffic around points of failure (wrapback communication). In a failed condition the fiber optic communication network will self-heal around a fault by redirecting data communications around the point of failure. This is accomplished by wrapping back network communications at the communication nodes on either side of the point of failure, through the use of a high-speed, combinational wrapback communication switch (hardware pass-thru, non-software interactive) built into the front-end optical interface of each Phoenix Digital fiber optic module.

Two fiber modules on every fiber optic ControlNet network (and on every fiber network segment in star and tree topology network configurations) must be switch configured to be Network Master modules. (See Tables 7, 9, and 10 for fiber optic module Master/Slave Switch Designations. See Configuration Instructions in Chapter 2, Section 2.7 for more detailed information.) One of these modules will serve as the Master for fiber optic network Channel A (Ch A Transmit Master), and the other for Channel B (Ch B Transmit Master). These two fiber optic Master modules may be located anywhere on the fiber optic network, but must always be logically adjacent to each other and directly interconnected in all fault tolerant, ring topology fiber optic network configurations. The A Channel Master fiber optic module must have its Ch A Transmit Output connected to the Ch A Receive Input of the B Channel Master fiber module. Similarly, the B Channel Master fiber optic module must have its Ch B Transmit Output connected to the Ch B Receive Input of the A Channel Master fiber module. All other fiber optic modules on the network must be switch configured to be Slaves.

Figure 2 illustrates a typical fiber optic ControlNet fault tolerant ring topology network configuration. In this example the Master fiber optic modules are directly interconnected via fiber cable. The fiber modules located between the two Master modules are configured as Slave modules. Diagnostic monitoring circuitry at each module (Master and Slave) will continuously monitor the integrity of the communication carriers present at the receive data inputs of each communication channel. This high speed combinational diagnostic monitoring circuitry will monitor and detect communication failures in carrier symmetry, jitter, amplitude, and jabber. In the event a fault condition is diagnosed on the network (Figure 2: Node 2/Channel B receiver and Node 3/Channel A receiver) the fiber modules detecting the failure (Nodes 2 and 3) will immediately redirect communication around the point of failure using the wrapback fiber channels between the Master fiber optic modules. Essentially, the network dynamically reconfigures to form a new communication path from node 2 to node 3, away from the point of failure (the long way around the network), thus insuring communication network continuity and fault isolaton. In additon to providing network fault tolerance, Phoenix Digital's fiber optic modules enable maintenance personnel to locate fault conditons (remote status monitoring), add/delete nodes, and splice/terminate/replace media on-line, without disrupting network communications.

In point-to-point fiber network configurations (two fiber optic modules interconnected via fiber cable) both fiber modules must be configured as Masters. One fiber module should be configured as the Ch A Master, and the other as Ch B Master. Communication is achieved between fiber optic



(1) OCM = Optical Communication Module (1771 Plug-In or Panelmount, Standalone)
(2) OLC = Optical Link Coupler (1746 Plug-In)
(3) OCX = Optical ControlLogix Module or Optical Communication Module (1756 Plug-In or DIN Rail, Standalone)
(4) PLC 5/40C = PLC 5/40 with ControlNet Processor Interface
(5) SLC 5 w/ 1746-KFC15 = SLC Processor with KFC15 ControlNet Comm Module
(6) Logix L555x w/ 1756-CNB = ControlLogix Processor with CNB ControlNet Comm Module

ControlNet FIBER OPTIC NETWORK ILLUSTRATING SELF HEALING COMMUNICATION WRAPBACK

FIGURE 2

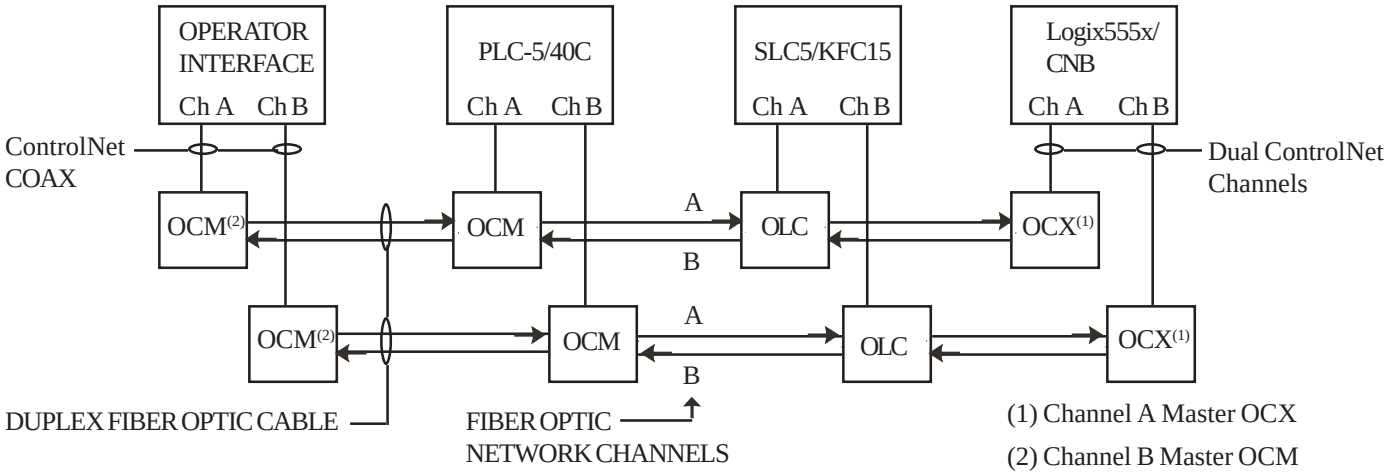
modules in point-to-point fiber networks by using one fiber on Channel A (Fiber Module 1 Ch A Tx to Fiber Module 2 Ch A Rx) and a second fiber on Channel B (Fiber Module 1 Ch B Rx to Fiber Module 2 Ch B Tx). This configuration may be made Fault Tolerant by connecting a second pair of fibers between the two modules, on the unused fiber connections (Fiber Module 1 Ch B Tx to Fiber Module 2 Ch B Rx, and Fiber Module 1 Ch A Rx to Fiber Module 2 Ch A Tx).

Communication continuity will be unconditionally maintained by the fiber optic modules in the event of either node or media failure. When the source of the network failure is corrected, the fiber modules will automatically restore the communication network to its' original traffic patterns.

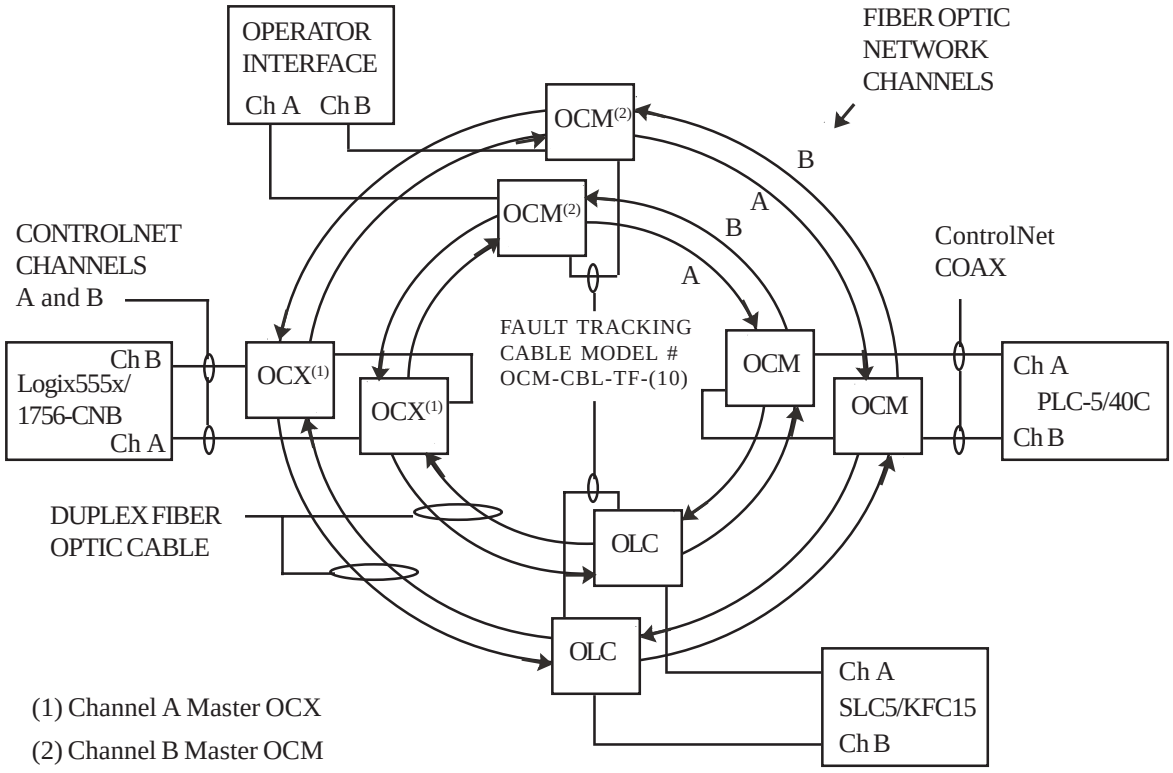
Figure 2 illustrates a redundant, self-healing fiber optic ControlNet network configuration using a single ControlNet channel. Because Phoenix Digitals' fiber optic modules provide fault tolerant communication redundancy throughout the fiber optic network, one ControlNet channel should be adequate for most applications when using Phoenix Digital fiber modules in a ring network configuration. However, it may be desireable in certain fault-critical applications to provide 100% hardware redundancy or multi-point media fault tolerance throughout the ControlNet network. In this case both ControlNet channels may be run in parallel... with redundant fiber modules (two) located at each drop on the fiber optic network. This dual channel ControlNet network configuration is illustrated in both bus and ring topology examples in Figure 3.

The bus topology example in Figure 3 provides single point fault tolerant redundancy (similar to that given in the single channel ControlNet ring topology example in Figure 2), as well as 100% hardware redundancy throughout the network. If a single point of failure occurs anywhere on the network (fiber module failure or media failure), there will be no loss of communication... even at the location where the fault occurs. Note that in dual channel ControlNet bus topology networks the paths for data flow for both ControlNet channels must track, such that their relative propagation times are approximately equivalent. This is a requirement of the ControlNet protocol. This is explained in more detail in Chapter 2 Section 2.7. (In bus topology fiber optic network configurations the Master Fiber Optic Modules may either be located adjacent to each other, as in ring topology networks, or on opposite ends of the bus... as shown in Figure 3. Essentially a bus network configuration is treated by the fiber modules the same as a ring network, with a network fault between the two end fiber optic modules... which are not connected together.)

The ring topology example in Figure 3 provides multipoint media fault tolerance. This network configuration will tolerate multiple, simultaneous failures (two) on the fiber optic physical layer (media only). However, if the fiber optic module itself fails (or if power is removed from the fiber module), the complementary fiber optic module will be forced off-line through the Fault Tracking option (ControlNet protocol requirement). Communication continuity will be maintained throughout the rest of the network, but it will be lost to that one location. (In dual channel ControlNet ring topology networks the paths for data flow for both ControlNet channels must also track, for the



DUAL CHANNEL FIBER OPTIC ControlNet NETWORK ILLUSTRATING BUS CONFIGURATION



DUAL CHANNEL FIBER OPTIC ControlNet NETWORK ILLUSTRATING RING CONFIGURATION

FIGURE 3

same reasons given above and described in Chapter 2 Section 2.7. This may be achieved by interconnecting the complementary ControlNet Ch A and Ch B fiber modules at each location on the fiber optic network with a local Fault Tracking interconnect cable... Model #OCM-CBL-TF-(10). This is explained in more detail in Chapter 2 Section 2.7.)

In dual channel ControlNet, ring topology fiber optic network configurations (using Fault Tracking), the Channel A and B Master Fiber Optic Modules must be located and interconnected with Fault Tracking cables such that the Channel A Master Fiber Modules are co-located and inteconnected, and the Channel B Master Master Fiber Modules are co-located and interconnected.

1.2.2 FAULT PREDICTIVE COMMUNICATION (850 nm and 1300 nm MULTIMODE ONLY)

Phoenix Digitals' Fault Predictive Communication Technology provides diagnostic monitoring and detection of impending communication failures resulting from gradual degradation of the communication link itself. Phoenix Digitals' fiber optic modules monitor impending fault conditions by continuously measuring the actual in-line signal strength (optical power) of the data comunications at each receive input on the module. The fiber modules continuously compare these actual in-line measurements to preset optical power reference thresholds, which are normalized to power levels where valid network communications will still be assured but impending communication failures can be accurately predicted. If the actual in-line data communication signal strength degrades below these power thresholds (resulting from one or more sources of link degradation), the fiber modules will automatically detect and annunciate the impending failure conditions via visual indicators on the front of the module. Phoenix Digitals' fiber optic modules also provide User Program Accessible, Interactive Diagnostics (1771, 1746, and 1756 Plug-In Fiber Modules) and Hardwired Diagnostic Ouputs (Panelmount, Standalone and DIN Rail, Standalone Fiber Modules) for remote monitoring, detecting, and locating of impending fault conditions (remote status monitoring). In addition, the fiber optic modules provide a linear DC voltage representation (analog) of the actual in-line signal strength (normalized for a 0 to 3.5 VDC range) for more precise monitoring of communication link status (online optical power metering). Thus, communication link status is continuously monitored and impending failure conditions are annunciated by the fiber modules before the communication failure actually occurs, enabling maintenance personnel to perform Predictive Maintenance on the fiber optic communication network at-large. (The Impending Fault Monitoring feature is available only on multimode fiber optic modules with the "-D" Diagnostic Option.)

1.2.3 WAVELENGTH SELECTION FOR LONG DISTANCE COMMUNICATION

Phoenix Digital's fiber optic modules provide five options for wavelength selection. The economical 850 nanometer multimode wavelength may be selected for data communication networks with less than 12,000 feet (3,650 meters) between communication nodes. The higher performance 1300 and 1550 nanometer multimode wavelengths may be selected for longer distance applications, extending communication distances between nodes to over 6 miles (10 kilometers). For maximum distance, the ultra-high performance 1300 and 1550 nanometer singlemode wavelengths may be selected, extending communication distances to over 16 miles (25 kilometers) between communication nodes!

1.3 PRODUCT SPECIFICATIONS

Fiber Optic Module Mounting Dimensions and Connector Designations are provided in Figures 4 thru 8.

1.3.1 DEVICE INTERFACE SPECIFICATIONS

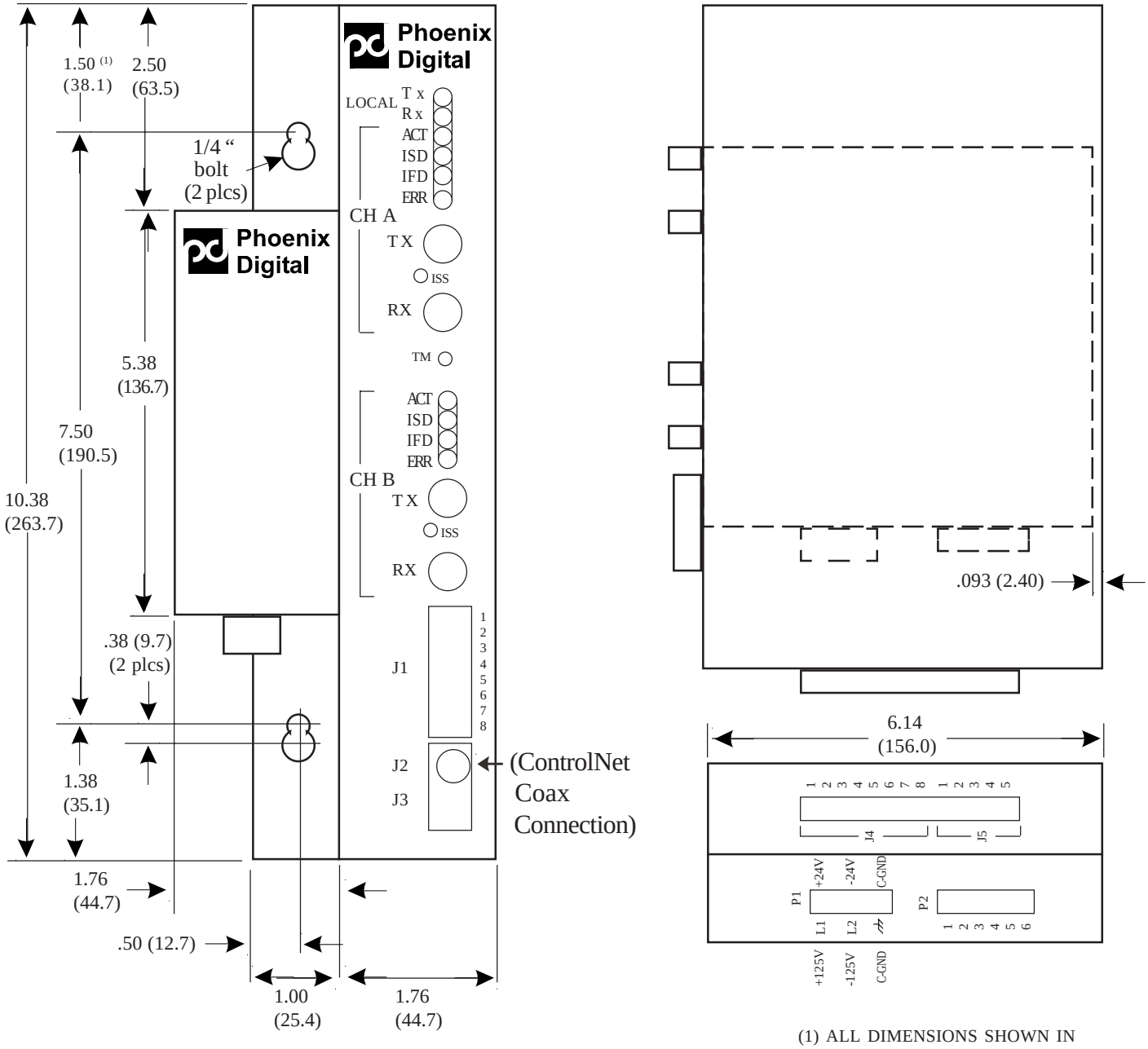
1.3.1.1 ControlNet Interface

The ControlNet Interface Port connection is provided on the front of the 1771 and Panelmount, Standalone OCM modules (designated as J2 - See Figures 4 and 5), and on the bottom of the 1746 Plug-In OLC, 1756 Plug-In OCX, and DIN Rail, Standalone OCX modules (designated as J2 - See Figures 6, 7, and 8).

The J2 BNC connector on Phoenix Digital ControlNet fiber optic modules is used for direct connection to ControlNet network devices, using RG-6 coaxial network cable. This connection may be made through the use of a ControlNet Coax Tap. Both ends of each segment of ControlNet coaxial trunk cable (at each fiber module location) must be terminated with 75 ohm resistors at the end coaxial tap locations.

The user must follow all Allen-Bradley Installation, Wiring Guidelines, and Termination Procedures for interconnect wiring of ControlNet devices and Phoenix Digital fiber optic modules.

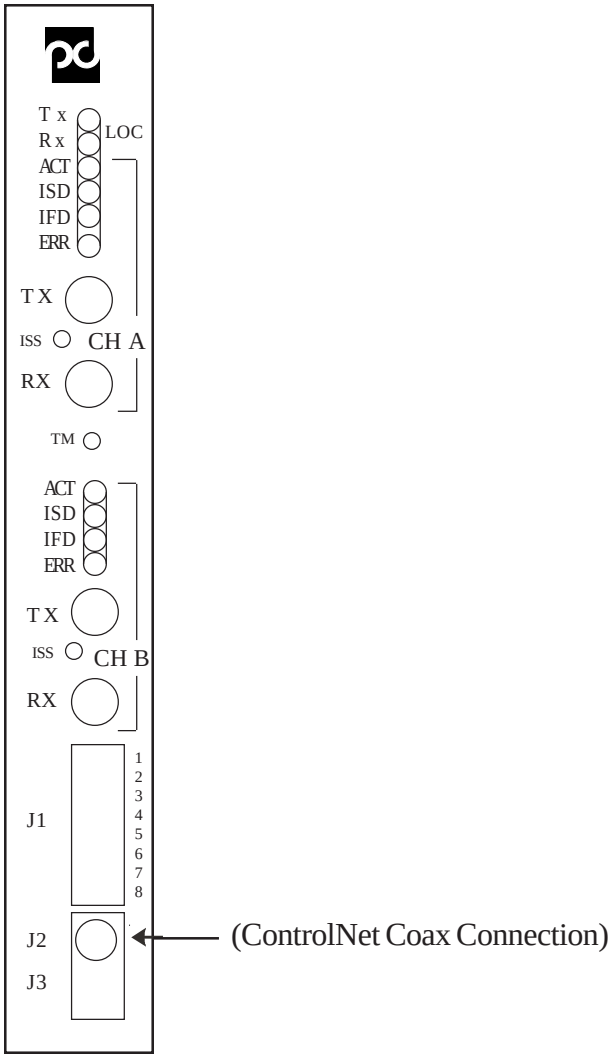
If the Phoenix Digital fiber optic module is used as a fiber optic repeater on the network, and no connection is made to the ControlNet coaxial interface on the J2 connector, then for 1771 Plug-In and Panelmount, Standalone OCM modules, Diagnostic/Configuration Select Switch 4 Position 7 must be set ON to disable the ControlNet Interface. Similarly, for 1746 Plug-In OLC, 1756 Plug-In OCX, and DIN Rail, Standalone OCX modules, Diagnostic/Configuration Select Switch 2 (SW 2) must be set to VALUE "4" to disable the ControlNet Interface. (See Chapter 2 Section 2.7 for more detailed information.)



(1) ALL DIMENSIONS SHOWN IN INCHES (MILLIMETERS) +/- 2 %

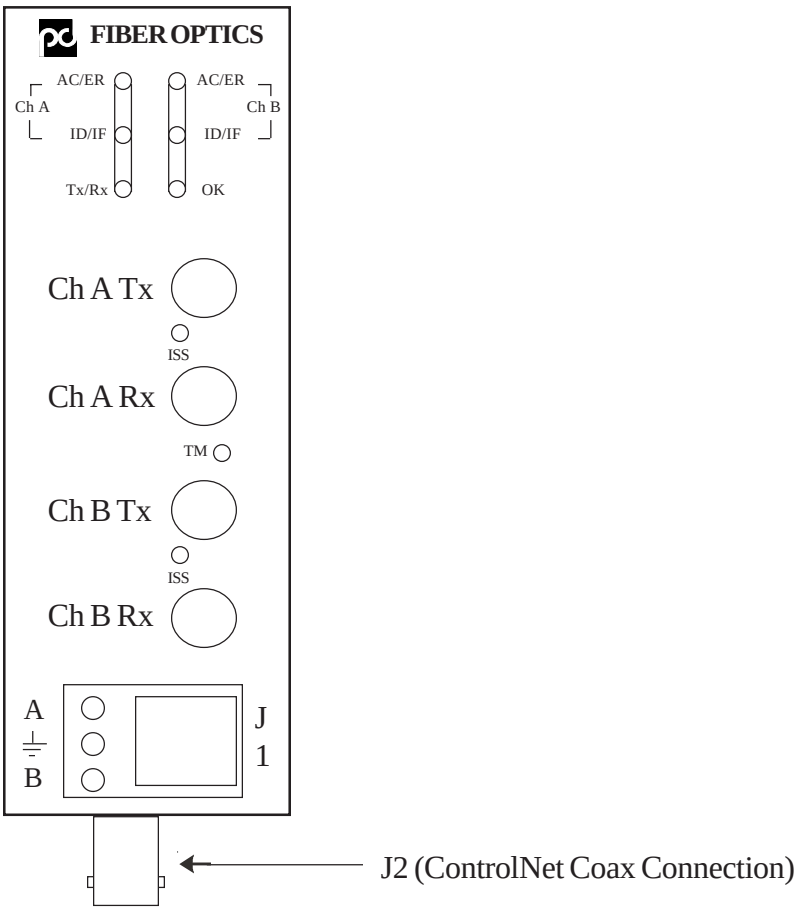
ALLEN-BRADLEY ControlNet
PANELMOUNT, STANDALONE OCM MOUNTING
DIMENSIONS AND CONNECTOR DESIGNATIONS

FIGURE 4



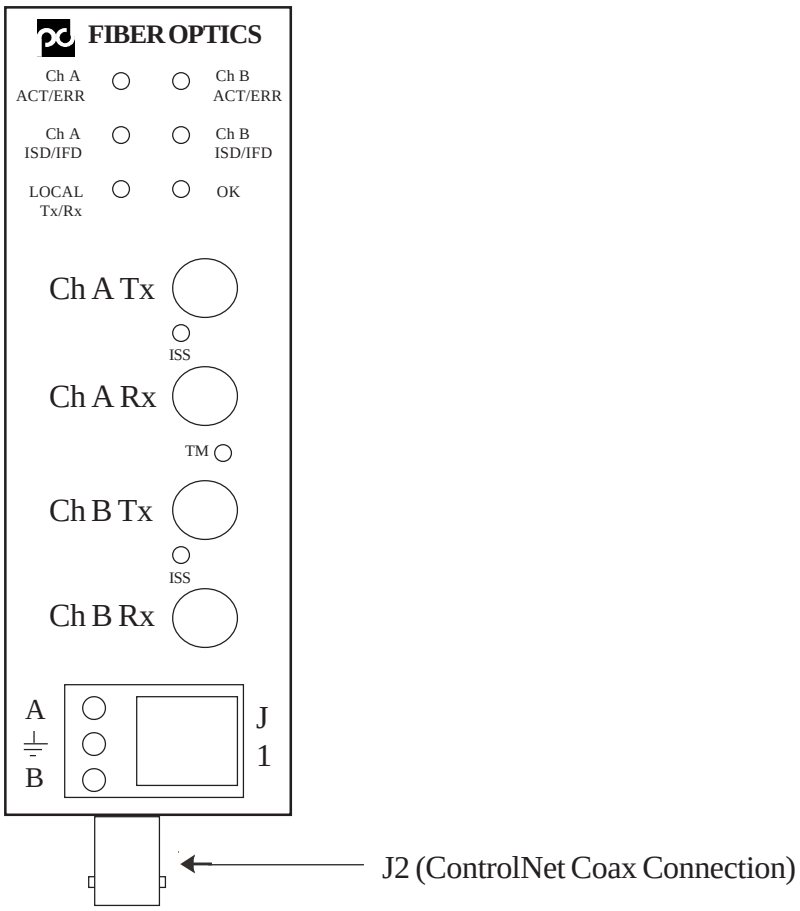
ALLEN-BRADLEY ControlNet
1771 PLUG-IN OCM CONNECTOR DESIGNATIONS

FIGURE 5



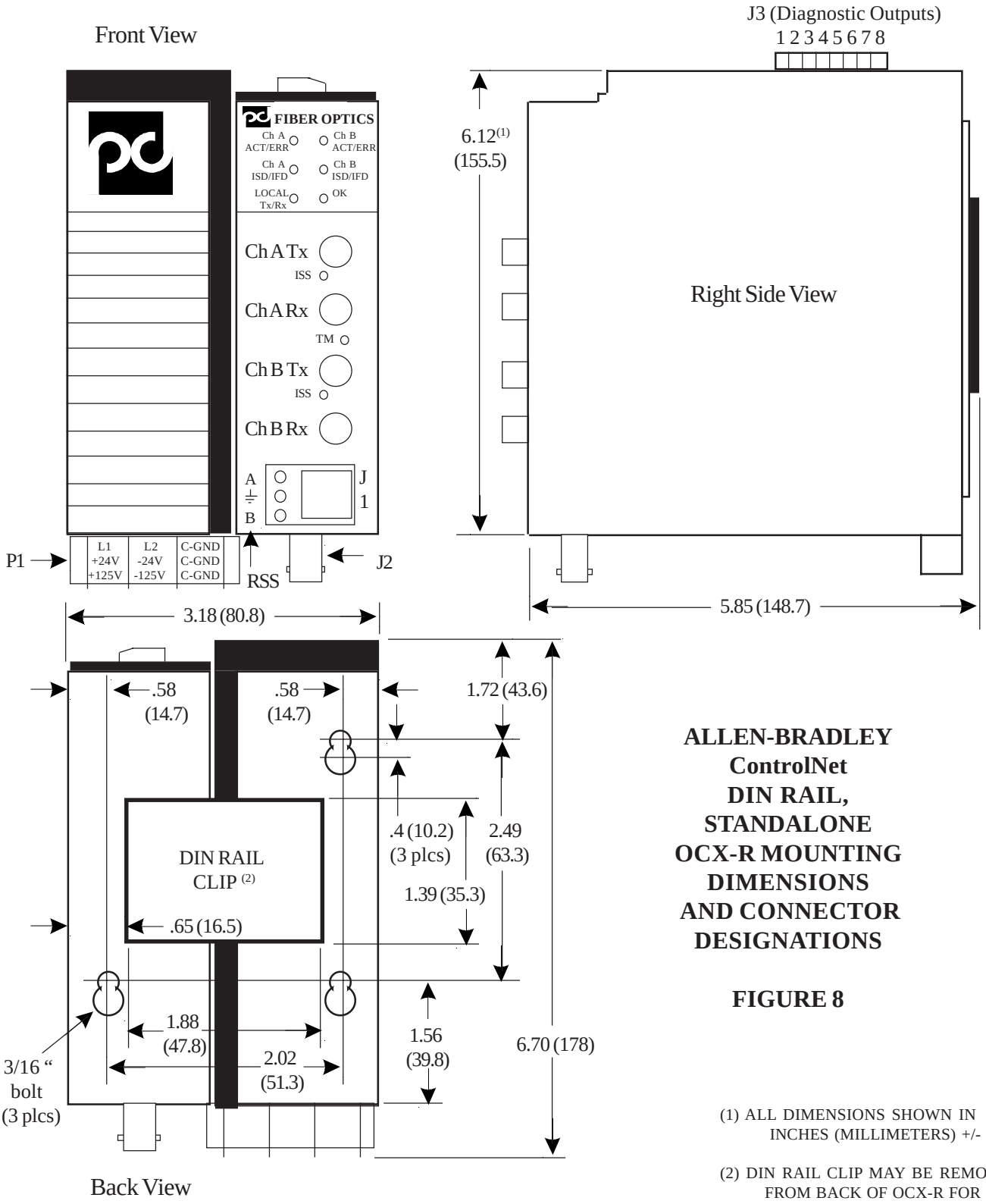
ALLEN-BRADLEY ControlNet 1746 PLUG-IN OLC
CONNECTOR DESIGNATIONS

FIGURE 6



ALLEN-BRADLEY ControlNet 1756 PLUG-IN OCX
CONNECTOR DESIGNATIONS

FIGURE 7



ALLEN-BRADLEY ControlNet DIN RAIL, STANDALONE OCX-R MOUNTING DIMENSIONS AND CONNECTOR DESIGNATIONS

FIGURE 8

(1) ALL DIMENSIONS SHOWN IN INCHES (MILLIMETERS) +/- 2 %

(2) DIN RAIL CLIP MAY BE REMOVED FROM BACK OF OCX-R FOR OPTIONAL PANELMOUNTING.

1.3.1.2 Fault Tracking Interface

All Phoenix Digital ControlNet fiber optic modules provide a Fault Tracking Interface. The OCM J3 Interface (RJ-45 Connector), OLC J1 Interface (RJ-45 Connector), and OCX J1 Interface (RJ-45 connector) are used for Fault Tracking between fiber optic ControlNet modules, for dual channel ControlNet operation in fiber optic ring network configurations. In a dual channel ControlNet network configuration (using both ControlNet Channels A and B), two fiber optic modules (OCMs, OLCs, and/or OCXs... in any combination) must be co-located at each location on the fiber optic network. These complementary Ch A and Ch B fiber modules must be interconnected between their respective Fault Tracking Interface connectors using a Fault Tracking Cable (Model # OCM-CBL-TF-(10)) at each location. The Ch A and Ch B fiber modules may then be interconnected on two parallel fiber optic ring topology networks (see Figure 3).

Everything on a dual channel ControlNet network must be duplicate and identical, as if two independent networks were being configured... one for ControlNet Channel A and the other for Channel B. However, they are not independent. In fact, the ControlNet network traffic flow must track between the two ControlNet channels such that the network propagation delay between any two locations on the Ch A Network be made virtually identical to that of the Ch B Network. In order to insure this tracking requirement is met, the fiber optic module Fault Tracking feature interlocks the two co-located fiber modules to insure that if one fiber module detects a fault and reconfigures to self heal around the fault, the other will reconfigure to provide an identical path for communication flow. Thus, Fault Tracking insures any fault experienced by either the ControlNet Ch A or Ch B fiber optic module will be simulated in a duplicate, parallel manner on the complementary fiber modules on the redundant network, thereby maintaining parallel, duplicate communication paths for both ControlNet channels A and B. (Note: Dual Channel ControlNet operation will usually NOT be required in fiber optic networks using Phoenix Digital fiber optic modules. This is because the fiber modules themselves provide dual channel, redundant, self-healing fiber optic communication when connected in a ring network configuration, thereby enabling fault tolerant operation in single channel ControlNet networks. See Chapter 1 Section 1.2.1 for more detailed information.)

1.3.2 OPTICAL NETWORK INTERFACE SPECIFICATIONS

The Optical Network Interface is designated as ChA Tx, Ch A Rx, Ch B Tx, and ChB Rx on the fiber optic module faceplate (see Figures 4, 5, 6, 7, and 8). Phoenix Digital fiber optic modules are compatible with either ST or SMA 905/906 style fiber optic connectors... as an ordering option (mating connector which is terminated to the fiber media). (Alignment sleeves should be provided on all SMA Style 906 connectors for optical alignment.) Detailed specifications describing optical network transmit and receive capabilities at the 850 nm multimode, 1300 nm multimode, 1550 nm multimode, 1300 nm singlemode, and 1550 nm singlemode wavelengths are provided below:

OPTICAL TRANSMITTER (850nm MULTIMODE)

Electro-Optical Characteristics

Parameter	Test Condition	SYM.	MIN.	TYP.	MAX.	UNITS
Fiber Coupled Power	50/125 micron, Graded, 0.20NA	Poc	10/-20.0	20/-17.0		microwatts/dBm
	62.5/125 micron, Graded, 0.28NA		21.9/-16.6	45/-13.5		microwatts/dBm
	100/140 micron, Graded, 0.29NA		58.0/-12.4	115/-9.4		microwatts/dBm
	200/230 micron, Graded, 0.37NA		320/-4.9			microwatts/dBm
Peak Wavelength		λ_P		850		nm
Spectral Width		λ_W		50		nm

TABLE 2

OPTICAL TRANSMITTER (1300nm MULTIMODE)

Electro-Optical Characteristics

Parameter	Test Condition	SYM.	MIN.	TYP.	MAX.	UNITS
Fiber Coupled Power	50/125 micron Graded, 0.20NA	Poc	25/-16.0			microwatts/dBm
	62.5/125 micron Graded, 0.28NA		50/-13.0			microwatts/dBm
Wavelength		λ_P	1290		1350	nm
Spectral Width		λ_W			160	nm

TABLE 3

OPTICAL TRANSMITTER (1550nm MULTIMODE)

Electro-Optical Characteristics

Parameter	Test Condition	SYM.	MIN.	TYP.	MAX.	UNITS
Fiber Coupled Power	50/125 micron Graded, 0.20NA	Poc	50/-13.0			microwatts/dBm
Wavelength		λ_P	1510		1580	nm
Spectral Width		λ_W	45		100	nm

TABLE 4

OPTICAL TRANSMITTER (1300nm SINGLEMODE)

Electro-Optical Characteristics

Parameter	Test Condition	SYM.	MIN.	TYP.	MAX.	UNITS
Fiber Coupled Power	9/125 micron	Poc	16/-18.0			microwatts/dBm
Wavelength		λ_P	1270		1340	nm
FWHM		λ_W	70		90	nm

TABLE 5

OPTICAL TRANSMITTER (1550nm SINGLEMODE)

Electro-Optical Characteristics

Parameter	Test Condition	SYM.	MIN.	TYP.	MAX.	UNITS
Fiber Coupled Power	9/125 micron	Poc	30/-15.0			microwatts/dBm
Wavelength		λ_P	1510		1580	nm
FWHM		λ_W	45		100	nm

TABLE 6

OPTICAL RECEIVER (850 nm MULTIMODE, 1300/1550 nm MULTIMODE, and 1300/1550 nm SINGLEMODE)

Receiver Sensitivity: -32dBm

Phoenix Digital's fiber optic modules may be interconnected on the fiber optic network in an active bus configuration. Network Channel A Receive Data inputs and Transmit Data outputs should be interconnected sequentially from fiber module to fiber module in one direction, and Channel B Receive and Transmit Data inputs and outputs interconnected sequentially in the opposite direction. This configuration may be made fault tolerant by cross-connecting Channel A (Ch A Transmit to Ch A Receive) and Channel B (Ch B Transmit to Ch B Receive) on the fiber modules on either end of the active bus (See Figure 9). This effectively transforms the network into a ControlNet counter-rotating ring network configuration.

1.3.3 INTERACTIVE DIAGNOSTICS

Phoenix Digital's fiber optic modules provide advanced, interactive, system-level diagnostics. (Fiber modules must be ordered with the "-D" Option for Interactive Diagnostics.) These diagnostics may be accessed thru the PLC User Program (1771, 1746, and 1756 Plug-In Modules) or via Discrete Contact Outputs (Panelmount, Standalone and DIN Rail, Standalone Fiber Modules) to validate network integrity and assist in troubleshooting network problems...

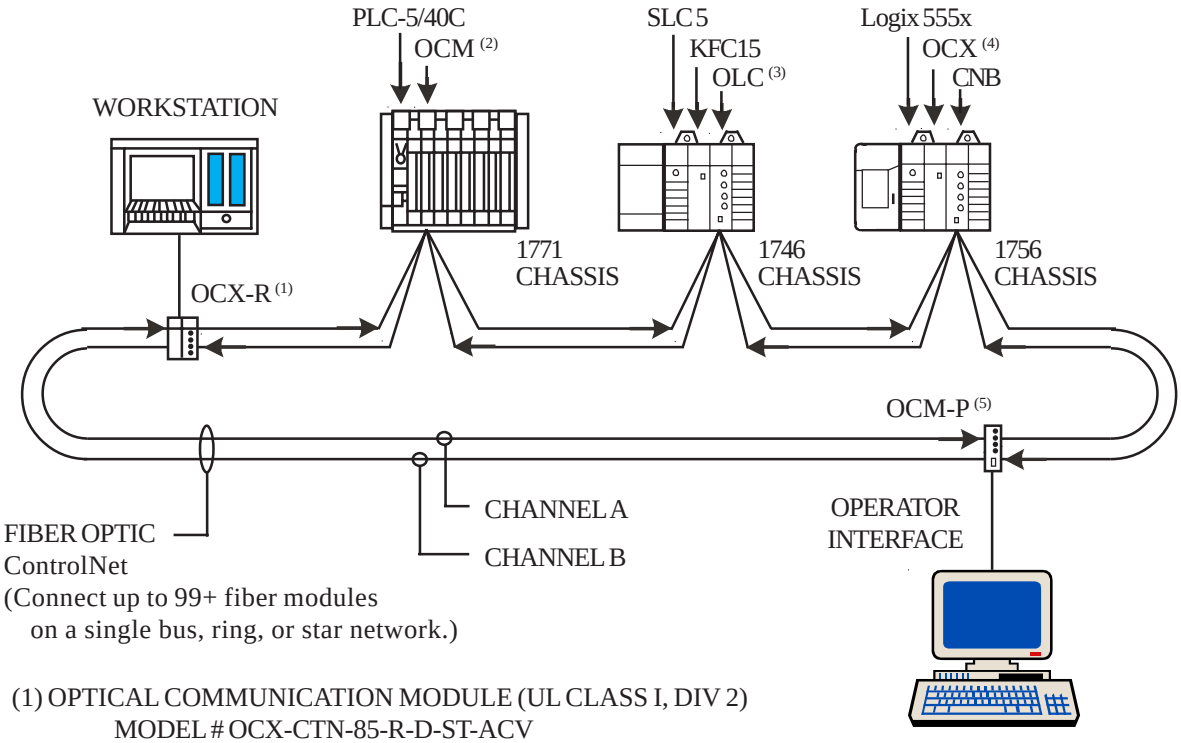
-Detect and Locate Fault Conditions Throughout the Network
-Trap-and-Hold, and Locate Intermittent Communication Failures
-Detect and Locate Impending Fault Conditions Throughout the Network
-Simulate Network Fault Conditions
-Verify Fault Managment and Overall Network Integrity
-Optical Power Metering

These advanced interactive diagnostics provide the user with a powerful set of tools, greatly simplifying network start-up and on-line maintenance of ControlNet communication networks.

1.3.3.1 PANELMOUNT, STANDALONE OCM-P MODULES

Activation and control of Panelmount, Standalone OCM-P Diagnostics is provided through Diagnostic/Configuration Select Switch Settings. Diagnostic/Configuration Select Switch Settings are provided in Table 7. Monitoring of Panelmount, Standalone OCM-P diagnostics is provided using reed relay contact outputs. These outputs are provided on Panelmount, Standalone OCM-Ps (with the "-D" Option) and are accessible on the J4 connector.

ControlNet DUAL MEDIA RING CONFIGURATION (FAULT TOLERANT)



(1) OPTICAL COMMUNICATION MODULE (UL CLASS I, DIV 2)
MODEL # OCX-CTN-85-R-D-ST-ACV
(2) OPTICAL COMMUNICATION MODULE
MODEL # OCM-CTN-85-D-ST
(3) OPTICAL LINK COUPLER
MODEL # OLC-CTN-85-D-ST
(4) OPTICAL ControlLogix MODULE (UL CLASS I, DIV 2)
MODEL # OCX-CTN-85-D-ST
(5) OPTICAL COMMUNICATION MODULE
MODEL # OCM-CTN-85-P-D-ST-ACV

TYPICAL CONTROLNET FIBER OPTIC MODULE INSTALLATION CONFIGURATION

FIGURE 9

SWITCH [1]	POSITION [1]	FUNCTION [2]	FACTORY CONFIGURATION (DEFAULT)
Switch 4	1	Network Master OCM (Channel A) [3]	OFF
(SW 4)	2	Network Master OCM (Channel B) [3]	OFF
	3	Unused [4]	OFF
	4	Trap Mode Select	OFF
	5	Force Channel B Error	OFF
	6	Force Channel A Error	OFF
	7	Disable Local Interface (J2)	OFF
	8	Enable Impending Fault Detection	OFF
	9	Unused [4]	OFF
	10	Enable Diagnostic Relay Outputs	OFF

(1) See Figure 10 for designated switch locations

(2) ON = Assert (Active, Switch Closed)
OFF = Inactive (Switch Open)

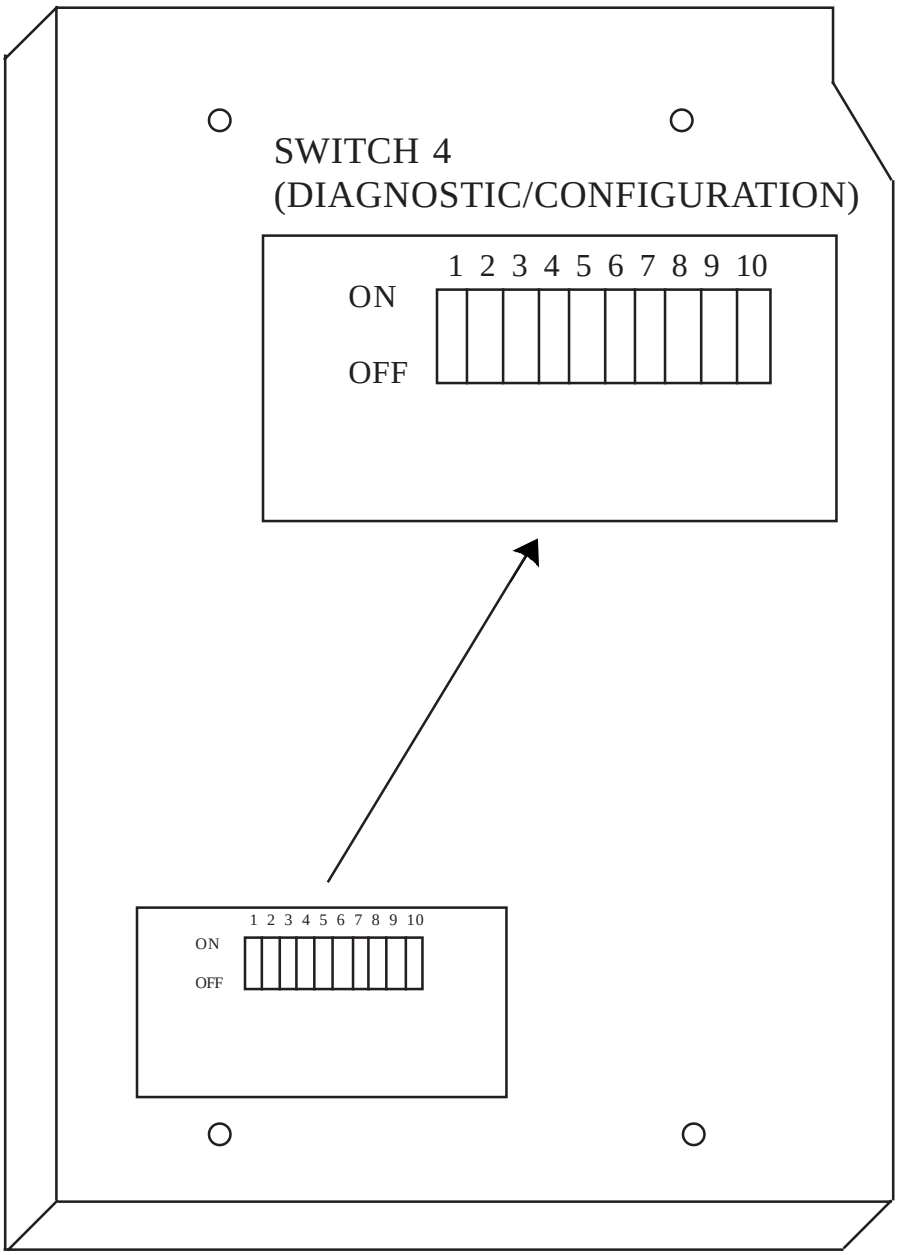
(3) See Chapter 2, Section 2.7 for Configuration Instructions.

SW 4-1	SW4-2	OCM Master/Slave Selection
OFF	OFF	Slave
ON	OFF	Channel A Master
OFF	ON	Channel B Master
ON	ON	Invalid, Not Allowed

(4) All unused switch positions must remain set in the Factory Default Configuration.

PANELMOUNT, STANDALONE OCM-P DIAGNOSTIC/CONFIGURATION SELECT SWITCH DESIGNATIONS

TABLE 7



1771 PLUG-IN OCM AND PANELMOUNT, STANDALONE OCM-P DIAGNOSTIC AND CONFIGURATION SWITCH DESIGNATIONS

FIGURE 10

Electrical specifications for diagnostic relay outputs, and specifications detailing J4 connector pin-out are provided in Table 8. Further explanation of OCM diagnostic functions is provided in Sections 1.3.3.6-1.3.3.10.

1.3.3.2 1771 PLUG-IN OCM Modules (Modules with "-D" Diagnostic Option Only)

Activation, control, and monitoring of 1771 Plug-In OCM diagnostics is provided under program control thru read/write status and control bytes in the PLC I/O Image Table, and is also provided under manual control via Diagnostic/Configuration Select Switch Settings. The 1771 Plug-In OCM (with "-D" Option) occupies a single I/O module slot, and simulates either an 8 bit bi-directional I/O module (when OCM Processor Write is enabled... SW 4 Position 3 ON, see Table 9) or an 8 bit input module (when OCM Processor Write is disabled... SW 4 Position 3 OFF, see Table 9). The OCM is addressable to the 1771 I/O module slot it occupies. The 1771 I/O module slot addressing density (2-slot, 1-slot, 1/2-slot I/O Group) is switch selectable on the backplane of the 1771 chassis. (OCM modules without the "-D" diagnostic option do not have a 1771 bus interface and appear as empty slots to the processor.)

RSLogix 5 OCM I/O module configuration is similar to other types of 1771 I/O modules. The first step is to select "I/O Configuration" for the 1771 Chassis. Next select the chassis and I/O slot where the OCM is located, and open the "Edit Module - Module Type" configuration table. From this table select either "1771-SIM - 8pt Discrete I/O Simulator" if OCM Processor Write is Enabled (SW 4 Position 3 ON), or "1771-IG - 5v DC TTL 8pt Input" if OCM Processor Write is Disabled (SW 4 Position 3 OFF). (Note: User should consult Rockwell Allen-Bradley Hardware Installation Manual for more information on addressing modes and program configuration for I/O Groups, Chassis, and Racks.)

Read/Write Diagnostic Status and Control functions for the 1771 Plug-In OCM Module are given in the Diagnostic I/O Bit Map illustrated in Figure 11. Definitions of Diagnostic/Configuration Select Switch Settings are provided in Table 9. Specifications and further explanation of OCM diagnostic functions are provided in Sections 1.3.3.6-1.3.3.10.

J4 OCM-P CONNECTOR J3 OCX-R CONNECTOR PIN #	PANELMOUNT, STANDALONE OCM-P and DIN RAIL, STANDALONE OCX-R DIAGNOSTIC OUTPUTS (1)
1, 2	Channel A Error (ERR)
3, 4	Channel A Impending Fault Detect (IFD)
5, 6	Channel B ERR
7, 8	Channel B IFD

(1) Each diagnostic output is provided as a normally open FORM A contact on the designated pair of OCM-P J4 or OCX-R J3 pin numbers. (Contact will be open when no error or impending fault condition is detected on the corresponding optical receiver input.) When a diagnostic function is asserted (i.e. error or impending fault), the corresponding contact will close.

Diagnostic/Configuration Select Switches must be set to enable diagnostic relay outputs

Diagnostic Relay Electrical Specifications:

Arrangement	:	1a
Initial contact resistance, max.	:	30 Meg Ohm
Rating (resistive)		
Max. switching voltage	:	380 VAC, 125 VDC
Max. switching current	:	.5A
Initial breakdown voltage		
Between open contacts	:	1,000 Vrms
Between contact sets	:	2,000 Vrms
Between contacts and coil	:	3,000 Vrms
Initial insulation resistance	:	1,000 mohm at 500 VDC
FCC surge voltage between open contacts	:	1,500 V

(Note: Panelmount, Standalone OCM-P's are shipped from the factory with Diagnostic Relays disabled. DIN Rail, Standalone OCX-R's are shipped from the factory with Diagnostic Relays enabled.)

PANELMOUNT, STANDALONE OCM-P J4 CONNECTOR AND DIN RAIL, STANDALONE OCX-R J3 CONNECTOR DIAGNOSTIC OUTPUT PIN DEFINITIONS AND DIAGNOSTIC RELAY ELECTRICAL SPECIFICATIONS

TABLE 8

1.3.3.3 1746 PLUG-IN OLC Modules (Modules with "-D" Diagnostic Option Only)

Activation, control, and monitoring of 1746 Plug-In OLC diagnostics is provided under program control thru read/write status and control bytes in the PLC I/O Image Table, and is also provided under manual control via Diagnostic/Configuration Select Switch Settings. The 1746 Plug-In OLC (with "-D" Option) occupies a single I/O module slot, and simulates either an 8 bit bi-directional I/O module (when OLC Processor Write is enabled... SW 2 VALUE 7 is not selected, see Table 10) or an 8 bit input module (when OLC Processor Write is disabled... SW 2 VALUE 7 is selected, see Table 10). The 1746 I/O module designation, density, and type are program configurable, and must be configured to match the I/O modules in the system... prior to programming. If the 1746 Plug-In OLC module is configured to simulate an 8 bit bi-directional I/O module (SW 2 VALUE 7 is not selected), then the module designation is "OTHER", I/O Mix Code = 19, and the I/O Type Code = "35". (Example: If the 1746 Plug-In OLC Module is in I/O slot 1 then the correct configuration for this slot would be "Slot 1 = OTHER 1935".) If the 1746 Plug-In OLC module is configured as an 8 bit input module (SW 2 VALUE 7 is selected) then the module designation is "OTHER", I/O Mix Code = 19, and the I/O Type Code = "00". (OLC modules without the "-D" diagnostic option do not have a 1746 bus interface and appear as empty slots to the processor.)

RSLogix 500 OLC I/O module configuration is similar to other types of 1746 I/O modules. The first step is to select "I/O Configuration" for 1746 Chassis. Next select the chassis and I/O slot where the OLC is located. This will also open an "I/O Configuration" table which will show "Current Cards Available". From this table select "Other - Requires I/O Card Type ID", which will prompt you to "Enter the I/O Card's ID (decimal);". If OLC Processor Write is Enabled (SW 2 VALUE 7 is not selected) enter "1935". If OLC Processor Write is Disabled (SW 2 VALUE 7 is selected) enter "1900". (Note: User should consult Rockwell Allen-Bradley Hardware Installation Manual for more information on addressing modes and program configuration for I/O Groups, Chassis, and Racks.)

Read/Write Diagnostic Status and Control functions are given in the Diagnostic I/O Bit Map illustrated in Figure 11. Definitions of Diagnostic/Configuration Select Switch Settings are provided in Table 10. Specifications and further explanation of OLC diagnostic functions are provided in Sections 1.3.3.6-1.3.3.10.

1.3.3.4 1756 PLUG-IN OCX Modules (Modules with "-D" Diagnostic Option Only)

Monitoring of 1756 Plug-In OCX module diagnostics is provided thru a read status register in the PLC Processor I/O memory. The 1756 Plug-In OCX module (with "-D" Option) occupies a single I/O module slot, and simulates a 16 bit input module, addressable to the 1756 I/O module slot it occupies. Diagnostic function control is provided via Diagnostic/Configuration Select Switch Settings. (OCX modules without the "-D" diagnostic option do not have a 1756 bus interface and appear as empty slots to the processor.)

RSLogix 5000 OCX I/O module configuration is similar to other types of 1756 I/O modules. The first step is to confirm the OCX module is "Offline". Next open the "Select Module Type" configuration screen (right click mouse on "I/O Configuration", and select "New Module"), and select from the list given on the screen the I/O Module Type/Description... "1756-Module Generic 1756 Module". This will create a new module "Module Properties" configuration screen. In the "Module Properties" configuration screen, the user must enter and/or select the following I/O module configuration information:

Name:	OCX_CTN_ x *
Description:	Optical Comm Module
Comm Format:	Data - DINT
Slot:	The I/O slot # where the OCX is located.

Connection Parameters

	Assembly Instance:	Size:
Input:	130	2
Output:	197	1
Configuration:	1	8

* Each OCX module must have a unique Name, so that each I/O module in the I/O configuration can be individually identified and located by RSLogix I/O configuration software. Therefore, in the example given above, the Name field "OCX_CTN_" is followed by a variable field "x", and this field should be designated by the user as a number (ie. 1, 2, 3, 4, 5, etc.) or letter (ie. a, b, c, d, e, etc.) so that each OCX-CTN module present in the I/O configuration will have a unique name.

After putting the OCX module “Online”, the user may confirm OCX identification information in the “Module Properties” screen by selecting the “Module Info” tab. The following informtion should be provided:

Identification

Vendor:	(420) Unknown
Product Type:	(128) Unknown
Product Code:	(549) Unknown
Revision:	x.x
Serial Number:	000xxxxx
Product Name:	OCX_CTN_x
	Phoenix_Digital_Rx.x

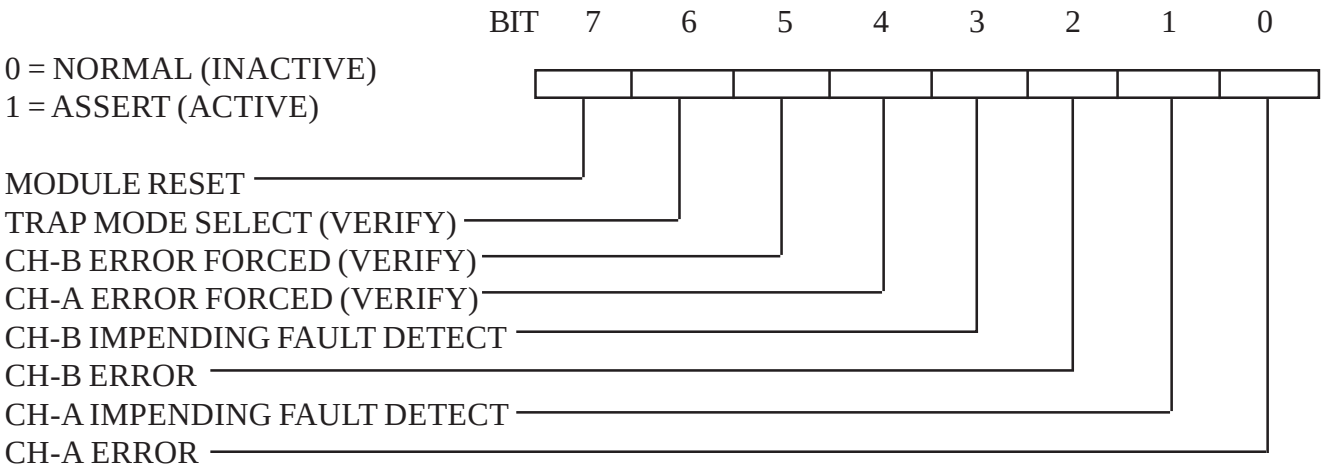
The OCX-CTN module revision level will be 1.2 or above. Module serial numbers will range between 00000000 and 00099999. The numeric information given above for Vendor, Product Type, and Product Code have been assigned by ControlNet International specifically to Phoenix Digital and to the OCX-CTN module. Rockwell anticipates that RSLogix software will eventually be able to provide this identification information in a descriptive text format, but as of the date of publication of this manual this capability is not available in RSLogix software.

Read Diagnostic Status functions are given in the Diagnostic Input Bit Map illustrated in Figure 12. Definitions of Diagnostic/Configuration Select Switch Settings are provided in Table 10. Specifications and further explanation of OCX diagnostic functions are provided in Sections 1.3.3.6-1.3.3.10.

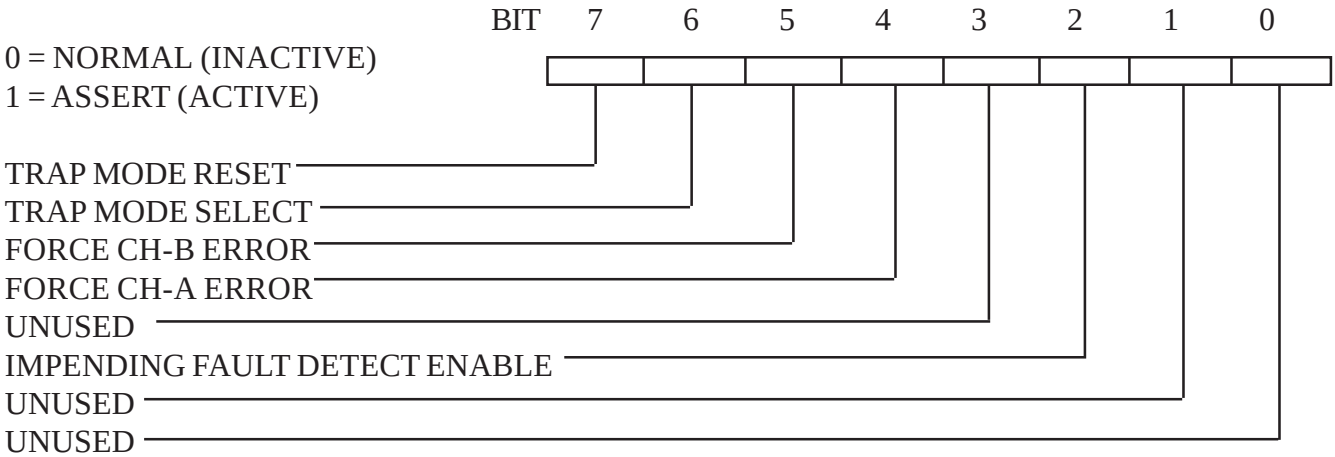
1.3.3.5 DIN Rail, Standalone OCX-R Modules

Activation and control of DIN Rail, Standalone OCX-R Diagnostics is provided through Diagnostic/Configuration Select Switch Settings. OCX-R Diagnostic/Configuration Select Switch Settings are provided in Table 10. Monitoring of DIN Rail, Standalone OCX-R diagnostics is provided using reed relay contact outputs. These outputs are provided on DIN Rail, Standalone OCXs (with the “-D” Option) and are accessible on the J3 connector. Electrical specifications for diagnostic relay outputs, and specifications detailing OCX-R J3 connector pin-out are provided in Table 8. Further explanation of OCX-R diagnostic functions is provided in Sections 1.3.3.6-1.3.3.10.

READ STATUS BYTE



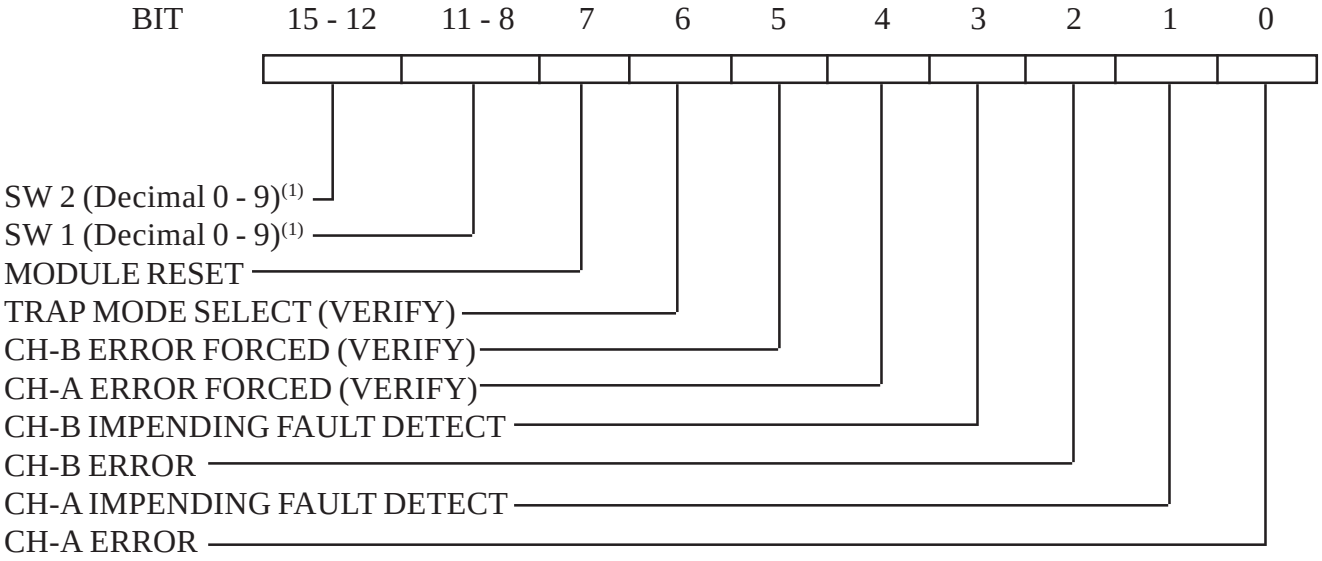
WRITE CONTROL BYTE



1771 PLUG-IN OCM AND 1746 PLUG-IN OLC
DIAGNOSTIC STATUS AND CONTROL FUNCTIONS

FIGURE 11

READ STATUS REGISTER : 0 = NORMAL (INACTIVE); 1 = ASSERT (ACTIVE)



(1) Rotary Switch Definition

SW 2	BIT # 15	14	13	12
0	1	1	1	1
1	1	1	1	0
2	1	1	0	1
3	1	1	0	0
4	1	0	1	1
5	1	0	1	0
6	1	0	0	1
7	1	0	0	0
8	0	1	1	1
9	0	1	1	0

SW 1	BIT # 11	10	9	8
0	1	1	1	1
1	1	1	1	0
2	1	1	0	1
3	1	1	0	0
4	1	0	1	1
5	1	0	1	0
6	1	0	0	1
7	1	0	0	0
8	0	1	1	1
9	0	1	1	0

1756 PLUG-IN OCX
DIAGNOSTIC STATUS AND CONTROL FUNCTIONS

FIGURE 12

SWITCH [1]	POSITION [1]	FUNCTION [2]	FACTORY CONFIGURATION (DEFAULT)
Switch 4	1	Network Master OCM (Channel A)[4]	OFF
(SW 4)	2	Nerwork Master OCM (Channel B)[4]	OFF
	3	Processor Write Enable	OFF
	4 [3]	Trap Mode Select	OFF
	5 [3]	Force Channel B Error	OFF
	6 [3]	Force Channel A Error	OFF
	7	Disable Local Interface (J2)	OFF
	8	Enable Impending Fault Detection	OFF
	9	Unused [5]	OFF
	10	Unused [5]	OFF

(1) See Figure 10 designated switch locations.

(2) ON = Assert (Active, Switch Closed)
OFF = Inactive (Switch Open)

(3) On (Assert) overrides corresponding (complimentary) bit of Write Control byte for 1771 Plug-In OCMs.

(4) See Chapter 2, Section 2.7 for Configuration Instructions.

SW 4-1	SW4-2	OCM Master/Slave Selection
OFF	OFF	Slave
ON	OFF	Channel A Master
OFF	ON	Channel B Master
ON	ON	Invalid, Not Allowed

(5) All unused switch positions must remain set in the Factory Default Configuration.

1771 PLUG-IN OCM DIAGNOSTIC/CONFIGURATION SELECT SWITCH DESIGNATIONS

TABLE 9

SWITCH [1]	VALUE SELECTED ON DIAL	FUNCTION [2]
SW 1	0 [3]	Slave [4]
	1	Network Master OCM (Channel A) [4]
	2	Network Master OCM (Channel B) [4]
	3 - 9	Unused [5]
SW 2	0 - 2	Unused [5]
	3 [3]	Enable Impending Fault Detection (IFD/IF), Enable ALL Relays (OCX-R)
	4	Disable Local Interface (J2), Enable IFD/IF, Enable ALL Relays (OCX-R)
	5	Trap Mode Select, Enable IFD/IF, Enable ALL Relays (OCX-R)
	6	Disable IFD and Trap Mode, Disable ALL Relays (OCX-R)
	7	Disable IFD, Trap Mode, and Processor Comm [6], Disable ALL Relays (OCX-R)
	8	Force Channel A Error, Enable IFD/IF, Enable ALL Relays (OCX-R)
	9	Force Channel B Error, Enable IFD/IF, Enable ALL Relays (OCX-R)

(1) See Figure 13 for designated switch locations. (Note that VALUES for both SW2 and SW1 are echoed in bits 15-12 and 11-8, respectively, in the upper byte of the 16 bit Read Status register for the 1756 Plug-In OCX module.)

(2) Switch Function overrides corresponding (complementary) bits of Write Control Byte for 1746 Plug-In OLC modules.

(3) Factory Default Value selected on the dial.

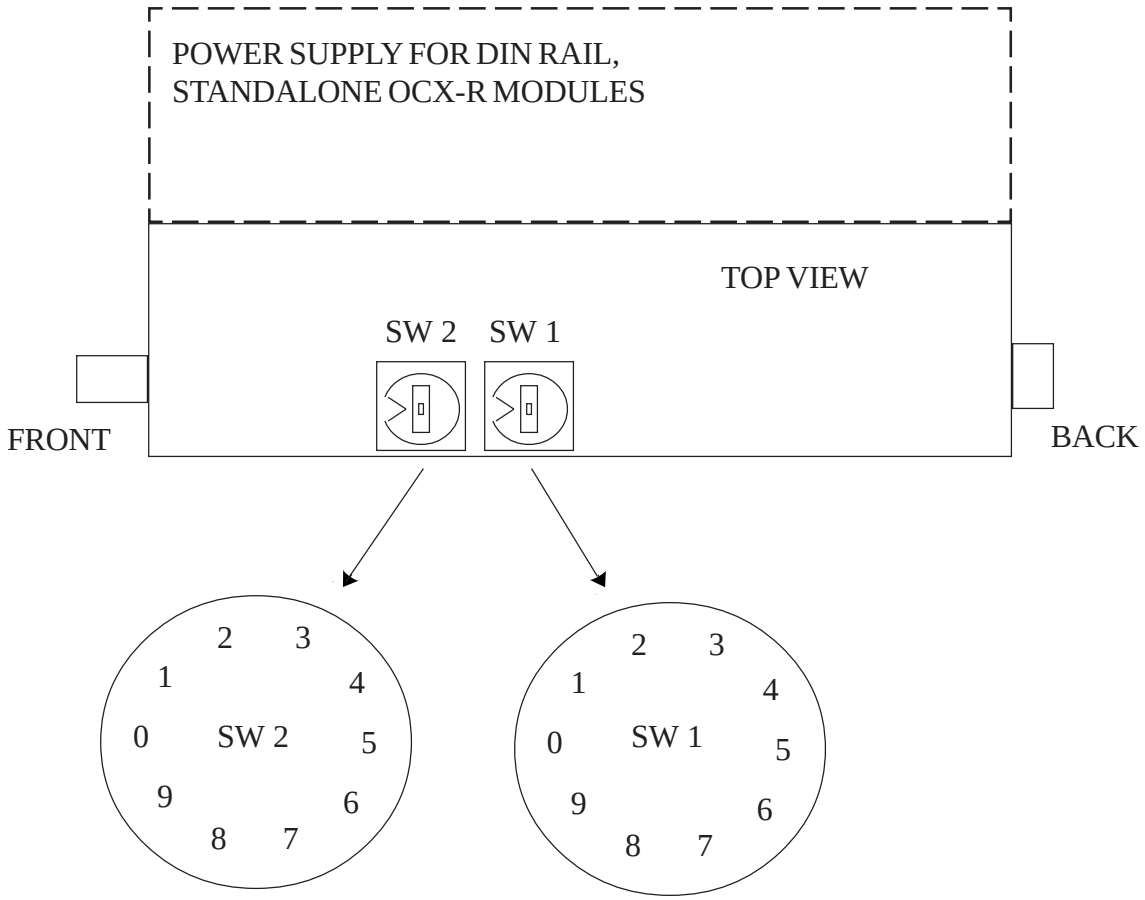
(4) See Chapter 2, Section 2.7 for Configuration Instructions.

(5) Unused switch positions are not allowed, and may not be selected on the dial.

(6) SW 2, VALUE 7 will disable Processor Write commuincation only, for the 1746 Plug-In OLC module. SW 2, VALUE 7 will disable Processor Read communication for the 1756 Plug-In OCX module.

1746 PLUG-IN OLC, 1756 PLUG-IN OCX, AND DIN RAIL, STANDALONE OCX-R DIAGNOSTIC/CONFIGURATION SELECT SWITCH DESIGNATIONS

TABLE 10



1746 PLUG-IN OLC, 1756 PLUG-IN OCX, AND DIN RAIL, STANDALONE OCX-R DIAGNOSTIC AND CONFIGURATION SWITCH DESIGNATIONS

FIGURE 13

1.3.3.6 DETECT AND LOCATE NETWORK FAILURES

Fiber optic network fault conditions are reported by 1771, 1746, and 1756 Plug-In fiber optic modules on diagnostic status bits 0 and 2... for fiber optic receive Channels A and B respectively (see Figures 11 and 12). Fault conditions are reported by Panelmount, Standalone OCM-P fiber optic modules on reed relay contact outputs on J4 connector pin #s 1,2 and 5,6... for fiber optic Channels A and B respectively. Fault conditions are reported by DIN Rail, Standalone OCX-R fiber optic modules on reed relay contact outputs on J3 connector pin #s 1,2 and 5,6... for fiber optic Channels A and B respectively. (Corresponding Diagnostic/Configuration Select Switches must be set to enable Processor Communication on all PLC chassis plug-in modules, and diagnostic relay outputs on all standalone modules.) If a fiber optic module detects a communication failure on the fiber optic receive data inputs on either Channel A or B (due to either a media failure or failure of an adjacent fiber module) it will assert the corresonding diagnostic status bit or contact output. These bits and contact outputs may be used to locate the precise fiber location where the failure is occurring.

1.3.3.7 TRAP-AND-HOLD, AND LOCATE INTERMITTENT NETWORK FAILURES

When a fiber optic communication failure occurs it normally causes the network to remain in a failed condition until the source of the failure is identified and corrected (solid failure). Diagnostic status bits on all plug-in fiber modules (bits 0 and 2), contact outputs on Panelmount, Standalone OCM-P fiber modules (J4 Pin#s 1,2 and 5,6), and contact outputs on DIN Rail, Standalone OCX-R fiber modules (J3 Pin#s 1,2 and 5,6) enable network maintenance personnel to quickly locate this type of failure. However, occasionally an intermittent communication failure may occur, causing the network to briefly fail and then automatically recover. This type of failure can be very difficult to locate because it does not remain in the failed condition long enough for maintenance personnel to locate the source of the problem.

In the factory default configuration, all Phoenix Digital fiber optic modules provide automatic recovery from communication failures. In Auto-Recovery Mode, Phoenix Digitals' fiber modules automatically detect, isolate, and correct communication failures by switching the network around points of failure, and then automatically restoring the network to its original configuration when the source of the failure(s) is corrected. However, as an alternative to Auto-Recovery Mode, Phoenix Digitals' fiber optic modules may be configured by the user for Trap Mode Operation. This configuration may be selected on Panelmount, Standalone OCM-P Modules by setting Diagnostic/ Configuration Select Switch SW4-4 ON (assert... Trap Mode Select); on DIN Rail, Standalone OCX-R Modules by setting Diagnostic/Configuration Select Switch SW2 to VALUE 5; on 1771 Plug-In OCM Modules by setting Diagnostic/Configuration Select Switch SW4-3 ON (assert... Enable Processor Write) and setting Diagnostic Control Byte, Bit 6 ON (assert... Trap Mode Select), or by setting Diagnostic/Configuration Select Switch SW4-4 ON (assert... Trap Mode Select); on 1746 Plug-In OLC Modules by setting Diagnostic Control Byte, Bit 6 ON

(assert... Trap Mode Select... assumes Processor Communication is Enabled), or by setting Diagnostic/Configuration Select Switch SW2 to VALUE 5; and on 1756 Plug-In OCX Modules by setting Diagnostic/Configuration Select Switch SW2 to VALUE 5. See Figures 11 and 12, and Tables 7, 9, and 10 for more information.

In Trap Mode, Phoenix Digital's fiber optic modules will continue to automatically detect, isolate, and correct communication failures, just as in Auto-Recovery mode. But when the source of the failures is corrected the Trap Mode fiber modules will NOT automatically restore the network to its original configuration. Instead, the network will remain trapped in the failed condition until the source of the failures is corrected AND the trapping fiber modules are reset. Thus, intermittent failures will be continuously trapped by the fiber modules (latched), providing maintenance personnel with the necessary time to locate and correct the source of the network failures.

When Trap Mode is selected the fiber optic modules must be initialized for network communications in the following manner:

1. Install and interconnect all fiber modules on the network with fiber optic cable, in the appropriate network configuration. (Note that if the fiber modules on the network are not properly interconnected with fiber optic cable, they will assume that the improper connection is an intermittent failure and trap the failure accordingly.)

2. Apply power to all of the fiber optic modules on the network. (At this point fiber optic modules configured for Trap Mode operation may indicate a failed condition on both channels... Ch A ERR, Ch B ERR).

3. Reset each Trap Mode fiber optic module on the network by either toggling the Trap Mode Reset bit in the Write Control Byte (1771 Plug-In OCMs and 1746 Plug-In OLC modules only), or by depressing the TM (Trap Mode) Pushbutton on the front of each Trap Mode fiber optic module. This will switch the Trap Mode fiber modules into an active, on-line, error free mode of operation, until such time as an intermittent communication failure occurs and the fiber module traps the failure. (See Figures 4, 5, 6,7, and 8 for the fiber module TM Pushbutton front panel designations.)

4. Trap Mode fiber optic modules may be subsequently reset (after trapping an intermittent failure) by either toggling the Trap Mode Reset bit (1771 Plug-In OCMs and 1746 Plug-In OLCs only) or by depressing the TM Pushbutton.

1.3.3.8 DETECT AND LOCATE IMPENDING NETWORK FAILURES (850nm AND 1300 nm MULTIMODE ONLY)

Phoenix Digitals' fiber optic modules provide the unique capability to detect impending optical communication faults on the fiber optic network before they actually occur. Impending Fault Monitoring may be selected on Panelmount, Standalone OCM-P Modules by setting Diagnostic/Configuration Select Switch SW4-8 ON (assert... Enable Impending Fault Detection); on DIN Rail, Standalone OCX-R Modules by setting Diagnostic/Configuration Select Switch SW2 to VALUE 3; on 1771 Plug-In OCM Modules by setting Diagnostic/Configuration Select Switch SW4-3 ON (assert... Enable Processor Write) and setting Diagnostic Control Byte Bit 2 ON (assert... Enable Impending Fault Detection), or by setting Diagnostic/Configuration Select Switch SW4-8 ON (assert... Enable Impending Fault Detection); on 1746 Plug-In OLC Modules by setting Diagnostic Control Byte Bit 2 ON (assert... Enable Impending Fault Detection... assumes Processor Communication is Enabled), or by setting Diagnostic/Configuration Select Switch SW2 to VALUE 3; and on 1756 Plug-In OCX Modules by setting Diagnostic/Configuration Select Switch SW2 to VALUE 3. See Figures 11 and 12, and Tables 7, 9, and 10 for more information.

The Impending Fault Initialization procedure may then be performed through the simple adjustment of two potentiometers, one per optical network communication channel, located on the front of the fiber optic modules (labeled "ISS" ... see front panel designations in Figures 4, 5, 6, 7, and 8). No meters, gauges, or any other type of electrical or optical measurement equipment is required for fiber module initialization. (Note: If the Receive Optical Signal Strength is too high, the optical input may have to be attenuated before proceeding with the Impending Fault Initialization Procedure. If the Receive Signal Strength is greater than -20 dbm, the input signal should be artificially attenuated to reduce the signal strength below this threshold, before attempting Impending Fault Detect Initialization. As an alternative, the user may wish to leave the Impending Fault Detect thresholds at the factory default settings of -26 dBm for the 850 nm wavelength, and -28 dBm for the 1300 nm wavelength.)

The fiber optic module Impending Fault Initialization procedure is accomplished by first connecting the module optical receive inputs to the optical transmit outputs of adjacent fiber module(s) (adjacent on the fiber optic network), with the actual fiber optic cable to be used in the final installation. (It is recommended that this initialization be accomplished post-installation in order to match the fiber module impending fault monitoring circuitry to the final communication link characteristics.) The adjacent fiber modules (adjacent on the fiber optic network) must be powered during the initialization process to provide a receive signal reference (communication data carrier) to the fiber optic module undergoing initialization. The fiber modules must be powered for at least 15 minutes prior to initialization in order to stabilize all internal references. (The initialization procedure may also be performed on-line with actual network data transmissions, and will be totally transparent to network operation.) While visually observing the ISD/ID indicators on the front of the fiber optic module the

ISS (Initial Signal Set) potentiometers should be turned clockwise if the corresponding green ISD/ID indicators are off, or counterclockwise if they are on, until the ISD/ID indicators switch state (either turning on to off, or off to on). Then, as the final step, the Initial Signal Set potentiometers should be turned 1/4 turn clockwise, at which point the corresponding ISD/ID indicators should be maintained continuously on.

The fiber module initialization procedure normalizes the impending fault monitoring detection thresholds to the attenuation characteristics of the final network installation. (It should be noted that the ISD/ID indicators may occasionally flash on or off, or turn off entirely over time. This is a normal operating condition and should be ignored post installation.) After initialization, any optical network fault condition which causes the optical network receive power level to drop by more than 3.0 decibel-milliwatts (optical power dBm) relative to the initialization power level will cause the corresponding Impending Fault Detect (IFD/IF) indicator (red) to illuminate, and will be reported on the corresponding Diagnostic Status Bit(s) or Relay Output(s). (Note that both ID and IF are the given on the same indicator for 1746 Plug-In OLC modules, 1756 OCX Plug-In OCX modules, and DIN Rail, Standalone OCX-R modules. For ID the indicator changes between green and off, and for IF the indicator changes between red and off.)

No additional calibration adjustments will be required for the lifetime of the network installation, unless the network characteristics are changed. Changes affecting either the optical characteristics of the network media (media replacement, splice, new terminations, etc.), or replacement of one or more fiber optic modules will require that the initialization procedure be repeated for each fiber module which has one or more of its' optical network receive inputs affected by the change. (The initialization procedure may be done on-line, post installation, and will not affect real time network data transmissions.)

Impending fiber optic network fault conditions are reported by 1771 Plug-In OCMs, 1746 Plug-In OLCs, and 1756 Plug-In OCXs on Diagnostic Status Bits 1 and 3... for fiber optic receive Channels A and B respectively (see Figures 11 and 12). Impending Fault conditions are reported by Panelmount, Standalone OCM-P modules through reed relay contact outputs on J4 connector pin #s 3,4 and 7,8... for fiber optic channel A and B respectively, and by DIN Rail, Standalone OCX-R modules through reed relay contact outputs on J3 connector pin #s 3,4 and 7,8... for fiber optic channel A and B respectively (see Table 8). (Corresponding Diagnostic/Configuration Select Switches must be set to enable Processor Communication on all PLC chassis plug-in modules, and diagnostic relay outputs on all standalone modules.) If a fiber module detects an impending communication failure on the fiber optic receive data inputs on Channel A and/or B (due to either media failure or failure of an adjacent fiber module) it will assert the corresponding diagnostic status bit or relay output. These bits and relay outputs may be used to locate the precise fiber location where the failure is occurring. (Note: Impending Fault Monitoring is only available on 850 nm and 1300 nm multimode fiber optic modules.)

1.3.3.9 SIMULATE NETWORK FAULT CONDITIONS

After a fault tolerant fiber optic communication network becomes operational it is important to verify the network is correctly configured for fault managment. This may be done by deliberately introducing single points of failure throughout the network and verifying communication continuity after each failure.

Fiber optic network faults may be simulated by forcing errors on the Channel A or B transmit outputs. Simulation of fiber optic channel errors may be accomplished on 1771 Plug-In OCMs by either setting ON (assert) Diagnostic/Configuration Select Switches SW4-6 and SW4-5, or by setting ON (assert) Diagnostic Write Control Byte Bits 4 and 5... for fiber optic channels A and B respectively (see Figure 11 and Table 9). Simulation of fiber optic channel errors may be accomplished on 1746 Plug-In OLCs by selecting Diagnostic/Configuration Select Switch 2 (SW2) VALUES 8 or 9, or by setting ON (assert) Diagnostic Write Control Byte Bits 4 and 5... for fiber optic channels A and B respectively (see Figure 11 and Table 10). Simulation of fiber optic channel errors may be accomplished on 1756 Plug-In OCXs by selecting Diagnostic/Configuration Select Switch 2 (SW2) VALUES 8 or 9 (see Figure 12 and Table 10). Simulation of fiber optic channel errors may be accomplished on Panelmount, Standalone OCM-P modules by setting ON (assert) Diagnostic/Configuration Select Switches SW4-6 and SW4-5... for fiber optic channel A and B respectively (see Figure 4 and Table 7), and on DIN Rail, Standalone OCX-R modules by selecting Diagnostic/Configuration Select Switch SW2-8 or SW2-9... for fiber optic channel A and B respectively (see Figure 12 and Table 10). (Corresponding Diagnostic/Configuration Select Switches must be set to enable Processor Communication on all PLC chassis plug-in modules, and diagnostic relay outputs on all standalone modules.)

1.3.3.10 OPTICAL POWER METERING ("-D" OPTION... 850 nm and 1300 nm MULTIMODE ONLY)

Phoenix Digital fiber optic modules provide two analog outputs (one per optical network receive input), proportional to the receive optical signal strength at the module, for optical power measurement. These two analog outputs provide an absolute +DC voltage representation of the optical power level or Receive Signal Strength (RSS) for each network receive input. Panelmount, Standalone OCM-P modules and 1771 Plug-In OCM modules provide these two voltage outputs on J1 Connector Pin #s 1, 2, and 3. (See Figures 4 and 5, and Table 11 for OCM module Device Interface J1 Connector Pin Definitions.) These same two analog outputs are provided on the RSS Test Jacks on 1746 Plug-In OLC modules, 1756 Plug-In OCX modules, and DIN Rail, Standalone OCX-R modules (see Figures 6, 7, and 8).

J1 CONNECTOR PIN NUMBERS[1]	RECEIVE OPTICAL SIGNAL STRENGTH SIGNAL NAME
1	Ch A Receive Signal Strength (RSS)
2	RSS Signal Ground
3	Ch B Receive Signal Strength
4	NC (No Connection)
5	NC (No Connection)
6	NC (No Connection)
7	NC (No Connection)
8	NC (No Connection)

(1) Orientation - Top to bottom on front of module (Pins 1 thru 8 respectively). (Note: All unused connector screw terminals should be fully seated and not connected to any external devices.)

PANELMOUNT, STANDALONE OCM-P AND 1771 PLUG-IN OCM RECEIVE SIGNAL STRENGTH PIN DEFINITIONS

TABLE 11

RSS outputs are buffered for increased drive current capability. RSS output specifications are the following:

Linear Outputs (ChA RSS, ChB RSS)

Voltage Range (V_{out}) = 0 to 3.5 VDC
Drive Current (I_{out}) = 20 ma (max)

See Table 12 for corresponding values of RSS Voltage Out vs Receive Optical Power-In at both the 850nm and 1300 nm wavelengths (multimode only).

RSS V (OUT) (1)	OPTICAL POWER IN (dBm @ 850nm, MULTIMODE)	OPTICAL POWER IN (dBm @ 1300nm, MULTIMODE)
3.5	-18.0	-20.0
3.0	-18.6	-21.0
2.5	-19.4	-21.9
2.0	-20.4	-23.3
1.5	-22.0	-24.5
1.0	-24.0	-27.0
0.5	-28.0	-33.0
0.3	-33.2	

(1) Proportional Accuracy: $^{+}/_{-}$ 0.3 volt

NETWORK OPTICAL POWER-IN VERSUS RSS VOLTAGE-OUT (ANALOG)

TABLE 12

RSS Return connection is provided on the Panelmount, Standalone OCM-P and 1771 Plug-In OCM J1 connector (Pin #2... RSS Signal Ground), and on the 1746 Plug-In OLC, 1756 Plug-In OCX, and DIN Rail, Standalone OCX-R test jacks directly adjacent to the Signal Ground symbol. It is recommended that RSS Return/Signal Ground be used as the common mode reference for RSS analysis. (It can also be used as the negative signal reference for differential analysis of RSS.)

Since the RSS diagnostic outputs are active outputs the user must insure electrical compatibility before connection to any external device. (Note: Optical Power Metering is only available on 850 nm and 1300 nm multimode fiber optic modules, with the "-D" diagnostic option.)

1.3.4 POWER SUPPLY AND GROUNDING SPECIFICATIONS

1.3.4.1 PANELMOUNT, STANDALONE OCM-P AND DIN RAIL, STANDALONE OCX-R POWER SUPPLY AND GROUNDING SPECIFICATIONS

Standalone OCM-P modules and OCX-R modules may be operated from a 24 VDC, 120/220 VAC, or 125 VDC input power source (subject to Power Option specified at time of ordering... see Ordering Information). An Auxiliary 24 VDC, 120/220 VAC, or 125 VDC power supply is attached to the side of the Panelmount, Standalone OCM-P and DIN Rail, Standalone OCX-R enclosures.

The OCM-P Auxiliary Power Supply P2 Connector is hardwired at the factory to the Base Enclosure J5 connector. This cable brings the necessary regulated power supply voltages from the Auxiliary Power Supply module into the base of the OCM-P electronics. This cable should never be removed or modified in any way. Also, no other connection should be made to either the OCM-P P2 or J5 connectors.

1.3.4.1.1 AUXILIARY POWER SUPPLY SPECIFICATIONS

The Auxiliary Power Supply module must be ordered as an option to the Panelmount, Standalone OCM-P and DIN Rail, Standalone OCX-R modules (attached to the side of the OCM-P and OCX-R modules, as shown in Figures 4 and 8).

Table 13 provides input power pin definitions for the Auxiliary Power Supply Pl barrier strip, for the 24 VDC Power Supply Option (see Figures 4 and 8).

P1 BARRIER STRIP PIN DESIGNATION	SIGNAL NAME (PIN DEFINITION)
+24V	24 VDC
-24V	24 VDC Return
C-GND	Chassis Ground

24 VDC INPUT BARRIER STRIP PIN DEFINITIONS

TABLE 13

24 VDC Power Supply Requirements (Specified at the 24 VDC, 24 VDC Return Input Power Connections on the Panelmount, Standalone OCM-P and DIN Rail, Standalone OCX-R connectors):

Input Voltage Range	:	18 VDC to 30 VDC
OCM-P Input Current	:	0.6 Amps
OCX-R Input Current	:	0.5 Amps
Regulation (Load and Line)	:	0.6% (min)
Fuse (1)	:	2 AMP, 250 VAC SLO BLO (0.8 inch/20 millimeter)

(1) The fuse is mounted on the internal printed circuit board of the Auxiliary Power Supply. For fuse access the user must remove the Auxiliary Power Supply from the left side of the Panelmount, Standalone OCM-P enclosure, or the cover from the left side of the DIN Rail, Standalone OCX-R enclosure.

Table 14 provides input power pin definitions for the Auxiliary Power Supply Pl barrier strip for the 120/220 VAC Power Supply Option (See Figures 4 and 8).

P1 BARRIER STRIP PIN DESIGNATION	SIGNAL NAME (PIN DEFINITION)
L1	AC Power In (High Line)
L2	AC Power In (Neutral)
⏚ (OCM-P)	Chassis Ground
C-GND (OCX-R)	Chassis Ground

120/220 VAC INPUT BARRIER STRIP PIN DEFINITIONS

TABLE 14

120/220 VAC Power Supply Requirements (Specified at the L1, L2 Input Power Connections on the Panelmount, Standalone OCM-P and DIN Rail, Standalone OCX-R connectors):

Input Voltage Range	:	85 VAC to 264 VAC
Input Frequency Range	:	47 Hz to 440 Hz
Conducted RFI (Input Line Filter)	:	FCC limit B and VDE limt A
Hold-Up Time	:	12 milliseconds
OCM-P Power Consumption UL, CSA, VDE Approved	:	15 watts (approximate)
OCX-R Power Consumption UL, CSA, VDE Approved	:	10 watts (approximate)
Fuse (1)	:	2 AMP, 250 VAC, SLO BLO (0.8 inch/20 Millimeter)

(1) The fuse is mounted on the internal printed circuit board of the Auxiliary Power Supply. For fuse access the user must remove the Auxiliary Power Supply from the left side of the Panelmount, Standalone OCM-P enclosure, or the cover from the left side of the DIN Rail, Standalone OCX-R enclosure.

Table 15 provides input power pin definitions for the Auxiliary Power Supply Pl Barrier Strip for the 125 VDC Power Supply Option (See Figures 4 and 8):

P1 BARRIER STRIP PIN DEFINITIONS	SIGNAL NAME (PIN DEFINITION)
+125V	125 VDC In
-125V	125 VDC Return
C-GND	Chassis Ground

125 VDC INPUT BARRIER STRIP PIN DEFINITIONS

TABLE 15

125 VDC Power Supply Requirements (Specified at the 125V, 125V Return Input Power Connections on the Panelmount, Standalone OCM-P and DIN Rail, Standalone OCX-R connectors):

Input Voltage Range	:	120 VDC to 370 VDC
OCM-P Power Consumption UL, CSA, VDE Approved	:	15 watts (approximate)
OCX-R Power Consumption UL, CSA, VDE Approved	:	15 watts (approximate)
Fuse [1]	:	2 AMP, 250 VAC, SLO BLO (0.8 inch/20 millimeter)

(1) The fuse is mounted on the internal printed circuit board of the Auxiliary Power Supply. For fuse access the user must remove the Auxiliary Power Supply from the left side of the Panelmount, Standalone OCM-P enclosure, or the cover from the left side of the DIN Rail, Standalone OCX-R enclosure.

1.3.4.2 1771 PLUG-IN OCM POWER SUPPLY SPECIFICATIONS

Backplane (system chassis) power supply requirements for 1771 Plug-In OCMs are the following:

Input Voltage [1]	:	5 VDC
Input Current [1]	:	1.9 Amps

(1) Supplied by 1771 Chassis Power Supply

1.3.4.3 1746 PLUG-IN OLC AND 1756 PLUG-IN OCX POWER SUPPLY SPECIFICATIONS

Backplane (system chassis) power supply requirements for 1746 Plug-In OLCs and 1756 OCXs are the following:

Input Voltage [1]	:	5 VDC
Input Current [1]	:	1.5 Amps

(1) Supplied by 1746/1756 Chassis Power Supply

1.3.4.3 ELECTRICAL GROUNDING

The Panelmount, Standalone OCM-P and DIN Rail, Standalone OCX-R enclosures must be electrically connected to earth ground. This may be accomplished by connecting the Chassis Ground on the Auxiliary Power Supply connector to earth ground, or by attaching a ground electrode directly to the chassis or module cover. To ensure a good electrical connection between the ground lug and the module, remove paint from the cover where the lug makes contact. Connect the ground lug to earth ground with an adequate grounding electrode.

1.3.5 MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

FIBER OPTIC MODULE DIMENSIONS :

Panelmount, Standalone OCM-P Module	:	10.38” H x 3.50” W x 6.14” D (26.37 cm H x 8.89cm W x 15.60 cm D)
DIN Rail, Standalone OCX-R Module	:	6.70” H x 3.18” W x 5.85” D (17.8 cm H x 8.1 cm W x 14.9 cm D)
1771 Plug-In OCM Module	:	Single slot, 1771 Chassis Installation.
1746 Plug-In OLC Module	:	Single slot, 1746 Chassis Installation.
1756 Plug-In OCX Module	:	Single slot, 1756 Chassis Installation.

FIBER OPTIC MODULE ENVIRONMENTAL SPECIFICATIONS :

Temperature	:	Operating 0° to 60°C Storage -40°C to +85°C
Relative Humidity	:	0 to 95% (non-condensing)

CHAPTER 2

CONFIGURATION AND INSTALLATION INSTRUCTIONS

This chapter provides preparation for use and installation instructions (including unpacking and inspection instructions), and a functional description of indicators, diagnostics and configuration instructions.

2.1 UNPACKING INSTRUCTIONS

All Phoenix Digital fiber optic modules are shipped from the factory in shock absorbing materials. Remove the fiber modules from the packing material and refer to the packing list to verify that all items are present. Save the packing materials for future storage or reshipment.

NOTE: If the shipping carton is damaged upon receipt, request that the carrier's agent be present while the unit is being unpacked and inspected.

2.2 INSPECTION PROCEDURE

Fiber optic modules should be inspected visually for damage upon removal from the shipping container.

2.3 INSTALLATION MOUNTING PROCEDURE

Panelmount, Standalone OCM-P modules and DIN Rail, Standalone OCX-R modules should be mounted per the mounting specifications provided in Figures 4 and 8. All Phoenix Digital fiber optic modules are convection cooled, requiring no fan or forced air cooling. An unobstructed air space must be maintained above and below the fiber modules (6 inches minimum) to insure adequate convection airflow. The air at the bottom of the fiber optic module may not exceed 60 degrees celsius (140 degrees F).

The user should follow Allen-Bradley Installation and Mounting Procedures for 1771, 1746, and 1756 Chassis Installation... for 1771 Plug-In OCM, 1746 Plug-In OLC, and 1756 Plug-In OCX modules.

2.4 DIAGNOSTIC STATUS INDICATOR DEFINITION

2.4.1 PANELMOUNT, STANDALONE OCM-P MODULES AND 1771 PLUG-IN OCM MODULES. (REFERENCE FIGURES 4 AND 5 FOR OPTICAL MODULE NOMENCLATURE AND DESIGNATIONS).

(i) Tx, Rx (local)
- Illuminates flashing alternately green/red during power-up reset (approx. 5 seconds), or if module has no active fiber and coax connections.
- Illuminates continuous green during normal operation (network continuously passing data thru the J2 connector)
- Indicator is off if unit is not powered
- Illuminates flashing green/off if experiencing temporary network errors.
- Illuminates flashing red/off if experiencing a high level of network errors, or if there is no network activity (no network data passing thru the J2 connector).

(ii) ACT (Ch A, B Active) - Illuminates green when the corresponding optical network receive input is receiving a valid data or carrier frequency. (Note that in dual ControlNet channel, ring topology network configurations using Fault Tracking, when a network fault is detected by one OCM and passed to the second OCM thru the Fault Tracking cable, the tracking OCM ACT indicator will turn off, but no ERR indicator will be given on that OCM.)

(iii) ISD (ChA, B Initial Signal Detect) - Illuminates green when the corresponding optical network receive input is initialized for Impending Fault Detection (see Section 1.3.3.8 for Initialization Procedure).

(iv) IFD (ChA, B Impending Fault Detect) - Illuminates red when the corresponding optical network receive input power level drops 3.0 decibel-milliwatts (optical dBm) below the Initial Signal Strength (see Section 1.3.3.8 for Initialization Procedure).

(v) ERR (ChA, B Communication Error) - Illuminates red when the corresponding optical network receive input fails to detect a valid data or carrier frequency.

2.4.2 1746 PLUG-IN OLC MODULES, 1756 PLUG-IN OCX MODULES, AND DIN RAIL, STANDALONE OCX-R MODULES. (REFERENCE FIGURES 6, 7, AND 8 FOR FIBER OPTIC MODULE NOMENCLATURE AND DESIGNATIONS.)

(i) Local Tx, Rx
- Illuminates flashing alternately green/red during power-up reset (approx. 5 seconds), or if module has no active fiber and coax connections.
- Illuminates continuous green during normal operation (network continuously passing data thru the J2 connector)
- Indicator is off if unit is not powered.
- Illuminates flashing green/off if experiencing temporary network errors.
- Illuminates flashing red/off if experiencing a high level of network errors, or if there is no network activity (no network data passing thru the J2 connector).

(ii) OK... 1746 OLC and 1756 OCX Plug-In Modules Without Diagnostic Option - Illuminates continuous green when the module is powered.
OK... 1746 OLC Plug-In Module With Diagnostic Option - Illuminates continuous green when the module is powered.
OK... 1756 OCX Plug-In Module With Diagnostic Option -
Illuminates flashing red when previously established communication with the OCX I/O module slot has timed out.
Illuminates continuous red during reset condition.
Illuminates flashing green when the OCX I/O module slot is not correctly configured, or is not actively controlled by a system processor.
Illuminates continuous green during normal operation.
OK... DIN Rail, Standalone OCX-R Module -
Illuminates continuous green when the module is powered.

(iii) Ch A, B AC/ER for OLC; Ch A, B ACT/ERR for OCX (-R) (Ch A, B Active/Error) - Illuminates green when the corresponding optical network receive input is receiving a valid data or carrier frequency. Illuminates red when the corresponding optical network receive input fails to detect a valid data or carrier frequency. (Note that in dual ControlNet channel, ring topology network configurations using Fault Tracking, when a network fault is detected by one fiber optic module and passed to the second fiber module thru the Fault Tracking cable, the tracking fiber module ACT indicator will turn off, but no ERR indicator will be given on that fiber module.)

(iv) Ch A, B ID/IF for OLC; Ch A, B ISD/IFD for OCX (-R) (ChA, B Initial Signal Detect/Impending Failure Detect) - Illuminates green when the corresponding optical network receive input is initialized for Impending Fault Detection. Illuminates red when the corresponding optical network receive input power level drops 3.0 decibel-milliwatts (optical) below the Initial Signal Strength (see Section 1.3.3.8 for Initialization Procedure).

2.5 INITIAL SIGNAL SET POTENTIOMETERS AND TRAP MODE PUSHBUTTON

(i) ISS (Initial Signal Set Potentiometers) - Initializes Impending Fault Detection thresholds for the corresponding optical network receive inputs (see Section 1.3.3.8 for Initialization Procedure)

(ii) TM (Trap Mode Pushbutton) - Resets Trap Mode operation (see Section 1.3.3.7 for Trap Mode Initialization Procedure).

2.6 DIAGNOSTIC STATUS OUTPUT CONNECTIONS

(i) IFD (ChA, B Impending Fault Detect... Panelmount, Standalone OCM-P Modules and DIN Rail, Standalone OCX-R Modules) - Switches ON (closed contact) when the corresponding optical network receive input power level drops 3.0 decibel-milliwatts (optical) below the initial signal strength (see Section 1.3.3.8 for Initialization Procedure). (Diagnostic/Configuration Select Switches must be set to enable diagnostic relay outputs.)

(ii) ERR (ChA, B Communication Error... Panelmount, Standalone OCM-P Modules and DIN Rail, Standalone OCX-R Modules) - Switches ON (closed contact) when the corresponding optical network receive input fails to detect valid data communications. (Diagnostic/Configuration Select Switches must be set to enable diagnostic relay outputs.)

(iii) RSS (ChA, B Receive Signal Strength) - Provides a linear voltage representation (analog - scaled from 0 to 3.5 VDC) for the corresponding optical network receive input.

2.7 CONFIGURATION INSTRUCTIONS

2.7.1 FIBER OPTIC MODULE CONFIGURATION INSTRUCTIONS

Each fiber optic module must be configured (switch selectable) prior to installation.

Configuration Switch locations are identified on the overview of the fiber optic modules depicted in Figures 10 and 13. Specifications detailing fiber optic module Network Configuration Switch designations are provided in Tables 7, 9, and 10.

2.7.1.1 FIBER OPTIC MODULE REPEATER OPERATION

All Phoenix Digital fiber optic modules function as active fiber optic repeaters on the ControlNet fiber optic network. Each fiber module serves to both restore and resynchronize the ControlNet data on the fiber optic network. Therefore, ControlNet fiber modules may be daisy-chained and/or cascaded together over virtually any network distance, subject only to the maximum overall network distance limitations of the ControlNet protocol itself (approximately 16 miles/25 kilometers).

The maximum distance allowed between adjacent fiber modules on the ControlNet fiber optic network is a function of optical attenuation (loss) only... which is caused by optical connectors, series optical couplers, splices and/or the fiber cable itself. If the actual distance between adjacent fiber modules is greater than the maximum allowable distance on one or more points on the ControlNet network (due to optical attenuation), the user should consider upgrading to a more powerful version of the fiber optic module (1300 nm/1550 nm multimode or 1300 nm/1550 nm singlemode). However, as an alternative to upgrading the module's optical interface, an additional fiber module may be inserted into the network and used as a standalone fiber optic repeater, without making any type of connection to the fiber module ControlNet interface (J2). In this case, the fiber optic module will serve as a fiber network repeater only, extending the maximum allowable distance between adjacent locations on the network. When fiber modules are used as standalone fiber optic repeaters, with no electrical connection to the ControlNet interface, the fiber module ControlNet Interface (J2 Connector) must be disabled. On Panelmount, Standalone OCM-P and 1771 Plug-In OCM modules Switch 4, Position 7 should be switched ON to disable the fiber module ControlNet Interface for fiber optic repeater operation. On 1746 Plug-In OLC modules, 1756 Plug-In OCX modules, and DIN Rail, Standalone OCX-R modules Diagnostic/Configuration Select Switch 2 (SW2) should be set to VALUE 4 to disable the fiber module ControlNet Interface, for fiber optic repeater operation.

2.7.1.2 FIBER OPTIC MODULE MASTER/SLAVE CONFIGURATION

One pair of fiber optic modules, located at logically adjacent locations on the fiber optic network, must be switch configured to be Network Master modules. One of these modules will serve as the Master for fiber optic network Channel A (Ch A Transmit Master), and the other for Channel B (Ch B Transmit Master). These Master modules provide data management and control throughout the fiber optic network. [In tree (combinaton ring, bus/star) network topologies, each fiber network segment must have one Ch A Transmit Master and one Ch B Transmit Master.] The two Master fiber optic modules must be connected together, adjacent on fiber optic ring topology networks, and may either be adjacent or at opposite ends of fiber optic bus topology networks. When the two Master fiber optic modules are at adjacent locations on the network, the Ch A Master Ch A transmit output must be connected to the Ch B Master Ch A receive input. Similarly, the Ch B Master Ch B transmit output must be connected to the Ch A Master Ch B receive input. When the two Master fiber optic modules are located at opposite ends of a fiber optic bus topology network, the Ch A Master Ch A transmit output and Ch B receive input should not be connected to any other fiber optic module. Similarly, the Ch B Master Ch B transmit output and Ch A receive input should not be connected to any other fiber optic module. All other fiber optic modules on the network must be configured as Slaves. Examples of fiber optic module Master/Slave configurations in ring topology network configurations are illustrated in Figures 2 and 3. Fiber optic module Master/Slave Selection switch configuration instructions are provided in Tables 7, 9, and 10. (Note that in the event of failure of either of the two Master fiber optic modules in a fault tolerant ring topology network configuration, the remaining Master fiber module will assume network management of both fiber optic channels. Communication continuity will be maintained throughout the network.)

2.7.2 ControlNet NETWORK CONFIGURATION INSTRUCTIONS

The user must configure the ControlNet “RS NetWorx” software to match the physical characteristics of each ControlNet network link, before the network link can become operational. Network Configuration may be done starting from the “RS NetWorx” main screen by first selecting the “Network” pull-down menu, and then selecting “Properties”. This chapter provides the user with guidelines for specifying fiber optic network parameters in “RS NetWorx - Network - Properties.”

The “RS NetWorx - Network - Properties” screen requires the user to configure a variety of options pertaining to the physical and link layer characteristics of the ControlNet network. Guidelines for configuring “Media Redundancy”, “Media Configuration”, and “Network Update Time” (NUT) options are given below. All other “RSNetWorx - Network - Properties” options must be configured to comply with standard ControlNet network configuration guidelines provided by Rockwell Allen-Bradley.

To configure “Media Redundancy” on the “RSNetWorx - Network - Properties” screen, select the “Network Parameters” tab. Under “Network Parameters” the “Media Redundancy”option must be configured to match the ControlNet Channel A and/or B network configuration. If ControlNet Channel A only is used, then “A Only” must be selected. If ControlNet Channel B only is used, then “B Only” must be selected. (The ControlNet “Media Redundancy” option is NOT related in any way to the redundancy provided by fiber optic modules. Phoenix Digital’s fiber optic modules provide network redundancy when configured in a ring topology, on a single ControlNet channel. In the case of a single ControlNet channel redundant fiber optic network configuration, the “Media Redundancy” option must be selected to be either “A Only” or “B Only” (whichever ControlNet channel is used), but not both (“A/B”).) If both ControlNet Channels A and B are used and fiber optic modules are provided on both ControlNet channels A and B in parallel, then “A/B” must be selected for network redundancy. (Examples where both ControlNet channels are used are given in Figure 3.)

To configure “Media Configuration” on the “RSNetWorx - Network - Properties” screen, select the “Media Configuration” tab. The “Media Configuration” options must be selected to match the physical layer requirements of the coax/fiber optic ControlNet network. This part of the configuration “teaches” the ControlNet network management software the worst case network time latency resulting from network propagation thru the physical media. This configuration should normally be performed thru the use of an Electronic Data Sheet (EDS) provided by Phoenix Digital and Rockwell Allen-Bradley, with real time parameters defining characteristics unique to the Phoenix Digital products. However, as of the date of publication of this document, the Phoenix Digital EDS is not yet available. Therefore, the necessary ControlNet network time latency configuration must be configured thru emulation of existing Allen-Bradley network parameters. The “Media Configuration” parameters which must be configured include the following:

a) “1786 Hub Starter Block” (integer quantity)
b) “1786 Medium Distance Fiber Module” (integer quantity)
c) “RG6 Coax Cable” (length in meters)
d) “Glass Fiber Cable” (length in meters)

The methodology for determining the correct configuration parameter for each of these “Media Configuration” options is dependent upon the physical network topology (installation configuration). Table 16 provides the methodology for determining the correct configuration parameter for each of these ControlNet configuration options.

NETWORK TOPOLOGY (CONFIGURATION) [9]	MEDIA CONFIGURATION
Ring, Bus, Point-to-Point	1786 Hub Starter Block = 2 1786 Medium Distance Fiber Module = 2 RG6 Coax Cable = c_1 [1] + c_2 [2] Glass Fiber Cable = f [3] + (n [4] x 340) + 1,000
Star	1786 Hub Starter Block = 2 1786 Medium Distance Fiber Module = 2 RG6 Coax Cable = $c_1 + c_2$ Glass Fiber Cable = f_{r1} [5] + f_{r2} [6] + 2,360
Tree (Hybrid Ring/Bus And Star)	1786 Hub Starter Block = 2 1786 Medium Distance Fiber Module = 2 RG6 Coax Cable = $c_1 + c_2$ Glass Fiber Cable = $f_{r1} + f_{r2}$ + (n_{r1} [7] x 340) + (n_{r2} [8] x 340) + 1,000

(1) c_1 = Longest Coax Segment Length from any fiber optic module (meters)
(2) c_2 = Second Longest Coax Segment Length from any fiber optic module (meters)
(3) f = Overall Fiber Network Distance (meters)
(4) n = Number of fiber optic modules
(5) f_{r1} = Length of Network Segment from Hub to furthest remote
(6) f_{r2} = Length of Network Segment from Hub to second furthest remote
(7) n_{r1} = Largest Number of fiber modules on any one Network Segment
(8) n_{r2} = Second Largest number of fiber modules on any one Network Segment
(9) Consult factory for more information on “Media Configuration” guidelines for other network configurations, hybrid topologies, etc.

ControlNet SYSTEM SOFTWATE CONFIGURATION
(“MEDIA CONFIGURATION”)

TABLE 16

To configure “Network Update Time” (NUT) on the “RSNetWorx - Network - Properties” screen, select the “Network Parameters” tab. The “Network Update Time” (NUT) defines the repetitive time interval in which data can be sent on the ControlNet Network. The “RS NetWorx - Network Properties” default value for the NUT is set to 5 milliseconds. However, the NUT can be set by the User to any integer value from 2 to 100 milliseconds. The User should consult Rockwell Allen-Bradley ControlNet network configuration guidelines for defining the optimum value for NUT.

In certain long distance, high node count fiber optic ControlNet network configurations, the NUT may have to be increased to accomodate the worst case sequential node, media propagation delay. The maximum amount of additional time the NUT may have to increase, attributed to the fiber optic media physical layer only, may be determined by the following equation:

$$NUT^{(1)}_{(Total)} = NUT^{(2)} + [(\#\ ControlNet\ Devices)^{(3)} \times (Overall\ Network\ Distance)^{(4)} \times .000005\ ]$$

(1) Total NUT in milliseconds.

(2) NUT without media delay, in milliseconds (See Rockwell Allen-Bradley network configuration guidelines)

(3) Includes both “Scheduled” and “Unscheduled” devices.

(4) “RG6 Coax Cable” + “Glass Fiber Cable”, in meters (See Table 16)

(The additional media delay of the fiber optic network should be negligable relative to the default time value of the NUT in most ControlNet network configurations.)

The following examples are provided to assist in applying Table 16 in typical fiber optic ControlNet network configurations.

EXAMPLE 1

Network : Fault Tolerant ring (loop) with 12 fiber optic modules daisy-chained together, with 2,460 feet (1 meter = 3.281 feet; 2,460 feet = 750 meters) of fiber between each pair of adjacent fiber modules, and 10 meters of coax cable at each location.

ControlNet "Media Configuration":

1786 Hub Starter Block	=	2
1786 Medium Distance Fiber Module	=	2
RG6 Coax	=	10 + 10 = 20 meters
Glass Fiber Cable	=	9,000 + (12 x 340) + 1,000 = 14,080 meters

EXAMPLE 2

Network : Bus with 8 fiber optic modules daisy-chained together, with 6,890 feet (2,100 meters) of fiber between each pair of adjacent fiber modules, and a maximum of 100 meters of coax cable at two different locations.

ControlNet "Media Configuration":

1786 Hub Starter Block	=	2
1786 Medium Distance Fiber Module	=	2
RG6 Coax	=	100 + 100 = 200 meters
Glass Fiber Cable	=	(7 x 2,100) + (8 x 340) + 1,000 = 18,420 meters

EXAMPLE 3

Network : Star (Radial) topology with 6 fiber optic modules bussed together at the hub using ControlNet coax wire, and 6 remote sites... each with a fiber module connected to a corresponding hub fiber module via fiber. Two furthest remote sites are 4,921 feet (1,500 meters) and 6,562 feet (2,000 meters) from the hub location. The two longest coax segments are 500 meters each.

ControlNet "Media Configuration" :

1786 Hub Starter Block	=	2
1786 Medium Distance Fiber Module	=	2
RG6 Coax	=	500 + 500 = 1,000 meters
Glass Fiber Cable	=	1,500 + 2,000 + 2,360 = 5,860 meters

EXAMPLE 4

Network : Tree with 3 Fault Tolerant Ring networks which are interconnected with 3 fiber optic modules... bussed together at a hub location using ControlNet coax wire. Two of the rings have 4 fiber modules each and the third has 5, with 1,312 feet (400 meters) of fiber between each pair of adjacent fiber modules on all 3 rings. All coax segments are 10 meters long.

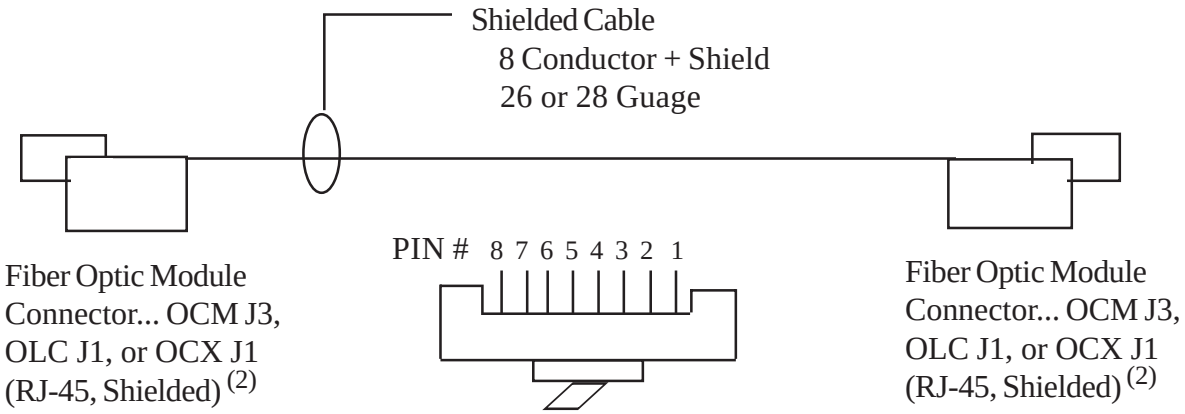
ControlNet "Media Configuration":

1786 Hub Starter Block	=	2
1786 Medium Distance Fiber Module	=	2
RG6 Coax	=	10 + 10 = 20 meters
Glass Fiber Cable	=	1,600 + 2,000 + (4 x 340) + (5 x 340) + 1,000 = 7,660 meters

Consult factory for more information on software configuration guidelines for other network configurations, hybrid topologies, etc.

APPENDIX A

FIBER OPTIC MODULE FAULT TRACKING CABLE DRAWING (OCM-CBL-TF-(10))



RJ45 Connector Orientation (Front End View)

Ch A Fiber Module Connector Pin Number	Ch B Fiber Module Connector Pin Number	Signal Name
1	3	OCM (A) to OCM (B) ChA Err +
2	4	OCM (A) to OCM (B) ChA Err -
3	1	OCM (B) to OCM (A) ChA Err +
4	2	OCM (B) to OCM (A) ChA Err -
5	7	OCM (A) to OCM (B) ChB Err +
6	8	OCM (A) to OCM (B) ChB Err -
7	5	OCM (B) to OCM (A) ChB Err +
8	6	OCM (B) to OCM (A) ChB Err -

(1) 3 Foot/0.9 Meter Length = No Suffix; 10 foot/3 meter Length = "-10" Suffix

(2) Cable shield foil or braid should be placed under RJ-45 shield housing in order to make good electrical contact.

APPENDIX B

LIST OF FIGURES IN MANUAL

APPENDIX C

LIST OF TABLES IN MANUAL