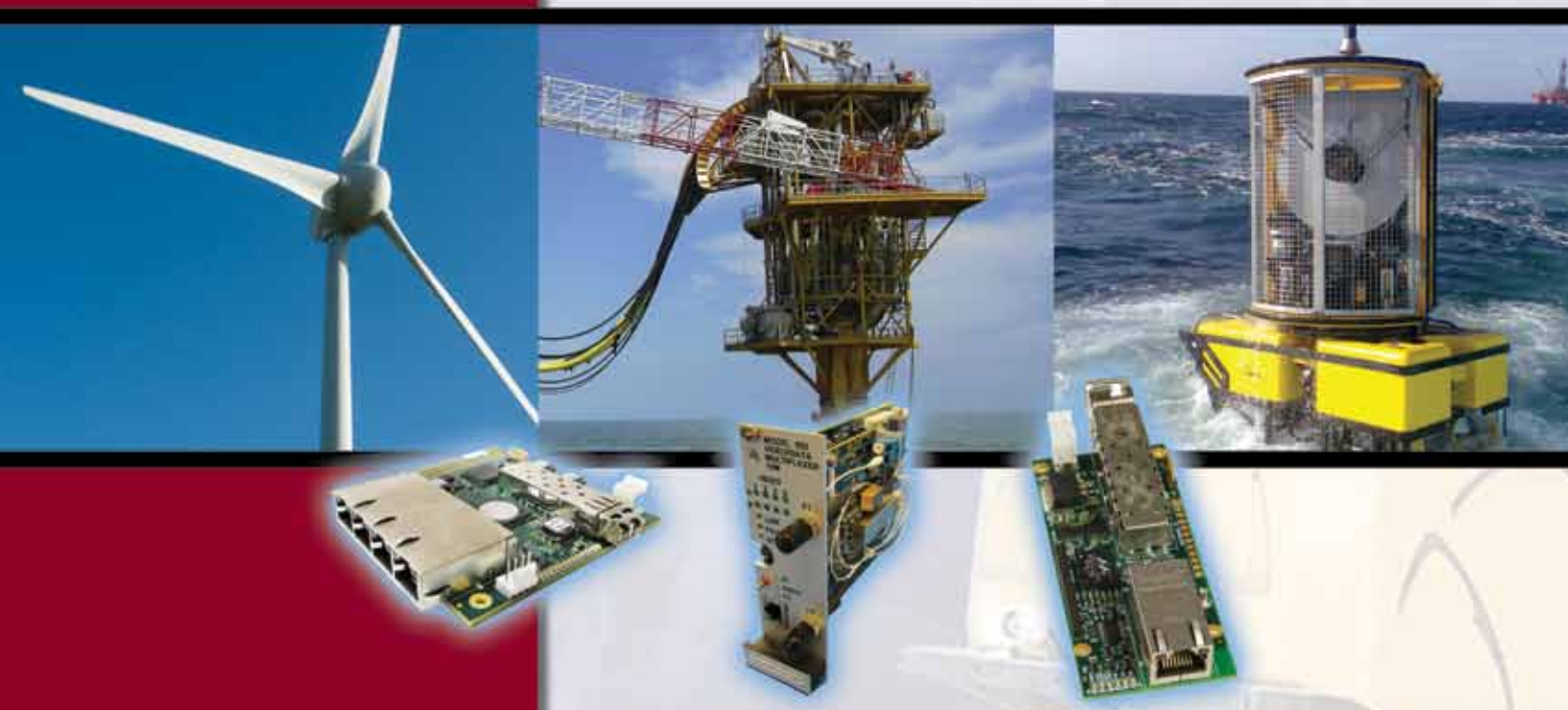
Fiber Optic Multiplexer Catalog

FOCAL™ Product Line



MOOG
COMPONENTS GROUP

Introduction

Moog has been developing rugged, subsea fiber-optic multiplexer systems for over 25 years. The expertise gained designing military telemetry systems for naval towed arrays in the 1980s led to several successful commercial product lines for video/data multiplexing in Remotely Operated Vehicles (ROVs). Standard multiplexer systems are now available in several sizes, ranging from the Eurocard-based Model 903 system to smaller form factors, such as the PC/104-based Model 907 and credit-card-size Model 914. All systems are based on digital signal transmission using pulses of light through optical fibers. Both legacy multimode fiber cables and higher bandwidth singlemode fibers are supported.

With over 2,000 systems deployed worldwide, these field-proven, modular systems are widely adopted telemetry solutions for Remotely Operated Vehicles (ROVs) used in the offshore oil and gas industry and for other applications in harsh environments. Many custom products have also been developed, particularly for high reliability applications in the defense and subsea control markets. Moog maintains a dedicated team of electronics designers to support ongoing expansion of existing product lines and provide rapid custom designs for specific applications.

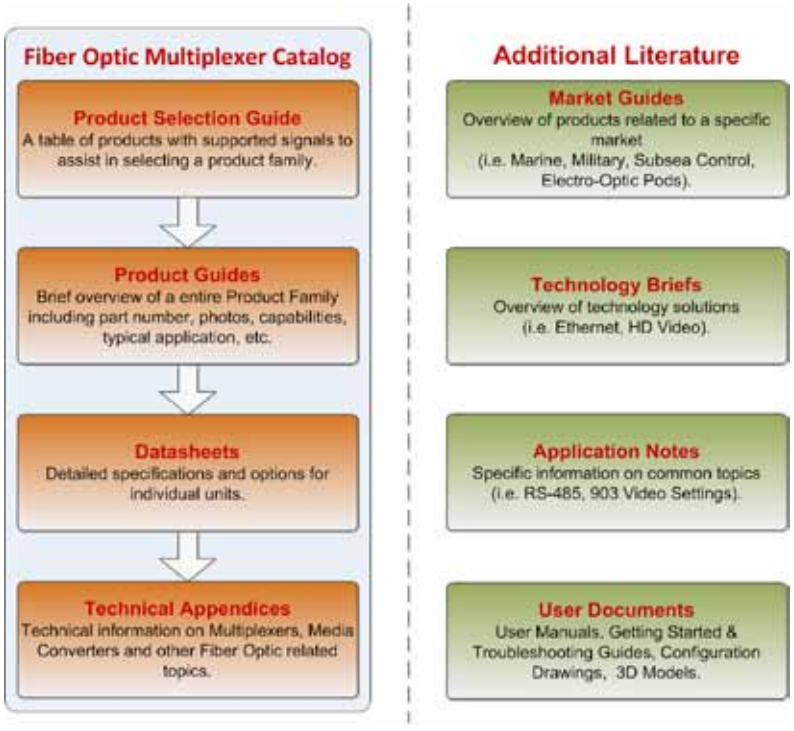
Moog Components Group's Focal™ multiplexers are supported by industry leadership in fiber optic development, including optical sensors, telemetry systems, connector design, ruggedized optics, and the widest selection of Fiber Optic Rotary Joints (FORJs). Applications for multiplexers include subsea ROVs, Explosive Ordinance Disposal (EOD) robots, Aerostat observational pods, industrial tooling stations, surveillance camera pods, remote mining controls, wind turbines, subsea controls and military vehicles.

Table Of Contents

Welcome to the Moog Components Group Focal™ Fiber Optic Multiplexer Catalog. The fiber optic multiplexer literature, of which the catalog is a part, is organized in such a way as to make finding the information you need quick and easy. The catalog is structured into a selection guide, product guides, datasheets, and technical appendices.

Other literature on Focal™ multiplexer products, such as user manuals, configuration drawings, 3D models, market guides, technology briefs and application notes, can be found at **www.moog.com/marine** (select Focal™ Fiber Optic Multiplexers), or by contacting a sales representative.

Multiplexer Literature Structure



NOTE: These are standard commercial products that are available with many options or configurations not explicitly shown. These options include, but are not limited to, part substitutions for any other commercial components (e.g. integrated circuits, optical transceivers, optical couplers/connectors, and electrical connectors) as well as modifications to support different input power voltages, alternative fiber arrangements, industrial temperature operation, and new mechanical installations or enclosures.

Product Selection Guide

A wide variety of signal types are supported by Moog's Focal™ multiplexers and OEO converters, per the tables below. Custom solutions provide support for additional signal formats or unique combinations of standard protocols. Application specific products may be customized to reduce size or cost, optimize packaging, extend environmental performance, and integrate more directly with other equipment. Since new products are continually added, please contact Moog for updates.

Model 903 - 3U Eurocard-based modular system with slide-in card replacements. Suitable as standalone sub-racks or for 19" rack installations. Easy front panel access to all I/O and fiber.

Model 907 - PC/104 card-based modular multiplexer system stacked with standoffs. Typically cards are installed in existing enclosures but are also available with housings and pressure tolerant configurations.

Model 914 - Credit card size boards (1/2 PC/104) suitable for small vehicles and other tight spaces. Typically cards are installed in existing enclosures but are also available with housings.

Model 912 - OEM converters in Eurocard sizes for 3U racks. Used for boosting optical signals, converting between singlemode and multimode signals, and optical multiplexing to reduce fiber counts.

Custom Mux - Custom designed with a variety of form factors and interface signals for specific applications. Custom systems can be designed to integrate with other platforms, such as VME, Ethernet, and Modbus.

Model	903	907	912	914	Custom MUX
Video/Analog Signals					
Composite (NTSC, PAL)	●	●		●	●
S-Video (Y/C)	●	●			●
Component (YPbPr, RGB)	●	●			●
Audio/Hydrophone	●	●		●	●
Analog Sonar (MS900)	●	●		●	●
Resolver/Encoder	●	●			●
4-20 mA	●	●			●
Sensor (Voltage Output)	●	●			●
Digital Video Signals					
SD-SDI (SMPTE 259M)	●	●	●		●
HD-SDI (SMPTE 292M)	●	●	●	●	●
3G HD-SDI (SMTPE 424M)	●		●	●	●
CameraLink					●
GigE Vision	●	●	●		●
Serial Data Signals					
RS-232	●	●		●	●
RS-485/422	●	●		●	●
TTL	●	●		●	●
Responder Trigger	●	●		●	●
IRIG Timing	●	●		●	●
ECL/PECL	●	●			●
LVDS			●	●	●
On/Off Controls (TOR)	●	●			●
Network/Bus Signals					
10/100M Ethernet	●	●	●	●	●
Gigabit Ethernet	●	●	●	●	●
10G Ethernet					●
Tritech ARCNET	●	●		●	●
PROFIBUS	●	●		●	●
CAN Bus, Device Net	●	●			●
EtherCAT, PROFINET	●	●	●		●
USB 2.0, 3.0					●
Diagnostics					
LEDs On Board	●	●	●	●	●
LEDS, External		●			●
Serial Port (RS-232)	●				●
Ethernet Port	●	●			●
Modbus TCP/RTU	●	●			●

Model 903 Multiplexer Product Guide

FOCAL™

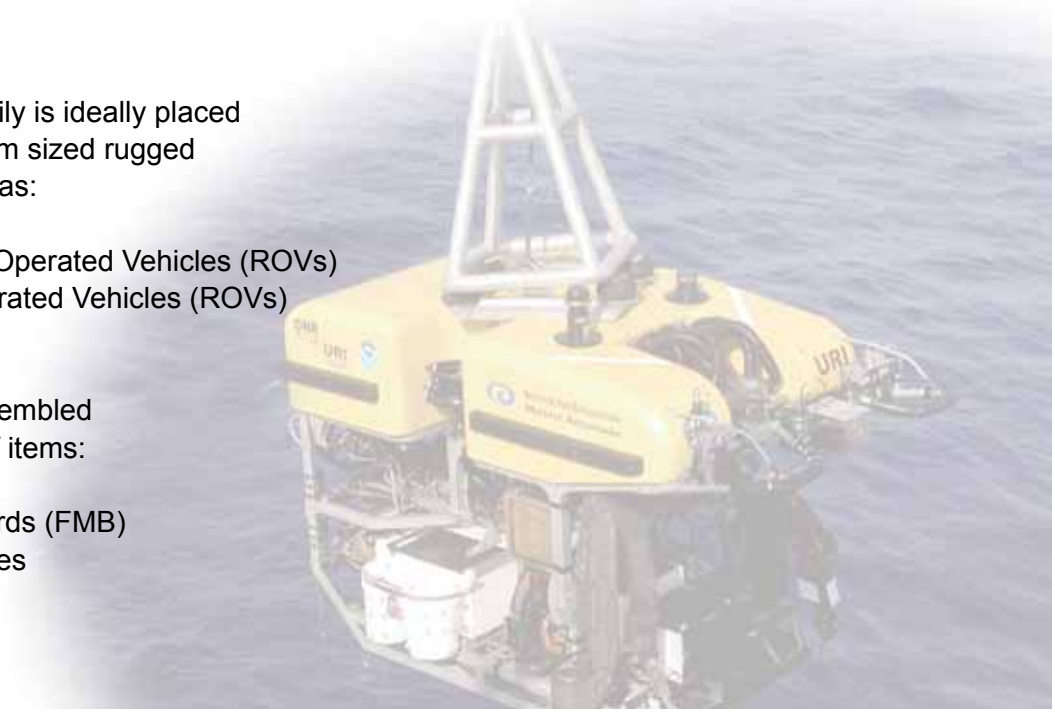
The Focal™ Model 903 product family provides a rugged video/data multiplexer and fiber optic communication system for Remotely Operated Vehicles (ROVs) and other industrial machines operating in harsh environments.

A rack based 3U height (5.25 inch) Eurocard system with a flexible architecture that supports reconfiguration and expansion of the system to meet application specific requirements. Expansion cards include analog video, serial data, Ethernet, sonar, and others. Media converter cards are available for HD video, and Gigabit Ethernet.

Typical Applications

The Model 903 product family is ideally placed to meet the needs of medium sized rugged fiber optic converters, such as:

- Work class Remotely Operated Vehicles (ROVs)
- Military Remotely Operated Vehicles (ROVs)
- Subsea mining

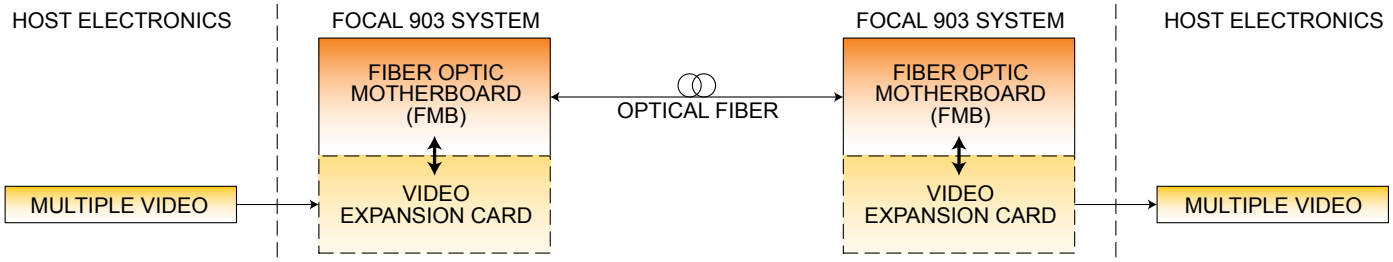


Model 903 systems are assembled from five main categories of items:

- Fiber-optic motherboards (FMB)
- Chassis and backplanes
- Media converters
- Expansion cards
- System modules

Fiber-Optic Motherboards (FMB)

A Model 903 system contains one remote (subsea) FMB and one console (surface) FMB. The FMB converts electrical signals from a Eurocard backplane into a bidirectional fiber-optic telemetry link. Expansion cards (also called interface boards) can be added to the chassis for analog video, Ethernet, serial data such as RS-232 and RS-485/422, and many special signal formats for sonar, responder trigger, and other devices.



903 FMBs come standard with redundant fiber operation and have an option for Coarse Wavelength Division Multiplexing (CWDM) transceivers.

Motherboard	FMB-X-2.5
Description	Fiber-optic motherboard
Part Number	903-5082-XX (R) 903-5083-YY (C)
Features	Redundant-fiber operation with auto fiber switching; 100 Mbps Ethernet; remote diagnostics
Baud Rate	2.5 Gbaud
Wavelength	Standard: 1310/1550 nm, CWDM: 1471 – 1611 nm, 20 nm spacing
Card Width	8 HP (40.64 mm)

For CWDM wavelengths, substitute the following two digit code for XX/YY:
47 = 1471 nm, 49 = 1491 nm, 51 = 1511 nm, 53 = 1531 nm, 55 = 1551 nm, 57 = 1571 nm, 59 = 1591 nm, 61 = 1611 nm.
Other wavelengths available upon request.

FMB-X-2.5 cards provide more advanced diagnostic features and higher bandwidth than older FMB (i.e. FMB-VTX/FMB-VRX) cards, and may be installed as upgrades to older multiplexer system as long as:

- If using a medium speed backplane, replace with a -X backplane;
- Both console and remote FMBs need to be the same. For example an FMB-VTX will not communicate with an FMB-X-2.5.

Chassis and Backplanes

Model 903 FMBs, media converters, expansion cards and system cards are housed in a Eurocard chassis. The backplane allows for communication between the FMB and the expansion cards. The backplane can also provide power to the installed cards. All chassis are available in a variety of widths to accommodate one FMB, up to two video and four data expansion cards. Cards come in standard widths of 4 HP, 6 HP, or 8 HP, where 1 HP is 5.08 mm (0.2 inch). Chassis are also available with additional slots for media converters.

903 Chassis	CBP-100-XR	CBP-200-XR	CBP-231	CBP-241
Description	Single High Density Remote Chassis	Dual High Density Remote Chassis	Standard Chassis	Extended Chassis
Part Number	903-0004-03	903-0005-12	903-6746-00 (R) 903-6747-00 (C)	903-6745-01 (R) 903-0007-06 (C)
Rack Width	12 HP (60.96 mm)	16 HP (81.28 mm)	40 HP (203.2 mm, R) 42 HP (213.4 mm, C)	50 HP (254 mm, R) 50 HP (254 mm, C)
No. Expansion Cards Supported	1 HD Slot	2 HD Slots	5 (2 Video, 3 Data)	6 (2 Video, 4 Data)
No. Media Converter Cards Supported	0	0	3	4

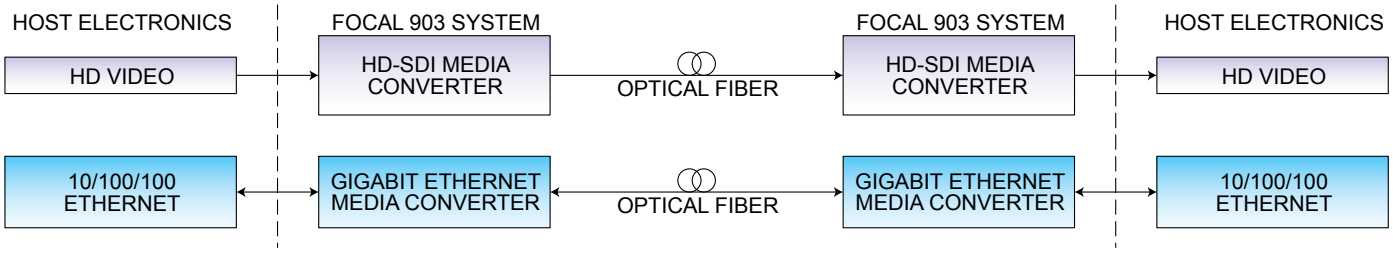
(R) = Remote, (C) = Console

Don't see a size or configuration to suit your application? We have built hundreds of different chassis and backplane configurations. Contact Moog to see how we can meet your specific application requirements.

For users of older 903 systems, backplanes were available in either 'medium' or 'high' speed versions. All new backplanes are 'high' speed versions only.

Media Converter Cards

Media converter cards provide direct electrical to optical signal conversion and transmit over one or two dedicated optical fibers. A number of signal formats are supported, including ECL/PECL signals for Cypress HOTLink™ and multi-beam sonar links; high-definition digital video (SMPTE-292); and one, two, and four channels of Gigabit Ethernet.



Media converters may be deployed on their own dedicated optical fiber or configured to support CWDM optical transceivers that allow for optically multiplexing of multiple cards using one of the passive 903 CWDM Optical cards.

Media Converter	HDSDI-SM	HDV-02	GBE-02	GBES-SM	ECL-02
Description	HD-SDI/SDI Media Converter	Dual HD-SDI/SDI Media Converter	Dual Gigabit Ethernet Media Converter	Quad Gigabit Ethernet Switch Media Converter	Dual ECL/PECL
Part Number	903-5060-XX[1]	903-5092-XX[1]	903-5091-XX[1]	903-5087-XX[1]	903-5050-XX[1]
Channel Direction	Unidirectional	Unidirectional	Bidirectional	Bidirectional	Unidirectional
NRZ Data Rate	143 – 1485 Mbps	143 – 1485 Mbps per Channel	10/100/1000 Mbps	10/100/1000 Mbps	30 – 150 Mbps
I/O Connectors	1 x SMB In, 1 x SMB Out	2 x SMB In, 2 x SMB Out	2 x RJ-45	4 x RJ-45	2 x SMB In, 2 x SMB Out
Card Width	4 HP (20.2 mm)	4 HP (20.2 mm)	4 HP (20.2 mm)	4 HP (20.2 mm)	4 HP (20.2 mm)

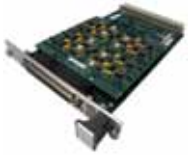
[1] XX – CWDM wavelength (47 = 1471, 49 = 1491, 51 = 1511, 53 = 1531, 55 = 1551, 57 = 1571, 59 = 1591, 61 = 1611 nm). Other wavelengths available by request.

Expansion Cards

A maximum of four data expansion cards and two analog video expansion cards can be added to a 903 chassis. An Adaptable Interface Board (AIB) expansion card allows standard AIB plug-in modules to be employed as well.








Expansion Card	Description	Part Number	Supported Video Formats	Video Channels	Supported Data Formats	On-board Data Channels
VIB-TX VIB-RX	4-Channel Video Expansion Card[2]	903-0014-00 (R) 903-0015-00 (C)	NTSC, PAL, RGB, S-Video (Y/C)	4	NA	NA
HDB-TX	High-Density Video/Data Expansion Card[1,2]	903-5006-00 (R)	NTSC, PAL, RGB, S-Video (Y/C)	4	4 x RS-232, 4 x AIB	8
AIB-4	Adaptable Interface 4-Channel Expansion Card[2]	903-5003-02	NA	NA	AIB	4
CIB-10	Control Interface Expansion Card[2]	903-5040-00	NA	NA	Bidirectional Channels (ON/OFF)	10
DIB-232-16	RS-232 16-Channel Expansion Card[2]	903-5020-00	NA	NA	RS-232	16
907-232-E	RS-232 8-Channel Expansion Card[2]	903-5056-00	NA	NA	RS-232	8
907-485-E	RS-485 8-Channel Expansion Card[2]	903-5053-00	NA	NA	RS-485, RS-422	8
EIB-10/100	Ethernet Expansion Card[2]	903-5044-00	NA	NA	10/100 Base-T(X) Ethernet	3

[1]The HDB-TX is compatible with a High Density remote chassis only.
[2]Expansion cards are 4 HP (20.2 mm) in width.

System Cards

System cards provide the support required to adapt the Model 903 architecture to many different applications. These cards provide mechanical integration of the Model 907 and Model 914 into Eurocard form-factor, and operation with a wide range of AC or DC input power.

System Card	PSU-AC	PSU-24V	PSU-48V	907-EURO4	914-EURO2
Description	Selectable AC Power Supply Module	Isolated DC-DC Power Supply Card for 18-36 VDC Input	Isolated DC-DC Power Supply Card for 36-60 VDC Input	907 to Eurocard Adaptor	914 to Eurocard Adaptor
Part Number	903-0022-00	903-0022-02	903-0022-01	907-0005-00	903-7208-00 (No 914s)
Features/ Options	Supports 115/230 VAC input, provides backplane power	Supports 18-36 VDC input, provides backplane power	Supports 36-60 VDC input, provides backplane power	Allows use of one Model 907 in a Eurocard System	Allows use of two Model 914 in a Eurocard System
Card Width	8 HP (40.64 mm)	8 HP (40.64 mm)	8 HP (40.64 mm)	4 HP (20.2 mm)	4 HP (20.2 mm)

Adaptable Interface Boards (AIB)

AIB plug-in modules are compatible with the Model 903, the Model 907, and the Model 914 product lines. The AIB-4 has four sockets for separate AIB plug-in modules. AIB plug-in modules are available for a variety of data signals and analog formats.

903-AIB supports four AIB plug-in modules

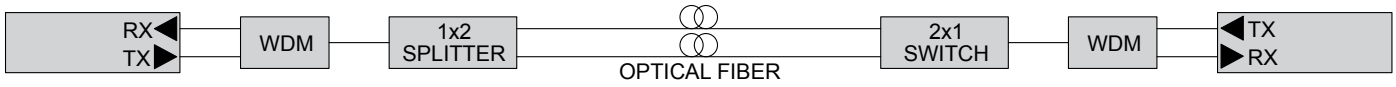
AIB plug-in modules are used to convert the signal interface format to a TTL format, which is then accessed through the Eurocard backplane. AIB plug-ins support standard serial data interfaces (RS-232/485/422), hydrophone and other audio signals, various digital and analog sonar telemetry, and control networks, such as CAN and Profibus.

AIB Card	AIB-232	AIB-485	AIB-HYDRO	AIB-ARCNET	AIB-MS900	AIB-CAN Bus
Description	1 x RS-232	1 x RS-485/422	1 x Hydrophone	1 x Tritech ARCNET	1 x MS-900 Analog Sonar	1 x CAN Bus Bridge
Part Number	903-0251-00	903-0252-00	903-0244-00	903-0261-00	903-0250-00	903-0297-00
Channel Direction	Bidirectional	Bidirectional	Unidirectional	Bidirectional	Bidirectional	Bidirectional
NRZ Data Rate	120 kbps	2.5 Mbps	30 Hz - 30 kHz BW	156 kbps/78 kbps	5 - 30 kHz, 380 - 580 kHz	62.5 kbps - 1 Mbps
I/O Connectors	4-pin WAGO headers on 903-AIB adapter card					
Options	Responder Trigger	AC-Coupled 485, TTL	IRIG-B, Audio	Terminations	Low Speed Telemetry (LF)	Repeater Mode

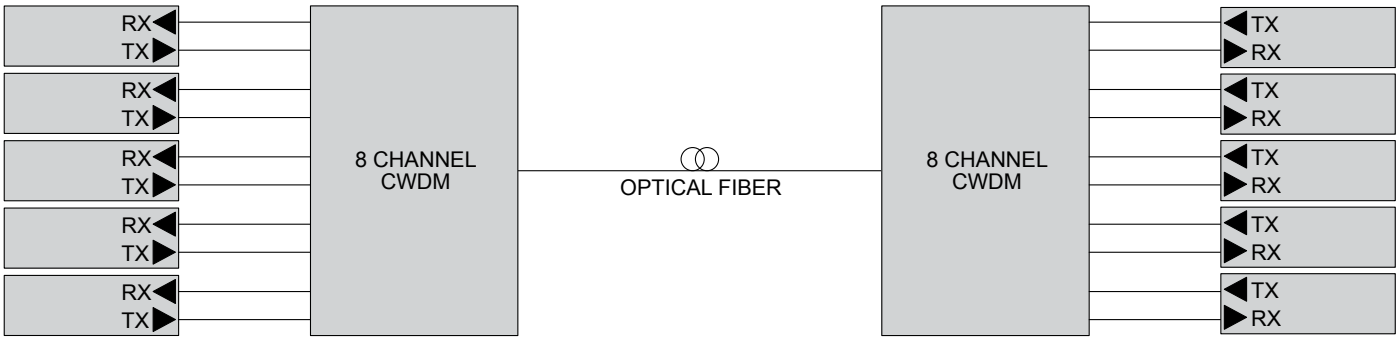
Optical Cards

Systems with only one motherboard or media converter typically transmit at an optical wavelength of 1310 nm for uplink and 1550 nm for downlink. In larger systems with multiple FMBs, media converters and expansion cards, fiber-optic signals may be combined on a single fiber using a Coarse Wavelength Division Multiplexer (CWDM) to take advantage of the high bandwidth of optical fiber. Standard CWDM optical wavelengths are separated by 20 nm and have center wavelengths of 1471 nm to 1611 nm. Bidirectional optical signals occupy two distinct wavelengths. For example, a 903 GBE-02 media converter using CWDM wavelengths may use 1471 nm for uplink traffic, and 1491 nm for downlink traffic.

To provide redundant communications between host electronics in the case of a fiber-optic cable failure, the FMB is fitted with a fiber-optic splitter, while the mating system is fitted with a fiber-optic switch. All optical traffic from the splitter system is transmitted along both fiber-optic cables. The switch system can automatically select the best fiber to use for communications.



Redundant Fiber



8-Wavelength CWDM

Optical Card	CWDM-8
Description	8-Channel CWDM Optics Card, 1471 - 1611 nm, singlemode, 20 nm spacing
Part Number	903-5251-00
Features/Options	4 HP (20.2 mm)

Key Specifications

Form Factor and Chassis

- Model 903 cards use the standard 3U Eurocard form factor of 3.937 x 6.29 inches (100 x 160 mm)
- Expansion cards communicate over the Eurocard backplane to the FMB fiber optic motherboard
- Cards plug into the Eurocard chassis, and are electrically connected via the backplane connector
- Various width chassis are available for remote and console

Analog Video

- Formats supported: NTSC or PAL, RGB or S-Video (Y/C)
- Sampled at 15MHz, providing minimum 6MHz bandwidth
- Voltage: 1.2 Vp-p max
- Impedance: 75 Ω

Digital HD-SDI Video

- Format supported: HD-SDI (SMPTE-292)
- Data rate: 1.485 Gbps (3 Gbps option)
- Voltage: 800 mV_{P-P} nominal
- Impedance: 75 Ω

Ethernet Options

- Support for full duplex 10/100/1000 Base-T(X) Ethernet
- Physical-layer (PHY) media converters for low latency
- Switched Ethernet for additional port count
- Multiplexed options for multiple isolated channels

Data Options

- RS-232: bidirectional channels, 120kbaud max
- RS-422/485: 5Mbps NRZ
- AIB Expansion card daughter-cards support additional channels of RS-232, RS-422/485, CAN Bus, Tritech Arcnet, and MS900 Sonar
- Other signals such as TTL, TOR, and support for Profibus

Power

- Built in or cassette-style power supply with options for 120 VAC 50/60 Hz, 230 VAC 50/60 Hz, 24 VDC (18-36 VDC) and 48 VDC (36-60V DC)
- Input Protection: over-voltage, reverse polarity, over-current

Optical Options

- Optical Fiber: 1 or 2 single-mode (9/125 µm)
- Wavelengths: 1310/1550 nm standard, CWDM options available
- Flux Budget: 20 dB min. standard (others available)
- Connectors: ST, others available

Diagnostics Support

- Diagnostics extracted from the FMB cards in both remote and console stacks using a 10 Base-T Ethernet or RS-232 link.
- Optical Transceiver data including Tx-Power, Rx-Power, Bias Current, Temperature, voltage and more
- Card identity, Serial Number
- Built-in Web Server
- Terminal diagnostics through RS-232 port on FMB
- Compatible with VDM software

Call or email our knowledgeable Application Engineers for more information: 902-468-2263 or focal@moog.com

903

Video/Data Multiplexer

Description

Model 903 multiplexers provide highly reliable fiber optic transmission of video and data signals in demanding environments. A modular Eurocard design based around the FMB-X-2.5 fiber-optic motherboard and a wide range of supported video and data formats ensure the flexibility needed for easy system configuration. Individual data channels can be mixed and matched with a variety of plug-in interface modules. Advanced optical multiplexing (CWDM, DWDM) enables system expansion to 32 video and 256 data channels as well as additional high data rate signals such as HD-SDI, ECL for advanced sonars and Gigabit Ethernet. Integrated diagnostics and software provide real time display and logging of all critical parameters.

Features

- Compact, modular, 3U sub-rack
- Highest quality digitized video
- Wide range of supported video and data formats
- Robust protection on I/O lines
- Singlemode and multimode fiber options
- Automatic fiber switching
- Extensive diagnostics monitors power system, video, data, temperature and fiber-optic link

Benefits

- Easily reconfigured at card level and individual channel level
- Diagnostics verifies health of umbilical and tether cables
- Continually updated with the newest data formats, including HD-SDI, and Gigabit Ethernet, to provide an extended upgrade path (custom interfaces available)
- Successful installation assured by factory acceptance tests at temperature extremes and 20 years of experience providing technical support for fiber-optic systems

Typical Applications

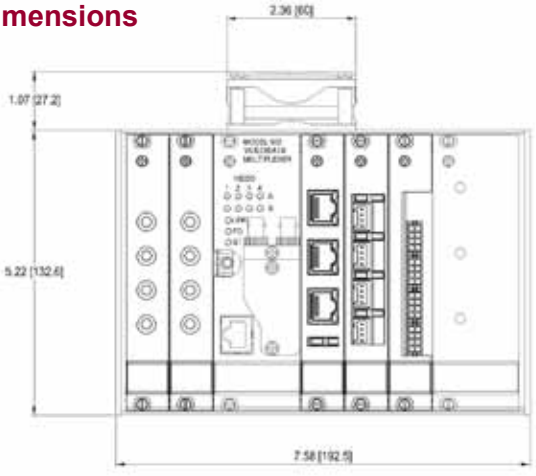
- Remotely operated vehicles (ROV)
- FPSO communications process control
- Defense systems
- Research ROV
- Subsea mining

Model 903 Datasheet

Video	
No. Slots	1 - 2 (3 - 8 optional with CWDM)
No. Channels	4 per slot (8 with switched video)
Format	NTSC/PAL composite signals, RGB, Y/C (S-Video), YPrPb, HD-SDI optional
Digitization	10-bit
Bandwidth	6.0 MHz
SNR	> 60 dB (62 dB typical)
Impedance	75 Ohms
Data	
No. Slots	2 - 4
Serial Data	4 - 16 channels per slot RS-232/485/422, TTL (2.5 Mbps NRZ max)
Ethernet	3 ports, 10 Base-T (electrical) 3 ports, 100 Base-TX (optical) 1 port, 10/100 BaseT(X) (electrical on front panel of FMB) 4 ports, 1000 Base TX (optical)
ARCNET	1 - 4 Tritech ARCNET channels per slot
Hydrophone	1 - 4 channels per slot, 12bit, 16 Hz 28 kHz
Analog Sonar	1 - 4 bidirectional channels per slot MS900/971 compatible
Control Lines	10 bidirectional control lines per slot
ECL (optical)	1 - 2 high speed ECL/sonar lines per slot, 30 - 150 Mbaud, 50/75 Ohm in/out
Other	Digital video, industrial control bus, CAN Bus, IRIG-B, HD-SDI
Electrical	
Power Supply	AC: 120/240 VAC (50/60 Hz) DC: 24 VDC, 48 VDC < 40 W each end typical
Isolation	Varies with signal type (consult factory)

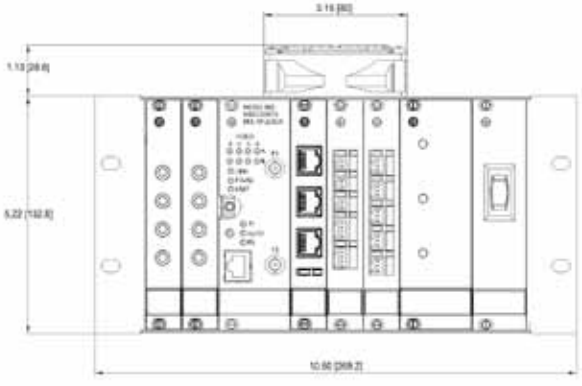
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm) 1 or 2 multimode (50/125 µm and 62.5/125 µm)
Baud Rate	FMB-X-2.5: 2.5 Gbaud, uplink and downlink
Wavelength	1310/1550 nm standard (CWDM Optional, 1471-1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Mechanical	
Chassis	Eurocard 3U subracks (28 - 84 HP) Rack width (mm) = 9.65 + (#HP x 5.08) 100 x 160 mm cards
Dimensions	Height = 133 mm, Depth = 210 mm Remote Rack Width = 28 - 84 HP Console Rack Width = 34 - 84 HP Fans add 27 - 29 mm to rack height See 903HD datasheet for 12 or 16 HP remote racks. Custom racks available
Weight	Remote 5.0 kg (11 lb), typical Console 5.4 kg (12 lb), typical
Connectors	
Optical	ST front panel bushing (FC optional)
Video	SMB
Data	2 x 6-pin Wago, BNC, D-Sub, RJ45, SMB
Diagnostics	DB-9S (Console FMB)
Environmental	
Temperature	-10°C to +60°C (operational) -20°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 251000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes

903 Dimensions



Remote (ROV) Module

Dimensions in inches [millimeters]



Console (Surface) Module

Note: Standard chassis shown with typical cards. Racks are available in a variety of widths up to 84 HP, corresponding to a size compatible with installation in a standard 19" equipment rack.

These are standard commercial products that are available with many options or configurations not explicitly shown.

903HD

High Density Video/Data Multiplexer

Description

The high density 903HD remote module provides the features of a fullsized subsea video/data multiplexer in a package of half the volume. This reduction enables installation in constrained spaces while supporting transmission of 48 high quality video channels and 816 bidirectional data channels over a single optical fiber. Since the 903HD uses the same FMB-X-2.5 fiber multiplexer boards (FMBs) as the standard 903, including CWDM versions, it supports singlemode or multimode fiber as well as dual fiber operation with automatic fiber switching. Data channels are easily configured with plug-in modules for various data formats. A standard 903 console module at the surface includes powerful diagnostics software with realtime display and logging of critical remote/console parameters.

Features

- Less than half the size of the standard FO903
- Wide range of supported video and data formats
- High quality digitized video
- Singlemode and multimode fiber options
- Extensive diagnostics monitors power systems, video, data, temperature and fiber-optic link

Benefits

- Easily reconfigured at card level and individual channel level
- Diagnostics verifies health of umbilical and tether cables
- Continually updated with the newest data formats, including HD-SDI, and Gigabit Ethernet, to provide an extended upgrade path
- Custom interfaces available
- Successful operation assured by factory acceptance tests at extremes and 20 years of experience providing technical support for fiber optic systems

Typical Applications

- Workclass Remotely Operated Vehicles (ROVs)
- Defense systems
- Subsea Mining

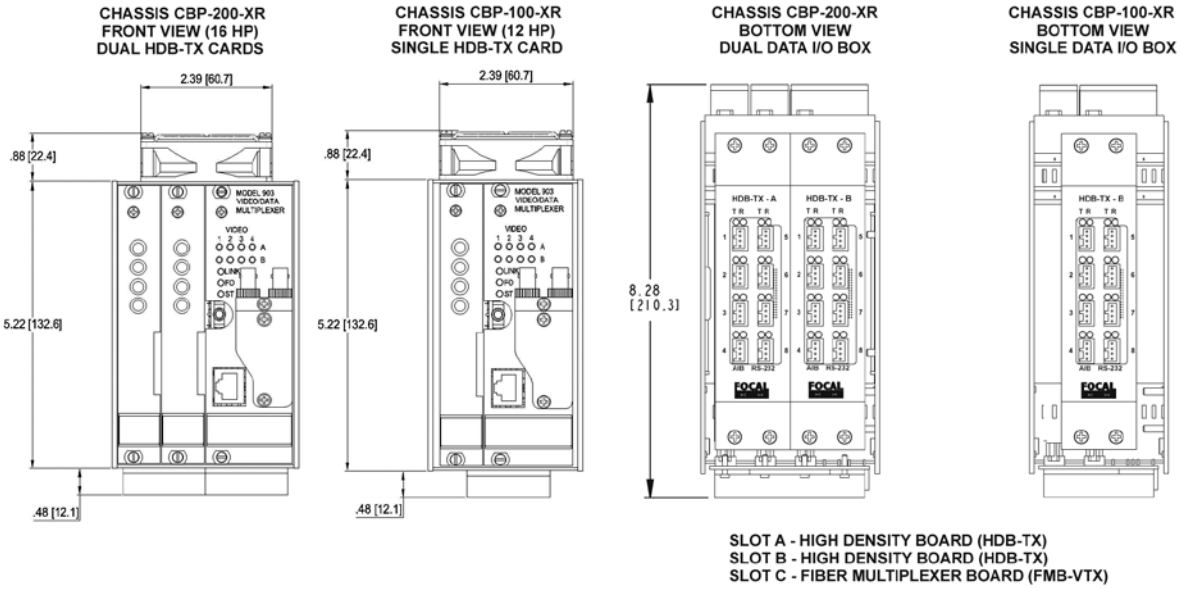
Model 903 Datasheet

Video	
No. Channels	4 per HDB-TX card
Format	NTSC, PAL (optional Y/C, RGB)
Digitization	10-bit
Bandwidth	> 6 MHz
SNR	> 60 dB (62 dB typical)
Data	
RS-232	4 channels per HDB-TX (120 kbps NRZ)
AIB Modules	4 plug-in modules per HDB-TX card
RS-232	1 channel per plug-in (120 kbps NRZ)
RS-422/485	1 channel per plug-in (2.5 Mbps NRZ)
ARCNET	1 Tritech sonar ARCNET port per plug-in (156 kbps max.)
Hydrophone	1 uplink analog channel per plug-in 12-bit resolution, 28 kHz bandwidth
Analog Sonar	1 MS900/971 analog sonar link per plug-in
Other	CAN Bus, Ethernet
Diagnostics	
LEDs	Power (electrical), optical link, optical fault, Ethernet port status, serial data Tx/Rx, video sync, over temperature limit
Ethernet to PC	Diagnostics from remote and console through Ethernet port on console FMB

Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm) or multimode (50/125 µm and 62.5/125 µm)
Baud Rate	FMB-X-2.5: 2.5 Gbaud uplink/downlink
Wavelength	1310/1550 nm, CWDM (1471-1611 nm)
Flux Budget	> 20 db (24 db typical)
Mechanical	
Chassis*	Eurocard 3U subrack, 12 HP and 16 HP CBP-100-MR uses CBP-121-MC console CBP-200-MR uses CBP-241 HC console
Weight*	< 2 kg (4.4 lb), CBP-100-MR (typical) < 3 kg (6.6 lb), CBP-200-HR
Connectors	
Optical	ST/PC (FC/PC optional)
Video	SMB
Data	4-pin WAGO Gage Clamp, data I/O box or ribbon cable (optional) at front panel
Diagnostics	DB-9S (Console Module)
Environmental	
Temperature	-10°C to +60°C (operational) -20°C to +85°C (storage)
Humidity	85% RH, noncondensing
Vibration	5 g, 25-1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	Extended temperature, stress screened or qualified

*See Model 903 data sheet for console module specifications.

903HD Dimensions



Dimensions in inches [millimeters]

Note: Dual (16 HP) and single (12 HP) high density chassis shown with 1 - 2 high density boards (HDB-TX), fiber multiplexer boards (FMB-VTX), and fiber option for use with automatic fiber switching at console module.

These are standard commercial products that are available with many options or configurations not explicitly shown.

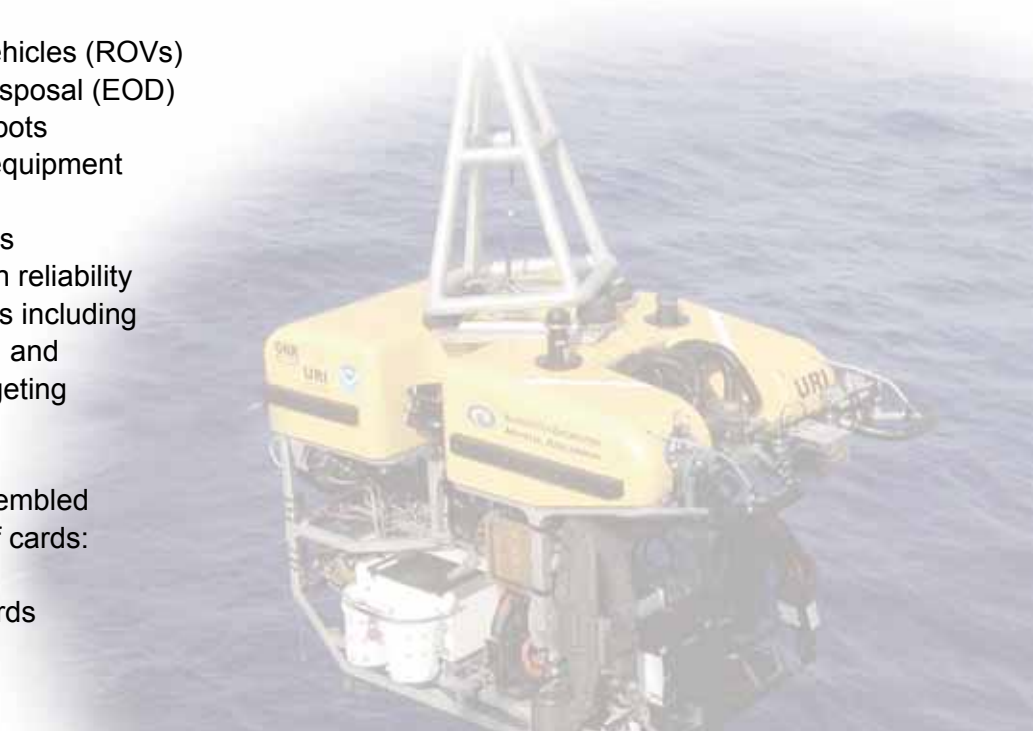
The family of Focal™ Model 907 products provides compact and rugged video/data multiplexers and fiber-optic transmission systems.

The Model 907 was designed for applications requiring the transmission of video and/or data over an optical link. A modular PC/104 form-factor and flexible design architecture supports reconfiguration and expansion of the multiplexer system to fit the specific data requirements of each application.

Typical Applications

The Model 907 product family is suited particularly well to applications requiring small and ruggedized fiber-optic converters, such as:

- Remotely Operated Vehicles (ROVs)
- Explosive ordinance disposal (EOD) and pipe inspection robots
- Industrial automation equipment
- Wind energy turbines
- Video security networks
- Defense and other high reliability ruggedized applications including radar, ground vehicles, and Electro-Optic (EO) targeting and surveillance pods

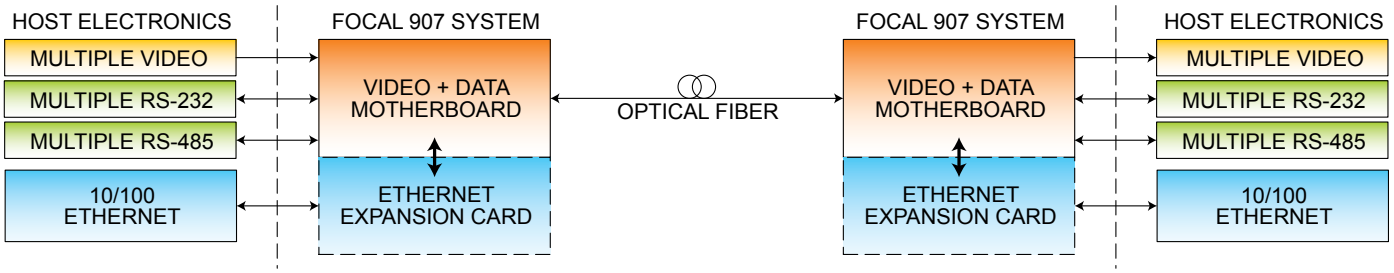


Model 907 systems are assembled from four main categories of cards:

- Multiplexer motherboards
- Media converters
- Expansion cards
- System modules

Multiplexer Motherboards

A Model 907 system consists, as a minimum, of a Model 907 remote motherboard (multiplexer), and a Model 907 console motherboard. Each motherboard can operate as a standalone multiplexer used to combine analog video, digital video, or Ethernet with on-board or backplane serial data such as RS-232 and high-speed RS-485/422. Motherboards can all be stacked together and communicate with expansion cards to send and receive data over the backplane for additional data capabilities.

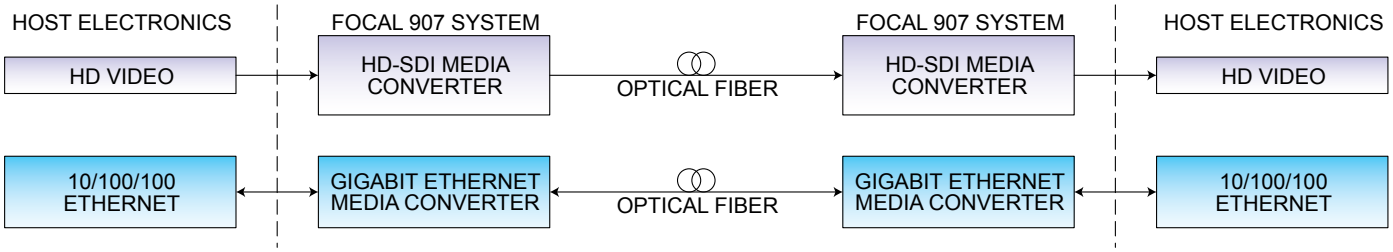


907 motherboards can be optically configured with Coarse Wave Division Multiplexer (CWDM) transceivers for use with passive 907 optical cards. High power transceivers are available for demanding optical systems, and low cost transceivers are available for cost sensitive applications.

Motherboard	907-R/C	907+	907V	907-HDM2	907-GEM
Description	3-Channel Video/Data Mux	4-Channel Video/Data Mux	6-Channel Video Mux	2-Channel HD-SDI/Data Mux	4-Channel Gigabit Ethernet Mux
Part Number	907-0001-XX (R) 907-0002-XX (C)	907-0025-XX (R) 907-0026-XX (C)	907-0023-XX (R) 907-0024-XX (C)	907-0050-XX (R) 907-0051-XX (C)	907-0060-XX
Supported Video Formats	NTSC, PAL, RGB, S-Video (Y/C)	NTSC, PAL, RGB, S-Video (Y/C)	NTSC, PAL, RGB, S-Video (Y/C)	HD-SDI (SMPTE-292)	GigE Vision
Video Channels	3	4	6	1-2 HD-SDI	4 max
Supported Data Formats	RS-232, RS-485/422, Backplane data	RS-232, RS-485/422, Backplane data	Backplane data	RS-232, RS-485/422, Backplane data	10/100/1000 Base-T Ethernet, Backplane Data
On-board Data Channels	6	6	None	2	4 Ethernet
Support for E-Diagnostics	No	Yes	Yes	Yes	Yes

Media Converter Cards

Media converter cards provide direct electrical to optical signal conversion and transmit over one or two dedicated optical fibers. A number of signal formats are supported, including ECL/PECL signals for Cypress HOTLink™ and multi-beam sonar links; high-definition digital video (SMPTE-292); and one, two, or four isolated channels of Gigabit Ethernet.



Media converters may be deployed as standalone cards running on their own dedicated optical fiber or configured to support CWDM optical transceivers that allow for optical multiplexing of multiple cards using one of the passive 907-CWDM optical cards. High power transceivers are available for demanding optical systems, as well as, low cost transceivers for cost sensitive applications.

Media Converter	907-HDV	907-GBE	907-GBE2	907-GBES	907-ECL
Description	Single HD-SDI, SDI	Single Gigabit Ethernet Media Converter	Dual Gigabit Ethernet Media Converter	Quad Gigabit Ethernet Switch	Single ECL/PECL/ Hotlink Media Converter
Part Number	907-0022-XX	907-0021-XX	907-0030-XX	907-0027-XX	907-0019-XX
Channel Direction	Unidirectional	Bidirectional	Bidirectional	Bidirectional	Unidirectional
NRZ Data Rate	143 – 1485 Mbps	10/100/1000 Mbps	10/100/1000 Mbps	10/100/1000 Mbps	30 – 600 Mbps
I/O Connectors	2 x SMB In, 2 x SMB Out	1 x RJ-45	2 x RJ-45	4 x RJ-45	2 x SMB In, 2 x SMB Out
Support for E-Diagnostics	YES	NO	YES	YES	YES

Expansion Cards

Up to six expansion cards may be stacked on a 907 motherboard using the backplane connector for power and signals. Each expansion card provides an increased number of data channels or added signal formats not supported by the motherboard directly. An Adaptable Interface Board (AIB) expansion card allows standard AIB plug-in daughter-card modules to be employed as well.

	Expansion Card	Description	Part Number	BP Channels used	Max. Data Rate	I/O Connectors
	**907-232**	8-Channel RS-232 Card	907-0212-00	1	120 kbps	4 x 8 pin Molex
	**907-485**	8-Channel RS-485/ 422 Card	907-0217-00	1, 2, 4	250 kbps to 2.5 Mbps[1]	4 x 8 pin Molex
	**907-SER**	8-Channel RS-232/485/ 422 Card[5]	907-0242-00	1, 2, 4	250 kbps to 2.5 Mbps	4 x 8 pin Molex
	**907-ADC/DAC**	8-Channel, 8/12-bit ADC/DAC[3] Card	ADC: 907-0218-00 DAC: 907-0219-00	1	50 kHz Bandwidth	2 x 8 pin Molex
	**907-AUDIO**	4-Channel, 24-bit Audio Card	907-0228-00	1	20 kHz Bandwidth	4 x 2 pin WAGO 2 x 3 pin WAGO
	**907-CIB**	4-Channel Control Interface[4] Card	907-0231-00	1	50 kHz Updates	4 x 2-Pin WAGO 2 x 3-Pin WAGO
	**907-AIB**	Dual Socket AIB Adaptor	907-0204-00	1, 2	Up to 2.5 Mbps[2]	2 x 4-Pin WAGO
	**907-EIBS**	10 Mbps Ethernet Switch Card	907-0222-00	1	10 Mbps	3 x RJ-45

1. Maximum NRZ data rate increases with number of backplane channels used on the motherboard
2. Maximum NRZ data rate or analog bandwidth depends on the AIB plug-in modules installed.
3. Use 907-ADC Analog Input Card, P/N 907-0218-00 with complementary 907-DAC Analog Output Card, P/N 907-0219-00
4. CIB inputs are individually configurable as switch or voltage controlled; CIB outputs are all solid state relays, max. current 250 mA.
5. 907-SER supports Ethernet diagnostics when used with the 907-DIAG-E

Adaptable Interface Boards (AIB)

AIB plug-in modules are compatible with the Model 903, the Model 907, and the Model 914 product lines. The 907-AIB has two sockets for separate AIB plug-in modules. AIB plug-in modules are available for a variety of low speed data signals.

907-AIB supports two AIB plug-in modules

AIB plug-in modules are used to convert the signal interface format to a TTL format, which is then accessed through the expansion port on the 907 motherboard. AIB plug-ins support standard serial data interfaces (RS-232/485/422), hydrophone and other audio signals, various digital and analog sonar telemetry, and control networks, such as CAN Bus and Profibus.

AIB Card	AIB-232	AIB-485	AIB-HYDRO	AIB-ARCNET	AIB-MS900	AIB-CAN Bus
Description	1 x RS-232	1 x RS-485/ 422	1 x Hydrophone	1 x Tritech ARCNET	1 x MS-900 Analog Sonar	1 x CAN Bus Bridge
Part Number	903-0251-00	903-0252-00	903-0244-00	903-0261-00	903-0250-00	903-0297-00
Channel Direction	Bidirectional	Bidirectional	Unidirectional	Bidirectional	Bidirectional	Bidirectional
NRZ Data Rate	120 kbps	2.5 Mbps	30 Hz - 30 kHz BW	156 kbps/78 kbps	5 - 30 kHz, 380 - 580 kHz	62.5 kbps - 1 Mbps
I/O Connectors	4-pin WAGO headers on 907-AIB adapter card					
Options	Responder Trigger	AC-Coupled 485, TTL	IRIG-B, Audio	Terminations	Low Speed Telemetry (LF)	Repeater Mode

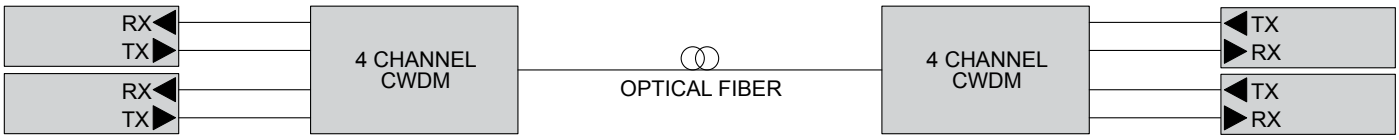
Optical Cards

Systems with only one motherboard or media converter typically transmit at an optical wavelength of 1310 nm for uplink and 1550 nm for downlink. In larger systems with multiple 907 motherboards, media converters and expansion cards, fiber-optic signals may be combined on a single fiber using a Coarse Wavelength Division Multiplexer (CWDM) to take advantage of the high bandwidth of optical fiber. CWDM optical wavelengths are separated by 20 nm and range from 1471 nm to 1611 nm. Bidirectional optical signals occupy two distinct wavelengths. For example a 907-GBE Media Converter using CWDM wavelengths may use 1471 nm for uplink traffic and 1491 nm for downlink traffic.

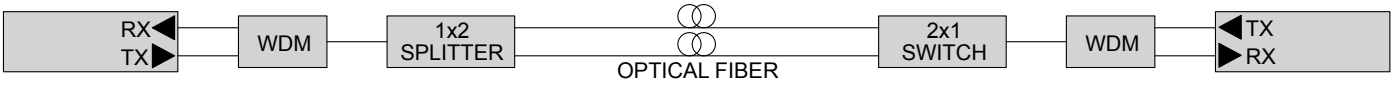
To provide redundant communications between host electronics in the case of a fiber-optic cable failure, one system may be fitted with a fiber-optic splitter, while the other system is fitted with a fiber-optic switch. All optical traffic from the splitter system is transmitted along both fiber-optic cables. The switch system can manually or digitally (TTL) select one of the two fibers for communication.

WDM

Integrated WDM for 1310/1550nm on one Fiber



4-Wavelength CWDM



WDM, Splitter and Switch

Optical Cards

Optical Card	Description	Part Number	Features/Options
907-WDM	WDM Optics Card, 1310/1550 nm, Singlemode	907-0015-35	Card-mounted, PC/104
907-CWDM	CWDM Optics Card, 1471/1491 nm with 1310/1550 nm Bypass, Singlemode	907-0015-00	1310/1550 nm bypass port for easy upgrade of existing 1310/1550 nm system
907-CWDM-MM	CWDM Optics Card, 1471/1491 nm with 1310/1550 nm Bypass, Multimode	907-0015-02	1310/1550 nm bypass port for easy upgrade of existing 1310/1550 nm system
907-CWDM-4R1	CWDM Optics Card, 1471 - 1531 nm, Singlemode, 20 nm Spacing	907-0015-03	Optional 1310 nm Bypass Port
907-CWDM-8R	CWDM Optics Card, 1471 - 1611 nm, Singlemode, 20 nm Spacing	907-0015-20	Optional 1310 nm Bypass Port
907-SPLIT-SM	1 x 2 Fiber Splitter Card, Singlemode	907-0015-05	Provides redundant fiber operation
907-FOS-SM	1 x 2 Fiber Switch Card, Singlemode	907-0015-06	Provides fiber-optic switch with manual or remote digital control (TTL)

Oil Filled/Pressure Tolerant

Standard Model 907 products require a 1 atmosphere (ATM) enclosure when used in subsea applications. However, specific 907 products are available in pressure tolerant versions for use in Pressure Balanced Oil Filled (PBOF) applications. Refer to application note AN-03 for a detailed analysis of pressure tolerant electronics.

Card	Card Type	Description	Part Number	Pressure Rating
907+P	Multiplexer Motherboard	4-Channel Video/Data Mux	907-0035-XX[1]	6000 psi [2]
907V-P	Multiplexer Motherboard	6-Channel Video Mux With Bidi Transceiver	907-0033-03	3000 psi [3]
907V-P	Multiplexer Motherboard	6-Channel Video Mux	907-0033-XX[1]	6000 psi [2]
907-GBE-P	Media Converter	Single Gigabit Ethernet Media Converter	907-0043-XX[1]	6000 psi [2]
907-GBE2-P	Media Converter	Dual Gigabit Ethernet Media Converter	907-0031-XX[1]	6000 psi [2]
907-GBES-P	Media Converter	Quad Gigabit Ethernet Switch	907-0028-XX[1]	6000 psi [2]
907-232-P	Expansion Card	8-Channel RS-232 Card	907-0212-02	6000 psi [2]
907-485-P	Expansion Card	8-Channel RS-485/422	907-0217-01	6000 psi [2]
907-SER-P	Expansion Card	8-Channel RS-232/485/422	907-0242-02	6000 psi [2]
907-CIB-P	Expansion Card	4-Channel Control Interface	907-0231-01	6000 psi [2]
907-AIB-P	Expansion Card	Dual Socket AIB Adaptor	907-0204-01	6000 psi [2]
907-EIBS-P	Expansion Card	10 Mbps Ethernet Switch Card	907-0222-01	6000 psi [2]
907-CWDM-4R1-P	Optical Card	CWDM Optics Card, 1471-1531 nm, Singlemode, 20 nm Spacing	907-0015-32	6000 psi [2]
907-CWDM-8R-P	Optical Card	CWDM Optics Card, 1471-1611 nm, Singlemode, 20 nm Spacing	907-0015-21	6000 psi [2]
907-WDM-P	Optical Card	WDM Optics Card, 1310/1550 nm, Singlemode	907-0015-36	6000 psi [2]
907-SPLIT-SM-P	Optical Card	1 x 2 Fiber Splitter Card, Singlemode	907-0015-05	6000 psi [2]

1. XX – CWDM wavelength (47 = 1471, 49 = 1491, 51 = 1511, 53 = 1531, 55 = 1551, 57 = 1571, 59 = 1591, 61 = 1611 nm). Other wavelengths available by request.
2. 6000 psi = 412 bar = 4 km ocean depth
3. 3000 psi = 206 bar = 2 km ocean depth

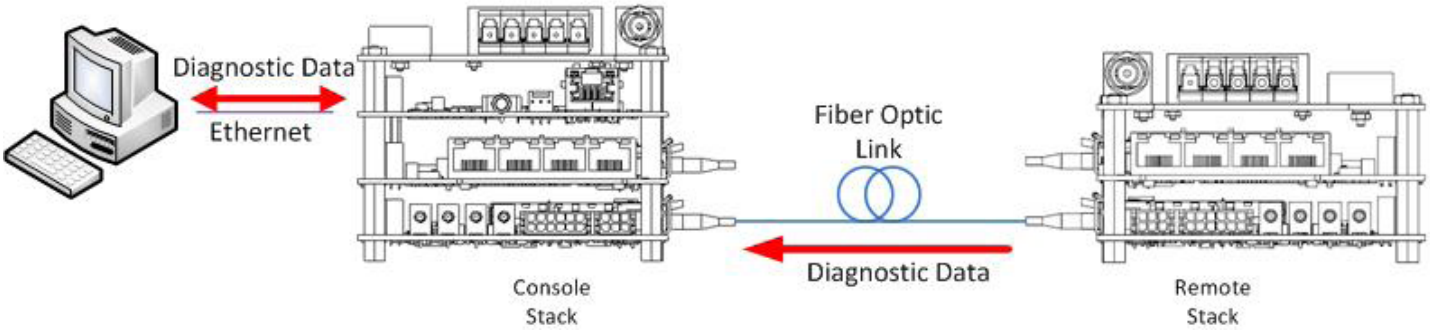
System Cards

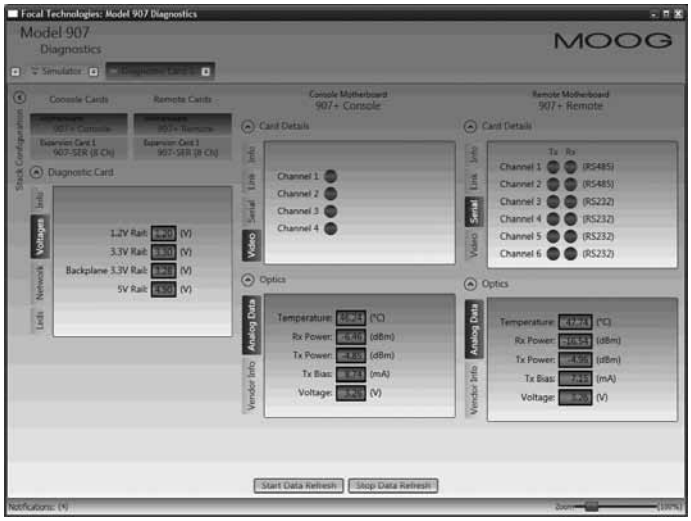
System cards provide the support functions required to adapt the Model 907 architecture to many different applications. These cards provide mechanical integration of the 907 into Eurocard form-factor, electrical interoperability with the standardized PC/104 backplane, operation with 18-30 VDC input, and 907 diagnostics.

System Card	907-DIAG-E	907-DC-24	907-EURO
Description	Ethernet Diagnostic Card	Isolated DC-DC Power Supply Card for 18-30 VDC Input	Eurocard Adaptor
Part Number	907-0238-00	907-0233-00	907-0005-xx 907-0006-xx
Features/Options	Ethernet Output. API and sample GUI available. Reads diagnostics from compatible cards in 907 stacks.	Supports 18-30 VDC input, provides multiple +5 VDC outputs	4 HP and 8 HP options available, typically supplied assembled with 907 card

Ethernet Diagnostics

Specific 907 products are compatible with the 907 Ethernet diagnostics. The 907-DIAG-E system card combined with the diagnostics .NET graphical user interface (GUI) allow for real time diagnostics of both remote and console multiplexer motherboards, media converters and expansion cards. Parameters include optical transmit power, optical receive power, optical transmitter temperature, voltages, and many more. The GUI can be configured to provide alarms on conditions and log data. An application programming interface (API) is available to provide a simple interface for customer developed software.





Model 907 Ethernet Diagnostics Compatible Cards

Card	Card Type
907+	Multiplexer Motherboard
907V	Multiplexer Motherboard
907-HDM2	Multiplexer Motherboard
907-GEM	Multiplexer Motherboard
907-HDV	Media Converter
907-GBE2	Media Converter
907-GBES	Media Converter
907-ECL	Media Converter
907-SER	Expansion Card

Key Specifications



Form Factor and Mounting

- Model 907 cards use the standard PC/104 form factor of 3.55 x 3.775 inches (90 x 96 mm)
- The cards are outfitted with a PC/104 connector to provide backplane connectivity between multiple cards assembled in a vertical stack
- Cards stack one on top of the other, supported by 0.625 inch standoffs fitted into mounting holes on the corners of the card, and are electrically connected via the PC/104 connector
- Some stack configurations require fiber pigtails to optically connect one card to another
- 19-inch EIA rack mount enclosures and custom enclosures available upon request

Analog Video

- Formats supported: NTSC or PAL, RGB, S-Video (Y/C), YPbPr
- 8-10-bit digitization, 6 MHz bandwidth
- Voltage: 1.2 Vp-p max
- Impedance: 75 Ω

Digital HD-SDI Video

- Format supported: HD-SDI (SMPTE-292)
- Electrical Data Rate: 1.485 Gbps (3 Gbps option)
- Voltage: 800 mV_{P-P} nominal
- Impedance: 75 Ω

Ethernet Options

- Support for full duplex 10/100/1000 Base-T(X) Ethernet
- Physical-layer (PHY) media converters for low latency
- GigE Vision cameras supported
- Switched Ethernet for additional port count
- Multiplexed options for multiple isolated channels

Data Options

- RS-232: bidirectional channels, 120 kbaud max
- RS-422/485: 5 Mbps NRZ
- AIB plug-in cards support additional channels of RS-232, RS-422/485, CAN Bus, Tritech ARCNET, and MS900 Sonar
- Other signals such as TTL, On/Off, and support for Profibus

Power

- Input Voltage: +5 VDC ± 10%, regulated, 0.5-1.0 A typical (2.5W to 5.0 W), per card
- Input Protection: Over-voltage, reverse polarity, over-current
- Model 907 motherboards obtain power through a 2-pin Molex power connector and are capable of providing power to other cards in the stack through the backplane PC/104 interface
- If regulated +5 VDC power supplies are not available, the 907-DC-24 PSU card can be added to a 907 stack to generate multiple +5 VDC supplies from 18-30 VDC input.

Pressure Tolerant

- Pressure tolerant versions of Multiplexer Motherboards, Media Converters and Expansion Cards are available for pressures up to 6000 psi

Optical Options

- Optical Fiber: 1 or 2 single-mode (9/125 µm), 1 or 2 multimode (50/125 µm and 62.5/125 µm)
- Wavelengths: 1310/1550 nm standard, CWDM options available
- Flux Budget: 20 dB min. standard (Others available)
- Connectors: LC or ST, depending on card (Others available)

Diagnostics Support

- Diagnostics extracted from compatible cards in both remote and console stacks using 907-DIAG-E card. Diagnostic data is accessible over a 10/100 Base-T(X) Ethernet link to the 907-DIAG-E.
- Optical Transceiver data including Tx/Rx Power, Bias Current, Temperature, voltage, and more
- Card identity, serial number
- Motherboard data-channel activity
- Ethernet port link speed and activity indicators
- Sample .NET GUI and full API is available
- LED diagnostics also available on board

Call or email our knowledgeable Application Engineers for more information: 902-468-2263 or focal@moog.com

907-R/C
Video/Data Multiplexer

Description
The 907 video/data multiplexer provides digital transmission over 1 or 2 singlemode or multimode optical fibers for 3 high quality analog video channels and 6 bidirectional data channels (4 x RS-232 and 2 x RS485/422/TTL) in a single, compact PC/104 form-factor card.

Expansion cards may be stacked to convert (i.e. replace) data channels on the motherboard to other data formats, such as Ethernet, analog sonar, hydrophone and Tritech ARCNET, or to replace each motherboard channel with up to 8 lower data-rate serial channels. Optical power budgets are typical 20 - 24 dB with 2 km of multimode fiber or 10 km of singlemode fiber. LEDs provide on-board diagnostics for data, video and optical link status.

Features
- High quality digitized video
- Standalone, single card multiplexer
- Supports up to six 907 expansion cards
- Standard PC/104 form factor
- Rugged design for harsh environments, including pressure tolerant version
- On-board diagnostic LEDs for power, optical link, and video sync
- Wide range of supported video and data formats
- Singlemode and multimode fiber options
- CWDM expansion for high speed data links, such as HD-SDI, ECL and Gigabit Ethernet

Benefits
- Highest channel density allows extremely compact solution for space limited application
- Easily reconfigured with a wide range of expansion cards including the same AIB plug-in modules used on the Model 903
- Extended temperature options allows use in the harshest environments
- Successful operation assured by factory acceptance test at temperature extremes and 20 years of experience providing technical support for fiber-optic systems

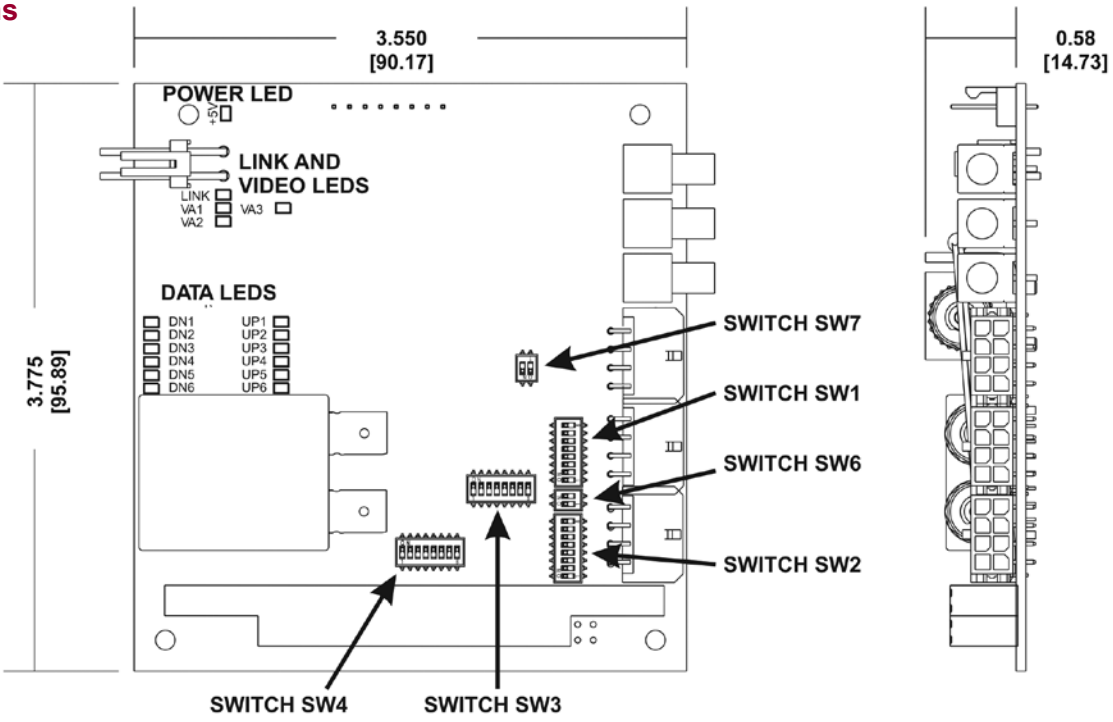
Typical Applications
- Subsea Remotely Operated Vehicles (ROVs) and tether management systems
- Pipe inspection robots
- Bomb disposal robots
- Armoured vehicles

Model 907 Datasheet

Video	
No. Channels	3
Format	NTSC/PAL, RGB, Y/C (S-Video), YPrPb
Digitization	8-bit (3 video channels) 10-bit (2 video channels)
Bandwidth	6.0 MHz
SNR	> 56 dB (62 dB typical)
Impedance	75 Ohms
Options	1 x non-video analog channel (1 Vpp) 1 x 12-bit, 12 Mhz analog channel (replaced all video channels)
Data	
RS-232	4 channels (120 kbps NRZ max.)
RS-485/422	2 channels RS-485 (2.5 Mbps NRZ max.) Supports AC-coupled RS-485, TTL
Options	907 expansion cards
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm) multimode (50/125 µm)
Baud Rate	600 Mbaud
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers

Electrical	
Power Supply	+5.0 VDC ± 10%, regulated
Power Used	5 W typical (10 W max.)
Grounding	Shared common for power, data, video
Options	Isolated power/data card
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.26 lb)
Options	Custom enclosures, Eurocard adapter
Connectors	
Optical	Single ST/PC
Video	SMB
Data (Serial)	3 x 8-pin Molex (Micro-Fit Series)
Power	2-pin Molex, 0.156 inch pin spacing
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	3000 psi pressure tolerant, extended temperature, stress screened or qualified

907 Dimensions



Dimensions in inches [millimeters] 907 shown with singlemode WDM option

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907PLUS
Video/Data Multiplexer

Description
The 907Plus is a multiplexer that extends the capabilities of standard 907 motherboards with an added video channel, galvanically isolated data channels, and a comprehensive, integrated diagnostics network. System expansion is even easier with a rapidly growing family of compatible expansion cards and media converters. A diagnostics add-on card is available that offers end-to-end performance monitoring and identification for multi-card systems via an Ethernet connection at the console, and Graphical User Interface (GUI) software.

Expansion cards may be stacked on the motherboard to add up to 48 data channels in a variety of formats, including RS-232, RS-485/422, TTL, Ethernet, CAN Bus, analog sonar, hydrophone, audio, and Tritech ARCNET. Depending on transceiver options, optical power budgets are typically 20-26 dB with 10 km or more of singlemode fiber.

Features
- I2C bus supports diagnostic communications with expansion cards and media converters
- Galvanically isolated data serial data channels
- Compatible with 907-DIAG-E diagnostic card and Graphical User Interface (GUI) software
- On-board diagnostic LEDs for power, optical link, and video sync, and serial data Tx/Rx
- Interchangeable SFP optical transceiver
- Supports up to six 907 expansion cards

Benefits
- Isolated data channels provide more robust interface to external equipment
- Supports a wide range of optical options, including CWDM wavelengths and multimode configurations
- No motherboard data channels are disabled when expansion cards are added
- Simplifies troubleshooting with advanced diagnostics

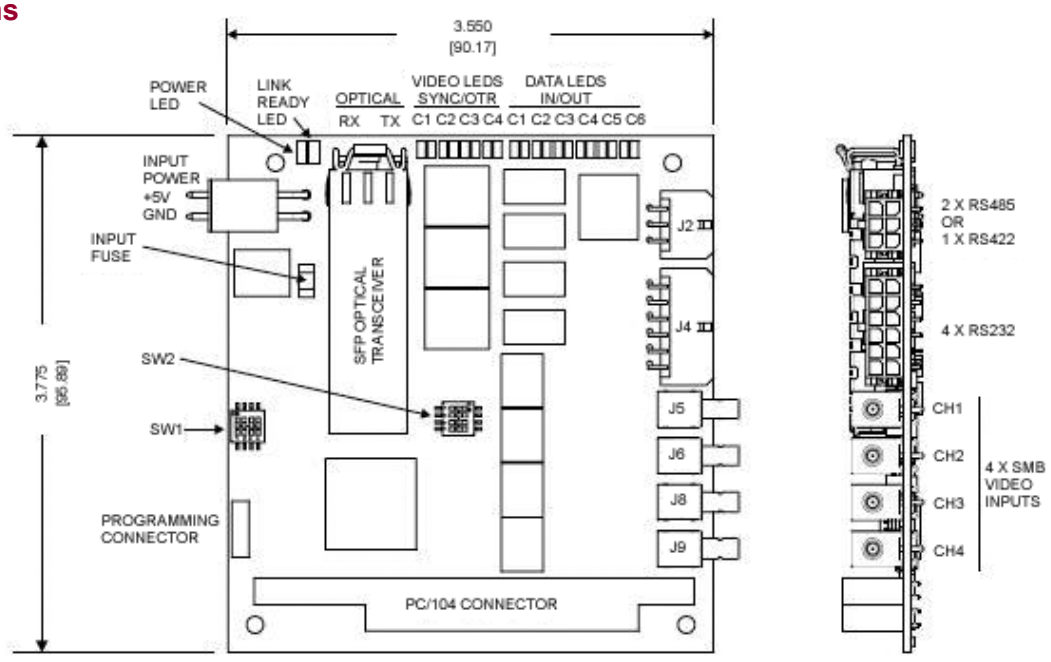
Typical Applications
- Remotely Operated Vehicles (ROVs
- Pipe inspection robots
- Bomb disposal robots
- Video Security Systems
- Tether management systems
- Tactical Networks
- Aerostat Balloons

Model 907 Datasheet

Video	
No. Channels	4
Format	NTSC/PAL, RGB, Y/C (S-Video), YPrPb
Digitization	10-bit
Bandwidth	6.0 MHz
SNR	> 56 dB (60 dB typical)
Impedance	75 Ohms
Data	
RS-232	4 isolated channels (120 kbps NRZ)
RS-485/422	2 isolated RS-485, or 1 isolated RS-422 (2.5 Mbps NRZ)
Options	907 expansion cards
Optical	
Fiber Type	1 or 2 singlemode (9/125 µm)
Format	AME-EP (Moog proprietary)
Baud Rate	1.25 Gbaud
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (26 dB typical)
Options	Bidi (bidirectional) transceivers; higher/lower power transceivers
Diagnostics	
LEDs	Power (electrical), optical link, optical fault, serial Tx/Rx, video sync
Ethernet to PC	Diagnostics from remote and console through 907-DIAG-E card at console

Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	0.7 A typical (1 A max.)
Power Used	3.5 W typical (5 W max.)
Protection	Overvoltage, reverse polarity, 2 A time delay fuse
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.25 lb)
Options	Custom enclosures, eurocard adapter
Connectors	
Optical	Dual LC (SFP)
Video	4 x SMB
Data	RS-232: 1 x 12-pin Molex (Micro-Fit Series) RS-485/422: 1 x 6-pin Molex (Micro-Fit Series)
Power	2-pin Molex, 0.156 inch pin spacing
Stacking	PC/104 (for stacking 907 cards only)
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25-1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant, extended temperature, stress screened or qualified

907Plus Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-GEM

Gigabit Ethernet (GbE) Multiplexer

Description

The 907-GEM is an expandable Gigabit Ethernet (GbE) multiplexer that enables modular fiber optic telemetry solutions, particularly for Ethernet intensive applications. As a motherboard, the 907-GEM provides four completely independent and “switchless” 10/100/1000 Mbps Ethernet links and can be stacked with standard 907 expansion cards to add other signal types, such as serial channels (RS-232/485/422), hydrophones, responder triggers, CAN Bus and various analog and digital sonars. Given the growing adoption of real-time Ethernet for critical control systems (e.g. EtherCAT) and digital video (e.g. GigE Vision), the low latency 907-GEM is an exceptional core solution for current and future applications.

As a standalone card, 907-GEM replaces four separate Ethernet media converters with a single board and a single fiber link. This significantly reduces size and cost compared to standard media converter solutions, which typically require 2-4 stacked cards plus four transceivers, eight fibers and an optical coupler for the same Ethernet capability.

A wide range of optical options are available for the 907-GEM, including CWDM wavelengths for optical multiplexing with other media converters and multiplexers. Optical power budgets are typically 20-26 dB over 10 km of singlemode fiber, and multimode links of up to 2 km are also supported. In addition to on-board LEDs, the 907-GEM includes integrated diagnostics when used with the standard diagnostics card (907-DIAG-E) and graphical user interface (GUI) software.

Features

- Four independent (switchless) 10/100/1000 Mbps Ethernet links
- Interchangeable SFP optical transceiver
- Rugged design for harsh environments, including pressure tolerant version
- Compatible with 907-DIAG-E diagnostic card and Graphical User Interface (GUI) software
- Supports up to six 907 expansion cards

Benefits

- Reduces cost and size for systems with multiple Ethernet media converters
- Provides low latency for real-time systems
- Simplifies troubleshooting with advanced diagnostics
- Enables expandable and reconfigurable multiplexer solutions
- Replaces many fiber links and transceivers with a single fiber link
- Supports a wide range of optical options, including CWDM wavelengths and multimode configurations

Typical Applications

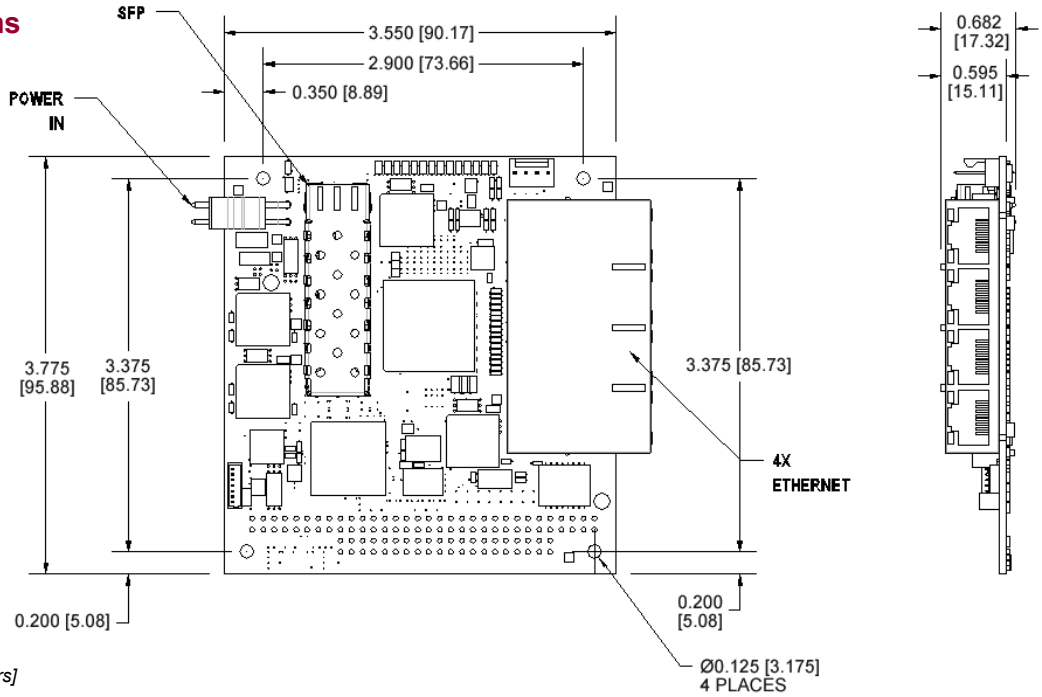
- Remotely Operated Vehicles (ROV) and Tether Management Systems
- Ethernet Based Video Systems
- Advanced Sonar Systems
- Tactical Networks and Defense Systems
- Industrial Process Control

Model 907 Datasheet

Data	
No. Copper Ports	4 (non-switched, independent)
Data Rates	10/100/1000 Base-T(X)
Total Throughput	500 - 2500 Mbps, via switch setting (0.01% used for embedded diagnostics)
Latency	< 25 us (not including fiber, ~5 µs/km)
Options	Standalone version; support for jumbo frames. Contact Moog for details.
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	625 - 3125 Mbaud
Format	AME-EP (Moog proprietary)
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers; higher/lower buget transceivers
Electrical	
Power Voltage	+5 VDC +/-10%, regulated
Power Current Draw	1.5 A typical (2 A max.)
Power Used	7.5 W typical (10 W max.)
Voltage Protection	Overvoltage, reverse polarity, 3 A time-delay fuse

Diagnostics	
LEDs	Power (electrical), Optical Link, Optical Fault, PHY Rx/Tx Activity, Port Rate, Port Error
Ethernet to PC	Diagnostic from remote and console through 907-DIAG-E at console
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	125 g (0.27 lb), including SFP
Options	Custom enclosures
Connectors	
Optical	Dual LC (SFP)
Data (Ethernet)	4 x RJ-45
Power	2-pin Molex, 0.156 inch pin spacing
Stacking	PC/104 (for stacking 907 cards only)
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25-1000 Hz, 3 axes
Shock	30 g, 11 ms half-sine, 3 axes
Options	6000 psi pressure tolerant; extended temperature; stress screened or qualified

907-GEM Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907V
Video Multiplexer

Description
The 907V Video Multiplexer provides digital transmission over a singlemode optical fiber for 6 high quality video channels (NTSC/ PAL, RGB, Y/C, YPrPb formats) in a single PC/104 form-factor card. The 907V may be configured to operate on a single uplink wavelength in video-only mode or with an uplink and downlink wavelength to support model 907 expansion cards with bidirectional data channels.

Expansion cards may be stacked on the motherboard to add up to 48 data channels in a variety of formats, including RS-232, RS-485/ 422, TTL, Ethernet, CAN Bus, analog sonar, hydrophone, audio, and Tritech ARCNET. Depending on transceiver options, optical power budgets are typically 20-26 dB with 10 km or more of singlemode fiber. Diagnostics are available as on-board LEDs for video and optical link status and as an optional serial link.

Features
- Highest density of high quality video channels available in PC/104 size
- Video-only mode operates on a single wavelength
- Compatible with 907-DIAG-E diagnostics card and Graphical User Interface (GUI) software
- Compatible with existing 907 expansion cards and media converters
- Interchangeable SFP transceiver

Benefits
- Reduces cost and number of cards required for video intensive applications
- Reduces number of wavelengths required in CWDM systems when using video-only mode
- Simplifies troubleshooting with advanced diagnostics
- Supports reuse of existing 907 cards and reduced sparing in mixed 907 and 907V systems
- Supports a wide range of options including CWDM wavelengths

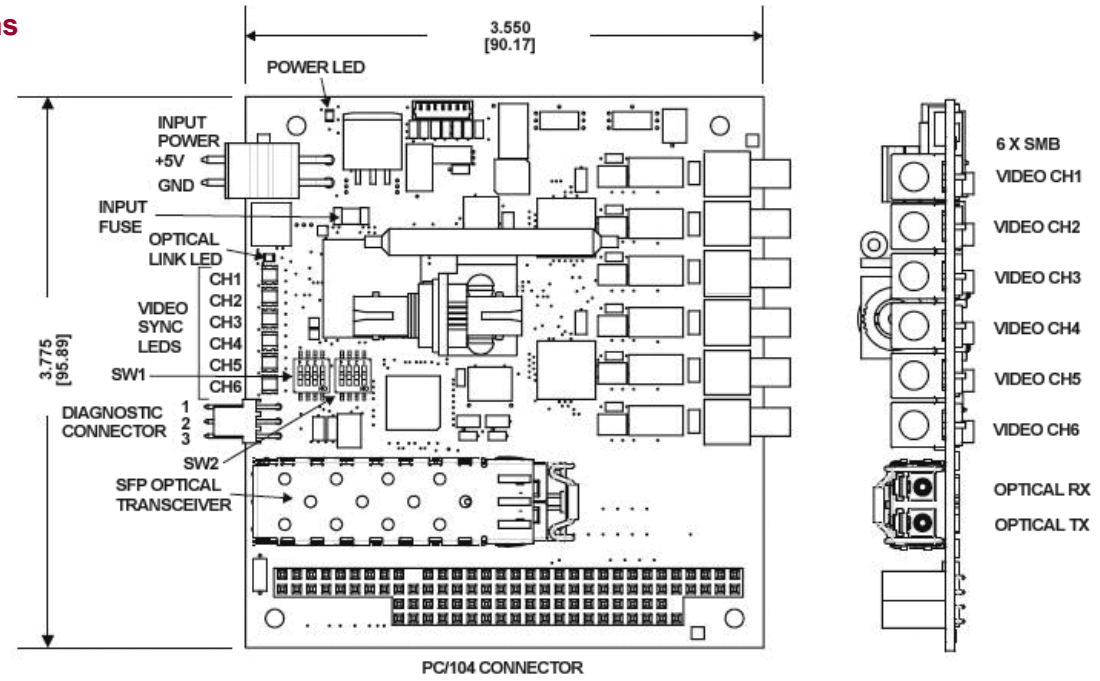
Typical Applications
- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tether Management Systems
- Tactical Networks

Model 907 Datasheet

Video	
No. Channels	6
Format	NTSC/PAL, RGB, Y/C (S-video),YPrPb
Digitization	10-bit (6 channels, video only) 10-bit (4 video channels with expansion cards) 8-bit (6 video channels with expansion cards)
Bandwidth	6.0 MHz
SNR	> 60 dB (62 dB typical)
Impedance	75 Ohms
Data	
Options	Expansion cards for isolated serial data (RS-232/485/422), TTL, Ethernet (10 Mbps), Tritech ARCNET, MS-900/971 sonar, hydrophone, audio, CAN Bus. Ethernet (10/100/1000 Mbps) HD-SDI, ECL
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	1200 Mbaud
Wavelength	1310, 1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers; higher/lower buget transceivers

Electrical	
Power Voltage	+5 VDC ± 10% regulated
Power Used	3.5 W typical
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120g (0.25lb), including SFP
Options	Custom enclosures
Connectors	
Optical	ST/PC (standard), LC (CWDM options)
Video	6 x 5 SMB
Power	2 pin Molex, 0.156” pin spacing
Environmental	
Temperature	-10°C to +60°C (operating) -20°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25-1000 Hz, 3 axes
Shock	30 g, 11 ms half-sine, 3 axes
Options	3000 psi pressure tolerant; extended temperature; stress screened or qualified

907V Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-HDM2

Dual High Definition Video Multiplexer

Description

The 907-HDM2 is an expandable High Definition (HD) Video Multiplexer that provides transmission of up to two HD-SDI camera signals along with four on-board serial channels (RS-232/485) for camera controls (e.g. pan and tilt) and sensors. Dual HD inputs on the remote card support connection of two HD-SDI cameras with either one channel at full 4:2:2 sampling and the other sub-sampled at 2:1:1, or both channels sampled at 4:1:1. The 4:2:2 channel can be selected via diagnostic software.

The 907-HDM2 can be used as a standalone card or stacked with a wide range of 907 expansion cards available in a variety of formats, including RS-232/485/422, TTL, Ethernet, CAN Bus, analog sonar, hydrophone, audio, and Tritech ARCNET. It may also be optically integrated into a larger 907 system via CWDM modules. Optical power budgets are typically 20-26 dB over 10 km of singlemode fiber. Enhanced diagnostics are supplied by on-board LEDs and through a dedicated Ethernet link when used with a diagnostics card (907-DIAG-E) and corresponding graphical user interface (GUI) software.

Features

- Dual HD inputs include cable equalization and reclocking to improve recovery of low level or distorted input signals
- Regenerated HD-SDI outputs to minimize jitter
- Interchangeable SFP transceiver
- 4x on-board bidirectional serial channels (RS-232 or RS-485)
- Compatible with 907-DIAG-E diagnostic card and Graphical User Interface (GUI) software
- Rugged design for harsh environments
- Supports up to six 907 expansion cards

Benefits

- Reduces cost and size for systems with need for combined data and HD video
- Supports a wide range of optical options, including CWDM wavelengths
- Simplifies troubleshooting with advanced diagnostics
- Maximum jitter margin available for cabling

Typical Applications

- Remotely Operated Vehicles (ROVs) and Tether Management Systems
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tactical Networks and Defense Systems
- Industrial Process Control
- Remote HD Video for Television

Model 907 Datasheet

Video	
No. Channels	1 or 2
Format	HD-SDI (SMPTE-292M) @ 720p, 1080i and 1080p
Data Rate	1483 or 1485 Mbps
Input Buffer	Adaptive cable EQ and reclocker
Output Voltage	800 mVpp nominal
Impedance	75 Ohms, input/output
Modes*	Dual Video, optimized (default): 1 x 4:2:2 and 1 x 2:1:1 or 2 x 4:1:1 with serial/backplane data, no ancillary data Dual Video, full HD-SDI: 2 x 4:2:2 with ancillary data no serial/backplane data Single Switched Video, full HD-SDI 1 x 4:2:2 (2 inputs) with ancillary data no serial or backplane data channels

Data	
No. Channels	4
Format	RS-232, RS-485 (selectable)
Data Rate	120 kbps NRZ max.
Options	Expansion cards

Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	2.5 Gbaud (3.125 Gbaud optional)
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers

**Factory configured modes*

Electrical	
Power Voltage	+5 VDC +/-10%, regulated
Current Draw	1.3 A typical (2 A max.)
Power Used	6.5 W typical (10 W max.)
Voltage Protection	Overvoltage and reverse polarity
Current Protection	Time delay fuse (3 A)

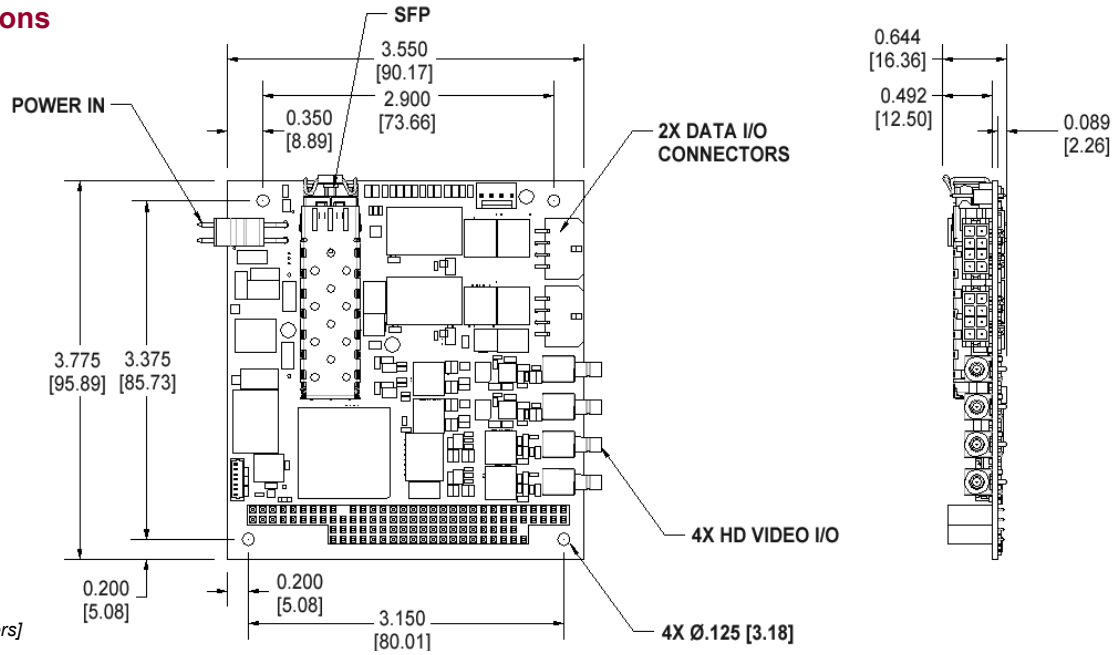
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 125 g (0.27 lb), including SFP
Options	Custom enclosures

Connectors	
Optical	Dual LC (SFP)
Video	Mini-SMB (75 ohm)
Data (Serial)	2 x 8-pin Molex (Micro-Fit Series)
Power	2-pin Molex, 0.156 inch pin spacing
Stacking Header	PC/104 (for stacking 907 cards only)

Environmental	
Temperature	-10°C to +60°C (operational) -20°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25-1000 Hz, 3 axes
Shock	30 g, 11 ms, half-sine, 3 axes

Diagnostics	
LEDS	Power (electrical), optical link, optical fault, serial Tx/Rx, video status
Ethernet to PC	Diagnostics from remote and console through 907-DIAG-E card at console

907-HDM2 Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-SER

8-Channel Serial Data Expansion Card

Description

The 907-SER card is an 8-Channel RS-232/485 serial data expansion card intended for stacking on top of a 907 motherboard to add channel capacity. By default, this card is switch configured to multiplex eight data channels onto a single backplane data port (8:1) connected to a 907 motherboard. This default configuration has a maximum baud rate of 250 kbaud on each of the eight serial channels. Options include support for RS-422 configurations and higher data rates.

Power is typically drawn from the 907 motherboard via the PC/104 connector.

A 907-DIAG-E diagnostic card may be added to the same stack as the console 907 motherboard to obtain system diagnostics of both the remote and console stacks through an Ethernet interface and Graphical User Interface (GUI) software.

Features

- Electrically isolated serial data channels (in pairs)
- Switch selectable RS-232/485 interfaces for individual channels
- RS-422 and RS-485 inputs have fail-safe biasing
- Compatible with 907-DIAG-E diagnostic card and Graphical User Interface (GUI) software
- On-board diagnostic LEDs
- Compatible with 907-232 and 907-485 serial cards

Benefits

- Isolated data channels provide more robust interface to external equipment
- Simplifies troubleshooting with advanced diagnostics
- Reduces sparing requirements

Typical Applications

- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Bomb Disposal Robots
- Tether Management Systems
- Tactical Networks

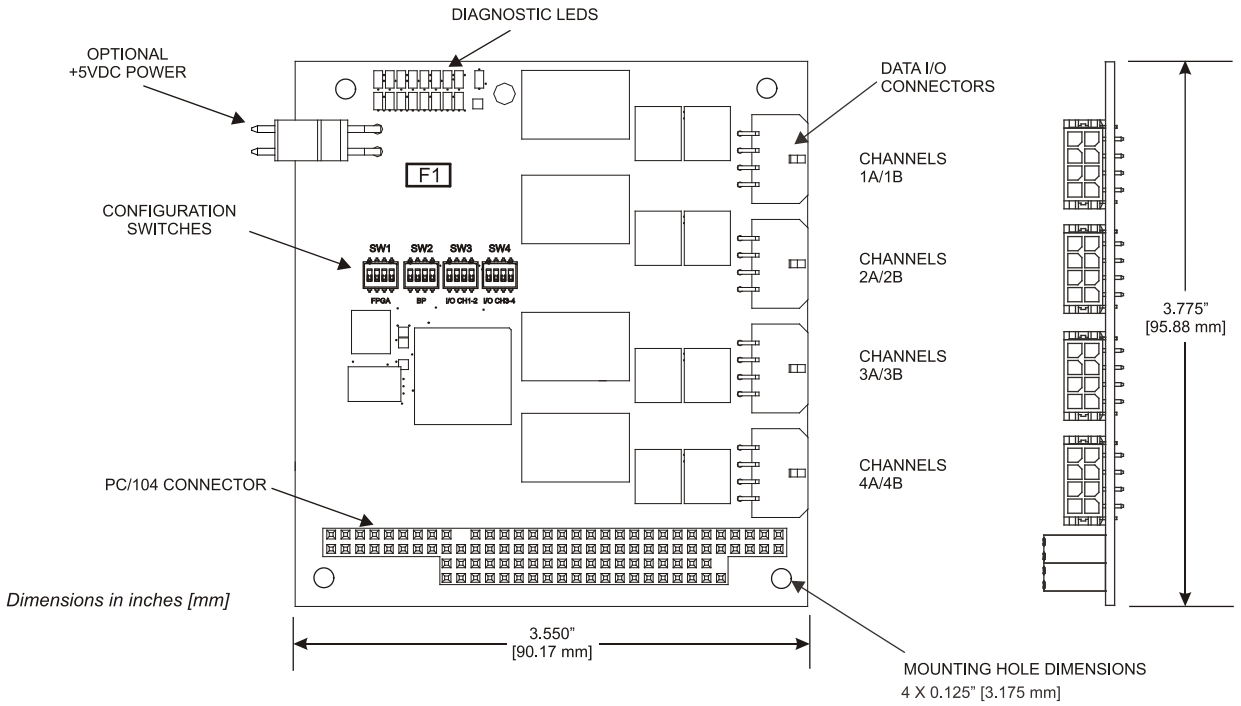
Model 907 Datasheet

Data	
No. Channels	8 channels of RS-232 (default), RS-485 or RS-422*
Data Rate	RS-232: 120 kbaud RS-485/422: 250 kbaud (2.5 Mbaud option)
Options	Factory configure RS-422 2.5 Mbaud on four channels (4 backplane lines) 400 kbaud on eight channels (2 backplane lines) Standalone serial copper mux Installed 120 Ohm terminators
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.26 lb)

**Factory configured option*

Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	0.75 A typical (1.5 A max)
Connectors	
Data I/O	4 x 8-pin Molex (Micro-Fit Series)
Power	Via PC/104 connector Optional: 2-pin Molex (KK Series)
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 – 1000 Hz, 3-axis
Shock	30 g, 11 ms, half-sine, 3 axes
Options	6000 psi pressure tolerant, extended temperature, stress screened or qualified

907-SER Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-ECL (Sonar)
Emitter Coupled Logic Media Converter

Description
The 907-ECL (Emitter Coupled Logic) media converter provides optical transmission of high speed data formats typically used by sonars over a singlemode or multimode fiber. This card may be switch configured to support single-ended and differential ECL/PECL signals.

For subsea applications, 907-ECL cards are typically connected to a sonar head at the remote end and the sonar processing unit at the console end. Supported sonar devices include the Reson 81XX Series, and the Kongsberg EM2000 and EM3000.

The 907-ECL card is available as a standalone card or as a CWDM stacking version for integration with a 907 multiplexer or other devices.

Features
- ECL/PECL inputs and outputs are AC-coupled, 75-ohm impedance
- On-board diagnostic LEDs for power and optical link
- External diagnostic LED connector
- Compatible with 907-DIAG-E diagnostic card and Graphical User Interface (GUI) software
- Interchangeable SFP optical transceiver
- Rugged design for harsh environments, including pressure tolerant version

Benefits
- Provides real-time, low latency, ECL/PECL signal transmission
- Extends sonar telemetry up to 10 km
- Simplifies troubleshooting with advanced diagnostics
- Supports a wide range of optical options, including CWDM wavelengths and multimode configurations

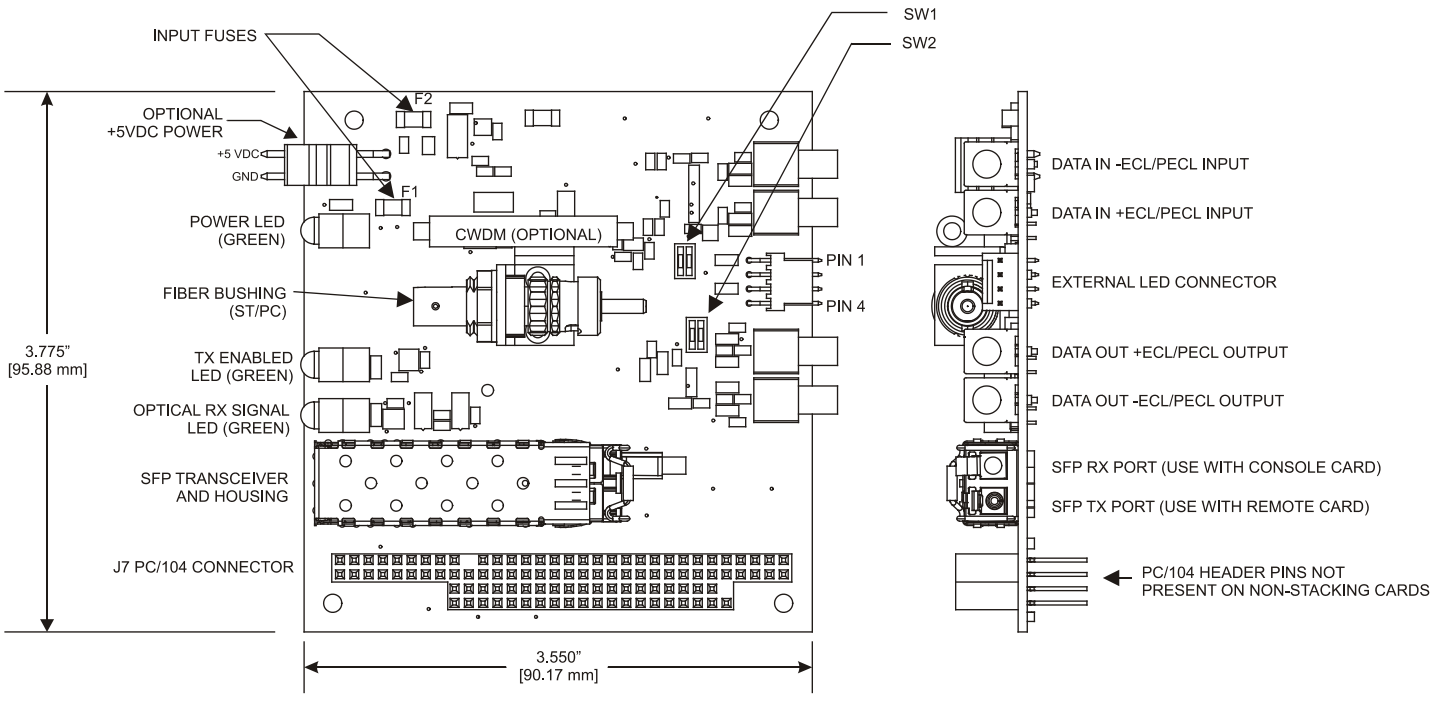
Typical Applications
- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Sonar Systems
- High Speed Data Links

Model 907 Datasheet

Data	
No. Channels	1
Format	ECL, PECL and pseudo-ECL
Data Rate	30 - 150 Mbaud
Impedance	75 Ohms (standard) 50 Ohms (option available)
Latency	<1 µs (not including fiber, ~5 µs/km)
Optical	
Optical Fiber	1 singlemode (9/125 µm) or multimode (50/125 µm)
Baud Rate	30 - 150 Mbaud
Wavelength	1310 nm standard (CWDM optional, 1471 – 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers; higher/lower budget transceivers
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	0.5 A typical (0.7 A max.)
Power Used	2.5 W typical (3.5 W max.)

Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.26 lb) including SFP
Options	Custom enclosure
Connectors	
ECL	SMB
LED Status	1 x 4-pin Molex connector
Optical	LC (SFP) ST/PC (fiber bushing)
Power	2 pin Molex, 0.156 inch pin spacing
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant, extended temperature, stress screened or qualified

907-ECL Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-HDV (HD-SDI)
High Definition Video Media Converter

Description
The 907-HDV (HD-SDI) media converter provides transmission of a single digital High Definition Video channel over a singlemode or multimode fiber. In addition to converting HD-SDI (SMPTE 292M) to fiber, this card also provides a solution for SD SDI (SMPTE-259M) to fiber conversion.

The 907 HDV media converter may be used as a standalone card or optically integrated into a Model 907 system stack via CWDM modules.

Features
- Supports SMPTE-292M (HD-SDI) and SMPTE-259M (SD-SDI) standards
- On-board diagnostic LEDs for power, optical link and video sync
- External diagnostic LED connector
- Compatible with 907-DIAG-E diagnostic card and Graphical User Interface (GUI) software
- Interchangeable SFP transceiver
- Rugged design for harsh environments, including pressure tolerant version

Benefits
- Provides real-time, low latency uncompressed video transmission
- Extends video transmission up to 10 km
- Simplifies troubleshooting with advanced diagnostics
- Supports a wide range of optical options, including CWDM wavelengths and multimode configurations

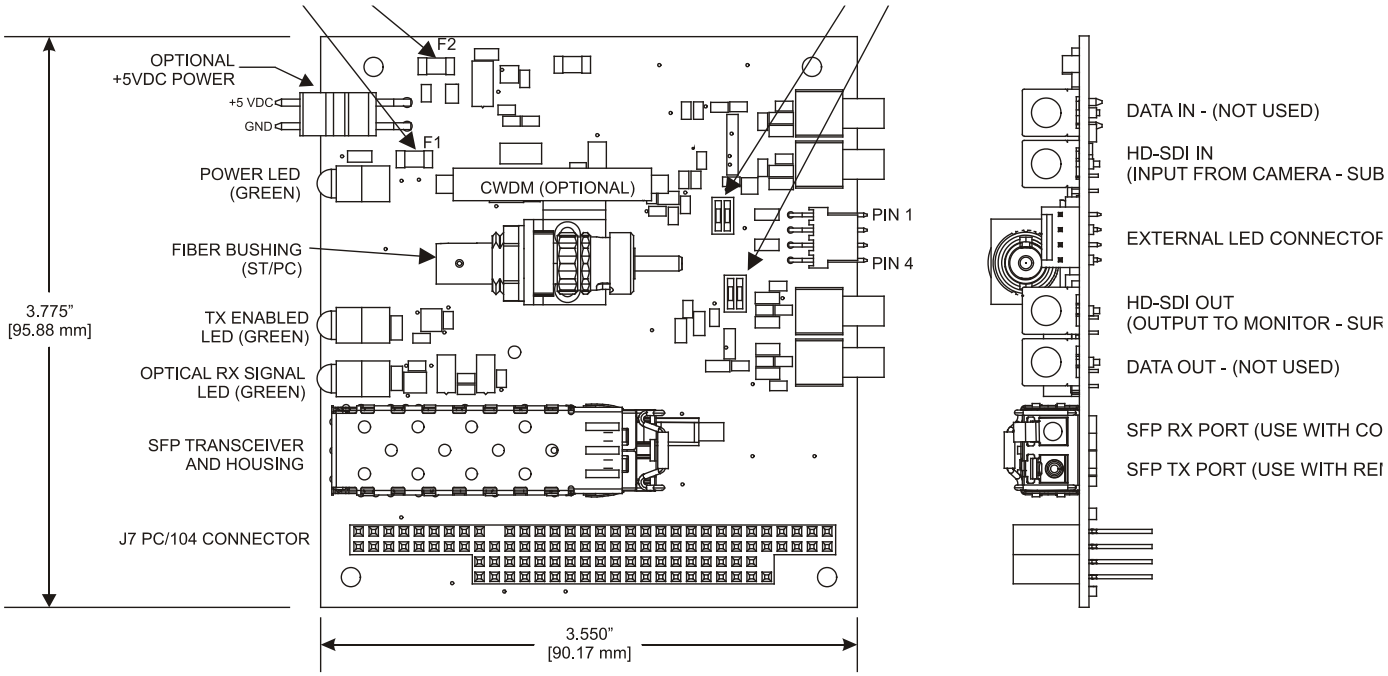
Typical Applications
- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tether Management Systems
- Tactical Networks and Defense Systems
- Industrial Process Control
- Remote HD video cameras

Model 907 Datasheet

Video	
No. Channels	1
Format	HD-SDI (SMPTE-292M) @ 720p, 1080i and 1080p SD-SDI (SMPTE-259M) @ 480p
Data Rate	HD-SDI: 1.483/1.485 Gbps SD-SDI: 143/177/270/360 Mbps
Impedance	75 Ohms
Latency	<1 µs (not including fiber, ~5 µs/km)
Optical	
Optical Fiber	1 singlemode (9/125 µm)
Baud Rate	143 - 1485 Mbaud
Wavelength	1310 nm standard (CWDM Optional, 1471-1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers; higher/lower budget transceivers, multimode
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	0.5 A typical (0.7 A max.)
Power Used	2.5 W typical (3.5 W max.)

Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.26 lb) including SFP
Options	Custom enclosures, PC/104 connector with stacking or non stacking pins
Connectors	
Video	SMB
LED Status	1 x 4-pin Molex
Optical	LC (SFP)
Power	2 pin Molex, 0.156 inch pin spacing
Options	Optical: ST/PC
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant, extended temperature, stress screened or qualified

907-HDV Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-GBE

Gigabit Ethernet Media Converter

Description

The model 907 Gigabit Ethernet (GbE) Media Converter is a PC/104 form-factor card that optically transfers Ethernet data at 1000 Mbps with low latency over a singlemode fiber. All three standard Ethernet rates (10/100/1000 Mbps) are compatible with the copper side RJ-45 input. As with other 907 media converters, the 907-GBE may be used as a standalone card or combined optically with other 907 cards. Optical power budgets are typically 20-26 dB with 10 km or more of singlemode fiber. Diagnostics are available as on-board LEDs for optical and data link status.

Features

- Lowest latency (no switch buffer delays)
- Compatible with 10/100/1000 Mbps copper links per IEEE 802.3
- Interchangeable SFP transceivers

Benefits

- Provides fastest response for time-critical links
- Backwards compatible with older 10/100 Mbps links
- Supports a wide range of optical options, including CWDM wavelengths

Typical Applications

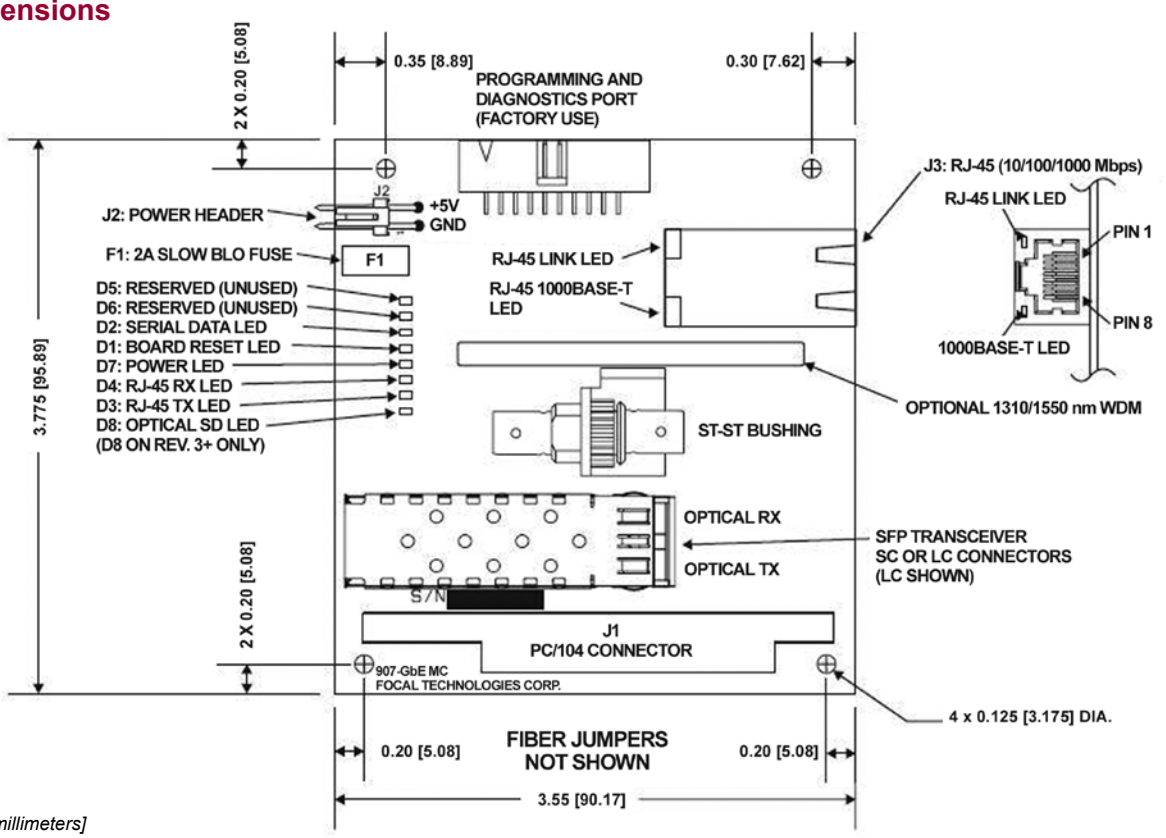
- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tether Management Systems
- Tactical Networks

Model 907 Datasheet

Data	
No. Copper Parts	1
Data Rate	10/100/1000 BASE-T(X)
Options	Half Duplex 10/100 Mbps Ethernet is supported for < 2 km optical links.
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	1.25 Gbaud
Format	SGMII
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers

Electrical	
Power Voltage	+5.0 VDC ± 10%, regulated
Power Used	4 W typical
Options	Isolated power card (DC-DC)
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.25 lb), including SFP
Options	Custom enclosures
Connectors	
Optical	ST/PC (standard), LC CWDM options
Data	1 x RJ-45
Power	2 pin Molex, 0.156 inch pin spacing
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant, extended temperature, stress screened or qualified

907-GBE Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-GBE2

Dual Gigabit Ethernet Media Converter

Description

The model 907-GBE2 is a Dual Gigabit Ethernet (GbE) Media Converter. This PC/104 card offers two independent 10/100/1000 Base-T(X) Ethernet ports (RJ-45) while maintaining the use of a single optical transceiver. This is the ideal solution for multi-beam sonar devices running "dual head" configurations, or any application that requires simultaneous yet dedicated point-to-point "switchless" connections over fiber. The 907-GBE2 may be used as a standalone card or optically integrated into a 907 system stack via CWDM modules. Optical power budgets are typically 20 - 26 dB over 10 km of singlemode fiber. Enhanced diagnostics are provided by on-board LEDs and through a dedicated Ethernet link when used with the diagnostics card (907-DIAG-E) and corresponding graphical user interface (GUI) software.

Features

- Two independent (switchless) 10/100/1000 Base-T(X) Ethernet links
- Single optical transceiver running with 2500, 1250 or 625 Mbaud optical link (switch settable)
- Interchangeable SFP transceivers
- Rugged design for harsh environments, including pressure tolerant version
- Compatible with 907-DIAG-E diagnostic card and Graphic User Interface (GUI) software

Benefits

- Reduces cost and size by replacing two GbE media converters with a single card and single optical transceiver
- Switchless design provides low latency and compatibility with non-standard packets often used by sonars and other proprietary data link
- Supports operation over multimode fiber with lower optical rate settings
- Supports a wide range of optical options, including CWDM wavelengths and multimode configurations
- Simplifies troubleshooting with advanced diagnostics

Typical Applications

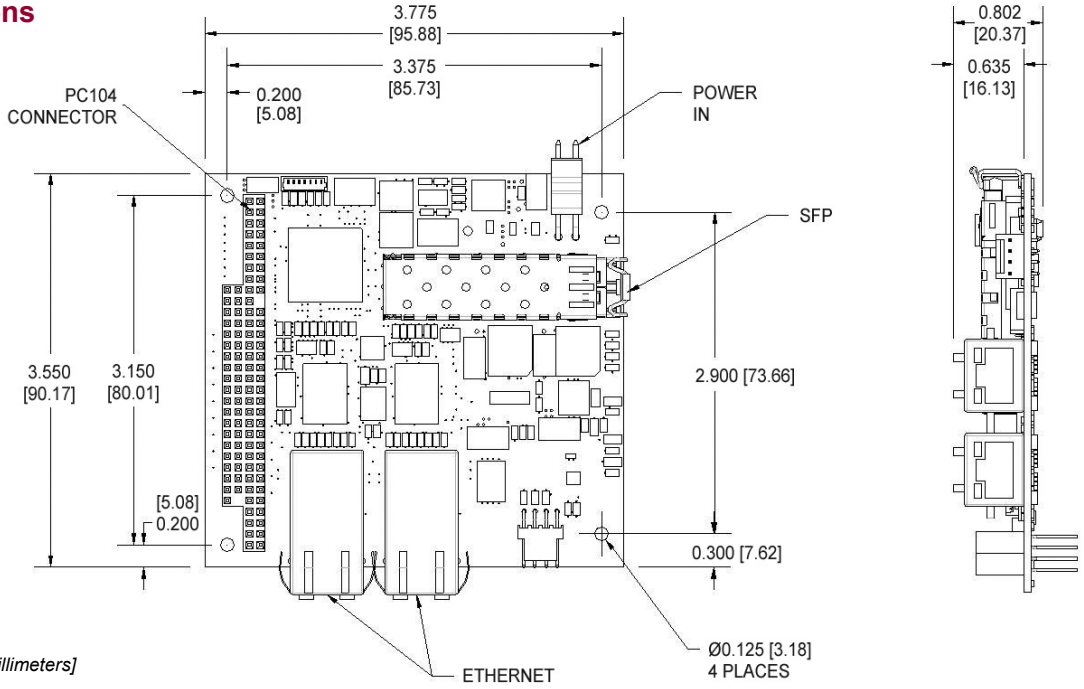
- Remotely Operated Vehicles (ROVs) and Tether Management Systems
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tactical Networks and Defense Systems
- Industrial Process Control

Model 907 Datasheet

Data	
No. Copper Ports	2 (non-switched, independent)
Data Rates	10/100/1000 Base-T
Total Throughput	~ 500/1000/2000 Mbps, via switch setting (0.01% used for embedded diagnostics)
Latency	< 25 us (not including fiber, ~5 µs/km)
Options	Standalone version; support for jumbo frames. Contact Moog for details.
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	625, 1250 or 2500 Mbaud
Format	AME-EP (Moog proprietary)
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers; multimode fiber
Electrical	
Power Supply	+5 VDC +/-10%, regulated
Current Draw	1 A typical (1.5 A max.)
Power Used	5 W typical (7.5 W max.)
Voltage Protection	Overvoltage, reverse polarity, 3 A time delay fuse

Diagnostics	
LEDs	Power (electrical), optical link, optical fault, optical speed, PHY Rx/Tx activity, port rate
Ethernet to PC	Diagnostics from remote and console through 907-DIAG-E card at console
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 125 g (0.27 lb), including SFP
Options	Custom enclosures
Connectors	
Optical	Dual LC (SFP)
Data (Ethernet)	2 x RJ-45
Power	2-pin Molex, 0.156 inch pin spacing
Stacking	PC/104 (for stacking 907 cards only)
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant; extended temperature; stress screened or qualified

907 GBE2 Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-GBES

Gigabit Ethernet Switch Media Converter

Description

The 907-GBES Gigabit Ethernet (GbE) Switch Media Converter is a 4-port switched version of the popular PC/104 form-factor cards. Compatible with 10/100/1000 Mbps devices, the switched interface card can manage traffic from multiple gigabit devices or allow simultaneous 100 Mbps Ethernet links to be transferred optically with bandwidth to spare.

The 907-GBES may be used as a standalone card or optically integrated into a 907 system stack via CWDM modules. Optical power budgets are typically 20 - 26 dB over 10 km of singlemode fiber. Enhanced diagnostics are provided by on-board LEDs and through a dedicated Ethernet link when used with diagnostics card (907-DIAG-E) and corresponding graphical user interface (GUI) software.

Features

- Ethernet switch with four 10/100/1000 Mbps RJ-45 copper ports and one 1.25 Gbaud optical port
- Wavelength selectable/interchangeable SFP transceivers
- Rugged design for harsh environments, including 6000 psi pressure tolerant version
- Compatible with 907-DIAG-E diagnostic card and Graphic User Interface (GUI) software

Benefits

- Provides multi-port Ethernet to optical conversion with a reliable small form-factor card
- Configures RJ-45 ports automatically to link with connected Ethernet device
- Supports a wide range of optical options, including CWDM wavelengths
- Simplifies troubleshooting with advanced diagnostics

Typical Applications

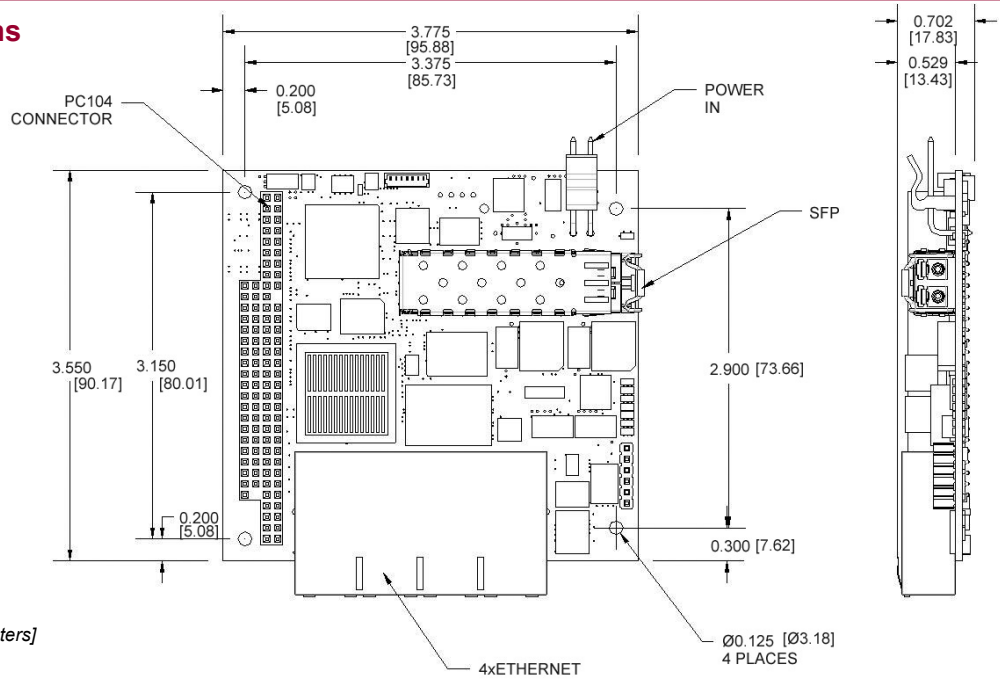
- Remotely Operated Vehicles (ROVs) and Tether Management Systems
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tactical Networks and Defense Systems
- Industrial Process Control

Model 907 Datasheet

Data	
No. Copper Ports	4 (switched)
Data Rates	10/100/1000 Base-T(X)
Total Throughput	~ 1000 Mbps (0.01% used for embedded diagnostics)
Latency	< 0.1 ms (single channel) < 10 ms (10 Mbps port, all ports active) typical, per RFC 2544
Options	Managed switch options for VLAN, port mirroring, quality of service, etc. Contact Moog for details.
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	1.25 Gbaud
Format	AME-EP (Moog proprietary)
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers; 2.5 Gbaud optical link
Electrical	
Power Supply	+5 VDC +/-10%, regulated
Current Draw	1.2 A typical (2 A max.)
Power Used	6 W typical (10 W max.)
Voltage Protection	Overvoltage, reverse polarity, 3 A time dealy fuse

Diagnostics	
LEDs	Power (electrical), over temperature limit, optical link valid, PHY Rx/Tx activity, Ethernet port link speed
Ethernet to PC	Diagnostics from remote and console through 907-DIAG-E card at console
Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 125 g (0.27 lb), including SFP
Options	Custom enclosures
Connectors	
Optical	Dual LC (SFP)
Data (Ethernet)	4 x RJ-45
Power	2-pin Molex, 0.156 inch pin spacing
Stacking	PC/104 (for stacking 907 cards only)
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant; extended temperature; stress screened or qualified

907 GBES Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-DIAG-E
Diagnostics Card, Ethernet

Description
The 907-DIAG-E card provides access to real-time diagnostic information from many of the Moog Focal™ Model 907 multiplexers, media converters and expansion cards. Typically mounted on top of a console stack, the 907-DIAG-E reads diagnostic values from both console and remote cards polled via the 10/100 Mbps Ethernet port. With programmable and switch configured IP addresses available, multiple diagnostics cards can be connected to the same network. In addition, a 20-pin header may be programmed to drive external LEDs as various status indicators, such as fault conditions, alarms, and optical link parameters.

Diagnostic information is polled from both optical transceivers (SFPs) and cards themselves. Transceiver data includes transmit and receive optical powers, temperature, laser bias current, power voltage, and various manufacturer information. Card specific data includes card identifier, serial number, and firmware version.

Diagnostic readings may be accessed by using Focal™ Graphical User Interface (GUI) software, based on the Microsoft® .NET Framework, or by using a customer's own software based on the Focal open communications protocol. A .NET library is also available to simplify the development of user GUI software.

Features
- Real-time health monitoring of power, optics, video, and data channels via Ethernet
- Configurable IP address for networked applications
- Sample diagnostic GUI software available for Windows based PC
- Open diagnostic protocol for customer development
- User defined configuration of on-board diagnostic LEDs and header pins

Benefits
- Allows early identification of potential problems, e.g. increasing optical loss
- Provides remote access to diagnostics for technical support
- Allows logging of diagnostics data to establish baseline and historical performance
- Provides access to custom LED configurations for customer control panels

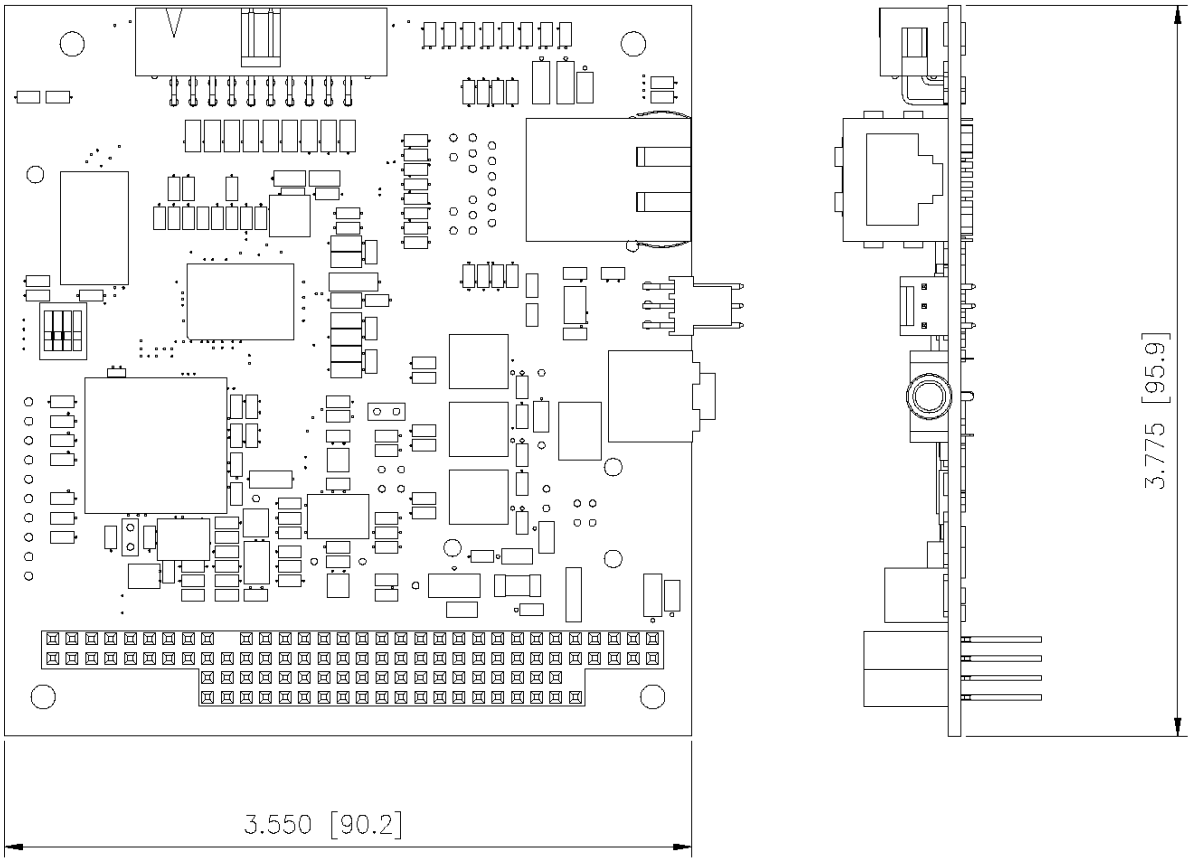
Typical Applications
- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Bomb Disposal Robots
- Tether Management Systems
- Tactical Networks

Model 907 Datasheet

Ethernet	
No. Copper Ports	1
Data Rates	10/100 Base-T(X)
RS-232	
No. Channels	1 (factory configuration)
Data Rate and Format	9600 Baud, 8-N-1 (1 start bit, 8 data bits, 1 stop bit, no parity, no flow control)
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	0.3 A typical (0.5 A max.)

Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 80 g (0.17 lb)
Connectors	
External LED Header	1 x 20-pin Samtec (TST Series) Mating P/N IDSD-10-S-XX.XX
Ethernet Connector	1 x RJ-45 (shielded)
Serial (RS-232)	3.5 mm stereo jack (TRS)
Power	PC/104 connector
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes

907-DIAG-E Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

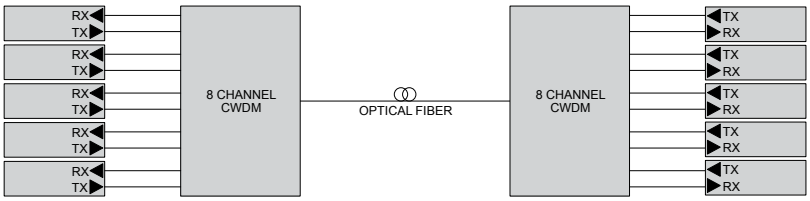
907-CWDM

Coarse Wave Division Multiplexers

Description

The model 907 series of CWDMs combine multiple media converters or multiplexer motherboards onto a single fiber-optic cable. All CWDM cards are ITU-T G.694.2 compliant, passive (no electrical power required), and perform as both an optical multiplexer and optical de-multiplexer, allowing for bidirectional communication. They are form factor compatible with the 907 products and can be added to an existing stack, providing an upgrade path for additional functionality.

A 2-channel with a 1310/1550 nm bypass, 4-channel and 8-channel versions are available. The 2-channel version allows for simple expansion of an existing 1310/1550 nm Focal™ system.

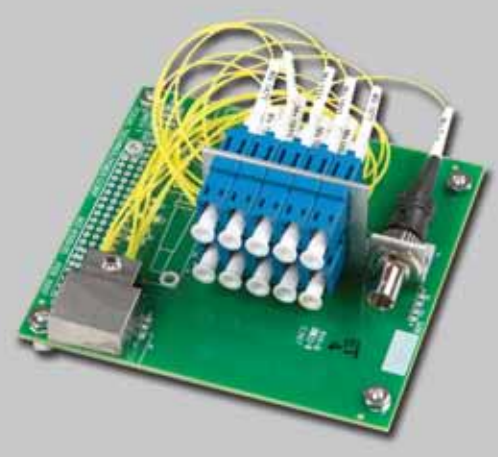


Features

- Modular design
- Passive optics
- Compatible with all Model 907 products
- Available in 2-channel with bypass (907-CWDM), 4-channels (907CWDM4), or 8-channels (907-CWDM-8)
- Rugged design for harsh environments, including pressure tolerant version

Benefits

- Reduces the number of fibers required in cables and rotary joints
- Modular format allows for future upgrades and channel expansion



Typical Applications

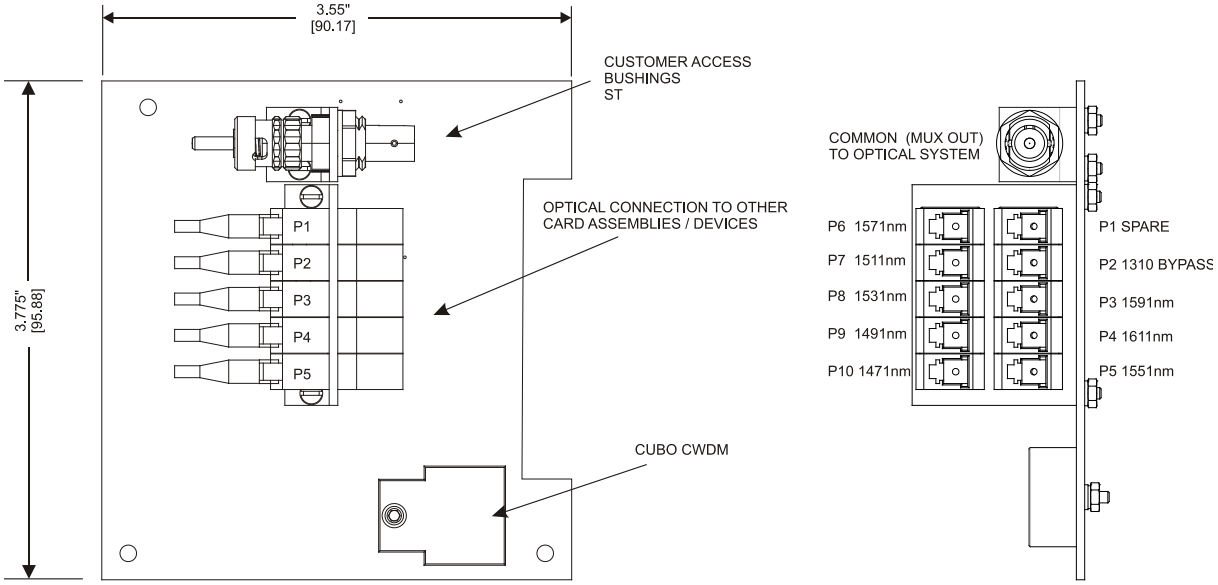
- Modular subsystems for Remote Operated Vehicles (ROVs)
- Multiple HD camera systems
- Imaging sonar systems
- Defense and security networks

Model 907 Datasheet

Optical	
Fiber Type	Singlemode (9/125 µm) Multimode (50/125 µm)
Center Wavelength	2-channel: 1310/1550, 1471, 1491 nm 4-channel: 1471, 1491, 1511, 1531 nm 8-channel: 1471, 1491, 1511, 1531, 1551, 1571, 1591, 1611 nm
Channel Spacing	20 nm
Isolation	> 30 dB
Return Loss	> 45 dB
Insertion Loss	2-channel: < 2.5 dB 4-channel: < 2.5 dB 8-channel: < 3 dB
Options	Other wavelengths available, optional bypass port

Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.25 lb)
Options	Custom enclosures, other form-factors available
Connectors	
Common	ST standard
To Cards	LC standard
Options	FC/PC
Environmental	
Temperature	0°C to +70°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	6000 psi pressure tolerant version, extended temperature, stress screened or qualified

907-CWDM Dimensions (8-channel version shown)

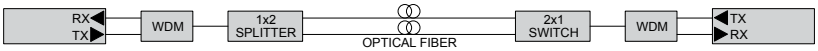


Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

907-FOS
Fiber Optic Switch

Description
The 907-FOS card is a 2 x 1 fiber-optic switch available in a PC/104 form-factor. When combined with a Focal™ 907-SPLIT fiber-optic splitter, they create a redundant fiber-optic path for multiplexer systems and other optical data links.



The 907-FOS is a powered fiber-optics card typically installed at the console end of the fiber-optic link. It is controlled by either a manual onboard toggle switch or with a TTL compliant input signal. The 907FOS will select one of the two fiber-optic paths or outputs and route all communications to a single fiber.

Features
- Supports ITU-T G694.2 CWDM wavelengths
- Manual or TTL controlled fiber-optic switch
- Singlemode or multimode versions available
- On-board LED indicating active fiber-optic link

Benefits
- Creates a redundant fiber-optic link, improving system reliability
- Allows remote selection of active fiber

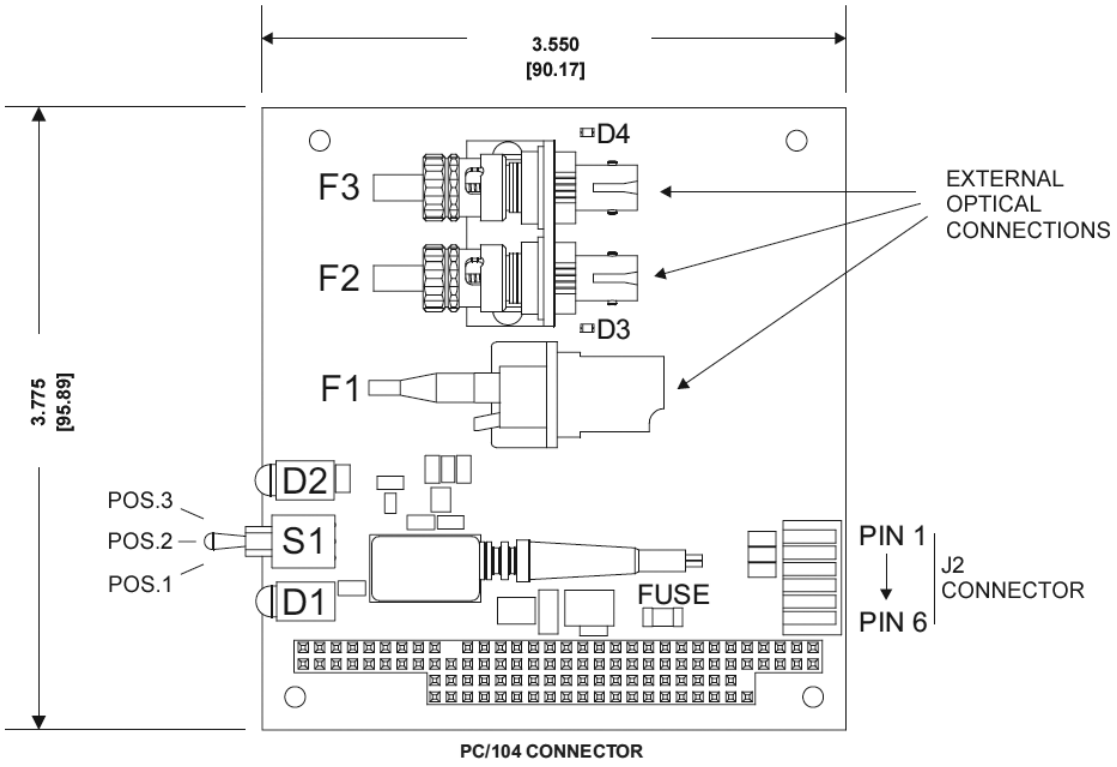
Typical Applications
- High failure resistant Remote Operated Vehicles (ROV)
- Pipe inspection robots
- Bomb disposal robots
- Video security systems
- Armored vehicles

Model 907 Datasheet

Optical	
Fiber Type	Singlemode (9/125 µm) Multimode (50/125 µm and 62.5/125 µm)
Wavelength	1310/1550 nm, ITUT G694.2 CWDM
Return Loss	> 40 dB
Insertion Loss	< 1.0 dB
Switching Time	< 100 ms, including debounce
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	0.07 A (typical), 0.09 A (max.)
Power Used	0.35 W (typical), 0.5 W (max.)
Protection	Overvoltage, reverse polarity, 1 A timedelay fuse
Switch Control	TTL compatible 2.4 V threshold (others available)
Diagnostics	
LEDs	Power (electrical), active fiber

Mechanical	
Dimensions	PC/104 (form-factor only)
Weight	< 120 g (0.26 lb)
Options	Custom enclosures
Connectors	
Optical	2 x ST in (F2, F3), 1 x LC out (F1)
Control and Power	6-pin Wago
Stacking Header	PC/104 (for stacking 907 cards only)
Environmental	
Temperature	0°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	Extended temperature, stress screened or qualified

907-FOS Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

Model 912 Media Converter Product Guide

FOCAL™

The family of Focal™ 912 Optical/Electrical/Optical (OEO) converters provides a wide range of optical conversion solutions.

Moog's family of low latency Optical/Electrical/Optical (OEO) converters provide a range of options for repeating optical data signals, converting them to other optical or electrical formats, or combining multiple fibers onto a single fiber via Coarse Wavelength Division Multiplexing (CWDM). Each product in the 912-OEO product family employs high-reliability design and production processes, including environmental stress screening (ESS) to ensure reliable performance over a long life, even in harsh environments.

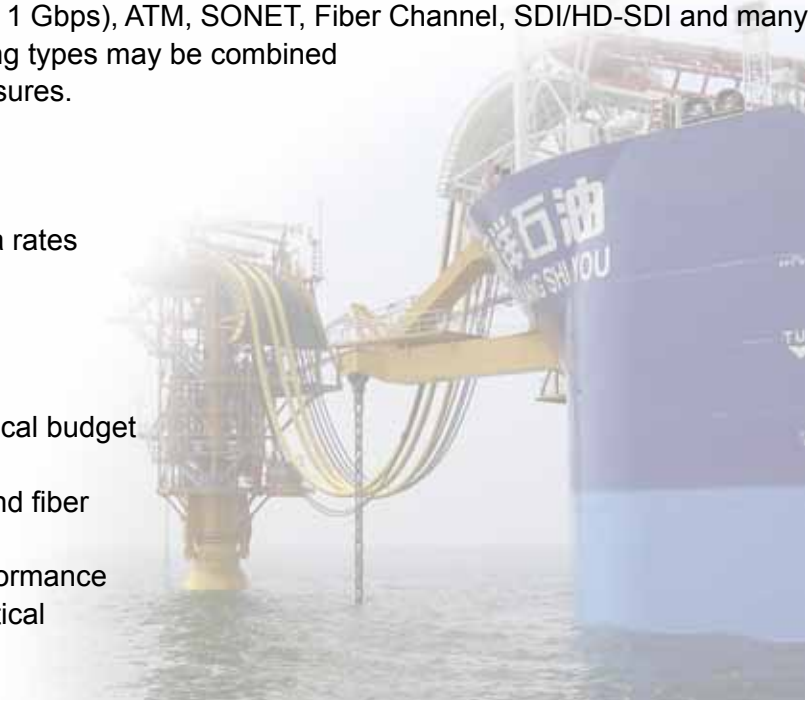
The conversion of optical wavelength or fiber type - singlemode to multimode or vice versa - is often a cost effective solution when integrating off-the-shelf optical equipment in nonstandard configurations (e.g. operation over long distances or through mixed fiber systems). Each converter supports multiple data rates and signal formats, including Ethernet (10 Mbps, 100 Mbps, 1 Gbps), ATM, SONET, Fiber Channel, SDI/HD-SDI and many industrial protocols. Multiple converters of differing types may be combined into single racks, boxes or explosion proof enclosures.

Key Features

- Modular optical and mechanical design
- Wide range of supported data formats and data rates
- Link diagnostic monitoring
- High reliability and long life

Benefits

- Easy extension of maximum distances and optical budget for optical telemetry
- Reduced number of fibers required in cables and fiber optic rotary joints
- Improve incoming signal integrity and jitter performance
- Extremely customizable to your application (optical wavelength, fiber-type, channel count)



Typical Applications

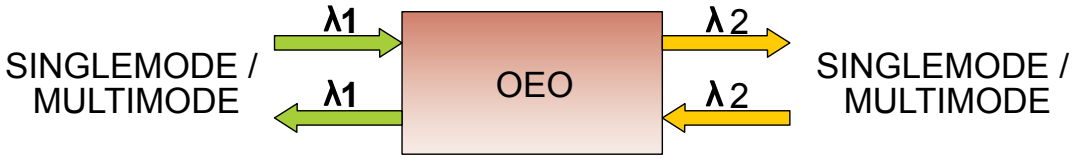
Optical Repeating (Boosting)

Moog 912 products can all be used to optically regenerate an incoming optical signal, providing increased optical budget, and extending transmission distance. Optical signals are received at low signal levels with a sensitive photo-detector and transmitted with a high optical output signal, providing a 15 to 25 dB boost in optical power. Shown here is an example of a two-channel (1 bidirectional channel) using the same wavelength on each channel.

2 channel (1 bidirectional channel)
Optical Boosting

Wavelength Conversion

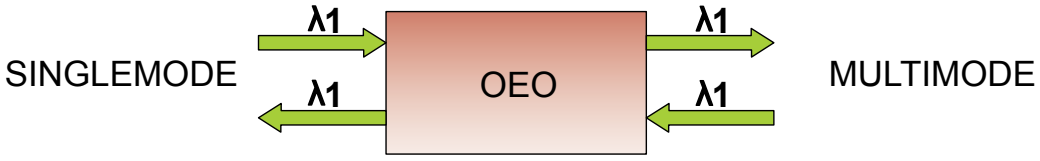
The 912 family has been designed using plug-and-play optical transmitters and receivers, allowing for simple factory configuration to meet a wide range of system architectures. This modularity allows users to easily customize the incoming and outgoing optical wavelengths for each channel, providing a simple means for wavelength conversion.



2 channel (1 bidirectional channel)
Wavelength Conversion

Fiber-type Conversion (SMF-MMF/MMF-SMF)

The modular design of the 912 product family allows for simple conversion from singlemode to-multimode fiber, or vice versa. This can be used for example to utilize an existing multimode fiber link with components designed for singlemode fiber.

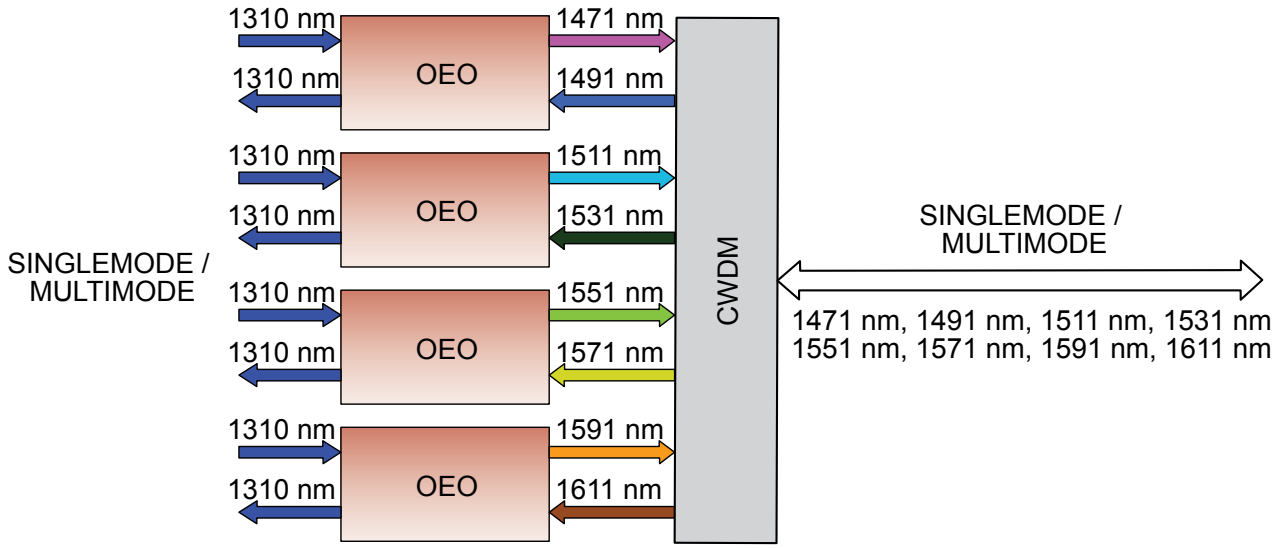


2 channel (1 bidirectional channel)
Singlemode to Multimode Fiber Conversion

Wavelength Conversion, Fiber Conversion and Optical Multiplexing

With the additional integration of Course Wavelength Division Multiplexing (CWDM) optical components into the 912 architecture, the 912-OEO can also be used to aggregate multiple incoming optical signals onto one singlemode fiber. The use of modular optical components within the 912 product family allow for factory selection of channel wavelength and inherently supports multimode-to-singlemode fiber conversion if required.

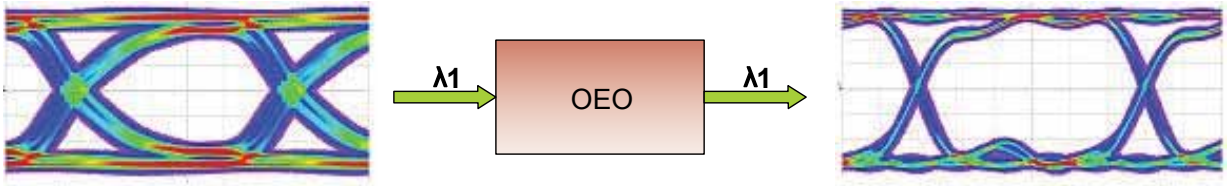
Each highly integrated and configurable assembly can be used to simplify fiber channel count within cable assemblies or over a fiber optic rotary joint, reducing weight and total system cost.



8 channel (4 bidirectional channel)
Wavelength Conversion, Fiber Conversion, and Optical Multiplexing

Signal Re-Clocking

One of the inherent advantages of the 912-OEO architecture, whereby an incoming optical signal is first converted to the electrical domain, is it allows for clock-recovery and re-generation before the signal is again converted to an optical signal for re-transmission. The clock-recovery and re-generation technique used in the 912 product family improves the timing and jitter performance of an incoming signal, effectively 'resetting' the jitter, allowing for extended transmission distances and improved signal integrity and error performance.



Other Architectures

Another feature of the 912 product family architecture is that it supports optical-to-electrical conversion using modular plug-and-play Copper transceivers. This allows for a diverse range of configurations for conversion between copper channels (such as 10/100/1000 Base-T(X) Ethernet, and SMPTE 292M HD SDI) and fiber optic channels.

Key Specifications



Optical Options

- Support for 850 nm, 1310 nm , 1550 nm, and ITU-T G.694.2 CWDM wavelengths
- Optical Fiber: Multimode (50/125 µm)/(62.5/125 µm) and singlemode (9/125 µm)
- Flux Budget: 20 dB min. standard (Others available)
- Optical Connectors: LC, ST are standard (depending on card), SC, FC options available.

Environmental

- 0 to +60 ˚C standard
- -45 to +85 ˚C optional
- Environmental Stress Screening

Signal Rates

- DC to 3Gbaud per channel, depending on card
- 10/100/1000 Base-T(X) Ethernet encoding, 8b/10b Encoding, Others
- Latency <10 ns
- Jitter reduction with re-clocking

Reliability

- MTBF = 200,000 hours min.

Form Factors

- Eurocard (100 mm x 160 mm, 4 HP) with or without Front Panels
- Multiple cards mounted in 19” 3U Chassis
- IP66 Ingress Protected and Explosion Proof Housing for use in Class 1 Hazardous Locations
- Custom

Power Requirements

- Input Voltage: +5 VDC ± 10%, regulated, 0.5-1.0 A draw typical per card
- 110/220 VAC or +24 VDC for chassis mounted systems
- Input Protection: Over-voltage, reverse polarity, over-current

Other Options

- SFP Diagnostics available via backplane (Temperature, Bias-current, Voltage Rail, Rx/Tx Power, etc.)

Call or email our knowledgeable Application Engineers for more information:
902-468-2263 or focal@moog.com

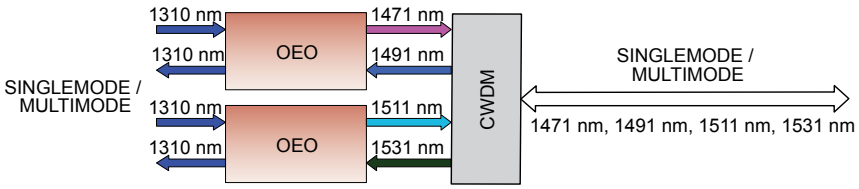
912-OEO-4R

4-Channel OEO Wavelength Converter with Re-clocking

Description

The model 912-OEO-4R is an Optical-Electrical-Optical (OEO) signal converter that provides several functions, including optical wavelength conversion, optical signal boosting, optical multiplexing, and re-clocking of optical outputs to reduce jitter. Although many configurations are possible, the standard card combines optical signals from four separate fibers into a single fiber, often with increased optical power budget to significantly extend the range of the original signals or pass the signals through higher loss cabling systems. The signals are converted back to their original wavelengths at the other end of the fiber link, thus providing a transparent, bidirectional system.

The form-factor and proven reliability of Moog products make the Model 912-OEO-4R ideal for applications such as FPSO (Floating Production, Storage and Offloading) units, optical data and telemetry networks, specialized industrial machines, advanced work class ROVs, tactical and industrial security networks, and armored vehicle platforms.



Wavelength Conversion With Optical Multiplexing

Features

- Built-in clock recovery and regeneration
- Modular design (3U Eurocard)
- Wide range of supported data formats including 10/100/1000 Base-T(X) Ethernet, ATM, SONET, Fibre Channel, SDI/HD-SDI
- Basic link diagnostics via front panel LEDs
- 20 year MTBF

Benefits

- Easy extension of the maximum operating distance of standard optical telemetry equipment
- Reduced number of fibers required in cables and rotary joints
- Increased optical power budgets and robustness of optical links
- Modular format allows future upgrades or augmentation in card-cage systems
- Reduces signal jitter

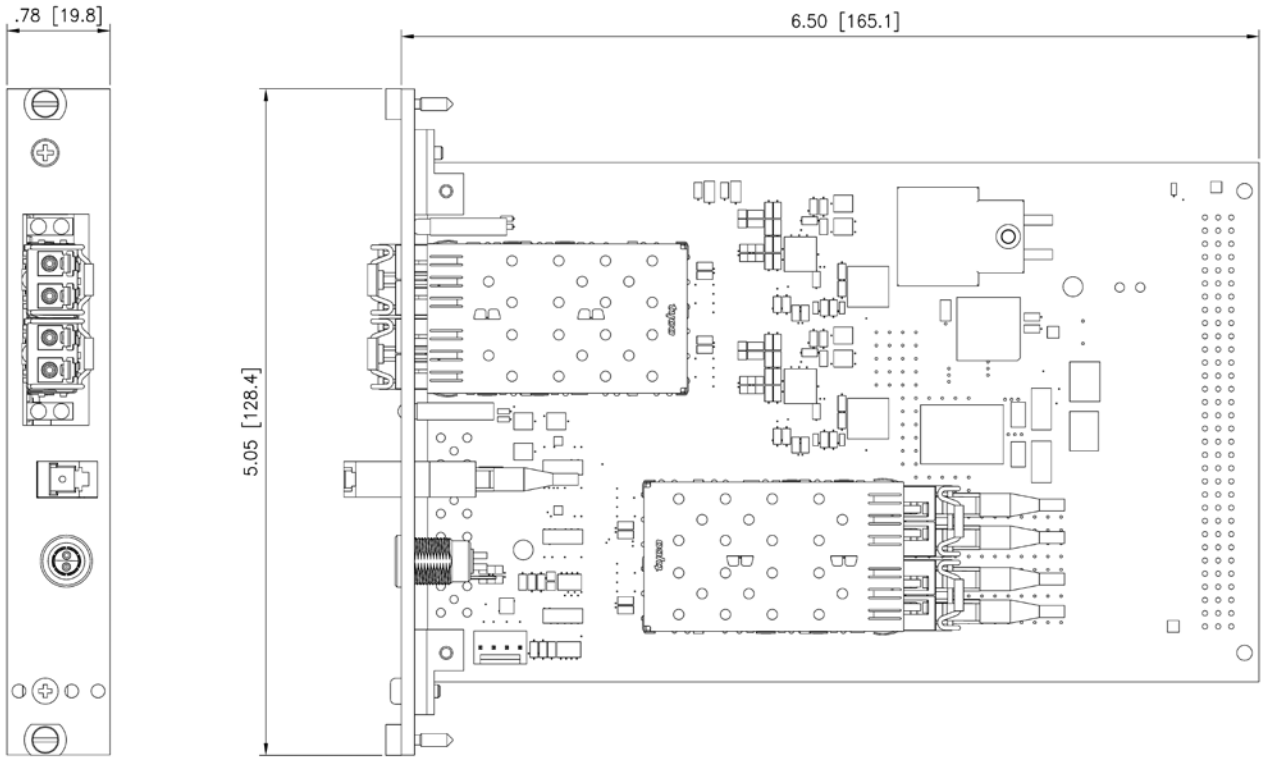
Typical Applications

- Industrial process control
- Rotating test stations
- FPSO data systems
- Telemetry extenders

Data	
No. Channels	4 wavelengths (i.e. 2 bidirectional channels) with signal re-clocking
Baud Rate	125 – 3125 Mbaud
Format	10/100/1000 Optical Ethernet, 8b/10b, or other encoding formats
Latency	<10 ns
Optical	
Optical Fiber	Singlemode (9/125 µm) Multimode (optional)
Wavelength	Input: 850, 1310/1550 nm standard Output: CWDM, 1471 – 1611 nm standard
Connectors	LC standard, other types optional
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated Other voltages optional
Power Used	5 W typical (10 W max.)

Mechanical	
Dimensions	Eurocard Format: 100 mm x 160 mm 4 HP Wide
Enclosures	Custom card cages and enclosures available, including explosion-proof enclosures for use in Class 1 hazardous locations
Environmental	
Temperature	0°C to +50°C (operational) -18°C to +70°C (extended operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	Stress screening
Reliability	
MTBF	200,000 hours minimum

912-OEO-4R Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

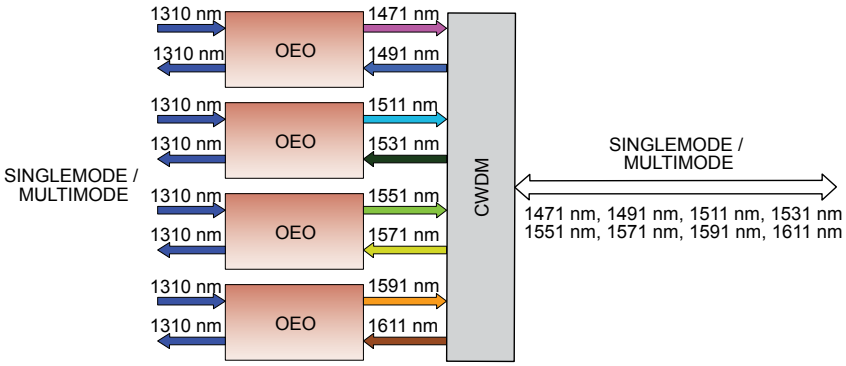
912-OEO-8

8-Channel OEO Wavelength Converter

Description

The 912-OEO-8 is an Optical-Electrical-Optical (OEO) signal converter that provides several functions, including optical wavelength conversion, optical signal boosting, and optical multiplexing. Although many configurations are possible, the standard card combines optical signals from eight separate fibers into a single fiber, often with increased optical power budget to significantly extend the range of the original signals or pass the signals through higher loss cabling systems. The signals are converted back to their original wavelengths at the other end of the fiber link, thus providing a transparent, bidirectional system.

The form-factor and proven reliability of Moog products make the Model 912-OEO-8 ideal for applications such as FPSO (Floating Production, Storage and Offloading) units, optical data and telemetry networks, specialized industrial machines, advanced work class ROVs, tactical and industrial security networks, and armored vehicle platforms.



Wavelength Conversion With Optical Multiplexing

Features

- Modular design (3U Eurocard)
- Wide range of supported data formats including 10/100/1000 Base-T(X) Ethernet, ATM, SONET, Fibre Channel, SDI/HD-SDI
- Basic link diagnostics via front panel LEDs
- 20 year MTBF
- Custom enclosures available on request

Benefits

- Easy extension of the maximum operating distance of standard optical telemetry equipment
- Reduced number of fibers required in cables and rotary joints
- Increased optical power budgets and robustness of optical links
- Modular format allows future upgrades or augmentation in card-cage systems

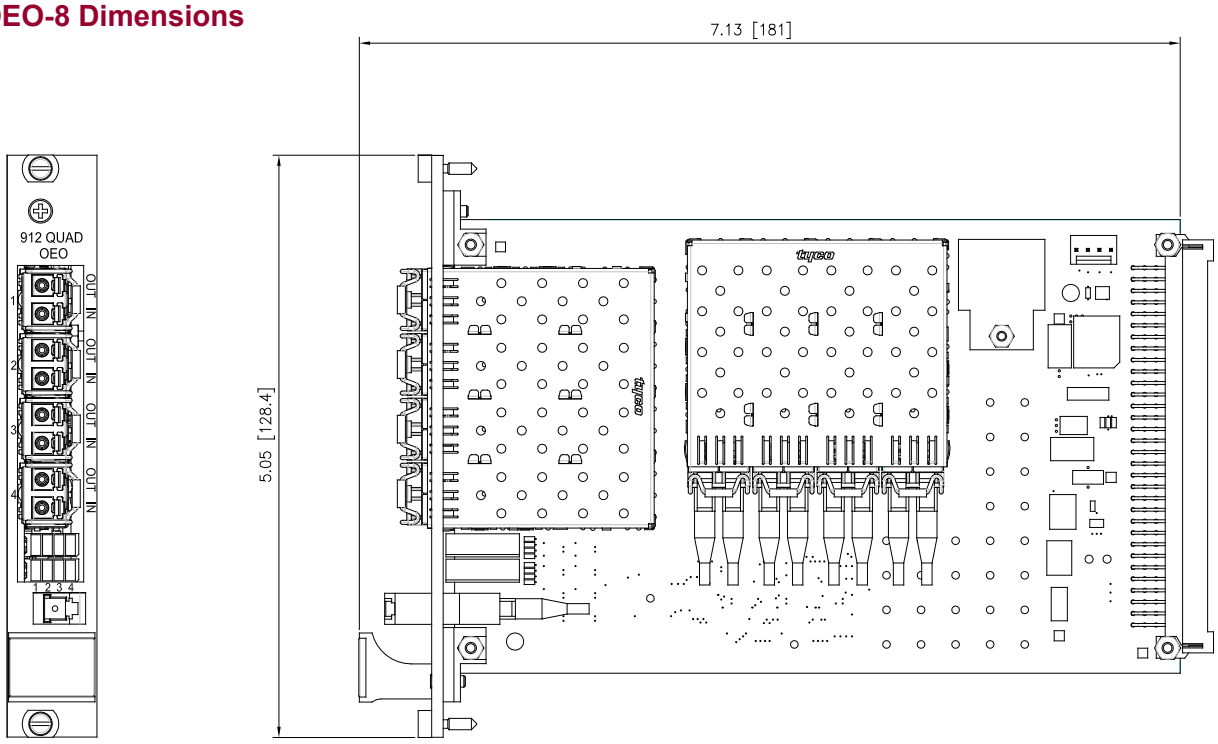
Typical Applications

- Industrial process control
- Rotating test stations
- FPSO data systems
- Telemetry extenders

Data	
No. Channels	8 wavelengths (i.e. 4 bidirectional channels)
Baud Rate	125 – 3125 Mbaud
Format	10/100/1000 Optical Ethernet, 8b/10b, or other encoding formats
Latency	<10 ns (not including fiber, ~5 µs/km)
Optical	
Optical Fiber	Singlemode (9/125 µm) Multimode (optional)
Wavelength	Input: 850, 1310/1550 nm standard Output: CWDM, 1471 – 1611 nm standard
Connectors	LC standard, other types optional
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated Other voltages optional
Power Used	5 W typical (10 W max.)

Mechanical	
Dimensions	Eurocard Format: 100 mm x 160 mm 4 HP Wide
Enclosures	Custom card cages and enclosures available, including explosion-proof enclosures for use in Class 1 hazardous locations
Environmental	
Temperature	0°C to +50°C (operational) -18°C to +70°C (extended operation option) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 1000 Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes
Options	stress screening
Reliability	
MTBF	200,000 hours minimum

912-OEO-8 Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

Model 914 Product Guide

FOCAL™

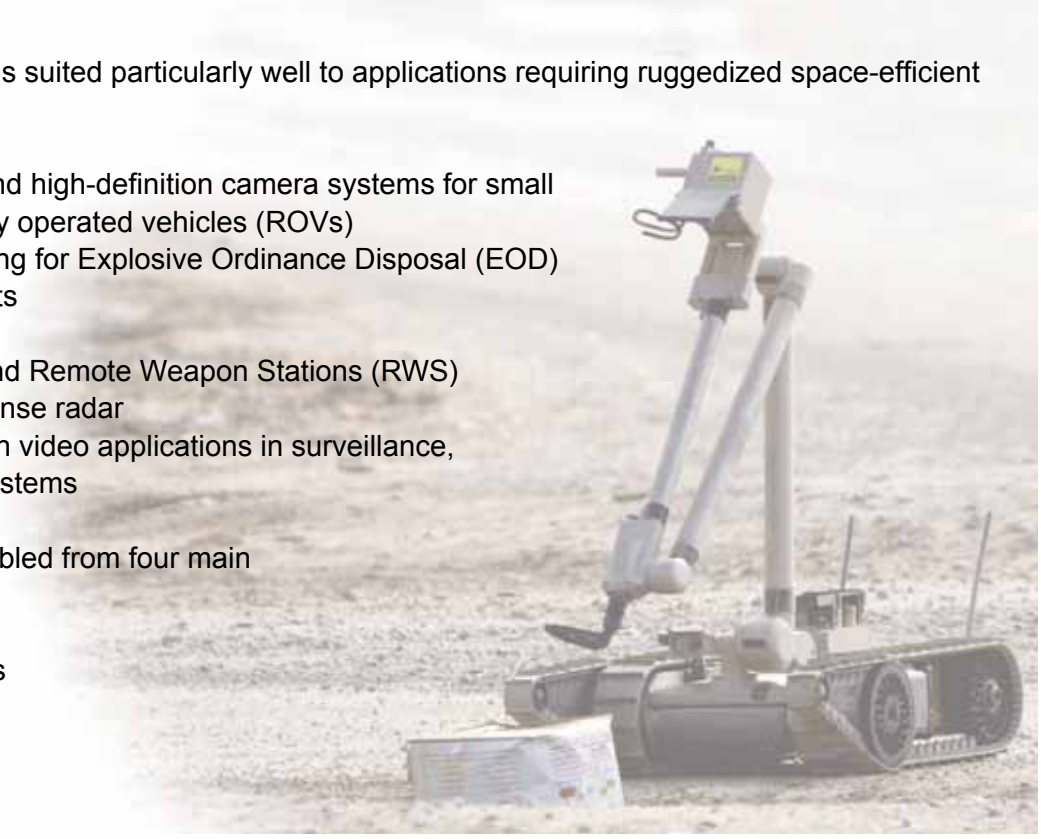
The Focal™ 914 media converter and multiplexer technology enables the transfer of analog component video, high definition HD-SDI video, 10/100/1000 Base-T(X) Ethernet, and serial data signals over a fiber-optic communication channel.

The Model 914 media converter and multiplexer technology enables the transfer of analog component video (NTSC, PAL), high definition HD-SDI (SMPTE-292) video, 10/100/1000 Base-T(X) Ethernet, and serial data signals (RS-232, RS-485, TTL, etc.) over a fiber-optic communication channel. These credit-card sized electronic cards have been designed specifically for use in harsh marine and industrial environments.

Typical Applications

The Model 914 product family is suited particularly well to applications requiring ruggedized space-efficient fiber-optic converters, such as:

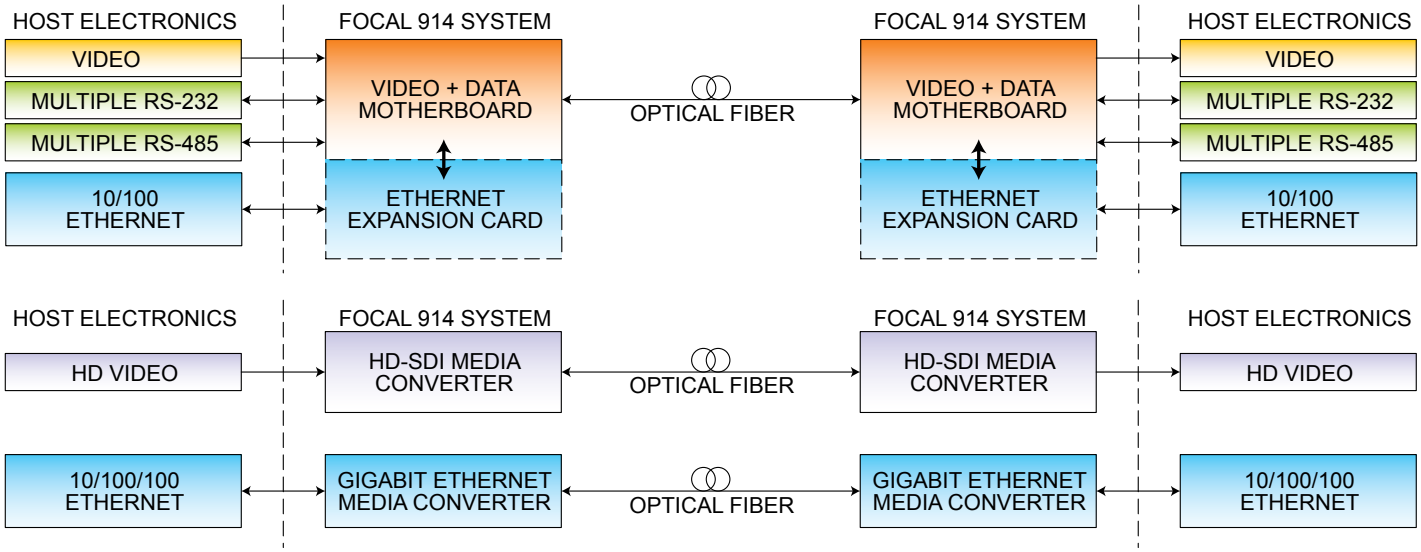
- Supporting NSTC/PAL and high-definition camera systems for small to medium sized remotely operated vehicles (ROVs)
- Video and control signaling for Explosive Ordinance Disposal (EOD) and pipe inspection robots
- Industrial sensors
- Ground vehicle turrets and Remote Weapon Stations (RWS)
- Naval, weather, and defense radar
- Many other high definition video applications in surveillance, defense and industrial systems



Model 914 systems are assembled from four main categories of cards:

- Multiplexer motherboards
- Media converters
- Expansion cards
- Optics cards

Multiplexers, Media Converters, and Expansion Cards



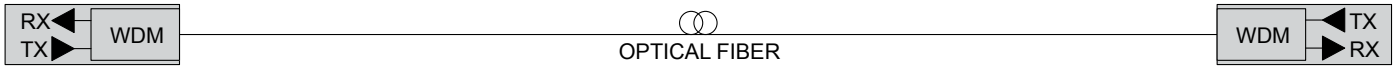
Focal 914 *media converter* technology converts data, HD-video, or Ethernet signals to optical format. Focal 914 *multiplexers* electrically combine serial data (RS-232, RS-422/485 and others) with video, providing simultaneous support for video and data signals over a single optical fiber.

Model	914-R/C	914-EIBS	914-MCS	914-GBE	914-HDV	914-HDM
Description	Video/Data Multiplexer	Ethernet Switch Expansion Card	Fast Ethernet Media Converter	Gigabit Ethernet Media Converter	HD-SDI Media Converter	HD-SDI/ Data Mux
Part Number	914-0001-xx (R) 914-0002-xx (C)	914-0202-00	914-0014-xx	914-0021-xx	914-0018-04	914-0023-xx (R) 914-0024-xx (C)
Supported Video Format	NTSC, PAL	None	None	None	HD-SDI (SMPTE 292)	HD-SDI (SMPTE 292)
Video Channels	1	None	None	None	1 x HD-SDI	1 x HD-SDI
Supported Data Formats	RS-232, RS 485/422, Expansion card	10/100 Base T(X) Ethernet*	10/100 Base T(X) Ethernet	10/100/1000 Base T Ethernet	None	RS-232, RS 485/422, Expansion Card
On-board Data Channels	4 Serial	2 Ethernet	2 Ethernet	1 Ethernet	None	2 Serial

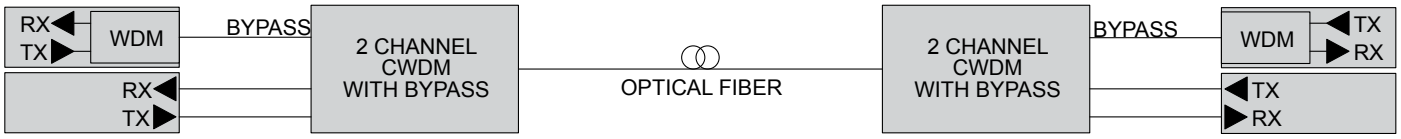
*Total maximum aggregate throughput of both 10/100 Ethernet ports is 10Mbps.
R – Remote, C – Console
-xx Variant depends on optical configuration (i.e. Dual LC, Bidi, CWDM wavelength)

Optical Cards

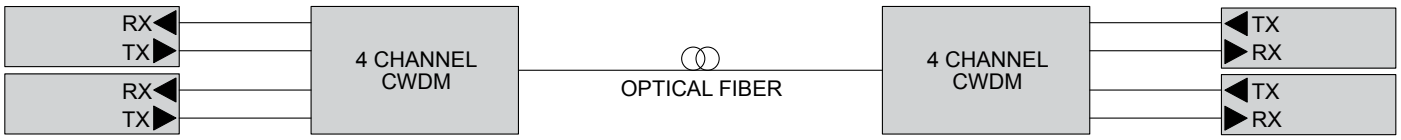
Systems with only one motherboard or media converter typically transmit at an optical wavelength of 1310 nm for uplink and 1550 nm for downlink. Bidirectional (Bidi) optical transceivers with built-in wavelength division multiplexers (WDMs) can be used to combine uplink and downlink wavelengths onto a single fiber. In larger systems with multiple 914 motherboards, media converters and expansion cards, fiber-optic signals may be combined on a single fiber using a Coarse Wavelength Division Multiplexer (CWDM) to take advantage of the high bandwidth of optical fiber. CWDM optical wavelengths are separated by 20 nm and range from 1471 nm to 1611 nm. Bidirectional optical signals require two distinct wavelengths. For example a 914-GbE Media converter using CWDM wavelengths may use 1471 nm for uplink traffic, and 1491 nm for downlink traffic.



Integrated WDM for 1310/1550nm on one Fiber



Daisy-chain 1471/1491nm with 1310/1550nm on one Fiber



4-Wavelength CWDM

Optical Card	914-CWDM	914-CWDM-4R1	907-CWDM-8R
Description	2-Channel CWDM Optics Card, 1471/1491 nm with 1310/1550 nm Bypass, Singlemode	4-Channel CWDM Optics Card, 1471 - 1531 nm, Singlemode, 20 nm Spacing	8- Channel CWDM Optics Card, 1471 - 1611 nm, Singlemode, 20 nm Spacing
PN	914-0006-00	914-0017-00	914-0017-02
Features/Options	1310/1550 bypass port allows dual CWDM 914 motherboard or media converter to be daisy-chained to an existing Focal 1310/1550 motherboard or media converter	Optional 1310 nm Bypass Port	Optional 1310 nm Bypass Port

Adaptable Interface Boards (AIB)

AIB plug-in modules are compatible with the Model 903, the Model 907, and the Model 914 product lines. The 914-AIB has one socket for any AIB plug-in module. AIB plug-in modules are available for a variety of low speed data signals.

914-AIB Adaptor Board supports any AIB Daughter-card Plug-in

AIB plug-in modules are used to convert the signal interface format to a TTL format, which is then accessed through the expansion port on the 914 motherboard. AIB plug-ins support standard serial data interfaces (RS-232/485/422), hydrophone and other audio signals, various digital and analog sonar telemetry, and control networks, such as CAN Bus and Profibus.

AIB Card	AIB-232	AIB-485	AIB-HYDRO	AIB-ARCNET	AIB-MS900	AIB-CAN Bus
Description	1 x RS-232	1 x RS-485/ 422	1 x Hydrophone	1 x Tritech ARCNET	1 x MS-900 Analog Sonar	1 x CAN Bus Bridge
Part Number	903-0251-00	903-0252-00	903-0244-00	903-0261-00	903-0250-00	903-0297-00
Channel Direction	Bidirectional	Bidirectional	Unidirectional	Bidirectional	Bidirectional	Bidirectional
NRZ Data Rate	120 kbps	2.5 Mbps	30 Hz - 30 kHz BW	156 kbps/ 78 kbps	5 - 30 kHz, 380 - 580 kHz	62.5 kbps - 1 Mbps
I/O Connectors	4-pin WAGO headers on 907-AIB adapter card					
Options	Responder Trigger	AC-Coupled 485, TTL	IRIG-B, Audio	Terminations	Low Speed Telemetry (LF)	Repeater Mode

Key Specifications

HD-SDI Video Options

- Format: HD-SDI (SMPTE-292), 3G HD-SDI (SMPTE-424M)
- Electrical Data Rate: 1.485 Gbps (3 Gbps option)
- Voltage: 800 mVP-P nominal
- Impedance: 75 Ω, SMB Connectors

Standard Video Options

- Format: NTSC or PAL
- 10-bit digitization, 6 MHz bandwidth
- Voltage: 1.2 VP-P max
- Impedance: 75 Ω, SMB Connectors

914 Ethernet Options

- Two switched 10/100 Base-T ports, with 10 Mbps aggregated throughput available via 914-EIBS expansion header of 914-R/C Video/Data multiplexer
- The 914-GBE Standalone Gigabit Ethernet media converter offers a single channel of 10/100/1000 Base-T(X) Ethernet
- 914-MCS is a switched, two-port 10/100 Base-T(X) Ethernet converter with standard 100 Base FX optical output

Data Options
(914-R/C or via AIB expansion cards)

- RS-232: 2 isolated bidirectional channels, 120 kbps max
- RS-422/485: 5 Mbps NRZ
- AIB Expansion daughter-cards support additional channels of RS-232, RS 422/485, Tritech Arcnet and CAN Bus
- Connectors: 2 x 8-pin Molex on Standard 914

914 Power Requirements

- Input Voltage: +5 VDC ± 10%, regulated, 0.5 - 1.0 A draw typical
- Input Protection: Over-voltage, reverse polarity, over-current
- Connector: 2-pin Molex

Optical Options

- Optical Fiber: 1 or 2 single-mode (9/125 µm)
- Wavelengths: 1310/1550 nm standard, CWDM options available
- Flux Budget: 16 dB min. standard, 20 dB for CWDM, Others available
- Connectors: LC or ST, depending on card

Call or email our knowledgeable Application Engineers for more information:
902-468-2263 or focal@moog.com

914-R/C

Fiber optic multiplexer

Description

The 914 video/data multiplexer provides digital fiber optic transmission for 1 high quality video channel and 4-6 bidirectional data channels in the industry's smallest package. The 914 offers extremely small size; rugged design with extended operational temperature range; bidirectional operation over 1 singlemode or multimode fiber; broadcast quality video with 10-bit digitization and greater than 6 MHz bandwidth for high resolution cameras; 4 bidirectional serial data channels (2 x RS-232, 1 x high speed RS-485, 1 x high speed RS-485/422); connector types and pin wiring compatible with the Focal 907; on-board LED diagnostics for data, video, and optical link status; and options for bidirectional video, daughter card expansion and CWDM upgrades.

Features

- Standalone, single card multiplexer in a small profile
- High speed RS-484/422
- Expansion port for 2 extra data channels
- High quality digitized video with bidirectional option
- Singlemode and multimode bidirectional transceivers
- Integrated ST fiber bushing for external connection

Benefits

- Simplified interfaces for minimal configuration
- Extremely small size allows installation in less than 2 inch diameter enclosures
- Less prone to fiber damage with no loose pigtails
- Operates reliably at extended temperatures
- Low cost

Typical Applications

- Small subsea remotely operated vehicles (ROV's)
- Pipe inspection robots
- Bomb disposal robots
- Security and defense applications
- Industrial sensor systems
- Armoured vehicles

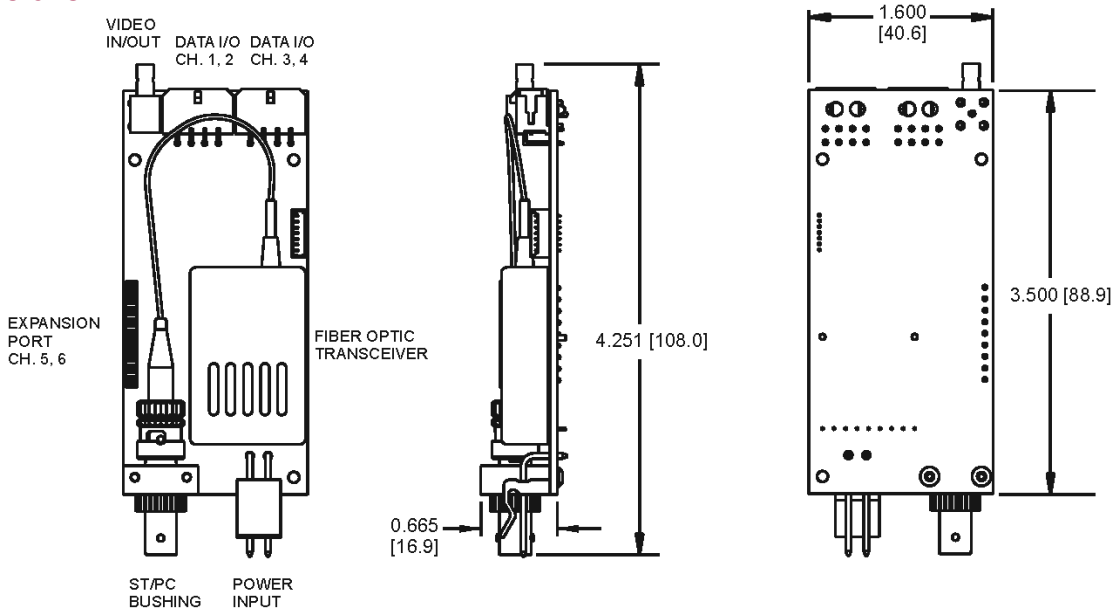
Model 914 Datasheet

Video	
No. Channels	1
Format	Composite (NTSC, PAL), 1 Vpp nom.
Digitization	10 bit @ 30 MHz sampling
Bandwidth	6.0 MHz, minimum
SNR	> 60 dB, typical
Impedance	75 Ohms
Options	Bidirectional video
Data	
RS-232	2 bidirectional channels, 120 kbaud
RS-422/485	1 bidirectional channel, Up to 5 Mbaud
RS-485	1 bidirectional channel, Up to 5 Mbaud
Options	Expansion cards including Ethernet, audio, serial data (RS-232/485/422), Tritech ARCNET, MS-900/971, TTL, and hydrophone
Optical	
Optical Fiber	1 singlemode or multimode
Data Rate	600 Mbaud uplink and downlink
Wavelength	1310 nm uplink, 1550 nm downlink standard
Flux Budget	16 dB min., 20 dB typical
Max. Link	2 km (50/125 µm multimode fiber)
Distance	4 km (singlemode fiber, FP lasers) 10 km (singlemode fiber, DFB lasers)
Options	850 nm uplink/downlink on 2 fibers; DFB or CWDM lasers; higher flux budgets

Electrical	
Power Supply	+5 VDC regulated input required
Power Used	< 3 W typical, each end
Grounding	Shared common for power, data, video
Options	Isolated power card (DC-DC)
Mechanical	
Dimensions	See drawing below
Weight	90 g (0.20 lb)
Enclosures	Standard and custom versions available
Connectors	
Optical	ST/PC bushing (FC/PC optional)
Video	SMB
Data	2 x 8-pin Molex, dual row Micro-Fit Series
Power	1 x 2-pin Molex, 0.156” pin spacing
Environmental	
Temperature	-40°C to +85°C (operating) -40°C to +85°C (storage)
Humidity	85% relative, non-condensing
Vibration	MIL-STD-167-1 (ships)
Shock	MIL-STD-810E

Refer to model 914 configuration drawings for detailed specifications and information on installing and configuring the boards.

914 Dimensions



Dimensions in inches [millimeters] 914 shown with singlemode bidirectional transceiver option

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

914-HDM

High Definition Video Multiplexer

Description

The model 914-HDM is a High Definition (HD) video multiplexer that provides transmission of a single HD-SDI camera signal along with two on-board serial channels (RS-232/RS-485) for camera controls (e.g. pan and tilt) and sensors. The 914-HDM cards support optical transmission of one HD-SDI input signal at full 4:2:2 sampling including ancillary data.

The 914-HDM can be used as a standalone card or optically integrated into a 914 system stack via CWDM modules. Optical power budgets are typically 20 - 26 dB over 10 km of singlemode fiber. Diagnostics are provided by on-board LEDs for optical, video and serial link status.

Features

- On-board diagnostic LEDs for power, optical link, and video sync
- HD input includes cable equalization and re-clocking to improve recovery of low level or distorted input signals
- Regenerated HD-SDI output minimizes jitter
- Interchangeable SFP optical transceiver
- Two on-board bidirectional serial channels (RS-232 or RS-485)
- Rugged design for harsh environments

Benefits

- Reduces cost and size for systems with need for combined data and HD video
- Supports a wide range of optical options, including CWDM wavelengths
- Provides Maximum jitter margin available for cabling
- Extends digital video transmission up to 10 km

Typical Applications

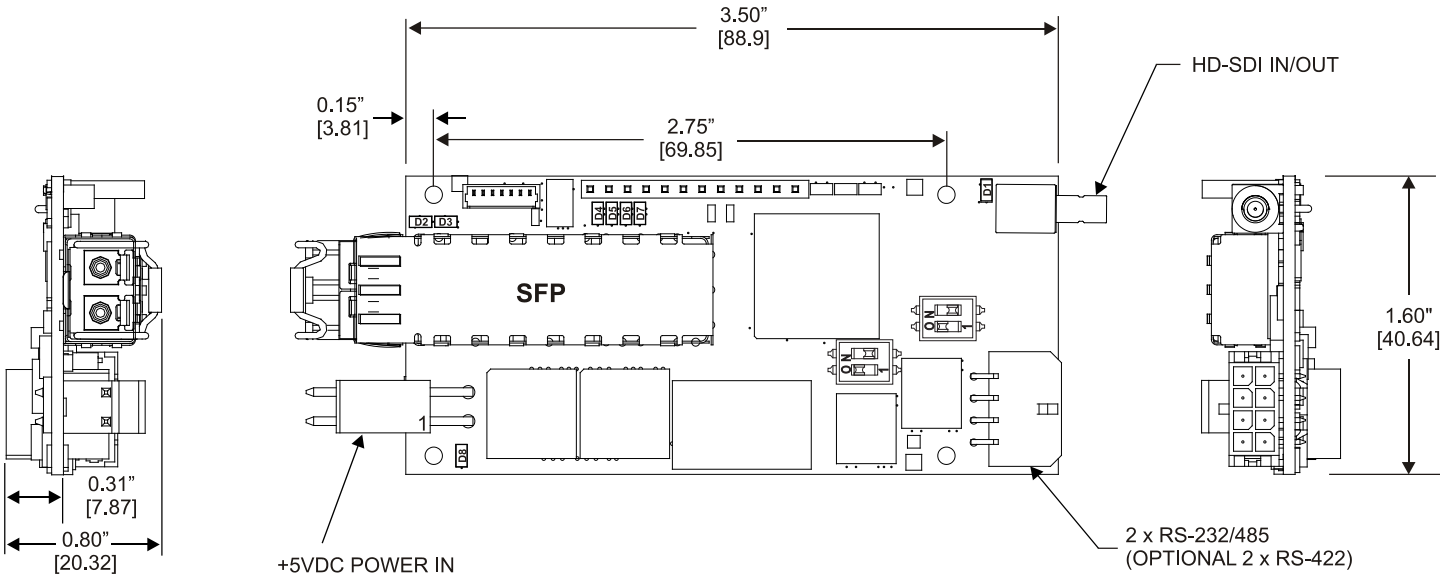
- Remotely Operated Vehicles (ROVs) and Tether Management Systems (TMS)
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tactical Networks and Defense Systems
- Remote HD Video for Television

Model 914 Datasheet

Video	
No. Channels	1
Format	HD-SDI (SMPTE-292M) @ 720p, 1080i and 1080p
Data Rate	1.483/1.485 Gbps
Input Buffer	Adaptive cable EQ
Output Voltage	800 mVpp, nominal
Impedance	75 Ohms, input/output
Sampling Modes	1-ch 4:2:2 (with ancillary data)
Data	
No. Channels	2
Format	RS-232, RS-485 (switch selectable)
Data Rate	RS-232: 1 Mbps max NRZ. RS-485: 10 Mbps NRZ
Options	Expansion cards for Ethernet; RS 422 on-board instead of RS-485
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Format	AME-TF (Moog proprietary)
Baud Rate	2.5 Gbaud (3.125 Gbaud optional)
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	Bidi (bidirectional) transceivers, higher/lower power transceivers

Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Current	1 A typical (1.5 A max.)
Power Used	5 W typical (7.5 W max.)
Mechanical	
Dimensions	See drawing below
Weight	<100 g (0.22 lb) including SFP
Options	Custom enclosures
Connectors	
Video	SMB
Data	1 x 8-pin Molex (Micro-Fit Series)
Optical	LC (SFP)
Power	2 pin Molex, 0.156 inch pin spacing
Options	Optical: ST/PC
Environmental	
Temperature	-10°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes

914-HDM Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

914-HDV

High Definition Video Media Converter

Description

The model 914-HDV Media Converter is an electro-optical device for transmitting High Definition Video over singlemode (9/125 µm) fiber, packaged into our 914 (credit card sized) form-factor, resulting in our smallest solution for HD-SDI (SMPTE-292 M) to fiber conversion. The 914-HDV media converter may be used as a standalone card or optically integrated into a 914 system stack via CWDM modules. Optical power budgets are typically 20 - 26 dB over 10 km of singlemode fiber. Diagnostics are provided by on-board LEDs for optical and video link status.

Features

- Video input includes cable equalizer
- Upgrade available for 1080 p (SMPTE-424) “Full HD” compatibility
- Wavelength selectable/interchangeable SFP transceivers
- Rugged design for marine environment, including 6000 psi pressure tolerant version

Benefits

- Simplified interfaces for minimal configuration
- Extremely small size allows installation in less than 2 inch diameter enclosures
- 4 HP adapter available for euro-rack upgrades/retro fits
- Supports a wide range of optical options, including CWDM wavelengths for combining multiple cards on a single optical fiber

Typical Applications

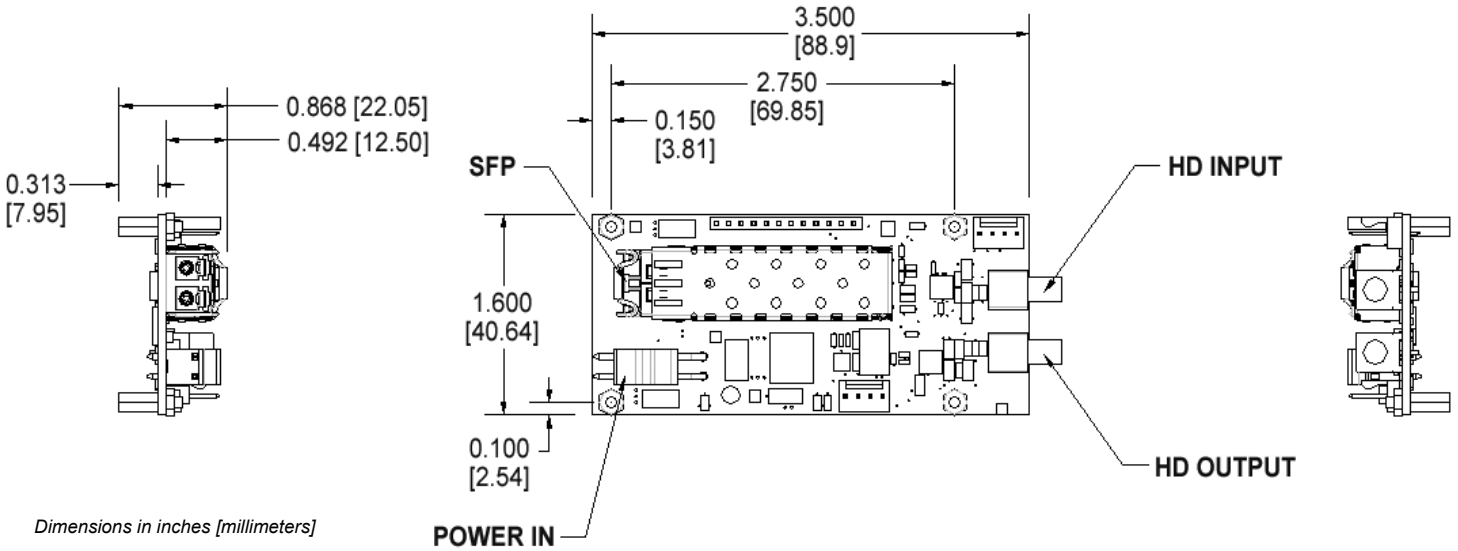
- Remotely Operated Vehicles (ROVs) and Tether Management Systems
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tactical Networks and Defense Systems
- Industrial Process Control

Model 914 Datasheet

Video	
No. Channels	1
Format	HD-SDI (SMPTE-292 M)
Data Rate	1485 – 2970 Mbps (see options)
Output Voltage	800 mV pp nominal
Impedance	75 Ohms
Options	Contact Moog for 1080 p (SMPTE-424) “Full HD” upgrade (3G-SDI)
Optical	
Optical Fiber	1 or 2 singlemode (9/125 µm)
Baud Rate	1.485 Gbaud (2.97 optional)
Wavelength	1310/1550 nm standard (CWDM optional)
Flux Budget	> 20 dB (24 dB typical)
Options	CWDM wavelengths for combining multiple 914 cards on one singlemode fiber; bidirectional transceivers; extended temperature
Electrical	
Power Voltage	+5.0 VDC ±10%, regulated
Power Used	4 W typical
Protection	Overvoltage and reverse polarity protection, fused

Mechanical	
Dimensions	See drawing below
Weight	< 90 g (0.2 lb), including SFP
Options	Custom enclosures
LED	On-board diagnostic LEDs including: power, receive optical link valid, valid HD activity
Connectors	
Optical	Dual LC (SFP)
Video	Mini SMB, 75 Ohm
Power	2-pin Molex, 0.156 inch pin spacing
Environmental	
Temperature	-10°C to +60°C (operational) -20°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes

914-HDV Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

914-GBE

Gigabit Ethernet (GbE) Media Converter

Description

The model 914-GBE Gigabit Ethernet Media Converter converts 10/100/1000 Base-T(X) Ethernet from a single RJ-45 to optics, and vice versa, all within a small, credit-card size form-factor. The 914-GBE may be used as a standalone card or optically integrated into a 914 system stack via CWDM modules. Optical power budgets are typically 20-26 dB over 10 km of singlemode fiber. Diagnostics are provided by on-board LEDs for power, optical, and data link status. A 12-pin header is also provided to drive LED diagnostics on a front panel or enclosure of a system.

Features

- Low Latency (no switch buffer delays)
- Compatible with 10/100/1000 Mbps copper links per IEEE 802.3
- Interchangeable SFP transceivers
- Rugged design for harsh environment, including 6000 psi pressure tolerant version

Benefits

- Provides fast response for time-critical links
- Backwards compatible with legacy 10/100 Mbps links
- Supports a wide range of optical options, including CWDM wavelengths for combining multiple cards on a single optical fiber

Typical Applications

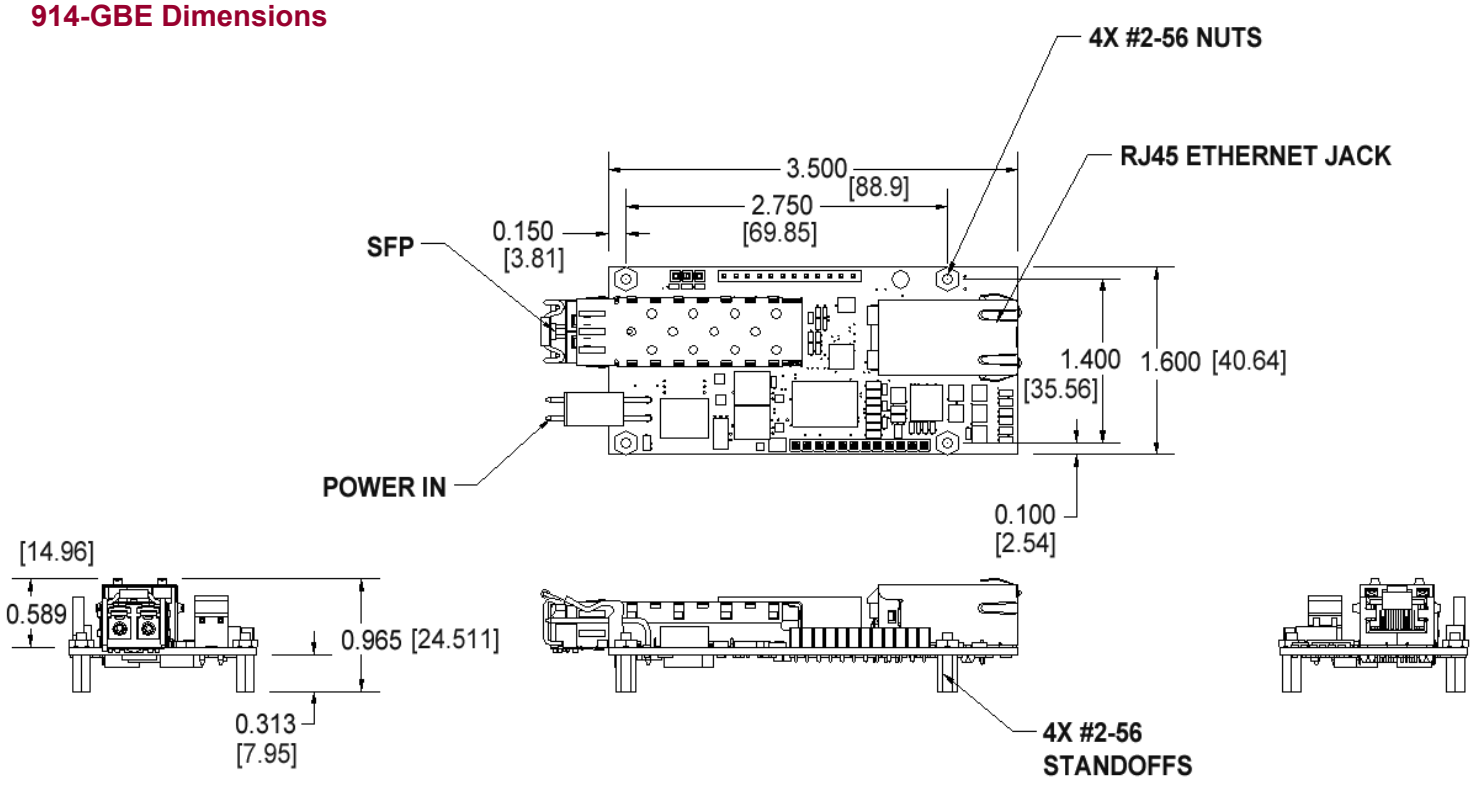
- Remotely Operated Vehicles (ROVs) and Tether Management Systems
- Pipe Inspection Robots
- Bomb Disposal Robots
- Video Security Systems
- Tactical Networks and Defense Systems
- Industrial Process Control

Model 914 Datasheet

Data	
No. Copper Ports	1
Ethernet	10/100/1000 BASE-T(X)
Total Throughput	Up to 1000 Mbps
Options	Half Duplex 10/100 Mbps Ethernet also supported
Optical	
Optical Fiber	1 - 2 singlemode (9/125 µm)
Baud Rate	1.25 Gbaud
Wavelength	1310/1550 nm standard (CWDM optional, 1471 - 1611 nm)
Flux Budget	> 20 dB (24 dB typical)
Options	No SFP, 1310/1550 nm or CWDM wavelengths for combining multiple model systems on one singlemode fiber
Electrical	
Power Supply	+5 VDC +/-10%, regulated
Power Used	4 W typical
Protection	Overvoltage and reverse polarity protection, fused

Mechanical	
Dimensions	See drawing below
Weight	< 90 g (0.2 lb), including SFP
Enclosures	Contact Moog for custom enclosures
LED	On-board diagnostic LEDs including: power, receive optical link valid, Tx and Rx activity, copper link speed and duplex
Connectors	
Optical	Dual LC (SFP)
Ethernet	RJ45
Power	2-pin Molex, 0.156 inch pin spacing
Diagnostic	12-pin 0.1 inch header
Environmental	
Temperature	-20°C to +60°C (operational) -40°C to +85°C (storage)
Humidity	85% RH, non-condensing
Vibration	5 g, 25 - 1000Hz, 3 axes
Shock	30 g, 11 ms half sine, 3 axes

914-GBE Dimensions



Dimensions in inches [millimeters]

Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

Market Specific Products

FOCAL™

Through close collaboration with customers and industry leaders, we develop market specific products that address particular design challenges.

Moog multiplexers and media converters are used worldwide for demanding applications in harsh subsea, marine and industrial environments. The flexibility and modularity of our standard product lines allow tailored configurations that meet the needs of many types of applications. For some unique markets, however, there may be special requirements for size, cost or functionality that do not allow standard modular solutions. In these cases, we use our expertise in multiplexer development to provide products that are optimized for the applications.

Typical requirements include:

- Redundancy for improved reliability,
- Reduced size for limited-space installations,
- Unique combinations of signal types on single multiplexer cards,
- Specialized packaging or interface connectors
- Designs that meet particular industry standards, such as ISO 13628-6 for subsea controls

Market specific products are technically superior solutions that maintain the advantages of product standardization, such as availability and well-established field performance, while avoiding the costs of custom development. Typical applications -- like subsea controls and wind energy -- require communication systems with high reliability and fault tolerance. For these types of requirements, market specific products deliver rugged, robust solutions with the assurances provided by precedent designs and extensive qualification testing. The use of market specific products can be further enhanced with custom products when necessary.

920-EDM
Ethernet and Data Multiplexer

Description
More than just a media converter, the Model 920-EDM Ethernet and Data Multiplexer combines two 10/100 Base-T(X) Ethernet channels, one 1000 Base-T gigabit Ethernet channel, and a CAN Bus channel on a single bidirectional fiber-optic link. This seamless integration of multiple channels in a single interface box reduces overall system costs and space requirements when optical links are needed. The availability of several interface types supports multiple control system protocols or upgrades without the need to change the interface modules. Furthermore, the low latency design of the 920-EDM makes it ideal for real-time control applications.

Front panel LEDs provide status on critical functions while detailed diagnostic information, such as optical Rx/Tx power, temperature, internal voltage and error counts, may be monitored through a Modbus TCP interface on a dedicated 10/100 Base-T(X) Ethernet port. Built-in-tests (BITs) may also be triggered and monitored via the diagnostic link to independently verify optical and system performance.

Features
- Multiplexes 10/100 M and Gigabit Ethernet, plus CAN Bus on the same optical link
- Ethernet and CAN Bus channels are independent and have dedicated bandwidth (i.e. non-switching)
- Single fiber operation
- Diagnostics via Modbus link on an independent Ethernet port
- Low and deterministic latency to allow for real-time protocols such as EtherCAT and DeviceNet

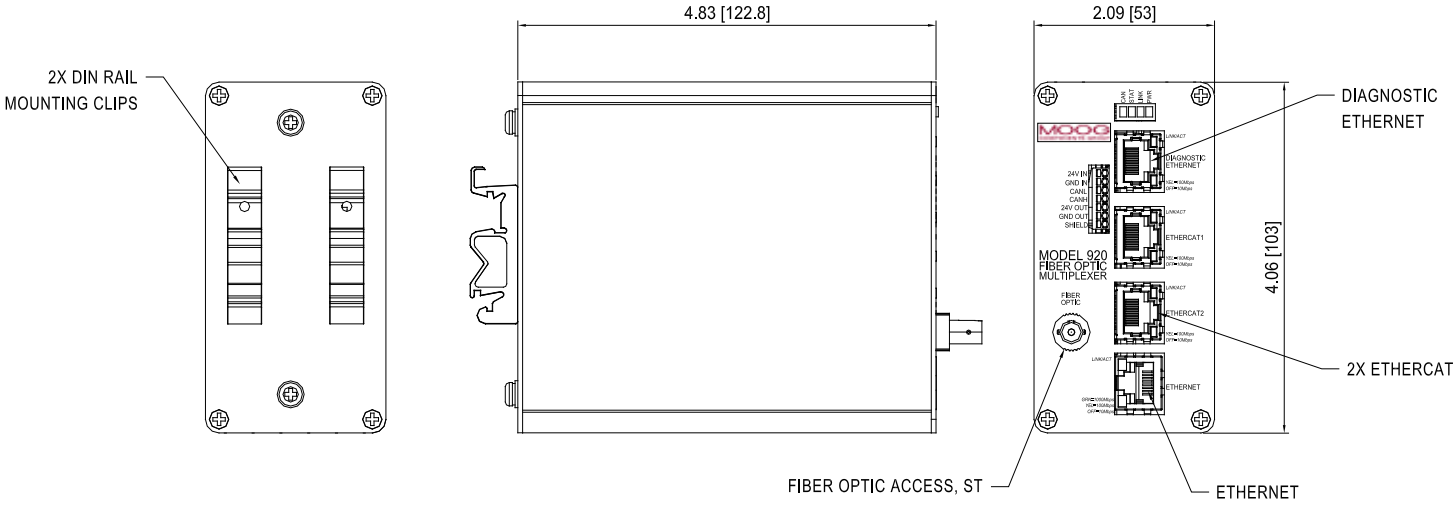
Benefits
- Replaces multiple media converters with a single module
- Replaces multiple fiber cables with a single fiber
- Supports multiple real-time serial protocols e.g. CAN Bus, DeviceNet
- Supports multiple real-time Ethernet protocols, e.g. EtherCAT, PROFINET, and Modbus TCP
- Simplifies troubleshooting and system testing with advanced diagnostics

Typical Applications
- Wind Energy
- Industrial Controls
- Remote Tooling Stations
- Sensor Monitoring Systems

Ethernet	
No. Copper Ports and Data Rates	3 x 10/100 Base-T(X) (920-EDM-600M) or 2 x 10/100 Base-T(X) and 1 x 10/100/1000 Base-T(X) (920-EDM-2.5G)
Features	Non-switched dedicated bandwidth ports, low latency for real-time signals, Auto-negotiation, Auto MDI/MDIX
CAN Bus	
No. Channels	1
Data Rate	125/250/500 kbps with Autobaud
Latency	0.12 to 4.6 ms depending on bit-rate
Optical	
Optical Fiber	1 multimode (50/125 µm)
Baud Rate	625 Mbaud (920-EDM-600M) or 2.5 Gbaud (920-EDM-2.5G)
Wavelengths	1310/1550 nm standard
Flux Budget	>10 dB (15 dB optional)
Range	500m — May be further limited by acceptable CAN Bus latency
Options	Singlemode, CWDM wavelengths
Mechanical	
Dimensions	See drawing below
Mounting	DIN-rail Mounts included

Electrical	
Power Voltage	+24V +/- 20%, regulated
Power Current	0.2 A typical (0.45 A max.)
Power Used	5 W typical (8 W max.)
Protection	ESD, EMI, overvoltage, reverse voltage, over-current
Connectors	
Optical	1 x ST/PC
Ethernet	4 x RJ-45 (Including diagnostics port)
CAN Bus	4 pins of 7-pin PC terminal block
Power	2 pins of 7-pin PC terminal block
Environmental	
Temperature	-10°C to +70°C (operational) -45°C to +85°C (storage)
Humidity	85% RH, non-condensing
Ingress	IP40
Diagnostics and Control	
IP Address	1 per card, assigned by DHCP or static
Accessibility	LEDs and Data over dedicated 10/100M Ethernet port using embedded webserver and Modbus TCP
Parameters	Tx/Rx power, optical/copper link, temp, current, voltages

920-EDM Dimensions



Dimensions in inches [millimeters]

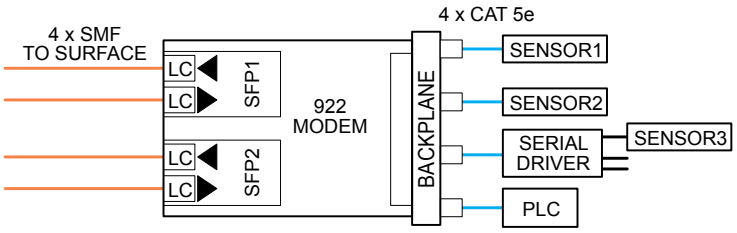
Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

922
High-Reliability Fiber-Optic Ethernet Switch

Description
The Focal™ Model 922 is a fiber-optic Ethernet switch with five copper Ethernet ports and two optical Ethernet ports, designed and extensively tested specifically for high-reliability subsea control and communication applications.

A range of qualified pluggable fiber-optic transceivers allow users to customize the Model 922 for reliable Ethernet communication over fiber umbilicals up to 200 km long. Dual fiber-optic transceivers and on-board link monitoring allow for optical redundancy with built-in automatic fiber switchover, and the modular 3U Eurocard design allows for complete system redundancy using multiple cards installed in a custom subsea housing or in a 3U rack at the surface. Remote diagnostics and managed switch controls are accessible via any optical or copper Ethernet port using Modbus TCP protocol or an embedded webserver.

The Model 922 is qualified to Q1 ISO 13628-6 standards. Additional Environmental Stress Screening (ESS) is available.



Multiple Sensors Transmitting Via Separate Or Redundant Fiber-Optic Links

Features
- Qualified, screened, and acceptance tested per ISO 13628-6
- Hi-rel, low power design with MTBF > 200,000 hours validated by accelerated life testing and field data from similar designs
- Redundant, pluggable optical transceivers with automatic fiber switchover
- Redundant Ethernet switches with managed switch functions including VLAN, QoS, priority, and port-based rate limiting
- Advanced diagnostics and modem configuration using Modbus TCP
- DHCP-configured IP address with static IP backup
- 3U Eurocard form-factor with options for front panels on console assemblies and heat-sinks on subsea assemblies

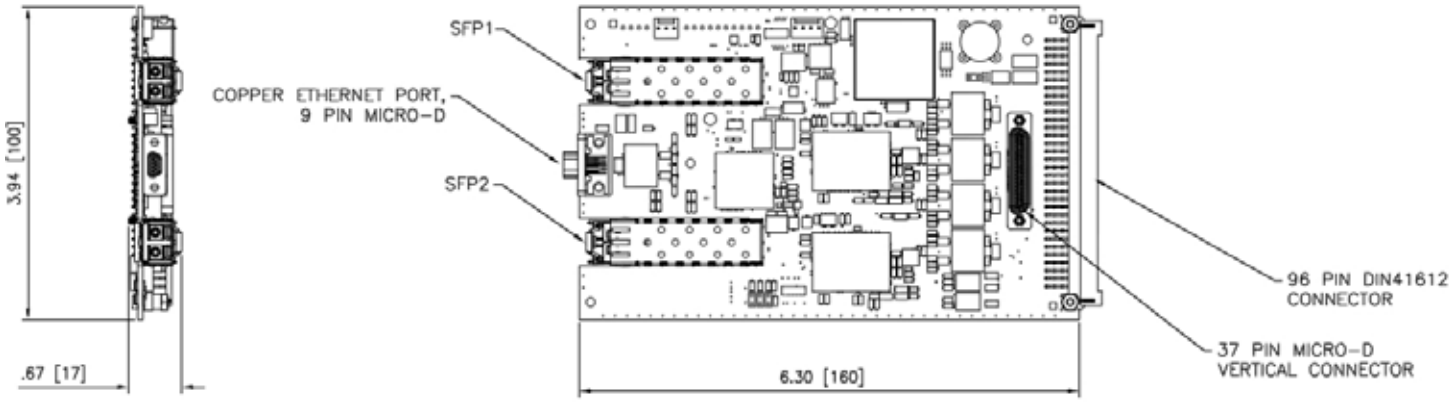
Benefits
- Provides a proven modem solution optimized for subsea controls
- Supports customer configuration of modems using a range of qualified pluggable optical transceivers, including CWDM wavelengths and bidirectional (single fiber) versions
- Reduces costs by using standard base configurations

Typical Applications
- Subsea Controls - Long fiber-optic links to Subsea Electronics Modules (SEMs) and other subsea distribution nodes

Ethernet	
Copper Ports	5 total; 4 on backplane, 1 on front panel
Data Rates	10/100 Base-T(X)
Switch Control and Status	Link/Speed/Duplex, flow control, QoS, VLAN, port mirroring, MIB counters
Optical	
Optical Ports	2 (can be configured as redundant or independent links)
Optical Fibers	2 per SFP (1 per SFP optional)
Data Rates	100 Base-FX (125 MBaud)
Wavelength	1310 and 1550 nm standard (CWDM optional, 1471-1611 nm)
Flux Budget	16 - 45 dB, depending on SFP installed
Range	10 - 200 km, depending on SFP installed
Options	Bidirectional (single-fiber) transceivers
Mechanical	
Dimensions	3U Eurocard (see drawing below)
Options	Front panel, heat-sink assembly
Diagnostics and Control	
IP Address	1 per card, assigned by DHCP or static
Accessibility	Over any optical or copper Ethernet port using Telnet terminal, Modbus TCP, or web browser (IE, Firefox, etc.)
Parameters	Tx/Rx pwr, optical/copper Link, temp, current, voltages, switch registers etc.

Electrical	
Power Voltage	+20 to +28 VDC, regulated
Power Current	0.2 A (0.4 A max.)
Power Used	5 W typical (10 W max.)
Protection	ESD, EMI, overvoltage, reverse voltage, overcurrent (no fuses)
Connectors	
Optical	LC
Backplane	96-pin DIN41612
Front Panel	9-pin Micro D
Options	37-pin Micro D (replaces DIN41612)
Environmental	
Temperature	-18°C to +70°C (operational) -40°C to +85°C (storage)
Humidity	Max 85% RH, non-condensing
Vibration	5g, Per ISO 13628-6
Shock	30g, Per ISO 13628-6
Life Cycle	
MTBF	> 200,000 hrs @ +40°C
Median Life	> 20 years @ +40°C
Testing	Q1 Qualification Tests, Factory Acceptance Tests, Accelerated Life Tests, Environmental Stress Screening (Optional)

922 Dimensions



Dimensions in inches [millimeters]

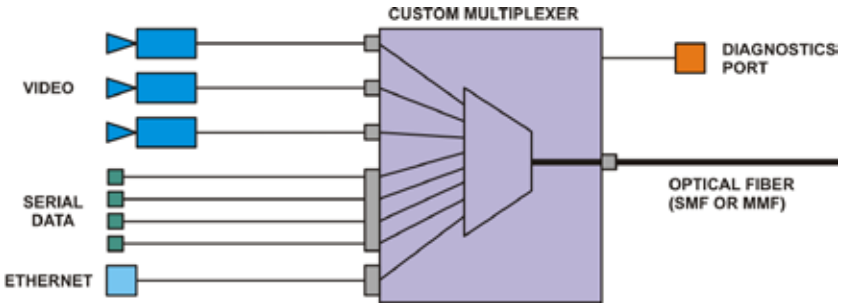
Note: These are standard commercial products that are available with many options or configurations not explicitly shown.

Custom Multiplexer Product Guide

FOCAL™

Moog offers custom designed multiplexer products that meet the exact requirements of OEM systems and special applications.

Moog offers custom designed multiplexer products that meet the exact requirements of OEM systems and special applications. In many cases, custom designs are either modifications to existing commercial-off-the-shelf (COTS) products or novel configurations of physical and electrical interfaces based on Moog's field-proven hardware, firmware, and software, thereby minimizing technical risk. Designs are often tailored to match specific form factors and connector types, extend environmental performance, reduce overall cost, interface directly with existing hardware or software, and provide extensive built-in-test (BIT) and health monitoring features.

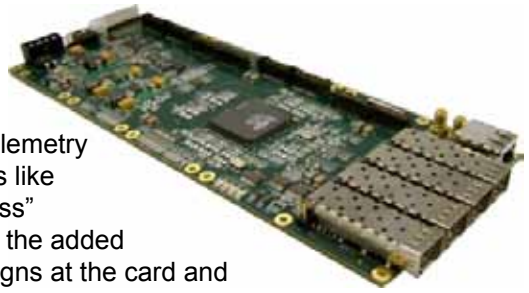


Typical Applications

Custom multiplexers and media converters are typically used in applications that require small, ruggedized, and highly reliable fiber-optic communications in areas such as:

- OEM configurations for Remotely Operated Vehicles (ROVs)
- Subsea control modems for SEMs and flow meters
- Remote data acquisition systems for use in harsh environments
- Fiber video/data networks for turreted vehicles
- Fiber extenders for radar and sensor applications
- Multi-gigabit digital video links for electro-optic (EO) pods for surveillance and targeting
- Data links for motion simulators and other rotating test beds
- Integrated solutions with Focal's Fiber Optic Rotary Joints (FORJs) for Gigabit data transmission through rotating interfaces

Technical Innovation



Moog Components Group is a leading supplier of COTS and custom fiber-optic telemetry systems with over 2000 fielded systems around the world. We pioneered features like embedded diagnostics and automated fiber switching for redundancy. Our "busless" backplane architecture provides the lowest possible video and data latency, since the added delay of buffers and bus addressing are avoided. Furthermore, with modular designs at the card and daughter-card level, systems are easily expanded and reconfigured. High reliability in harsh environments is ensured through extensive analysis, thorough design verification, qualification, and product stress screening.

We emphasize miniaturization and design flexibility through the use of Field Programmable Gate Arrays (FPGAs). Advanced CAD systems and an extensive library of proven designs enable rapid development of new products or repackaging of existing solutions. We now offer a full range of multiplexer products, from single channel media converters for Ethernet and HD-SDI to multi-channel CWDM and DWDM systems supporting 16 or more video lines, 128 serial data channels, multiple digital I/O, plus 10/100/1000M Ethernet and high bandwidth sonar interfaces, all on a single optical fiber.

Multiplexing systems can be based on a symmetric topology, where signal formats are the same at each end, or on an asymmetric topology, where various signal formats at one end are converted to a common, integrated digital format at the other end. Asymmetric multiplexers often use a standard format, such as VME or Gigabit Ethernet, for integration with data acquisition and control systems.

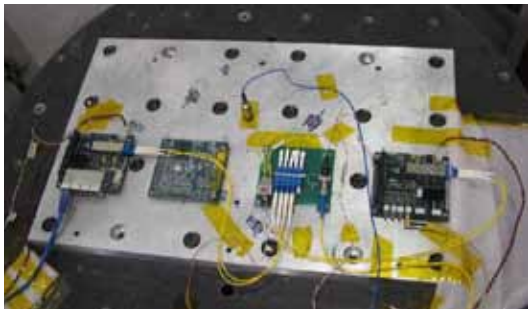
Previous custom designs include a number of high reliability systems with MTBFs over 200,000 hours, data acquisition systems with 256 sensors, and long-haul systems that operate on 200 km fiber links. The high data capacity of optical fiber inherently builds in "future proofing" of designs for increasing the number of channels or data rates supported.

- Ruggedized design for harsh environments (wide temperature range, high shock/vibration)
- Very low latency, modular design, and compact size
- Support for video (analog and digital), serial data, Ethernet, and other signal formats
- Up to 10 Gbps per wavelength using FPGA-based Time Division Multiplexing (TDM)
- Up to 16 wavelengths per fiber using Coarse Wavelength Division Multiplexing (CWDM)
- Advanced diagnostics and health monitoring

High Reliability for Harsh Environments

High reliability of custom products is implemented at all design and production stages in an ISO-9001 environment. Reliability analysis is supported by field experience and Relex software, allowing use of predictive models, such as 217Plus, PRISM, Telcordia, and FIDES, as well as failure mode analysis. Card level options include conductive cooling, board stiffeners for improved vibration tolerance, hot swap capability, and signal redundancy. At the system level, our custom designs include redundant optical transceivers, auxiliary power supplies, and robust transmission protocols that reduce the probability of accepting corrupted data (residual errors) to extremely low levels. The various options are applied as appropriate for the given cost, reliability, and environmental requirements of the system over the intended product life cycle.

Several processes are used to further support high reliability designs. Besides the acceptance testing at rated temperatures used for all electronic products, high-reliability products receive



additional environmental stress screening and qualification testing to further validate product reliability and life. Detailed analyses are conducted, including the calculation of product reliability and life, supported by manufacturer's data, empirical data, and component traceability. Additional testing includes shock, sinusoidal vibration, random vibration, humidity, acceleration, low pressure (altitude), and high pressure (in oil). Our engineering department will work closely with you to develop test plans for design, production, and qualification that make sense for your application.

Multiplexer products include advanced diagnostics and health monitoring functions to ensure systems are operating properly and to provide early warnings of any negative trends, for example degradation of cabling. Critical performance parameters, such as optical power, rail voltages, temperature, and fault conditions, are available through serial channels or Ethernet protocols. Customer equipment may access the diagnostics directly through open protocols, e.g. Modbus, or via Moog Graphical User Interface (GUI) software. Built-in test features, such as bit error rate tests and video test patterns, simplify system-level troubleshooting by helping to isolate any connection problems.

Moog provides rapid solutions for multiplexing and data conversion applications in the harshest environments, designed to your specifications. The results are proven, rugged products.

Key Specifications

Custom multiplexers support combinations of many different signal types including, but not limited to, the following:

- Video (Analog): NTSC/PAL (composite), Y/C, RGB, YPbPr (component, including HD)
- Video (Digital): SDI, HD-SDI, 3G HD-SDI, Camera Link, GigE Vision, IEEE-1394, HDMI, DVI
- Network/Bus: 10/100/1000M Ethernet, USB, MIL-STD-1553, CAN Bus, Modbus, Profibus
- Data: RS-232, RS-485/422, TTL, ECL/PECL, 4-20 mA, triggers, solid state relay controls
- Analog: hydrophone, audio, resolver/encoders, sensors (strain, temperature, etc.), IRIG
- Optical: singlemode/multimode fiber, high optical budgets (20 – 50 dB), 16 wavelengths
- Diagnostics: RS-232, RS-485/422, Modbus RTU/TCP, Ethernet

Products can be modified or designed for many different performance and regulatory standards, including but not limited to the following:

- Extended temperature range: -40 to +85 C, military requirements (including high altitude)
- Extended shock and vibration: ISO 13628-6, MIL-STD-810, MIL-STD-167
- Environmental: high altitude, humidity, sand and dust, acceleration (MIL-STD-810)
- Enclosure design: rugged, sealed (IP67), conductively cooled, corrosion resistant, RF shielding
- EMI/EMC: IEC 61000-6-2, IEC 61000-6-4, CISPR 25, MIL-STD-461
- Explosion Proof Ratings: IEC 60079 (ATEX)
- Safety: IEC 60950, UL-1950, IEC 61508/61511 (SIL Ratings)
- Reliability: > 200,000 hours MTBF, > 20 years life

Call or email our knowledgeable Application Engineers for more information: 902-468-2263 or focal@moog.com

Fiber-Optic Media Conversion and Multiplexing

Practical fiber-optic data links were initially adopted in the 1980s and 1990s for long-haul telecommunications and high data rate networks to support standard protocols, such as Ethernet and Fibre Channel. Fiber-optic communications are now widely used in a variety of applications based on several key advantages over copper data transmission:

Higher bandwidth - Optical fiber easily supports data rates of Gigabits per second over long distances (> 100 km), with advanced systems running many Terabits per second on a single fiber. The high data capacity of fiber also "future proofs" designs, as it supports expansion of the system by adding or upgrading terminal equipment without the need to change the fiber cable system itself.

Lower attenuation - Optical fiber has very low signal losses at high frequencies compared to copper signaling. Typical losses are under 0.25 dB/km, allowing fiber runs of several hundred kilometers without repeaters.

Smaller size and lower weight - Optical fiber is very small and lightweight compared to the equivalent copper cabling required for transmitting similar signals.

Better EMI performance - Photonic signals do not radiate significant electro-magnetic power and are generally immune to EMI or high voltages from nearby devices. Furthermore, optical data links inherently isolate the two ends of the communication system, thus avoiding ground loops and improving safety.

In subsea markets, fiber-optic telemetry links have become standard for Remotely Operated Vehicles (ROVs) given the requirement for high data rates generated by multiple video cameras, high resolution sonars, and Ethernet based devices. Fiber-optic umbilical cables and tethers have allowed significant reductions in size and weight compared to copper signal cables, enabling longer cables and ultimately a deeper and wider range of operation for the ROVs. Moreover, the trend for ever-increasing data rates follows advancements in sensors and video quality, for example moving from standard definition video to high definition video. Fiber-optic data links easily support future expansion by simply increasing data rates or adding new wavelength channels, none of which requires expensive changes to the underlying fiber-optic cabling.

Media Conversion

The simplest form of optical communication is the media converter, which is essentially a single channel multiplexer. This device converts one type of electrical signal (e.g. Ethernet or HD-SDI) to an optical signal for transmission over fiber, then receives the signal at the other end and converts it back to electrical format. This simple conversion allows for very low latency, usually sub-microsecond not counting the inherent cable delay of roughly 5 us/km. Media converters are normally used with higher data rate signals (> 10 Mbps) as lower data rate signals can be multiplexed with many other signals on the same optical link. Common signals for media converters include Ethernet (100 and 1000 Mbps), HD-SDI (1.485 and 2.97 Gbps), coaxial ECL/PECL for sonars (30 - 150 Mbps), and various proprietary high-speed data links.

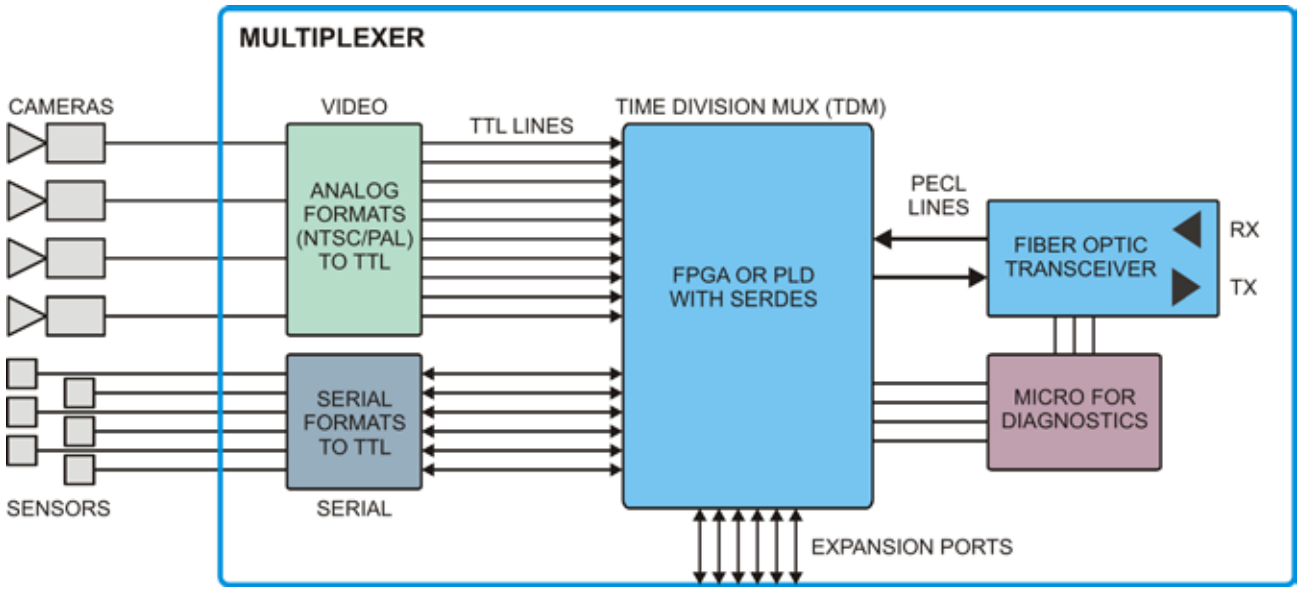
Multiplexing

Multiplexing involves the combination of multiple input signals and signal types into a single optical fiber link. The two most common multiplexing techniques for optical data links are time division multiplexing (TDM) and wavelength division multiplexing (WDM). Both can be used in isolation or in combination, and both support the mixing of signal types, such as video and serial data channels.

Time Division Multiplexing (TDM)

TDM places data from multiple inputs into a repeating series of frames, each frame having a pattern of time slots, or bits, assigned to specific channels. Typically a critical component known as a serializer-deserializer (SERDES) converts 8 to 20 parallel input lines into a single, high data rate serial stream, which is the series of TDM frames. This high speed serial data is subsequently converted by an optical transmitter to a photonic signal sent over the optical fiber. At the other end of the fiber, an optical receiver converts the optical signal back to a high speed serial signal. The SERDES synchronizes with the incoming frames and recovers the original parallel data lines. Higher level TDM protocols can structure the data into multiple "super" frames operating at a consistent synchronous frequency or into packets for a more asynchronous data protocol that supports highly variable channel demands for data capacity.

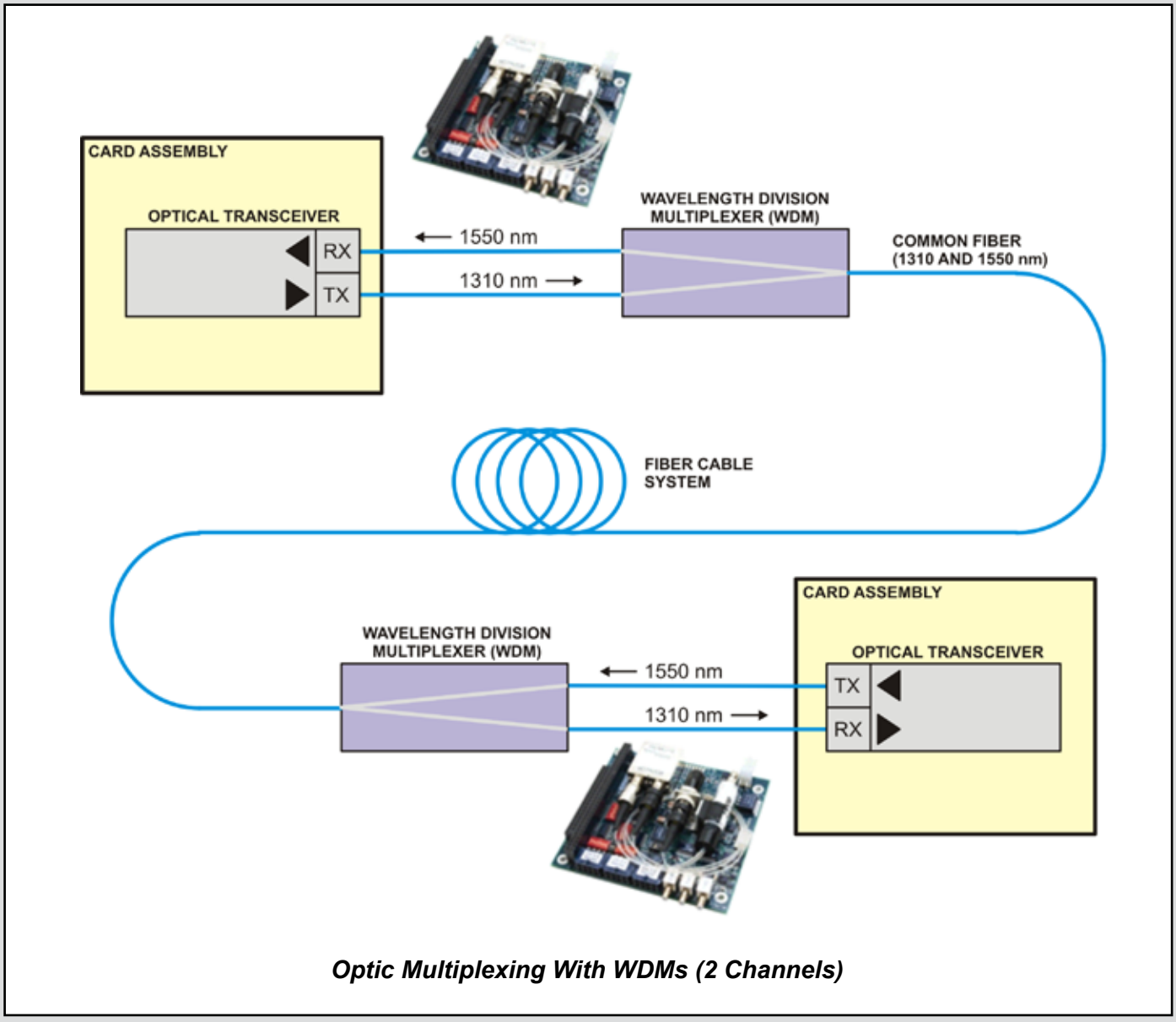
Prior to the TDM serialization, all incoming signals must be converted to a common digital format. Mixed input signals include analog video (PAL, NTSC), serial data formats (RS-232, RS-485/422), analog signals (audio, hydrophones, analog sonars), and various bus and network formats (Profibus, CAN Bus, Ethernet). Each input must be converted to a set of digital values either through analog-to-digital converters or digital level translators. The TDM protocol then assigns a certain number of bits per frame (or packet) to each signal. Higher data rate signals, such as video, get more bits assigned than lower data rate signals, such as RS-232. Often multiple low data rate signals, such as RS-232, are "pre-multiplexed" into a single stream that is further multiplexed into a TDM time slot.



Generic TDM Configuration

Wavelength Division Multiplexing (WDM)

Wavelength division multiplexers are commonly used to combine multiple TDM multiplexer and/or media converter signals. The most basic WDM component is a passive optical coupler, typically operating at 1310 nm and 1550 nm wavelengths, one for each direction. These WDMs are normally used to combine transmit and receive optical signals in a bidirectional data link onto a single fiber. The wide band filters used in these WDMs allow for considerable wavelength variation, e.g. +/- 50 nm, due to temperature drift and manufacturing tolerances of the lasers typically used.



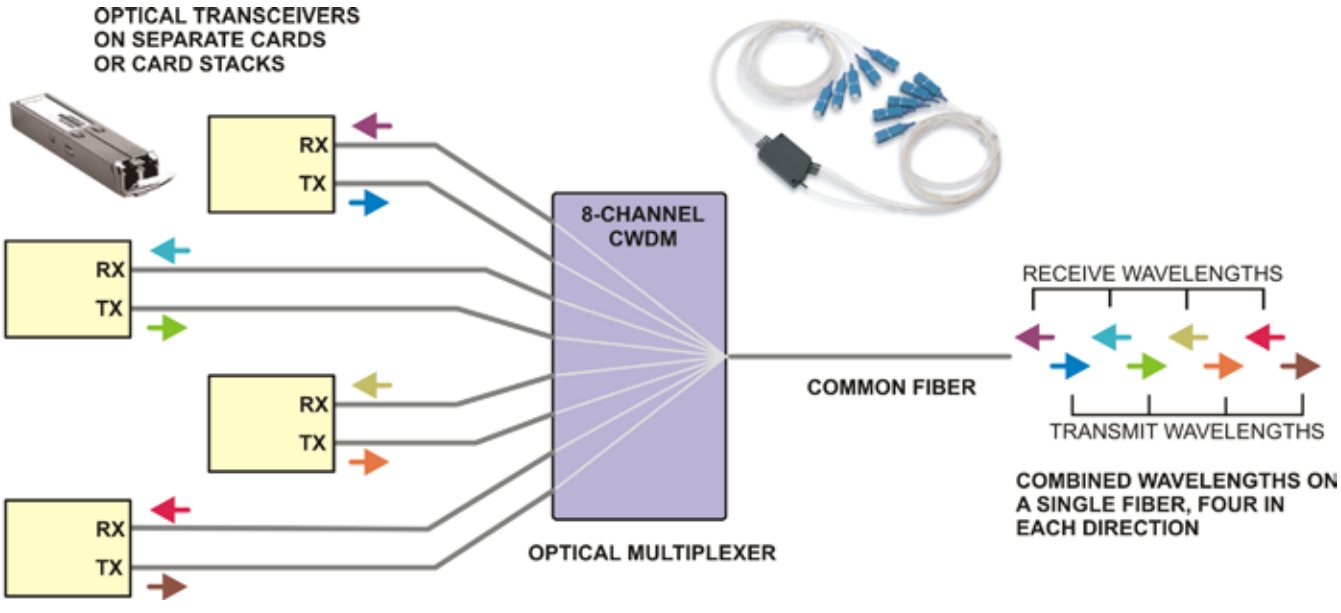
Optic Multiplexing With WDMs (2 Channels)

Fiber redundancy can be implemented by adding fiber-optic splitters and switches. Splitters are passive couplers that evenly split the optical power from one to two fibers. Switches are controlled either automatically or manually to choose one of two fibers for the local optical transceiver to link with.

Course Wavelength Division Multiplexing (CWDM)

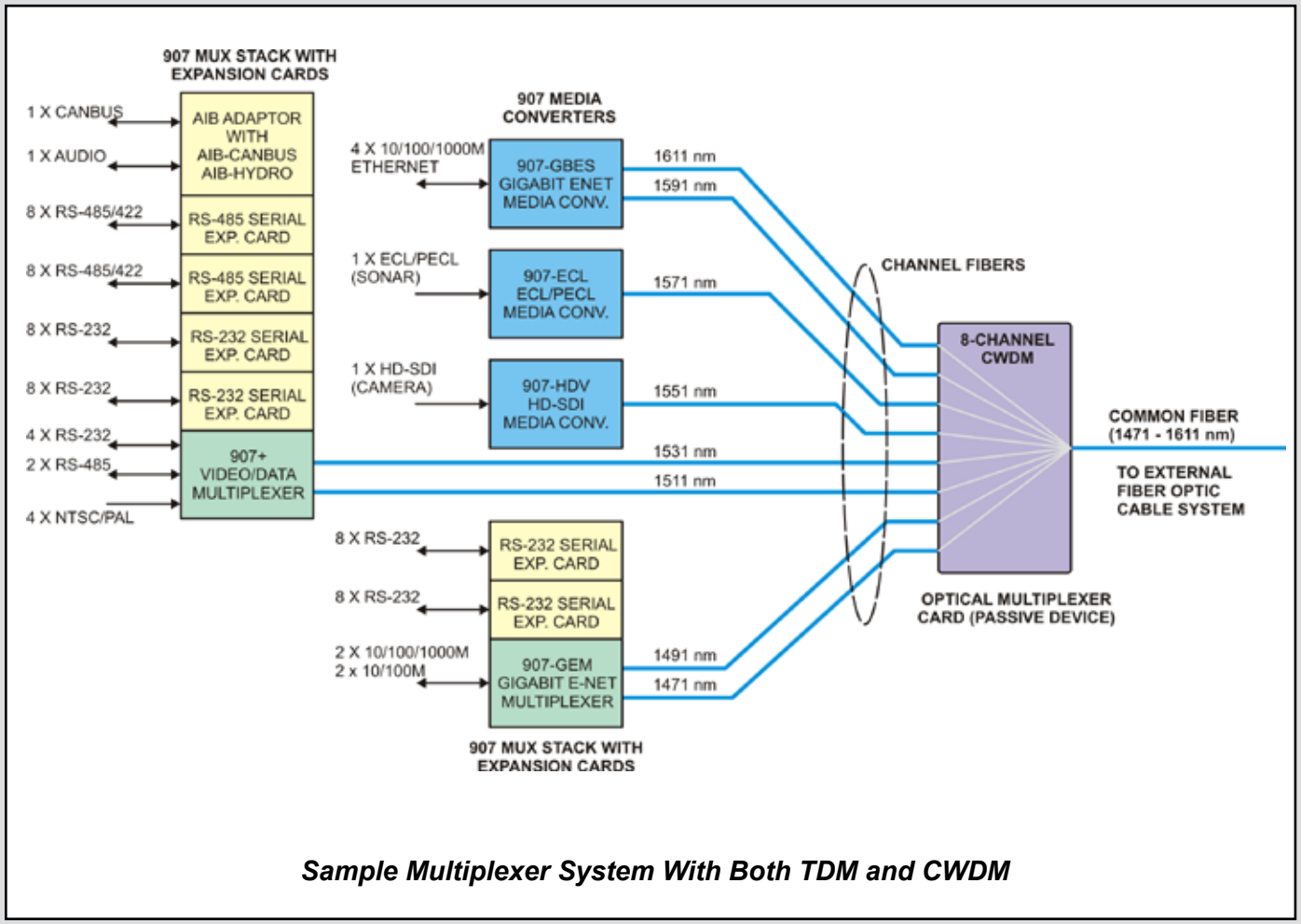
Special lasers with tighter manufacturing tolerances and lower temperature drift are used with coarse wavelength division multiplexers (CWDMs) to allow for the combination of up to 18 different wavelengths on a single fiber. Standard CWDM wavelengths and channel windows are defined by international standards with a nominal separation of 20 nm.

Th diagram below shows a CWDM system with eight wavelength channels from 1471 nm to 1611 nm. The common fiber has all eight channels present whereas each of the channel fibers is filtered for a single wavelength. Wavelengths are shown as visible colors, but in practice the actual wavelengths are all infrared. The width of the filter windows allows for the temperature drift and manufacturing tolerances of the lasers. Even higher channel densities are possible with dense wavelength division multiplexing (DWDM), with potentially hundreds of channels supported, but typically the expense and added complexity of DWDM solutions are not warranted for applications outside of telecommunications.



Optical Multiplexing with CWDM (8 Channels)

Shown below is a fiber-optic system combining electrical data with TDM, including expansion cards, and optical channels with CWDM technology. Unidirectional signals, such as HD-SDI, typically require just a single wavelength, whereas bidirectional signals, such as for serial data on video/data multiplexers, require two wavelengths, one for each direction. The system shows the modularity and large data capacity of TDM/CWDM systems. With Model 907+ multiplexer cards and expansion cards, a single 8-channel CWDM system will support up to 16 video channels and over 200 serial channels. Two 8-channel devices with different wavelength bands may be combined optically, thus doubling this capacity to 32 video channels and over 400 serial channels.



Sample Multiplexer System With Both TDM and CWDM

Call or email our knowledgeable Application Engineers for more information:
902-468-2263 or focal@moog.com

Other Products Offered

Motion Technology

Slip Rings

Moog Components Group is the world leader in slip ring design and manufacturing -- offering thousands of models. Slip rings are used in systems that require continuous rotation while transmitting power and data from a stationary unit to a rotating device.

Fiber Optic Rotary Joints

Moog Components Group's fiber optic rotary joints are to optical signals what electrical slip rings are to electrical signals, a means to pass signals across rotating interfaces, particularly when transmitting large amounts of data.

Motors

Moog Components Group provides a complete line of brush and brushless DC motors. These high performance motors are developed for a wide variety of applications, including medical, automation, industrial, aerospace and defense.

Resolvers

Moog Components Group's line of brushless resolvers are economical and highly accurate motion feedback sensors that are used to provide position and velocity information for closed-loop control, as well as brushless DC motor commutation.

Actuators

Moog Components Group offers high technology and utility electromechanical rotary and linear actuators for aerospace and industrial applications. These actuators utilize brush and brushless DC motors, planetary gears, modulated smart servo amplifiers, PWM amplifiers, multi-speed resolvers and potentiometers.

Fluid Rotary Unions

Moog Components Group's expanded line of fluid rotary unions offer reliable transmission of life support, process, power and control fluids. Fluid rotary unions can be combined with slip rings, fiber optic rotary joints, motors and resolver.

Air Moving

Moog Components Group now offers tailored airflow products that are designed using off-the-shelf components to provide cost effective solutions. With Moog's expertise in thermal management and innovative motor technology, there are new ways to solve difficult thermal, airflow, acoustic and efficiency problems.

Fiber Optics

Moog Components Group expands and enhances its motion capabilities with expertise in fiber optic design. From MEMS-based fiber optic switches to large rotary joints and multiplexers to fiber optic modems, we offer an array of solutions for today's demanding applications.

Custom Solutions

Moog Components Group does not stop with just standard models. Over the years, we have learned that many projects require a product that has unique specifications - either designed from scratch or modified from another design. One of Moog Components Group's strong points is providing exactly the right custom solution.

77 Frazee Avenue
Dartmouth, Nova Scotia
Canada B3B 1Z4

Tel: 888-302-2263
+1-902-468-2263
Fax: +1-902-468-2249

MOOG
COMPONENTS GROUP

www.moog.com/marine

Email: mcg@moog.com

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