Electronics Product Guide

Rugged Communication Solutions for Harsh Environments

MOOG
FOCAL™

Moog Focal has been developing rugged fiber-optic communications systems and components for over 30 years. The expertise gained designing military grade telemetry systems for naval towed arrays in the 1980s led to many successful commercial video/data multiplexing product lines for subsea Remotely Operated Vehicles (ROVs). Standard multiplexer systems are now available in many 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 optical fibers; both legacy multimode fiber cables and higher bandwidth singlemode fibers are fully supported.

With over 3,000 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 Focal maintains a dedicated team of electronics designers to support ongoing expansion of existing product lines and provide rapid custom designs for specific applications.

Moog Focal also specializes in providing electrical slip rings, fiber optic rotary joints, hydraulic utility swivels and fiber optic multiplexer solutions for the worldwide marine industry including ROV, seismic, offshore wind, FPSO turret and oceanographic applications. Rotary product features include hybrid solutions that combine fiber, electrical and fluid rotary joints for harsh environments, explosion proof/flameproof for hazardous locations and adaptation to customers' size and mounting constraints.

Moog Focal multiplexers are supported by industry leadership in fiber optic development, including optical sensors, telemetry systems, connector design, ruggedized optics and a large portfolio of fiber optic rotary joints. 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.

Welcome to the Moog Focal Electronics Product Guide. The multiplexer literature, of which the product guide is a part, is organized in such a way as to make finding the information you need quick and easy. The product guide is structured into a selection guide, organized by model number, and custom information.

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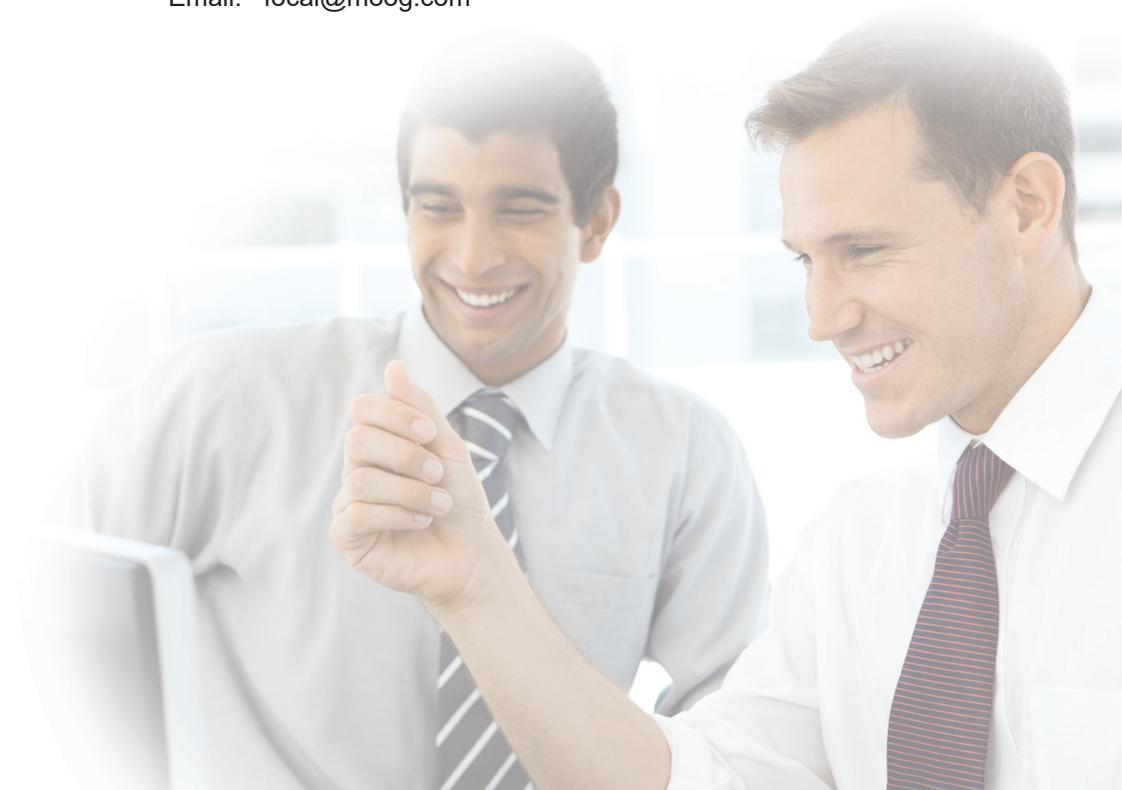
Model Number	903	907	914	920	922	924	OEM
Video Signals							
Composite (NTSC/PAL)	•	•	•				•
S-Video (Y/C)	•	•					•
Component (YPbPr, RGB)	•	•					•
SD-SDI (SMPTE 259M)	•	•	•			•	•
HD-SDI (SMPTE 292M)	•	•	•			•	•
3G-SDI (SMPTE 424M)	•	•	•			•	•
CameraLink							•
GigE Vision	•	•	•		•		•
Network / Bus Signals							
10/100M Ethernet	•	•	•	•	•	•	•
Gigabit Ethernet	•	•	•	•	•	•	•
10G Ethernet							•
Tritech ARCNET	•	•	•				•
PROFIBUS	•	•	•				•
CAN bus, DeviceNet™	•	•	•	•	•		•
EtherCAT®, PROFINET®				•			•
USB 2.0, 3.0							•
Serial Data Signals							
RS-232	•	•	•		•		•
RS-485/RS-422	•	•	•		•	•	•
TTL	•	•	•				•
Responder Trigger	•	•	•				•
IRIG Trigger	•	•	•				•
ECL/PECL	•	•	•				•
LVDS			•				•
On/Off Controls (TOR)	•	•	•				•
PPS	•	•	•				•
Analog Signals							
Audio/Hydrophone	•	•	•				•
Analog Sonar (MS900)	•	•	•				•
Resolver/Encoder	•	•					•
4 – 20 mA	•	•			•		•
Sensor (Voltage Output)	•	•					•
Diagnostics							
LEDs On Board	•	•	•	•	•	•	•
LEDs External		•	•		•		•
Serial Port (RS-232 or RS-485)	•	•	•			•	•
Ethernet Port	•	•		•			•
Modbus TCP/RTU	•	•			•		•
Factory Options							
Pressure Balanced Oil Filled (PBOF)		•	•				•

Product Overview

Model 903 3U Eurocard-based modular system with slide-in cards. Suitable as standalone sub-racks or for 19 inch 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 or pressure tolerant configurations.	
Model 914 Modular, credit-card sized multiplexer system and media converters with advanced features such as built in diagnostics, and firmware updates. Available in pressure tolerant configurations.	
Model 920 Rugged multiplexers for long term operational use with low maintenance costs and providing a cost effective solution for multiple Ethernet and real time protocols (e.g. EtherCat®).	
Model 922 The Model 922 product line is a modular set of interface and telemetry cards (3U Eurocard) specifically designed and tested for long term deployment in subsea communications systems. With full qualification to API/ISO standards, this flexible platform combines the high reliability and performance of custom, rugged solutions with the ready availability and cost-effectiveness of standard industrial products.	
Model 924 PC/104 sized optimized solutions for HD video, Ethernet and serial for defense applications. Advanced features such as built in diagnostics, and firmware updates. Using 10 G technology allowing for uncompressed HD video with extremely low latency.	
Model 928 The Optical Monitoring System (OMS) provides real time condition monitoring of fiber optic cables. Using optical loss and distance along the fiber the OMS hardware and Graphical User Interface (GUI) can pin-point problem locations before they become major faults. This can help plan preventative maintenance, reduce time troubleshooting, and save costs in down time.	

Application Overview

Moog Focal electronics are developed to provide reliable transmission of video, Ethernet and data signals for demanding applications, such as: marine Remotely Operated Vehicles (ROVs), Electro-Optic (EO) pods, Remote Weapon Stations (RWS), radar systems, wind turbines and other platforms operating in harsh environments around the world.

Remotely Operated Vehicles

Courtsey of Allseas

Moog Focal has been providing electronics for Remotely Operated Vehicles (ROVs) for over 17 years with a broad line-up of commercial off-the-shelf products supporting all common and special ROV requirements.

• Remotely Operated Vehicles (ROVs)
• Tether Management Systems (TMS)
• Explosive Ordinance (EOD) Robots
• Pipe Crawlers

Subsea Oilfield Communications

Robust, application specific qualified electronic communication solutions designed and tested for 20 year deployment for offshore marine.

• Blow Out Preventer (BOP) Systems
• Subsea Drilling, Processing and Well Head
• Intervention Workover Control Systems (IWOCS)
• Subsea Electronic Modules (SEMs)

Defense

Courtsey of PVP

Experienced provider of rugged electronic communication solutions for naval, ground and airborne defence applications with off the shelf and custom products.

- Electro-Optic (EO) Camera Pods
- Radar
- Security Systems
- Remote Weapon Stations (RWS)

Industrial

Electronic communications systems trusted to perform in the harshest industrial applications.

- Wind Energy
- Tidal Energy
- Industrial Controls
- Sensor Monitoring Systems

Moog Focal multiplexer families share many common configurations and definitions. This section shows how multiple Moog Focal cards can be combined to create a multiplexer system.

Motherboards

Multiplexing involves the combination of multiple input signals and signal types into a single optical fiber link. Moog Focal multiplexer motherboards have one or more optical transceivers and can multiplex data from various sources including expansion cards onto a single optical channel. Optical transceivers are typically single fiber, singlemode, bidirectional with 20 dB optical budgets, but also have a variety of options for CWDM wavelengths, higher or lower optical budgets, as well as multimode fiber support for shorter links. Data rates range from 600 Mbps to 10 Gbps.
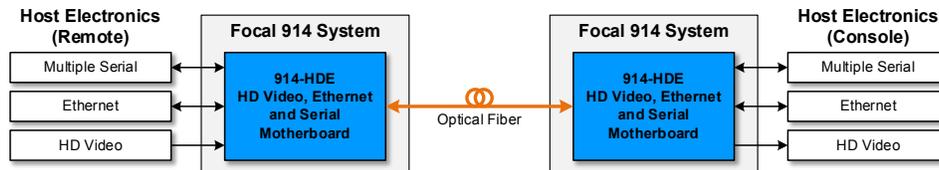

Media Converter Cards

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 easily multiplexed with many other signals on the same optical link. Common signals for media converters include Ethernet (100 and 1000 Mbps), HD/3G-SDI (1.485 and 2.97 Gbps), coaxial ECL/PECL for sonars (30 - 150 Mbps), and various proprietary high-speed data links. These cards cannot be expanded with expansion cards, but their optical channels may be combined using optical multiplexer cards.
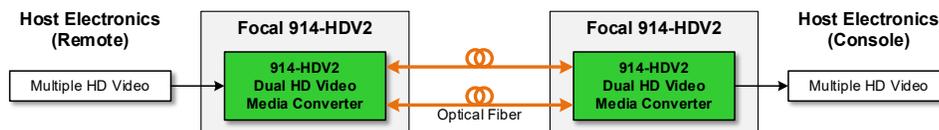

Expansion Cards

Moog Focal Expansion cards add signal interfaces to a Moog Focal motherboard via a backplane or expansion connector. Expansion cards do not have their own optical transceiver and must share optical bandwidth with a motherboard.
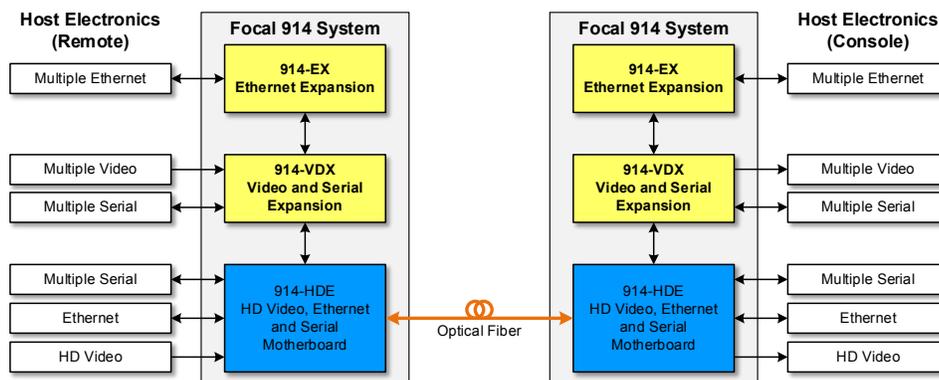

Optical Cards

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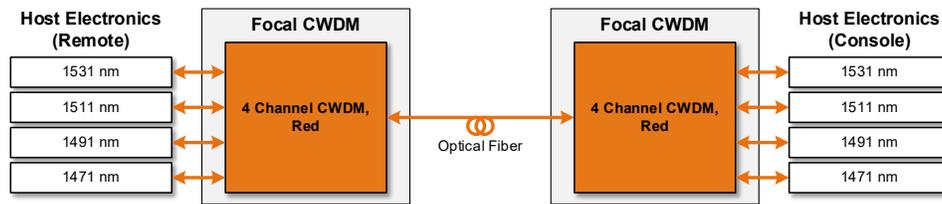
To provide redundant communications between host electronics in the case of a fiber-optic cable failure, one system may be fitted with a fiber-optic splitter, while the other system is fitted with a fiber-optic switch. All optical traffic from the splitter system is transmitted along both fiber-optic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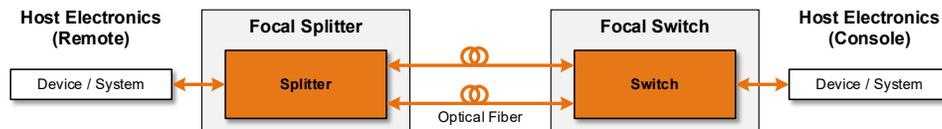

System Cards

System cards provide functional support to all Moog Focal cards where required. This support includes, but is not limited to: power conversion, Ethernet and serial diagnostics, and LED diagnostics.

Multiplexer System

By combining some or all of the modules detailed above, a complex optical system may be configured to suit most optical communication requirements. Moog Focal engineers can help you to create custom solutions that meet rigorous environmental specifications, complex multi-format data requirements and challenging optical bridges.
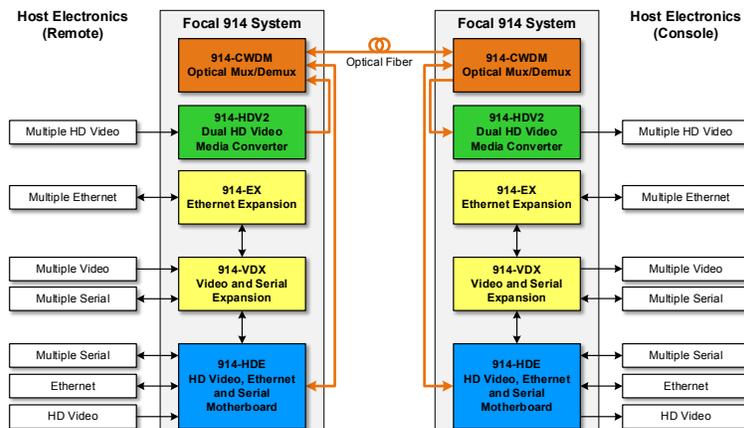
Pressure Bottles and Enclosures

In addition to selling individual cards and/or full multiplexer systems, Moog Focal can also integrate all multiplexer systems into custom pressure bottles for deep water environments, and 19 inch racks for surface systems. Moog Focal also has a full line of pressure tolerant electronics and optics that can eliminate the need for pressure rated enclosures. Please enquire about packaging your custom solution.
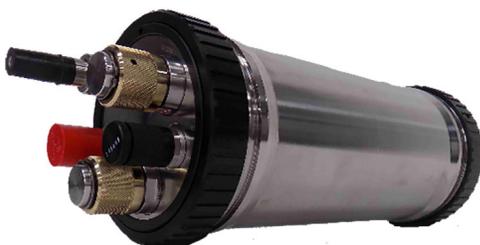
1ATM Pressure Bottle

19 Inch Rack-Mount Enclosure

Model 903 - 3U Eurocards

The legacy Moog Focal Model 903 product family provides rack-based, fiber-optic multiplexing for video/data communications in Remotely Operated Vehicles (ROVs) and other rugged industrial systems.

The Model 903 family's 3U Eurocards support quick board changes in the field, allowing easy reconfiguration of the system to meet changing mission requirements. Supported interfaces include analog video, serial data (RS-232/485/422), Fast Ethernet, sonar, hydrophone, responder trigger, CAN bus, Tritech ARCNET and others. Media converter cards are available for 3G/HD-SDI video, ECL/PECL links (sonar), and Gigabit Ethernet for use with high definition cameras and high resolution sonars.

Typical Applications
The Model 903 product family is ideally suited to meet the needs of medium to large vehicle applications, such as:

• Work class Remotely Operated Vehicles (ROVs)
• Military Remotely Operated Vehicles (ROVs)
• Subsea ploughs and trenchers
• Subsea mining

Multiplexers and Media Converters
Fiber Multiplexer Boards (FMBs) are used to combine video and data signals from multiple expansion cards into a single, bidirectional optical link. Fiber-optic splitters and switches are built into the FMBs to enable full redundancy on the optical link with automatic switchover and manual override. Extensive built-in diagnostics, available as RS-232 or Ethernet, offer detailed monitoring of optical power and losses in the system to quickly identify problems and allow for long-term logging of health data. Front panel LEDs further support direct troubleshooting of optical, video and data signal without the need for a PC.

Media converters are available to integrate higher speed signals, such as HD-SDI and Gigabit Ethernet. These signals can be run on separate fibers or combined with the FMB signals using optical modules.
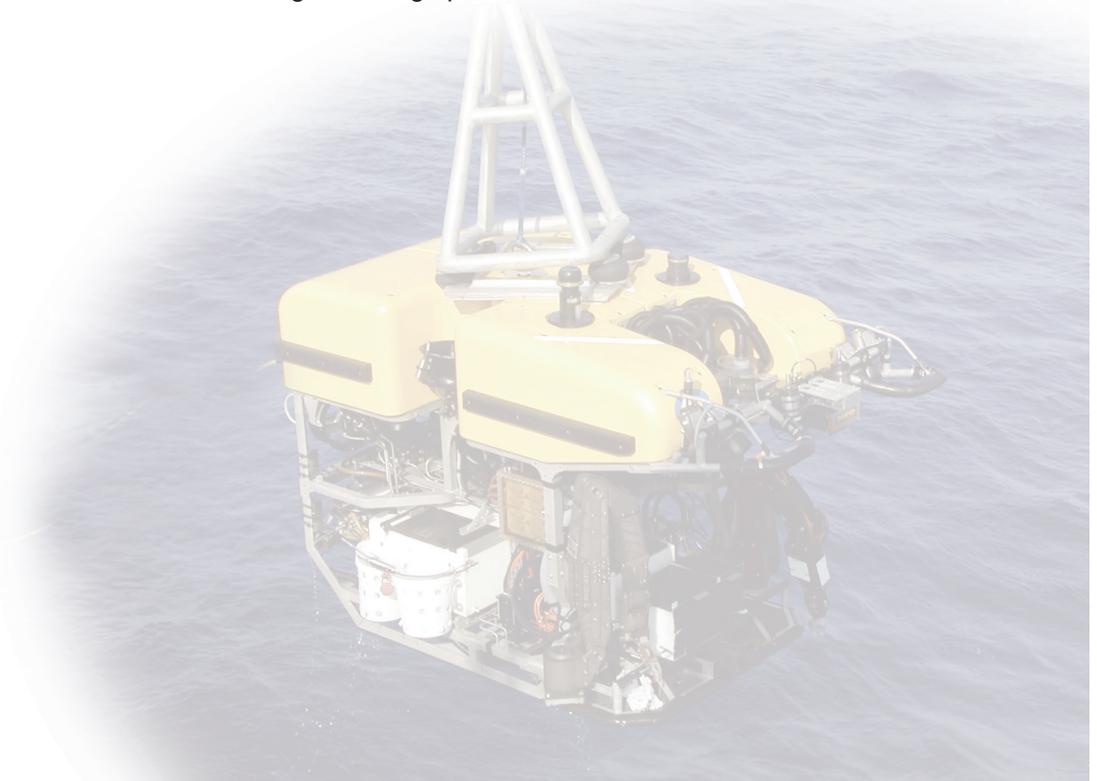
Expansion Cards

A maximum of four data expansion cards and two analog video expansion cards can be added to a standard 903 chassis for a total of up to 8 analog video channels and 64 serial channels. The versatile Adaptable Interface Board (AIB-4) allows any combination of four AIB plug-in modules, which support standard interfaces, such as RS-232, RS-485/422, TTL and specialized interfaces, such as hydrophone, MS-900 sonar, Tritech ARCNET and CAN bus. (See the AIB catalog section for more details.)

Interface Card	Description	Supported Video Formats	Video Channels	Supported Data Formats	Data Channels
VIB-TX/-RX	Video Interface Board	NTSC, PAL, RGB, S-Video (Y/C)	NTSC, PAL, RGB, S-Video (Y/C)	NTSC, PAL, RGB, S-Video (Y/C)	N/A
HDB-TX	High-Density Video/Data Interface Board	NTSC, PAL, RGB, S-Video (Y/C)	NTSC, PAL, RGB, S-Video (Y/C)	NTSC, PAL, RGB, S-Video (Y/C)	8
AIB-4	Adaptable Interface Board	N/A	N/A	N/A	4
CIB-10	Control Interface Board	N/A	N/A	N/A	10
DIB-232-16	RS-232 Interface Board High Density	N/A	N/A	N/A	16
907-232-E	RS-232 Interface Board Eurocard adapted 907	N/A	N/A	N/A	8
907-485-E	RS-485 Interface Board Eurocard adapted 907	N/A	N/A	N/A	8
EIB-10/100	Ethernet Interface Board	N/A	N/A	N/A	3

System Modules: Optics, Power Supplies, Racks, and Backplanes

Along with interface cards, system modules are used to configure Model 903 systems for specific applications. Optical modules, such as CWDMs, enable integration of optical links from multiple FMB and media converter cards into a single fiber. Power supplies (120/240 VAC, 48 VDC, 24 VDC) and various sizes of 3U racks and backplanes are available to suit the space available, from 12 HP to full 82 HP width.

903 PSU   *903 Remote HD System*   *903 Console System*   *903 Backplane*
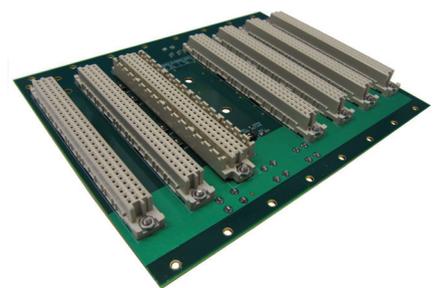
The family of Moog Focal Model 907 products provides compact and rugged video and data multiplexers and fiber-optic transmission systems.

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.

The Moog Focal Model 907 family is the most comprehensive multiplexer product line with an abundance of signal (video/data) and optical options to suit most any communication requirement. A full suite of motherboards provide base systems on which to add expansion cards. Multiple motherboard stacks may be combined via CWDM optics providing multi-gigabit optic links.
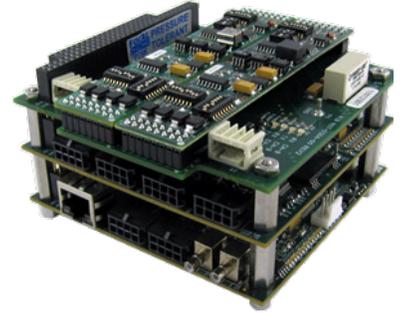
Typical Applications

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 Remote Weapon Stations (RWS)
- Electro-Optic (EO) targeting and surveillance pods
- Industrial sensors

Courtesy of Saab Seaeye

Motherboards

Model 907 Motherboards are the base building blocks of multiplexer systems. Choose between video based, Ethernet based or video - Ethernet hybrids; then add expansion cards to complete the system.

Model	907E	907-R/C	907Plus	907V	907-HDM2	907-GEM
Description	2-Channel Video/Data and Ethernet Mux	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
Supported Video Formats	2-Channels NTSC/PAL	3-Channels NTSC/PAL	4-Channels NTSC/PAL	6-Channels NTSC/PAL	2-Channels HD/SD-SDI	None
Supported Data Formats	4-Channels RS232/485/422 TTL Option	4-Channels RS232 2-Channels RS485/422 TTL Option	4-Channels RS232 2-Channels RS485/422 TTL Option	None	4-Channels RS232/485/422	None
Ethernet Channels	1-Channel 10/100 BASE-T(X) 1000 BASE-T (Optional)	None				4-Channels 10/100/1000 BASE-T(X)
Expansion Card Support	6-Channels	Up to 6-Channels	6-Channels			
Diagnostics	LEDs Ethernet Diagnostics via 907 DIAG-E	LEDs	LEDs Ethernet Diagnostics via 907 DIAG-E			
Optical Options	Bidirectional Single Mode Single Fiber (Standard) CWDM (Optional) Multimode (Optional) Pressure Tolerant (Optional)					
Input Voltage	5 V (12 V Option)	5 V				
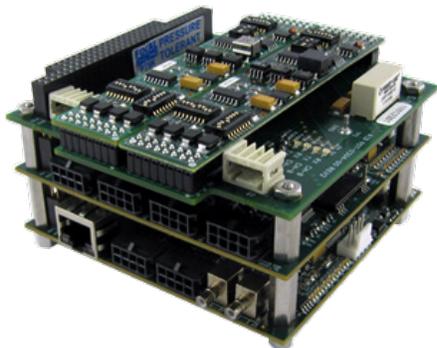
907 Stack

19 Inch Rack-Mount Enclosure

Media Converter Cards
Model 907 media converter cards add high bandwidth channels on their own optical wavelength to any multiplexer system.

Model	907 FLEX	907 GBES	907 GBE2	907 GBE	907 HDV	907 ECL
Description	Flexible Media Converter: 3G-SDI, Gigabit Ethernet	Quad Ethernet Switch Media Converter	Dual Ethernet Media Converter	Ethernet Media Converter	HD/SD-SDI Media Converter	ECL Media Converter
Supported Data Formats	Up to 4 Channels 3G/HD/SD-SDI And/Or Up to 2-Channels 10/100/1000 BASE-T(X)	4-Channels 10/100/1000 BASE-T(X)	2-Channels 10/100/1000 BASE-T(X)	1-Channel 10/100/1000 BASE-T(X)	HD/SD-SDI	ECL
Diagnostics	LEDs Ethernet Diagnostics via 907 DIAG-E	LEDs Ethernet Diagnostics via 907 DIAG-E	LEDs Ethernet Diagnostics via 907 DIAG-E and 907 Motherboard			
Bidirectional Single Fiber Optical Option	With Optional Integrated CWDM Module	Yes (Standard)	Yes (Standard)	Yes (Standard)	Unidirectional Single Fiber	Unidirectional Single Fiber
Optical Option	Single Mode CWDM (Standard)	Bidirectional Single Mode Single Fiber (Standard) CWDM (Optional) Multimode (Optional) Pressure Tolerant (Optional)			Single Mode Single Fiber CWDM (Standard) Multimode (Optional) Pressure Tolerant (Optional)	
Input Voltage	5V (12 V Pption)	5 V				

Expansion Cards
907 Expansion cards support low data rate signals that can be pre-muxed onto 1 of 6 backplane channels. Some higher data rate signals may be accommodated via dedicated backplane channels. 907 Motherboards can accommodate up to six 907 Expansion cards. For specific expansion card and motherboard compatibility questions, please contact Moog Focal.

Model	907-SER[3]	907-232	907-485	907-ADC/DAC	907-AUDIO	907-CIB	907-AIB	907-EIBS
Description	8-Channel RS-232/485/422 Card	8-Channel RS-232 Card	8-Channel RS-485/422 Card	8-Channel 8/12-bit ADC/DAC Card	4-Channel 24-bit Audio Card	4-Channel Control Interface Card	Dual Socket AIB Adaptor	3-Port 10 Mb/s Ethernet Switch Card
Backplane Channels Required	1, 2, 4	1	1, 2, 4	1	1	1	1, 2	1
Max Data Rate	250 kb/s to 2.5 Mb/s[1]	120 kb/s	250 kb/s to 2.5 Mb/s[1]	50 kHz Bandwidth	20 kHz Bandwidth	50 kHz updates	Up to 2.5 Mb/s[2]	10 Mb/s
I/O Connectors	4x 8-pin Molex Microfit			2x 8-pin Molex Microfit	4x 2-pin WAGO 2x 3-pin WAGO		2x 4-pin WAGO	3x RJ45

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. 907 SER is compatible with the 907 DIAG-E diagnostic card for full end-to-end diagnostics and configuration

Optical Cards

Model 907 optical cards allow multiple motherboards and media converters to be optically combined onto a single fiber.

Model	907-CWDM	907-CWDM-4R1	907-CWDM-8R	907-SPLIT-SM	907-FOS-SM
Description	CWDM Optics Card, 1471/1491 nm with 1310/1550 nm Bypass, Singlemode	CWDM Optics Card, 1471 - 1531 nm, Singlemode, 20 nm Spacing	CWDM Optics Card, 1471 - 1611 nm, Singlemode, 20 nm Spacing	1 x 2 Fiber Splitter Card, Singlemode	1 x 2 Fiber Switch Card, Singlemode
Features	1310/1550 nm bypass port for easy upgrade of an existing system	Optional 1310 nm bypass port	Optional 1310 nm bypass port	Provides redundant fiber operation	Provides fiber-optic switch with manual or remote digital control (TTL)

System Cards

System cards provide the support functions required to adapt the Model 907 architecture to many different applications.

Model	907-DIAG-E	907-DC-24V
Description	Ethernet Diagnostics Card	24 V DC-DC Converter
Features	Provides full system diagnostics from 907 stacks with compatible motherboards via Ethernet	Converts 24 V to 5 V for system power

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.

907 Ethernet Diagnostics

The Moog Focal 914-X Series multiplexer technology enables the transfer of HD video, analog composite video, Ethernet and serial data signals over a fiber-optic communication channel. These credit-card sized electronic cards have been designed specifically for use in harsh marine and industrial environments.

Advanced Modular Multiplexer System

The Moog Focal Model 914-X Series represents a technical leap forward for the Moog Focal Multiplexer product line. The 914-HDE is a single universal motherboard with 3 optical speed options, 20+ optical wavelength options, and an ever expanding array of expansion cards allow users to configure a modular multiplexing system. At its core is a multi-gigabit multiplexing fabric combining HD-SDI video, Ethernet and serial data. The multi-gigabit expansion interface permits up to 8 expansion cards to be added to the system without requiring multiple fibers or CWDM. For larger systems that do require more than a single 914-HDE motherboard can provide, optional CWDM transceivers and optical multiplexer cards assist multiple 914-X Series systems to share the same fiber. All of this advanced technology is available in an incredibly small credit card sized form factor ideal for pressure bottles, and can also be configured as a pressure tolerant version. High speed ribbon cabling can be used to arrange complex systems in space-challenged enclosures.

All 914-X Series cards include advanced serial diagnostics and configuration interfaces. This facilitates easy configuration of the cards without requiring physical access, as well as easy to display system status. The same interface can be used to update the system firmware or to upgrade the feature set with higher speed interfaces and new expansion possibilities. LED headers simplify integration with cost effective enclosure diagnostic LEDs.

Compatibility with Moog Focal's Adaptable Interface Boards (AIB) allow this new multiplexing system to be backwards compatible to unique signal interfaces that often present challenges for system architects.

Typical Applications

The Model 914-X Series is suited particularly well to applications requiring HD video in ultra-small and ruggedized fiber-optic converters, such as:

- Remotely Operated Vehicles (ROVs)
- 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
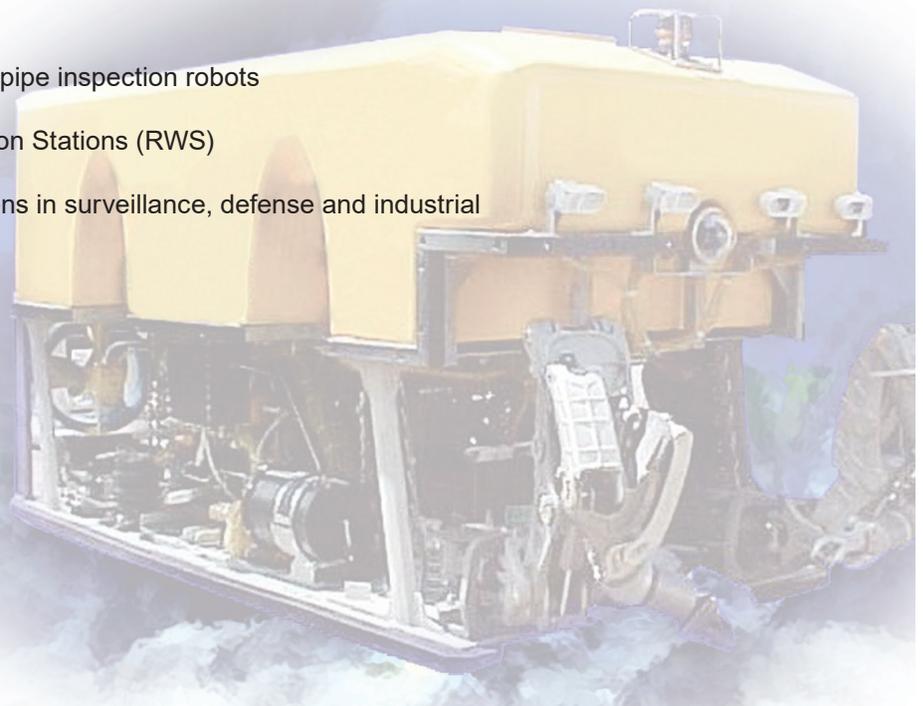
Model	914-HDE L1	914-HDE M1	914-HDE H1	914-VDX	914-EX	914-DX	914-AX	914-HDV2
Card Type	Motherboard			Expansion				Media Converter
Description	HD Video, Serial Data, and Ethernet Multiplexer Motherboard / Low Speed Version	Medium Speed Version	High Speed Version	Video and Serial Data Expansion	Ethernet Expansion	Serial Data Expansion	AIB Adaptor Expansion	Dual HD Video Media Converter
Supported Video Formats	1-Channel HD/SD-SDI	1-Channel 3G/HD/SD-SDI		2-Channels NTSC/PAL	None			2-Channels 3G/HD/SD-SDI
Supported Data Formats	2-Channels RS232/485/422 TTL Option			4-Channels RS232/485/422 TTL Option	None	6-Channels RS232 RS485 RS422 TTL	RS232 RS485/422 TTL Hydrophone Tritech ARCNET CAN bus MS-900 Analog Sonar	None
Ethernet Channels	1-Channel 10/100 BASE-T(X)[1]	1-Channel 10/100/1000 BASE-T(X)[2]	1-Channel 10/100/1000 BASE-T(X)	None	2-Channels 10/100/1000 BASE-T(X)	None		
Low Speed Expansion Channels	4-Channels			None		Requires 1		
Medium Speed Expansion Channels	0-Channels	2-Channels	4-Channels	Requires 1	Requires 1 or 2	None		
Diagnostics	Dedicated RS232 LEDs LED Header			RS232 (via 914-HDE) LEDs LED Header				Dedicated RS232 LEDs LED Header
In the Field Updates	Yes			Yes				No
Optical Options	Bidirectional Single Fiber (Standard) CWDM (Optional) Pressure Tolerant (Optional)			Shares Optical Bandwidth with 914-HDE				CWDM (Standard)
Input Voltage	5 V to 12 V			5 V to 12 V (As provided by 914-HDE)				5 V to 12 V
Optical Bandwidth	1.75 Gb/s	3.5 Gb/s	5.5 Gb/s	Shared with 914-HDE				Dual 2.97 Gb/s

1. Ability to trade HD-SDI support for 1000 BASE-T support
2. Reduced Ethernet bandwidth when 3G-SDI is plugged

The 914-X Series was developed with cost in mind. By default, all cards are shipped individually with mounting hardware included. Each system may be built by the user and then configured with the (included) user friendly diagnostics and configuration software. Sparing is easy as most cards may be configured for either remote or console operation, and SFP optical transceivers may be ordered individually by function and wavelength.

Model 914-X Series Value
- Lower starting system costs for many signal configurations
- High speed expansion options that do not require optical (CWDM) expansion
- Field upgrades available (order what you need now, upgrade the system later)
- Field updates available (stay current with next year's features)
- Optical expansion options available for larger systems
- Compact size keeps pressure rated enclosures cost effective
- Full end-to-end software configuration allows system changes without opening enclosures
- Included diagnostics allow for quick fault finding

Factory Order Options
- Extended factory temperature testing
- Test cables and fiber jumpers
- Custom system configuration/card stacking
- 19 inch rack enclosures
- Pressure bottle integration
- Split stacks using high speed ribbon expansion tethers

Advanced 914-X Series Diagnostics
Every 914-X Series system includes software for advanced diagnostics. Features include:

- Optical parameters
- Tx Power/Rx Power
- Transceiver temperature
- Link History
- Card part number and revision
- Electronic serial number
- Voltage rail measurements
- FPGA junction temperature
- Port/Channel
- Video status
- SDI video format
- SDI video test patterns
- Ethernet plug status and speed
- Ethernet auto-negotiate settings
- Serial data status and configuration

The same software is used to configure the system for:

- Ethernet settings
- Video test pattern activation
- Video direction, settings
- Serial port configuration
- Statistics gathering
- Feature upgrades
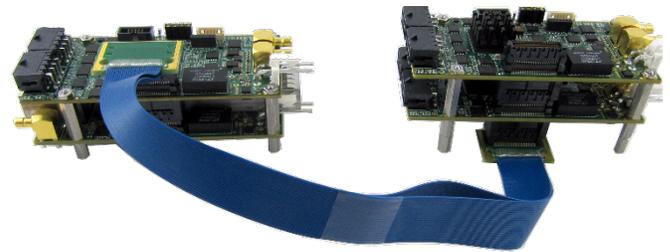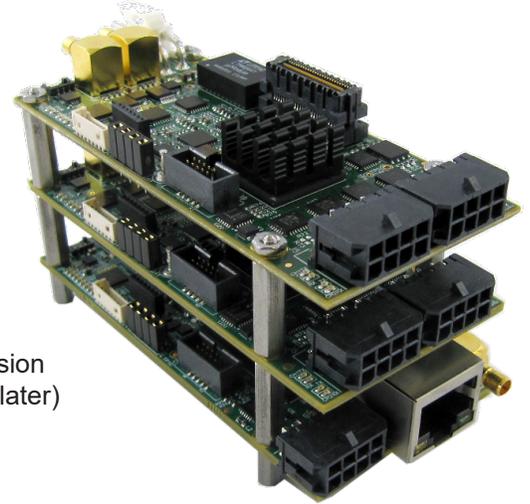
914-X Series Ribbon Cable Tether

914-X Series Diagnostics

Model 914 Optical Cards

Model 914 optical cards allow multiple motherboards and media converters to be optically combined onto a single fiber.

Optical Card	914-CWDM	914-CWDM-4R1	914-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
Features/Options	1310/1550 bypass port allows dual CWDM 914 motherboard or media converter to be daisy-chained to an existing Moog Focal 1310/1550 motherboard or media converter	Optional 1310 nm Bypass Port	Optional 1310 nm Bypass Port

Classic Model 914

Classic Model 914 multiplexers and media converters share the same form factor and mounting arrangements as the Model 914-X series. Their data may be combined optically via CWDM to the 914-HDE optical feed, but the cards themselves do not share diagnostic or data information and use different expansion interface technologies.

Model	914-R/C	914-EIBS	914-MCS	914-GBE
Description	Video/Data Multiplexer	Ethernet Switch Expansion Card	Fast Ethernet Media Converter	Gigabit Ethernet Media Converter
Supported Video Formats	1-Channel NTSC/PAL	None	None	None
Supported Data Formats	4-Channels RS232/485/422	None	None	None
Ethernet Channels	None	2-Channels 10/100 Base-T(X)	2-Channels 10/100 Base-T(X)	1-Channel 10/100/1000 Base-T(X)
Low Speed Expansion Channels	2-Channels	Requires 1	None	None
Diagnostics	LEDs	LEDs	LEDs LED Header	LEDs LED Header
Optical Options	Bidirectional Single Fiber Singlemode Multimode CWDM Pressure Tolerant	N/A	Bidirectional Single Fiber Singlemode Multimode CWDM Pressure Tolerant	Bidirectional Single Fiber Singlemode Multimode CWDM Pressure Tolerant
Input Voltage	5 V	5 V	5 V	5 V

Adaptable Interface Boards (AIB)

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

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 a 903, 907 or 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.
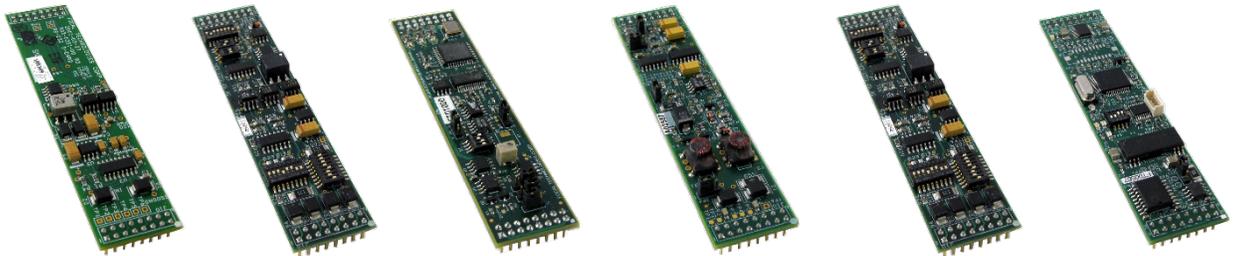
AIB Card	AIB-232	AIB-485	AIB-HYDRO	AIB-ARCNET	AIB-MS900	AIB-CAN bus
Description	1 x RS-232	1 x RS-485/ 422	1 x Hydrophone	1 x Tritech ARCNET	1 x MS-900 Analog Sonar	1 x CAN bus Bridge
NRZ Data Rate	120 kbps	2.5 Mbps	30 Hz - 30 kHz BW	156 kbps/78 kbps	5 - 30 kHz, 380 - 580 kHz	62.5 kbps - 1 Mbps
I/O Connectors	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

Small Form-Factor Pluggable (SFP) Optical Transceivers

SFP optical transceivers from are compatible with all Moog Focal optical products, as well other vendor's products. Single mode and multimode units available up to 4.25Gbps. Refer to the 922 section for qualified subsea SFP modules, or the pressure tolerant section for pressure balanced oil filled SFP modules.

Fiber Type	SFP-SMBXX-2G5-20-P0F	SFP-SMBXX-4G25-20-P0F	SFP-SMDXX-4G25-24-P0F	SFP-MMBXX-625M-16-P0F
SFP	1	1	2	1
Number of Fibers	Singlemode	Singlemode	Singlemode	Multimode
Operating Temperature Range (°C)	-40 to +85	-40 to +85	-20 to +85	-10 to +85
Data Rate	2.5 Gbps Max.	4.25 Gbps Max.	4.25 Gbps Max.	625 Mbps Max.
Tx Power (dBm)	-2 to +3	0 to +5	+2 to +7	-5 to 0
Rx Sensitivity (dBm)	-22	-24	-24	-25
Wavelength (nm)	1310, 1550	1310, 1550	1271 to 1611	1310, 1550

Pressure Tolerant

Moog Focal offers standard, qualified, pressure tolerant (PT) electronics, optical couplers and fiber optic transceivers for demanding subsea applications. These devices withstand extreme pressures at up to 5000 m ocean depth when installed in a pressure balanced, oil filled (PBOF) enclosure. Using PT electronics and PT fiber solutions significantly reduces the size, weight and costs associated with heavy one atmosphere bottles and subsea connectors.

Thousands of Moog Focal's pressure tolerant products are installed and operating in ROVs and other subsea installations around the world. Since initial product introduction in 2007, Moog Focal has introduced a wide range of PT solutions for analog video, HD video, Ethernet, serial data, optical couplers (WDM, CWDM, splitter) and fiber optic transceivers supporting up to 4.25 Gbps data rates in CWDM (dual fiber) and bidirectional (single fiber) versions. Pressure tolerant versions are available for almost all cards in the Model 907 family, as well as select cards in other series.

To support high reliability operation, rigorous design testing and extensive qualification are conducted on all new products to ensure optical and electrical performance at rated pressure and during rapid pressure cycling. Qualification and design tests are redone following any changes to the build process or component structures. Well-controlled manufacturing processes and high levels of factory screening further ensure the quality and reliability of the fielded products.

Pressure tolerant products are typically installed in a subsea junction box or enclosure filled with oil. Moog Focal has tested compatibility with many typical oils used in the marine industry and continues to validate additional fluids. Please contact Moog Focal with any questions on material compatibility for your application.

Features
- Standard ocean depth rating to 4000 m, optional rating to 5000 m and higher
- SFP optical transceivers up to 4.25 Gbps data rate
- CWDM and BIDI SFP optical transceivers, BIDI 1x9 transceivers
- Electronics, cabling and optical assemblies available
- Fully qualified for pressure and fluid compatibility
- Each production unit screened with rapid pressure cycles and
  long term soak

Typical Applications
- Remotely Operated Vehicle (ROV)
- Subsea controls (BOP, drilling, processing)
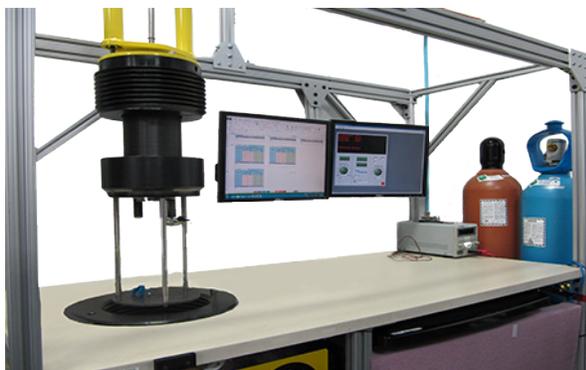
Factory Pressure Testing

Pressure Compensated Junction Box

Model 920-EDM Ethernet and Data

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 linkoptic 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.

These are used in hostile conditions and harsh environments communicating multiple data sets across a single fibre optic rotary interface or over long distances.

Features
- Multiplexes 10/100 M and Gigabit Ethernet, plus CAN bus on the same optical line
- 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™
- Multimode (MM) options available with baud rates from 625 MHz to 2.5 GB and distances from 20 m to 2 km in this mode
- Single Mode (SM) options available with baud rates at 2.5 GB and communication distance from 20 m to 40 km in this mode

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
- Cost saving by combining multiple datasets over a single FO link
- Pairs well with Moog rotary products

Typical Applications
The Model 920 EDM is suited particularly well to applications requiring ruggedized real time single fiber multiplexing, such as:
- Wind energy
- Industrial controls
- Remote tooling stations
- Sensor monitoring systems
- Tidal turbines
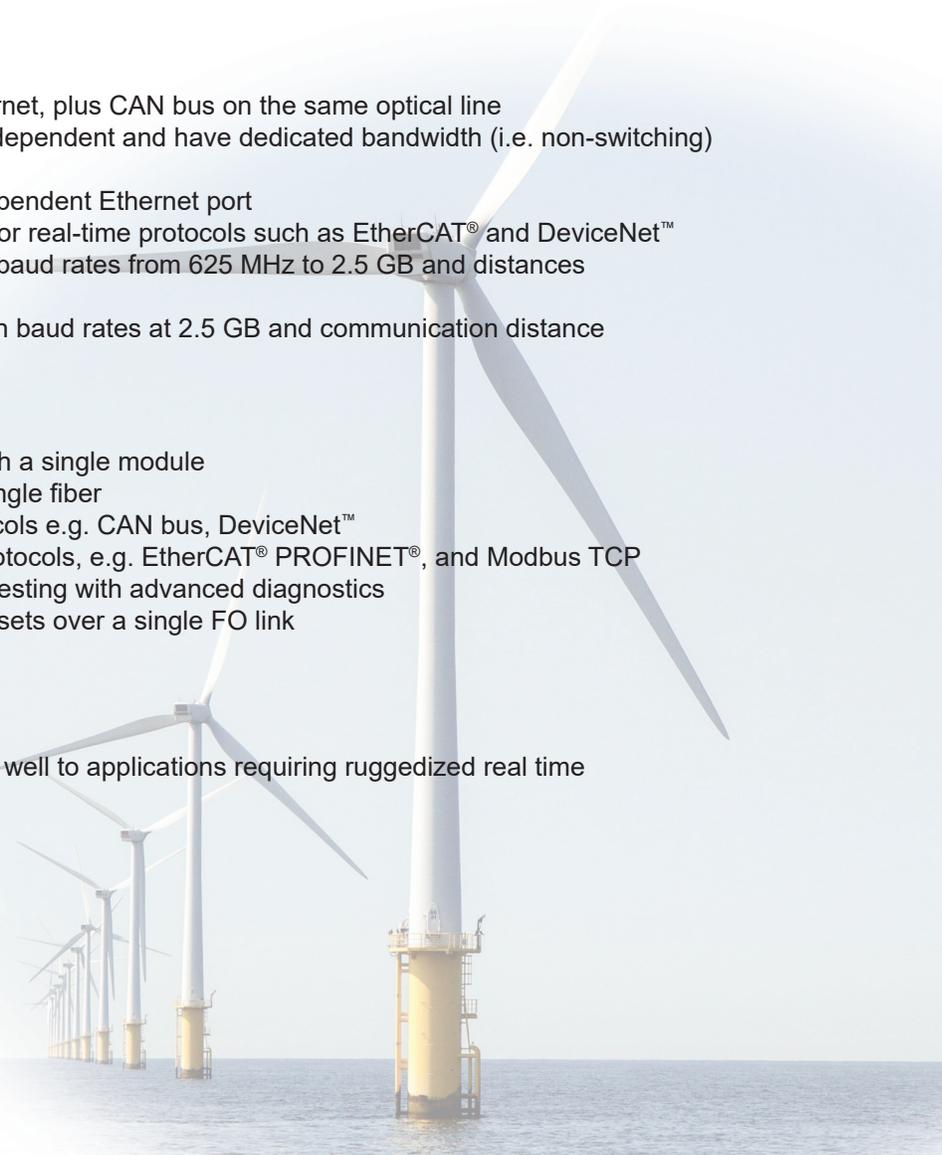
Model	920-EDM
Description	Ethernet and CAN bus Multiplexer
Supported Data Formats	CAN bus
Ethernet Channels 10/100 BASE-T((X)	2-Channels
Ethernet Channels 10/100/1000 BASE-T(X)	1-Channel
Diagnostics	Full End-to-End Diagnostics via Dedicated Ethernet Port
Input Voltage	24 V
Enclosure	Extruded Aluminum IP40 (Standard) IP65 (Optional)
Mounting	DIN Rail (Standard) Flange Mount (Optional)
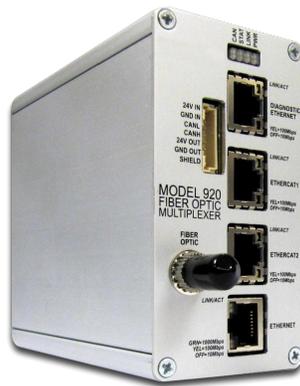
Model 920-EDM

Model 920-EDM Diagnostics

Model 922 - API Eurocards

Unlike product offerings from industrial suppliers, Moog Focal's Model 922 family of subsea controls and resilient networking products are specifically designed and qualified for permanent subsea installation and address key application requirements expected of subsea systems.

- **API/ISO Qualified** – Moog Focal products are designed, qualified and screened to meet the latest subsea industry standards, including API 17F and ISO 13628-6
- **Locked BOMs** - Bills of Materials (BOMs) are locked down with full product and part level traceability
- **Availability** - Proven high reliability components from approved vendors are selected for long term availability
- **Environmental Screening Program** - All products pass factory acceptance tests at temperature extremes, typically with environmental stress screening (ESS) programs. Build and test documentation is provided with each shipment
- **Design Documentation** – Moog Focal provides extensive design and qualification test reports, as well as product design analyses. Projects are supported by a comprehensive project management group
- **Customization** - Unique form factors, connectors, I/O formats, thermal management, diagnostics and user software, allowing easy integration of our proven designs into existing customer systems
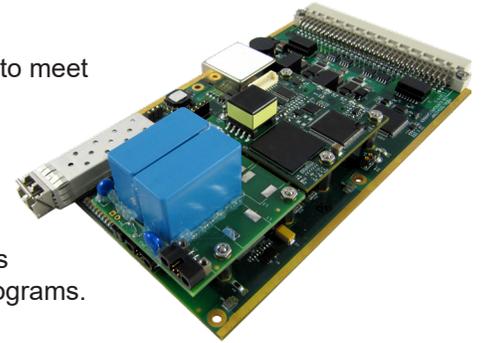
Robust and highly reliable subsea communication systems are required to safely and efficiently control a wide range of subsea applications from Blow Out Preventer (BOP) controls to subsea processing and well-head instrumentation. We provide both standard and customized systems for critical subsea applications with options for card-level and packaged solutions.

Typical Applications
The Model 922 product family is suited particularly well to subsea control applications for:
- Production controls, drilling and BOP controls
- Wellhead communications, Brownfield retrofits, subsea factories
- IWOCS, OEM subsea equipment (pump controls, multi-phase flow meters, chemical injection, etc.)
- Subsea sensor nodes
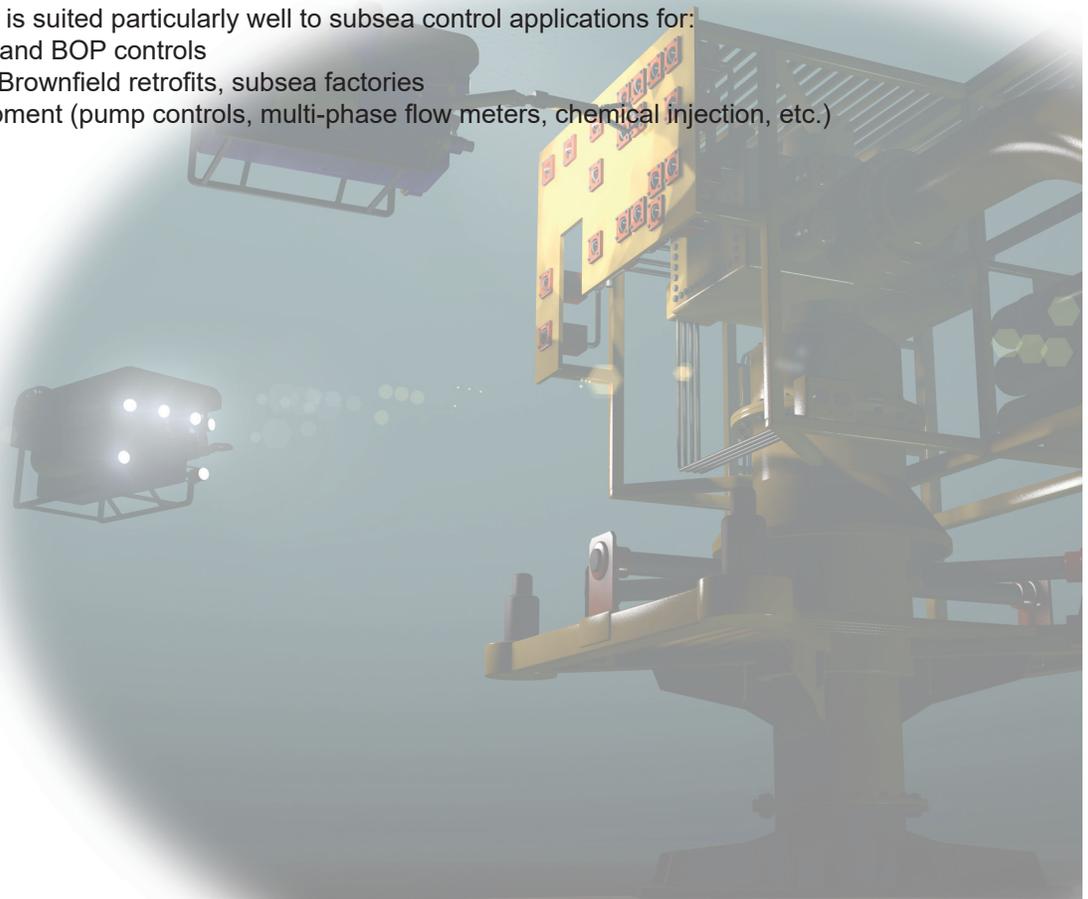
Model 922 Electronics Cards

Designed to support subsea installation with many critical features:
- Reliable continuous operation for > 20 years in subsea applications
- MTBF > 400,000 hours, verified with Accelerated Life Testing (ALT) and field data
- Qualified and screened (ESS) to ISO 13628-6 / API 17F for temperature, shock and vibration
- Low power design with conductive cooling to extend operating life
- SIIS compatible signal interfaces for levels I, II, and III
- Remote firmware updates using a robust protocol with verification and failsafe backup
- Extensive diagnostics (e.g. temp, voltage, error counters) via Modbus TCP, web server and Telnet
- Product life-cycle management with full traceability of all components
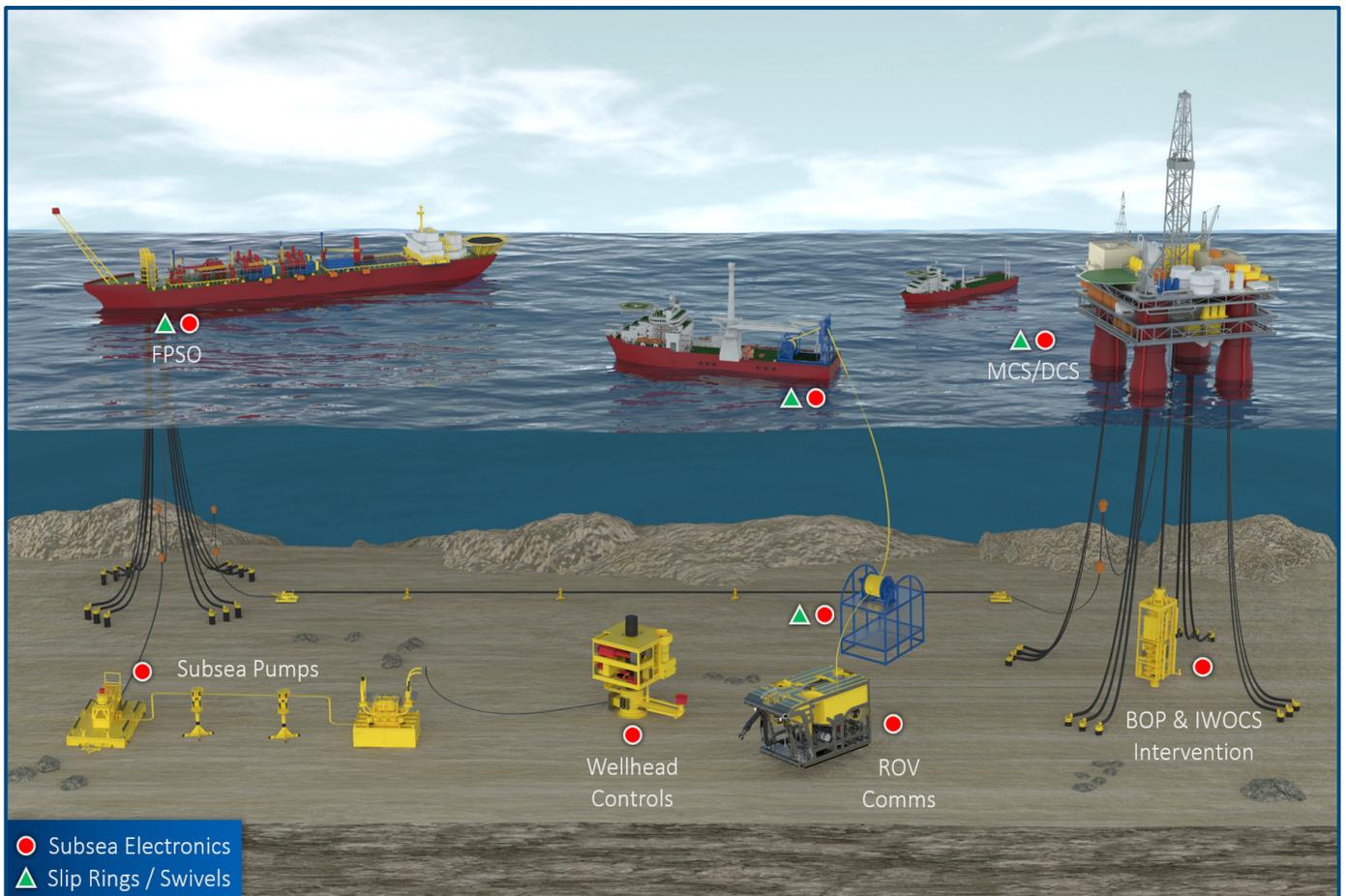
Moog Focal Installation Locations

Typical Network Configuration
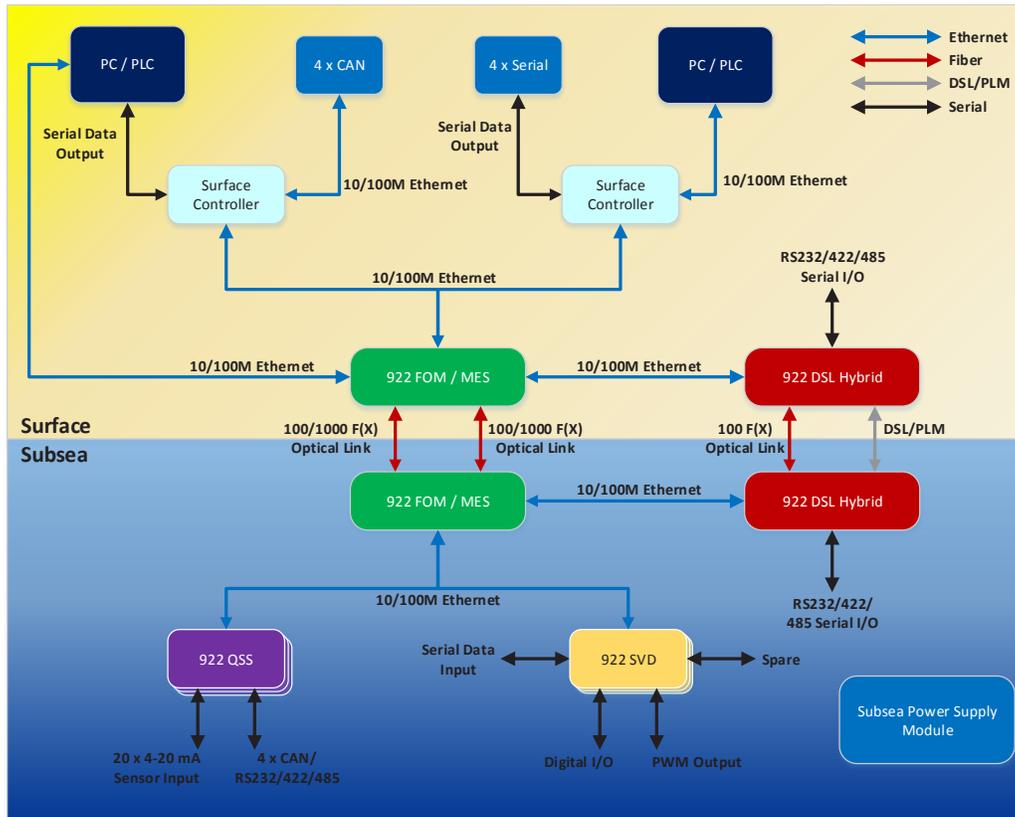
Model 922 Typical Network Configuration

Product Offerings

Ethernet Switches, Fiber Modems and Optical Transceivers

Layer-2 managed Ethernet switches (10/100/1000M) with dual optical links and fallback to copper links plus qualified subsea optical transceivers supporting CWDM configurations, bidirectional operation on single fibers and long haul step outs up to 200 km. Resilient networking features include redundant optical transceivers, RSTP, MRP and optional HSR/PRP, with precision network synchronization based on IEEE-1588.

Long Range Copper Modems

High speed (SHDSL) copper modems with extended step outs (DSL up to 6 km or 15 Mbps), multiple media support (twisted pair, power lines, copper/optical Ethernet) and integrated serial servers with options for transmission over existing AC power lines.

Gateways and I/O Modules

SIIS/IWIS compatible serial-to-Ethernet and analog-to-Ethernet gateways for easy conversion of sensors to modern Ethernet-based control systems or transmission of IP data over existing serial telemetry links. Includes serial formats (RS-232, RS-422, RS-485), CAN bus, 4-20 mA, PPP to IP gateways, Modbus TCP to Modbus RTU conversion and serial to UDP conversion.

System Integration Components

Backplanes and card racks for integrating sets of 922 cards into a compact 3U Eurocard module. Subsea power supply units for DC-DC conversion or AC-DC conversion. Qualified optical couplers and optical transceivers (SFP), and pressure tolerant cards and components.

Model 922 Communications Cards
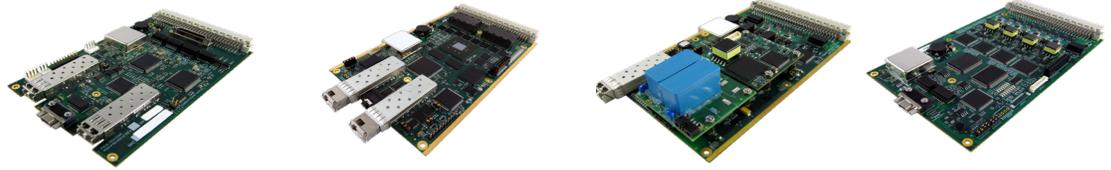
Model	922-FOM	922-MES	922-DSLH	922-QSS
Description	10/100M Fiber Optic Modem	Managed Ethernet Switch	Hybrid DSL Modem	Quad Serial Server
Copper Ethernet Channels	5 x 10/100M	8 x 10/100/1000M	2 x 10/100M	3 x 10/100M
Fiber Ethernet Channels	2 x 100M	2 x 100/1000M	1 x 100M	
Serial Channels			2 x RS-232/485/422	4 x RS-232/485/422
DSL/PLM Channels			1 x SHDSL via Twisted Pair or AC lines	
Options	- Bidi Transceivers - CWDM Transceivers - Heat Plate/Front Panel	- Bidi Transceivers - CWDM Transceivers - Heat Plate/Front Panel	- Bidi Transceivers - CWDM Transceivers - Heat Plate/Front Panel - AC Filter Modules	- CAN bus, 4-20 mA - Custom Expansion Card - Heat Plate/Front Panel

Model 922-MES Diagnostics

The Model 924-HDE is a high speed fiber-optic multiplexer supporting multiple uncompressed HD video channels, multiple serial data channels and a single Gigabit Ethernet port.

Incorporating Moog Focal's expertise in efficient FPGA-based Time Division Multiplexing (TDM) and high speed optical links, the 924-HDE provides the most compact, rugged, low power solution for many digital video intensive applications.

With its high level of signal integration, a single 924-HDE can replace as many as three HD video converters, four serial data converters and one Gigabit Ethernet converter. The 924-HDE compares even more favorably where a single fiber solution is needed, for example when used with a fiber optic rotary joint (FORJ).

By using high speed optics and a high speed FPGA, the 924-HDE avoids video compression. The resulting latency of the video is less than 30 micro-seconds, comparable to media converters. Jitter, another key parameter of video transmission, is also extremely low. The 924-HDE suits many industrial, security, and defense applications requiring high quality video. Variations are available, such as form factor, connector type and placement, signal quantities and diagnostic formats.

Features
• Three 3G/HD/SD-SDI video channels, auto detect video mode
• Four RS-422 serial data channels
• One Gigabit Ethernet port
• Rugged design for harsh environments
• On-board diagnostics, option
• Optional Built-in Self-Test (BIST)
• Field updateable firmware

Benefits
• Reduces size, weight, power consumption and cost (SWaP-C)
• Replaces eight media converters
• Simplifies troubleshooting with advanced diagnostics
• Supports a wide range of optics, including CWDM wavelengths
• Un-compressed, real time video

Typical Applications
• Ground combat vehicles
• Security systems
• Airborne, land based and naval EO pods
• Marine survey ROVs with multiple HD cameras

Courtesy of PVP

Model	924-HDE LS	924-HDE MS	924-HDE HS
Description	HD Video and Serial Data Multiplexer	HD Video, Ethernet and Serial Data Multiplexer	HD Video, Ethernet and Serial Data Multiplexer
Supported Video Formats	2-Channels HD/SD-SDI	3-Channels HD/SD-SDI	3-Channels 3 G/HD/SD-SDI
Supported Data Formats	4-Channels RS-422		
Ethernet Channels	None	1-Channel 10/100/1000 BASE-T(X)	
Diagnostics	Full End-to-End Diagnostics via RS-422. Occupies 1 of 4 serial ports		
Input Voltage	12 V		
In the Field Updates	Yes		
In the Field Upgrades	Yes		
Optical Option	Single Mode Bidirectional Single Fiber (Standard) Multimode (Optional) CWDM (Optional)		
Enclosure	Optional Housing and Heat Plates		

For many applications, the cost of downtime is significant. Access to installations can be difficult, due to environmental conditions and remote geographical locations, and service costs may be compounded by unplanned project delays or system shutdowns.

A suite of unified condition monitoring products has been developed by Moog Focal to help users remotely monitor the condition of their installed equipment, identify trends and predict maintenance intervals. Products are available for optical condition monitoring of the fiber optic cable, electro-optical slip rings and video/data telemetry systems.

The Model 928-OMS is part of Moog Focal's condition monitoring product line and provides continuous scanning and performance analysis of both live and spare optical fibers in critical telemetry and control systems, reducing downtime and saving operating costs. Features include real-time performance monitoring on fibers with active telemetry, monitoring of multiple fibers automatically and continuously, data logging and remote network access, and an intuitive graphical user interface (GUI) that also integrates diagnostics from other Focal products. The OMS is provided in a compact, 1U rack enclosure with and HDMI output for the GUI as well as status LEDs on the front panel.

Unlike standard Optical Time Domain Reflectometers (OTDR), the OMS operates simultaneously and continuously over the same fibers as the communication links without the need to shut down vital control systems for trouble-shooting or performance verifications. Furthermore, each element of the optical system is independently monitored for changes in performance and statistical trends. This provides timely warnings of emerging problems with a location accuracy of a few meters, thereby enabling earlier interventions and less downtime.

The OMS also acts as a diagnostic hub or gateway, integrating diagnostics from other Focal products, such as multiplexers and slip ring data loggers, as well as third party devices with serial or Ethernet based diagnostics. Using the secure Ethernet connections on the OMS, these integrated and synchronized diagnostics may be accessed remotely via the Internet. With an added IoT (Internet of Things) gateway, the health monitoring can be moved to a secure Moog Cloud service for data storage, data analytics, global trending and fleet level diagnostics updates.

Real-time diagnostic information is available from Moog Focal's multiplexers, media converters and expansion cards, including the Model 903, Model 907 and Model 914 families. Diagnostic readings are continuously updated from both console and remote cards and accessed via an Ethernet link at the console. Diagnostic information includes data signal input and output activity, optical transmit and receive power levels, temperature and optical link status.


Moog Focal 907 Diagnostics Multiplexer

Moog Focal OMS Diagnostics

The Model 923 slip ring sensor (SRS) is a miniature, ruggedized, health monitoring and data logging system for Moog Focal rotary products. When installed as an option in Moog Focal's slip rings, such as the Model 176 or larger units, the SRS provides real-time access to diagnostic information as well as data storage for offloading at a later time. A built-in turns counter helps monitor product life and facilitates predictive maintenance while rugged sensors capture environmental status of temperature, shock and vibration. A version is also available for use in the Model 400 series swivels.
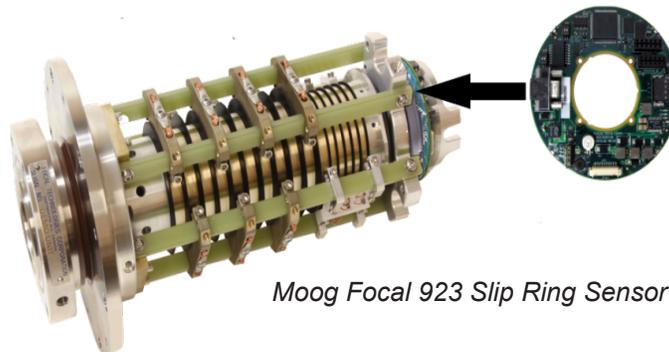
Moog Focal 923 Slip Ring Sensor

Moog Focal remains focused on providing high-quality and reliable power and data communication solutions for ROVs. We're excited about how our condition monitoring technology can help our customers avoid downtime and support world-class operations in extreme environments around the globe.

Custom multiplexer and media converter products fit the exact requirements of OEM systems and special applications. Based on proven designs from our full range of ruggedized products, these OEM solutions are optimized for cost and performance in harsh environments.

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 legacy hardware or software, and provide extensive built-in-test (BIT) and health monitoring features. They can be implemented as single board solutions or modular platforms.
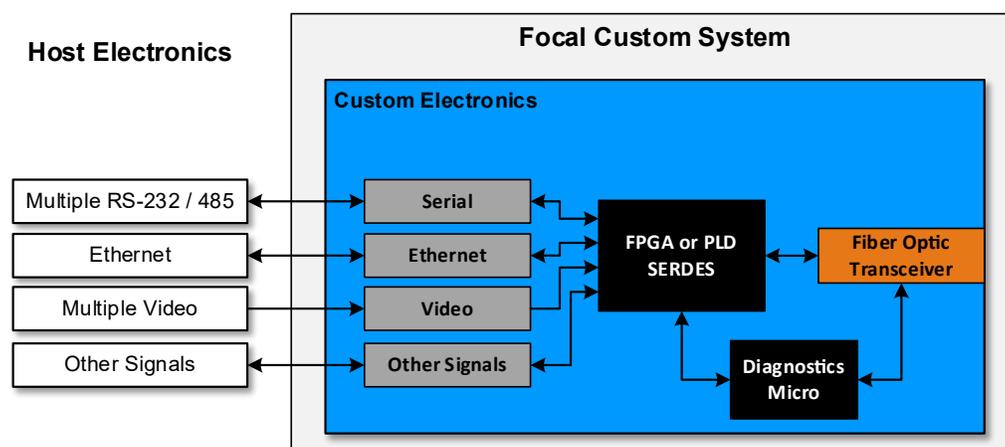

Diagram Showing a Moog Focal Custom System

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 Moog Focal's Fiber Optic Rotary Joints (FORJs) for Gigabit data transmission through rotating interfaces
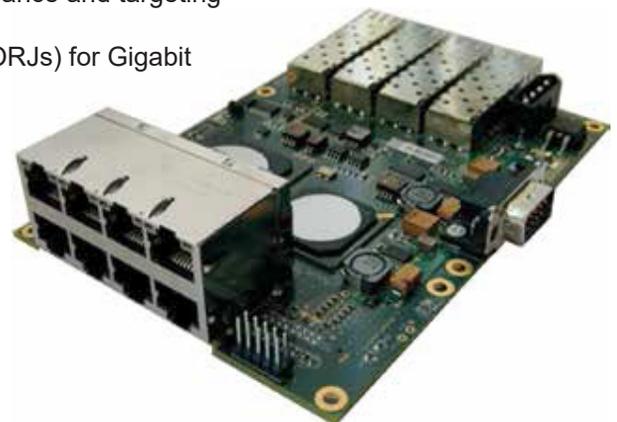
Technical Innovation

Moog Focal is a leading supplier of COTS and custom fiber-optic telemetry systems with over 3000 fielded systems around the world. We pioneered features like embedded diagnostics and automatic fiber switching for redundancy, and our "busless" backplane architecture provides the lowest possible video and data latency, measured in micro-seconds, by avoiding the added delay of buffers and bus addressing. Furthermore, with modular designs at the card and daughter-card level, systems are easily expanded and reconfigured. Moog Focal offers key support for mission critical applications:
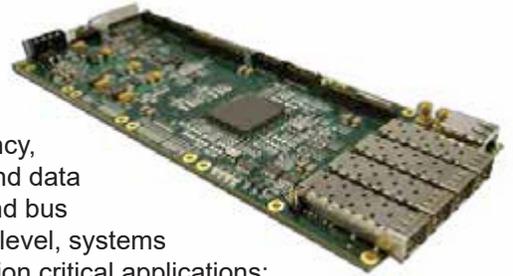
• High reliability performance in harsh environments through comprehensive analysis, design verification, qualification to industry and military standards and environmental stress screening
• Compact and highly integrated solutions for restricted spaces, such as subsea enclosures
• Design flexibility through the extensive use of Field Programmable Gate Arrays (FPGAs) and supervisory microcontrollers, which allows remote upgrades of firmware for future-proofing designs
• Advanced CAD systems and an extensive library of proven designs for rapid development of new products or repackaging of existing solutions.
• A full range of multiplexer products, from single channel media converters for Ethernet or 3G/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 interface, such as VME or Gigabit Ethernet, for integration with data acquisition and control systems. Previous custom designs include a number of subsea telemetry systems with MTBFs over 400,000 hours, test lab data acquisition systems with 256 sensors and Gigabit Ethernet based logging, and long-haul telemetry systems that operate over 200 km fiber links. The high data capacity of optical fiber inherently allows the expansion of a system to add more channels or higher data rates as requirements evolve. Key features include the following:

• Ruggedized design for harsh environments (e.g. wide temperature range, high shock/vibration)
• Very low latency, modular design and compact size
• Support for video (analog and digital), serial data, Ethernet, audio, field bus protocols 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, including remote access

Some of our custom multiplexers and media converter solutions are based on existing product platforms, such as the 907-FLEX and Model 912 OEO converters. The Model 907-FLEX supports multiple conversion options for Ethernet, analogue video, and digital video formats based on pluggable modules. Conversions can be electrical to optical or optical to optical, e.g. from multimode to singlemode, with the option to combine optical signals on a common fiber using a built-in CWDM. The Model 912 provides similar functionality, typically in a Eurocard form factor, for rack installations in laboratory environments as well as junction boxes and equipment cabinets used for process controls, e.g. for FPSO applications.

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, accelerated life testing, predictive models, such as MIL-HDBK-217F and Telcordia SR-332, 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 both error rates and 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.

Several processes are used to further support high reliability designs. Besides the acceptance testing at rated temperatures used for all hi-rel electronic products, additional environmental stress screening and qualification testing further validate product reliability and life. Additional environmental testing includes shock, sinusoidal vibration, random vibration, humidity, acceleration, low pressure (altitude) and high pressure (in oil), as required by the application or customer specifications. Our engineering department will work closely with you to develop test plans for design, production and qualification that suit your needs.

Multiplexer and media converter products include advanced diagnostics and health monitoring features to ensure systems are operating properly and to provide early warnings of any negative trends, for example degradation of cabling. Typical diagnostics functions include the following:

• Monitoring of critical performance parameters, such as optical power, rail voltages, temperature, data errors and fault conditions
• Access to diagnostics through serial channels or Ethernet protocols, e.g. Modbus, or via Moog Graphical User Interface (GUI) software with user configurable warnings and alarms
• Built-in test features, such as bit error rate tests and video test patterns, simplify system level troubleshooting to quickly identify and locate any connection problems without additional test equipment

Moog Focal offers rapid solutions for multiplexing and data conversion applications in the harshest environments, designed and tested to your specifications. Acting as an extension of your own engineering group, the Moog team provides a wide variety of support activities, including project management, documentation control, obsolescence management, configuration management, design analyses (e.g. FMEA, reliability, thermal performance) and regulatory compliance activities.

Please contact Moog Focal to discuss how we can help you reduce costs and time to market on rugged products for new applications.

Moog Focal has over 30 years expertise in the supply of standard and custom products for harsh environments and is a leading manufacturer of high performing and high quality electrical slip rings, fiber optic rotary joints, hydraulic utility swivels, fiber optic multiplexers and condition monitoring solutions. Contact Moog Focal for assistance in selecting the best solution for your requirement.

Subsea Oilfield Communications
Field-Proven and Qualified Electronics Solutions
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Marine Renewable Systems
Marine Swivels, Communication Equipment and Sensors
FOCAL™

Floating Production Systems
Swivels and Related Marine Equipment
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Marine & Energy
Product Guide

A complete product line of rotary and electro-optic solutions for the most demanding applications.

• Remotely Operated Vehicles (ROVs)
• Seismic Surveying
• Oceanographic Winches
• Subsea Communications
• Floating Production, Storage and Offshore Loading (FPSO)

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Oilfield and Downhole
Market Guide

A complete product line of rotary and electro-optic solutions for the oil and gas downhole market:

• Electrical Slip Rings
• Fiber Optic Rotary Joints
• Fluid Rotary Unions
• Complete Rotary Interface
• Multiplexers, Media Converters and Switches

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Fluid Rotary Unions
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