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Model 914-X Series
Modular Multiplexer System
User Manual

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Reference Documents

Document Number	Document Title and Description
914-0401-00	Model 914 Diagnostic GUI
914-0415-00	Model 914 HDV2 Diagnostic GUI
914-0401-01	Model 914 Programmer
914-2016-00	Model 914-HDE Configuration Drawing
914-2018-00	Model 914-HDV2 Configuration Drawing
914-2020-00	Model 914-VDX Configuration Drawing
914-2022-00	Model 914-EX Configuration Drawing
914-2023-00	Model 914-AX Configuration Drawing
700-0271-00	AIB Plug-in Module User Guide

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ACRONYMS AND ABBREVIATIONS

The list below contains the acronyms and abbreviations used in this user's guide.

ACRONYM / ABBREVIATION	DESCRIPTION
AIB	**A**daptable **I**nterface **B**oard
AX	**A**IB E**X**pansion Adaptor Card
3G	3 Gbps HD Video
BER	Bit Error Rate
CWDM	Coarse Wavelength Division Multiplexer / Multiplexing
DX	Serial **D**ata E**X**pansion
EIA	Electronic Industries Association
ESD	Electrostatic Discharge
EX	**E**thernet E**X**pansion
FORJ	Fiber Optic Rotary Joint
FPGA	Field Programmable Gate Array
GBE	Gigabit Ethernet
Gbps	Gigabits Per Second
HD	High Definition
HS	High Speed
HDE	**H**D-Video, Serial **D**ata, **E**thernet
HDV2	Dual (**2**) **HD V**ideo
I/O	Input/output
kbps	Kilobits Per Second
LC/PC	Lucent Connector / Physical Contact
LED	Light Emitting Diode
LS	Low Speed
Mbps	Megabits Per Second
MDI/MDIX	Automatic medium-dependent interface crossover
MS	Medium Speed
P/N	Part Number
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PPS	Pulse Per Second
SD	Standard Definition
SDI	Serial Digital Interface
SFP	Small Form-factor Pluggable (Optical Transceiver)
SMT	Surface Mount Technology
TDM	Time Division Multiplexer / Multiplexing
TTL	Transistor-Transistor Logic
VDX	Composite **V**ideo, Serial **D**ata, E**X**pansion
VOAT	Variable Optical Attenuator
WDM	Wavelength Division Multiplexer / Multiplexing

1.0 Introduction

The Focal Model 914-X Series Modular Multiplexer System is a compact and rugged video, data and Ethernet multiplexer and fiber optic transmission system designed for industrial environments and other applications requiring the transmission of HD video, serial data and Ethernet over an optical link. The 914-X Series has been optimized for low power operation and delivery of low latency, uncompressed video and Ethernet data.

A series of expansion cards are available, allowing additional composite video channels, serial data channels, Ethernet ports, as well as many specialty signals such as TTL, hydrophone, CAN bus and custom sonars to be added to any 914-X Series system without requiring extra fibers or wavelengths.

The rich feature set and vast signal options are packaged in an incredibly small form factor. The credit card size, along with the geometry and location of the connectors allow the 914-X Series multiplexers to be installed in very small enclosures. Multiple card systems can be configured either as stacks, or via flexible high speed ribbon cable providing even further installation flexibility.

This manual provides 914-X Series system users with detailed information relevant to the design, configuration, installation, and operation of the 914-X Series system. This manual and the appropriate reference documents should be reviewed prior to installation or configuration of the multiplexer system.

The figures below show different configurations and stacking options of the 914-X series. On the left, the 914-HDE motherboard is shown stand-alone. On the right, the 914-HDE and expansion cards (914-EX, VDX and AX-232) are shown stacked together and held into place via standoffs. At the bottom, a similar stack is shown but with a high-speed ribbon cable to accommodate applications such as bottles or low profile enclosures.

Figure 1-1: 914-X Series HDE Motherboard

Figure 1-2: 914-X Series System with Stacked Expansion Cards

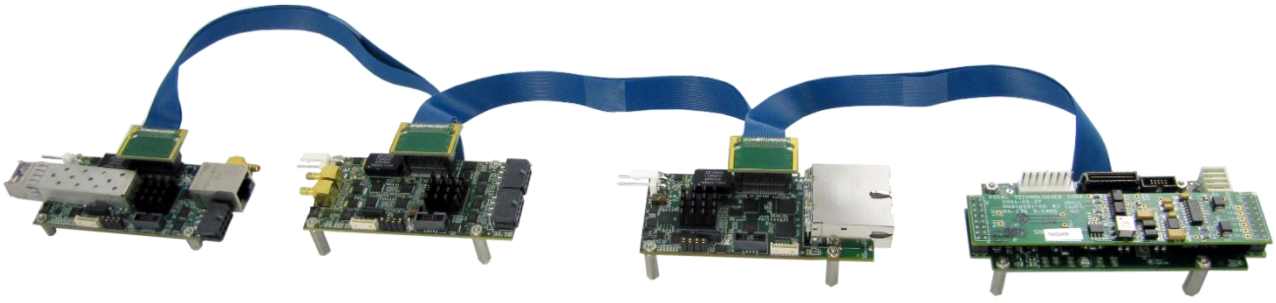

Figure 1-3: 914-X Series System with Tethered Expansion Cards

1.1 Model 914-X Series Benefits

- Modular Design, configured to custom requirements
- Very high bandwidth optical options replace many lower speed options.
- High budget optics allow for extended link distances
- Extremely small size will fit in cost effective enclosure systems
- Upgrade and add features or cards when required.
- Low cost of spare parts
- Full diagnostics provided with an advanced GUI included with every system
- Software configuration of features and settings
- Software configurable multi-protocol serial ports.
- Non-switched Ethernet ports guaranteeing throughput without collisions in real time
- Full bandwidth real time video, no compression, no compromises
- Latency for all signals is measured in micro-seconds
- Simple integration of complex systems with user friendly instructions, Moog Focal direct support when required
- Custom OEM options available

1.2 System Accessories and Options

Included:

- Mounting Hardware
- Pigtailed diagnostic (RS232) plug and wires
- Pigtailed power plug and cable for the 914-HDE Motherboard.
- Modules individually packaged with configuration drawings
- 914-0401-00 Diagnostic GUI – downloadable from www.moog.com/focal/914-x-series
- Default configuration settings
- Moog Focal direct support

Optional:

- Fiber jumpers and attenuators
- Mating connectors and plugs
- Thermal gap pad material
- Extended factory testing
- Factory custom configuration
- Factory multi-card system integration, build and testing
- Enclosure options:
    - Pressure bottles
    - 19” racks with diagnostic LEDs
    - Custom enclosures for OEM

1.3 Safety Precautions

The following safety precautions should be observed before using this product.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possible injury. Do not make module connections unless qualified to do so.

Before connecting this product to the power source, verify that the output voltage is within the specifications of the product's power supply.

Do not attempt to modify or repair any circuit unless recommended by the manufacturer.

Protect the power cable from being walked on or pinched by items placed or against them.

Always unplug the power cable at the plug, do not pull on the cord itself.

Do not block any ventilation openings.

Do not look into the end of a fiber when it is plugged into a transceiver or active fiber, especially when using a magnifying instrument, such as a fiber microscope.

Handle optical fiber with extreme care. Glass fiber is subject to breakage if mishandled.

2.0 Setup Check List

The purpose of this section is to provide a check list that can be followed to setup 914-X Series systems both physically and through electronic configuration. Details regarding each step can be found in this manual via the referenced section links.

1. Expansion cards:
   a. Set dip switch to appropriate setting, refer to **Section 6.1.6**.
      i. The (bottom) card closest to the 914-HDE should be set to OFF, OFF (Expansion 1).
2. Mounting cards:
   a. 5/32" (4 mm) minimum clearance under the 914-HDE. (included standoff P/N EL-M0260)
   b. 21/32" (16.67 mm) nominal standoffs of 2-56 type between cards. (included standoff P/N EL-M0247)
   c. All 914-X Series cards provide electrically isolated conductive cooling via the mounting holes.
   d. Thermal gap material (optional P/N 914-0118-00) to provide conductive cooling to an enclosure should be placed under the 914-HDE.
   e. Stacking order is 914-HDE on bottom, then medium speed (MS) expansion cards directly above, ending with low speed (LS) expansion cards on top. Media Converters and optical cards do not require electrical connection via the expansion connector, they can be the furthest away from the 914-HDE.
   f. Refer to **Section 10.1**.
3. Connect console to remote via LC to LC fiber jumper. For short links, attenuation is required. 10 dB is the suggested minimum attenuation in the fiber link. For flux budget calculations refer to **Section 4.8.1.**
4. Connect the diagnostic port of the *console* 914-HDE to a computer using either the local COM port or a serial-to-USB converter. Install and run the 914 Diagnostic GUI. Refer to **Section 5.0**.
5. Connect the 914-HDE to a DC power supply with 5 V to 12 V power. Refer to **Section 4.2**. All power LEDs on each card should be lit green. Verify all system voltages in the 914 Diagnostic GUI. Refer to **Section 5.0**.
6. Configure all cards (except 914-AX) via Diagnostic GUI:
   a. Configure console HDE
      i. Serial protocol. Refer to **Section 5.1.2**.
      ii. Ethernet auto-negotiate settings. Refer to **Section 0.**
   b. Configure console VDX
      i. Set as console. Refer to **Section 6.1.7**.
      ii. Set video direction to input. Refer to **Section 6.1.7**.
      iii. Set serial protocol. Refer to **Section 6.1.8**.
   c. Configure console EX
      i. Set as console. Refer to **Section 6.1.7**.
      ii. Set Ethernet speed and negotiation. Refer to **Section 6.1.7**.
   d. Configure remote HDE
      i. Serial protocol. Refer to **Section 5.1.2**.
      ii. Ethernet auto-negotiate settings. Refer to **Section 0.**
   e. Configure remote VDX
      i. Set as remote. Refer to **Section 6.1.7**.
      ii. Set video direction to output. Refer to **Section 6.1.7**.
      iii. Set serial protocol. Refer to **Section 6.1.8**.
   f. Configure remote EX
      i. Set as remote. Refer to **Section 6.1.7**.
      ii. Set Ethernet speed and negotiation. Refer to **Section 6.1.7**.
   g. Turn the power off, wait 10 seconds and power up again. Confirm the settings are correct using the 914 Diagnostic GUI.
7. Connect video, Ethernet and serial as required. Verify status and activity in the 914 Diagnostic GUI.
   a. HD Video – Refer to **Section 4.3**.
   b. Ethernet – Refer to **Section 4.5**.
   c. Serial– Refer to **Section 4.4**.
   d. Composite video – Refer to **Section 6.1.2**.
8. Perform bench level testing to verify links. Refer to troubleshooting **Section 14.0**.
9. Install cards in system, ensure good thermal contact via mounting hardware, thermal gap pads, and heat spreaders. Refer to **Section 10.0**.
10. Verify and monitor the FPGA and SFP temperatures and voltages during operation using the 914 Diagnostic GUI. All values should remain in green.

3.0 System Overview

3.1 914-X Series System Card Options

Users can combine the modular 914-X Series cards into complex fiber optic telemetry systems.

914-X Series cards are sorted into 4 basic categories:

1. **Motherboards**: Have optical transceivers and multiplex various different data types into a single data stream over fiber. This is the foundation to any multiplexing system, they provide expansion channels for expansion card integration.
    a. **Card(s)**: 914-HDE.
2. **Expansion Cards**: Add more signal interfaces to the motherboard. They draw power from the motherboard and do not require their own optical transceiver. They do not operate on their own. They require one or more low speed (LS) or medium speed (MS) expansion channels on a motherboard to operate.
    a. **Card(s)**: 914-VDX, 914-EX, 914-DX and 914-AX.
3. **Media Converters**: Convert a single data type to fiber, usually in a 1:1 signal to optical wavelength conversion. Can operate stand-alone, or can be optically combined with other multiplexers or media converters.
    a. **Card(s)**: 914-HDV2.
4. **Optical Cards**: Combine multiple optical wavelengths onto a single fiber, or create optical redundancies for increased system reliability.
    a. **Cards**: 914-CWDM, 914-CWDM-4, 914-CWDM-8, 914-SWITCH, 914-FOS

Table 3-1: 914-X Series System Modular Card List

Card ID	Ethernet	Video	Serial Data	Other	Optics	Expansion channels
Motherboards						
914-HDE L1	1x 10/100 Mb/s	1x HD/SD-SDI	2x RS232/485/422		Requires 2 wavelengths: Uplink and Downlink	4x LS
914-HDE M1	1x 10/100/1000 Mb/s	1x 3G/HD/SD-SDI	2x RS232/485/422		Requires 2 wavelengths: Uplink and Downlink	4x LS 4x MS
914-HDE H1	1x 10/100/1000 Mb/s	1x 3G/HD/SD-SDI	2x RS232/485/422		Requires 2 wavelengths: Uplink and Downlink	4x LS 4x MS
Expansion Cards						
914-VDX		2x NTSC/PAL	4x RS232/485/422		Via 914-HDE	1x MS
914-EX	2x 10/100/1000 Mb/s				Via 914-HDE	1x MS (2x MS Optional)
914-AX w/914-AIB			1x Isolated RS232 or RS485 or RS422	TTL MS900 ARCnet Hydrophone CAN bus	Via 914-HDE w/914-AIB installed on 914-AX	1x LS
914-DX			6x RS232/485/422		Via 914-HDE	1x LS

Card ID	Ethernet	Video	Serial Data	Other	Optics	Expansion channels
Media Converters						
914-HDV2		2x 3G/HD/SD-SDI			Requires 1 wavelength per video channel	None
Optical Cards						
914 CWDM					2 wavelengths + 1310/1550 bypass to single fiber	N/A
914 4Ch CWDM					4 wavelengths to single fiber	N/A
914 8Ch CWDM					8 wavelengths to single fiber	N/A
914-SWITCH					Splits the optical feed to two fibers for redundancy	N/A
914-FOS					Selects between two redundant optical fibers.	N/A

3.2 Defining a 914-X Series System

914-X Series systems are used as pairs (one remote and one console) to provide a transparent video, data and Ethernet link over optical fiber(s). The installed optical transceivers determine the maximum optical link speed, fiber type, number of fibers (1 or 2), and link distance. The card version sets the operational bandwidth, which is independent from the optical data rate. The optical link uses a proprietary data protocol ensuring reliable transmission with extremely low latency using highly efficient and dynamic bandwidth utilization.

Typically, the uplink (remote to console) and downlink (console to remote) are combined on a single fiber – multimode or singlemode (standard) – with a passive optical coupler known as a Wavelength Division Multiplexer (WDM). The WDM is integrated in the optical transceiver. Standard, single fiber systems operate with 1310 nm uplink and 1550 nm downlink wavelengths. In larger systems, multiple 914-X Series stacks may be combined on a single fiber using a Coarse Wavelength Division Multiplexer (CWDM) to take advantage of the high bandwidth of optical fiber.

Figure 3-1 illustrates an example of a simple 914-X Series system configuration using a standard, standalone 914-HDE motherboard, which supports the multiplexing of one (1) 3G/HD/SD-SDI channels, two (2) bidirectional RS-232 / RS-485 / RS-422 serial data channels and one (1) Gigabit Ethernet channel over a single optical fiber. This is the base card of any 914-X Series system.

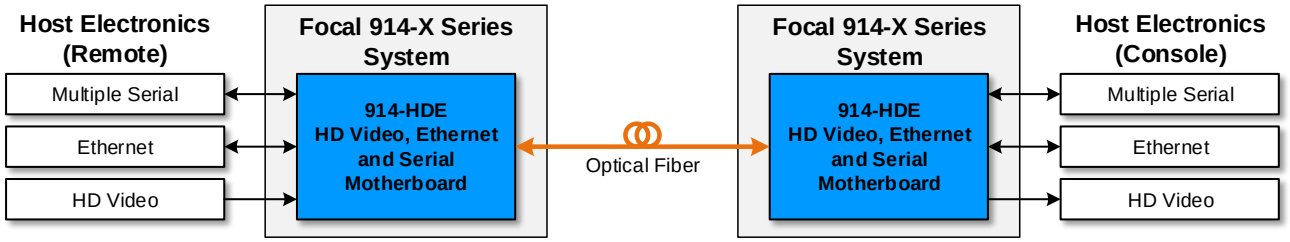

Figure 3-1: 914-HDE Motherboard

Note that the HD video source (e.g. from an HD camera) is connected at the remote end. The HD video output is provided at the console end (e.g. to an HD monitor).

The external fiber optic system includes optical components such as optical connectors and a Fiber Optic Rotary Joint (FORJ).

An expansion connector on the 914-HDE supports 8 expansion card ports: 4 low speed (LS) and 4 medium speed (MS) ports. Expansion cards allow a full system to be built using the 914-HDE Motherboard as the base optical card. Optional expansion cards are detailed in Section 6.0.

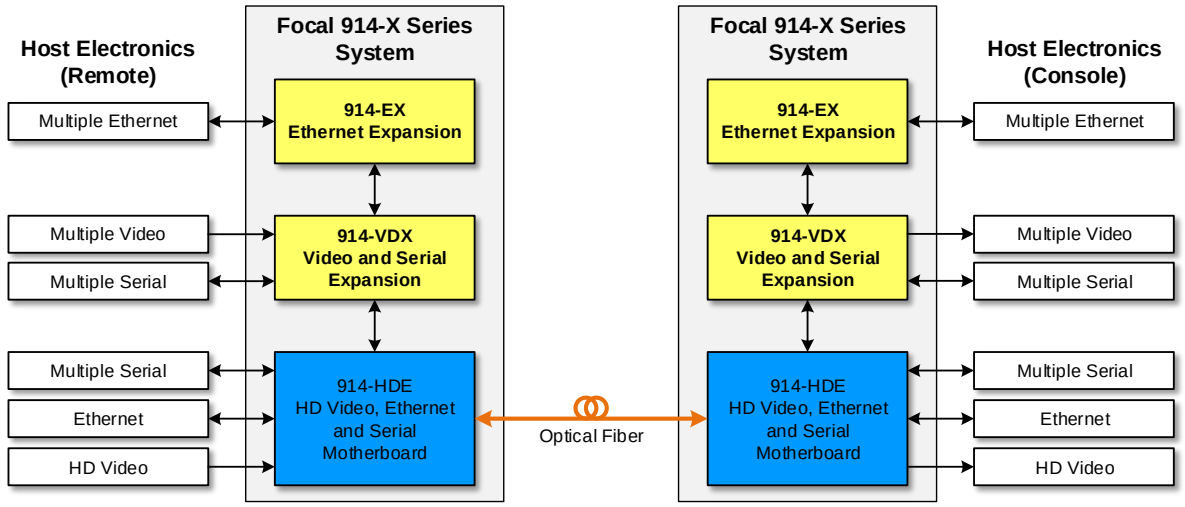

Figure 3-2: 914-X Series System with Expansion Cards

Figure 3-2 shows a 914-X Series system with both 914-VDX and 914-EX expansion cards added. These cards stack on top of the 914-HDE motherboard providing more video, Ethernet and serial data channels. No extra optical components are required for these additional expansion cards.

For larger systems requiring more optical bandwidth than a single 914-X Series stack can provide, Moog Focal has a series of CWDM products that allow many optical data streams to be combined onto a single fiber. These cards can handle the addition of 2, 4, 6, 8 or more systems onto a single fiber.

Figure 3-3 shows a simple 4 channel CWDM that would combine 4 optical wavelengths onto a single fiber.

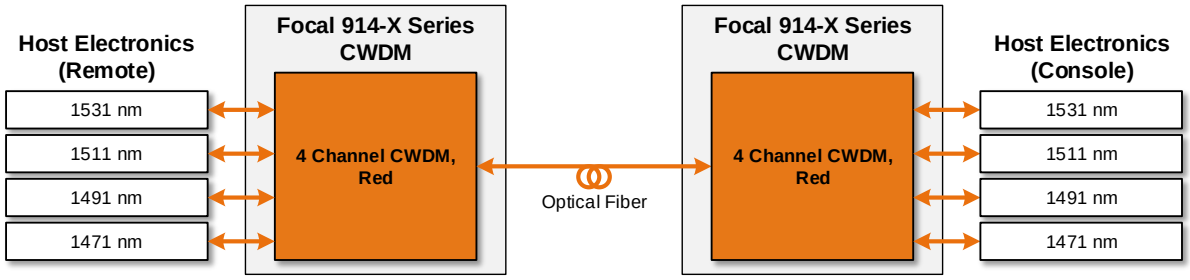

Figure 3-3: 914 4-CH CWDM Card

Figure 3-4 shows how a 914-X Series system can be combined with the 914-HDV2 media converter using a 4 channel CWDM.

This example system has 3 HD video channels, 2 NTSC/PAL channels, 3 Gigabit Ethernet channels and 6 serial data channels all combined in real time onto a single bi-directional fiber link.

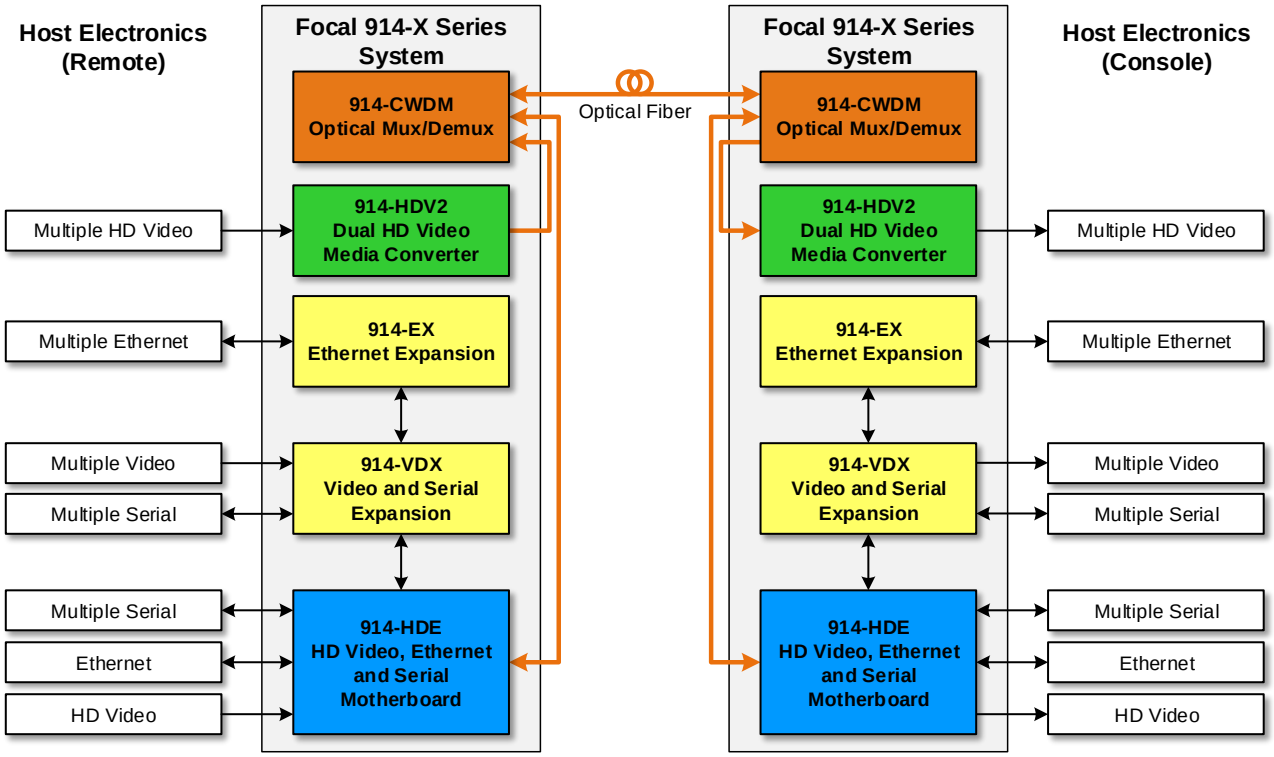

Figure 3-4: 914-X Series System with 914-HDV2 and CWDM

3.3 System Specification

When specifying a 914-X Series system, it is important to ensure there is enough available optical bandwidth to support the signals and data throughput required. Moog Focal has released three versions of the 914-HDE motherboard with pricing linked to bandwidth. This allows customers who do not require expansion cards, 3G-SDI, or gigabit Ethernet to specify a more cost effective solution. Moog Focal can work with customers to configure a complete optical multiplexer solution, and the following section shows signal bandwidths and sample system configurations. This allows customers to weigh the tradeoffs between system bandwidth, cost, size and power, while also showing the upgrade potential of any 914-X Series system.

Table 3-2: Signal Types and Required Bandwidths

Signal type or expansion card	Required Bandwidth
914-HDE base bandwidth for serial channels, diagnostics, and all low speed (LS) expansion channels	150 Mb/s (Always Enabled)
914-VDX base bandwidth (serial channels)	50 Mb/s total per card (Always Enabled)
10 Mb/s Ethernet	Up to 10 Mb/s
100 Mb/s Ethernet	Up to 100 Mb/s
1000 Mb/s Ethernet	Up to 1000 Mb/s
SD-SDI	300 Mb/s
HD-SDI	1550 Mb/s
3G-SDI	3050 Mb/s
Analog video (NTSC or PAL)	250 Mb/s per video channel
914-DX	0 Mb/s Included with 914-HDE base bandwidth
914-AX	0 Mb/s Included with 914-HDE base bandwidth

Table 3-3: Available Bandwidth by Motherboard Card Version

914-HDE Version	Available Bandwidth	Expansion Channels Supported
L1	1800 Mb/s	4 low speed channels
M1	3500 Mb/s	4 low speed channels 4 medium speed channels
H1	5600 Mb/s	4 low speed channels 4 medium speed channels

Using the above two tables as a reference, it becomes possible to specify a full system and ensure a lossless, low latency optical link.

3.4 How to choose the optimal 914-X Series System Architecture

1. Calculate the bandwidth of the required signals based on Table 3-2.
2. Choose the 914-HDE motherboard version based on required bandwidth. Multiple 914-X Series systems may be required for very high bandwidth applications. Refer to Table 3-3.
3. Consider using 914-HDV2 for systems requiring more than one HD video channel.
4. Choose 914 expansion card(s) with the required number and type of interfaces required.
5. Ensure the base bandwidths for the 914-HDE and any 914-VDX cards are included with the bandwidth calculations.
6. Verify expansion channels available vs required, refer to Table 3-1.
7. Balance expansion cards between motherboards in very large systems.

3.4.1 Example 914-X Series L1 System

Table 3-4: Example 914-X Series L1 System Requirements

Quantity	Required Signal	Bandwidth
1	HD-SDI video	1550 Mb/s
8	Serial channels	150 Mb/s (914-HDE base bandwidth)
1	CAN bus	Included
1	Hydrophone	Included
1	Fast Ethernet channel	100 Mb/s
Total		**1800 Mb/s** (= Max L1 bandwidth)

Table 3-5: Example 914-X Series L1 System Solution

Required Card	Quantity	Signals	Expansion Channels
914-HDE (L1)	1	1 x HD-SDI 2 x Serial 1 x Fast Ethernet	4 x Low speed available
914-DX	1	6 x Serial channels (6 per Card)	1 x Low speed
914-AX with AIB-CANBUS	1	1 x CAN bus	1 x Low speed
914-AX with AIB-HYDRO	1	1 x Hydrophone	1 x Low speed

3.4.2 Example 914-X Series M1 System

Table 3-6: Example 914-X Series M1 System Requirements

Quantity	Required Signal	Bandwidth
1	HD-SDI video	1550 Mb/s
18	Serial channels	200 Mb/s (914-HDE + 914-VDX base bandwidth)
1	Gigabit Ethernet channel	1000 Mb/s
2	Fast Ethernet channels	200 Mb/s (100 Mb/s each)
2	NTSC video channels	500 Mb/s (250 Mb/s each)
Total		**3450 Mb/s** (< 3500 Mb/s Max for M1)

Table 3-7: Example 914-X Series M1 System Solution

Required Card	Quantity	Signals	Expansion Channels
914-HDE (M1)	1	1 x HD-SDI 2 x Serial 1 x Gigabit Ethernet	4 x Low speed 4 x Medium speed Available
914-DX	2	12 x Serial channels (6 per card)	2 x Low speed
914-VDX	1	2 x Analog video 4 x Serial	1 x Medium speed
914-EX	1	2 x Fast Ethernet channels	1 x Medium speed

3.4.3 Example 914-X Series H1 System

Table 3-8: Example 914-X Series H1 System Requirements

Quantity	Required Signal	Bandwidth
1	3G-SDI Video	3050 Mb/s
16	Serial Channels	250 Mb/s (914-HDE + 2x 914-VDX base bandwidth)
1	Gigabit Ethernet Channel	1000 Mb/s
2	Fast Ethernet Channels	200 Mb/s (100 Mb/s each)
4	PAL Video Channels	1000 Mb/s (250 Mb/s each)
1	CAN bus	Included
1	Hydrophone	Included
Total		**5500 Mb/s** (< 5600 Mb/s Max for H1)

Table 3-9: Example 914-X Series H1 System Solution

Required Card	Quantity	Signals	Expansion Channels
914-HDE (H1)	1	1 x 3G-SDI 2 x Serial 1 x Gigabit Ethernet	4 x Low speed 4 x Medium speed Available
914-VDX	2	4 x Analog video (2 per card) 8 x Serial (4 per card)	2 x Medium speed
914-EX	1	2 x Fast Ethernet channels	1 x Medium speed
914-DX	1	6 x Serial	1 x Low speed
914-AX with AIB-CAN bus	1	1 x CAN bus	1 x Low speed
914-AX with AIB-HYDRO	1	1 x Hydrophone	1 x Low speed

3.4.4 Choosing an Optical Card

For systems requiring more than a single 914-X Series stack with a single fiber bi-directional transceiver, an optical CWDM card may be used to combine more signals onto the same fiber.
Please refer to section 8.0 for more details.

4.0 914-HDE Motherboard Overview

Figure 4-1 shows the top view of a 914-HDE card with user interface connectors highlighted. The remote and console 914 cards are physically identical; the only difference between them is the EEPROM configuration and optical transceiver. The 914-HDE does not use physical DIP switches for system configuration and settings. All settings are accessed via the Model 914 Diagnostic GUI and are saved in non-volatile memory. Firmware updates may also be available. Please visit http://www.moog.com/products/multiplexers-media-converters/focal-multiplexer-product-line/multiplexer-technical-documents.html to check for updated firmware and/or manuals.

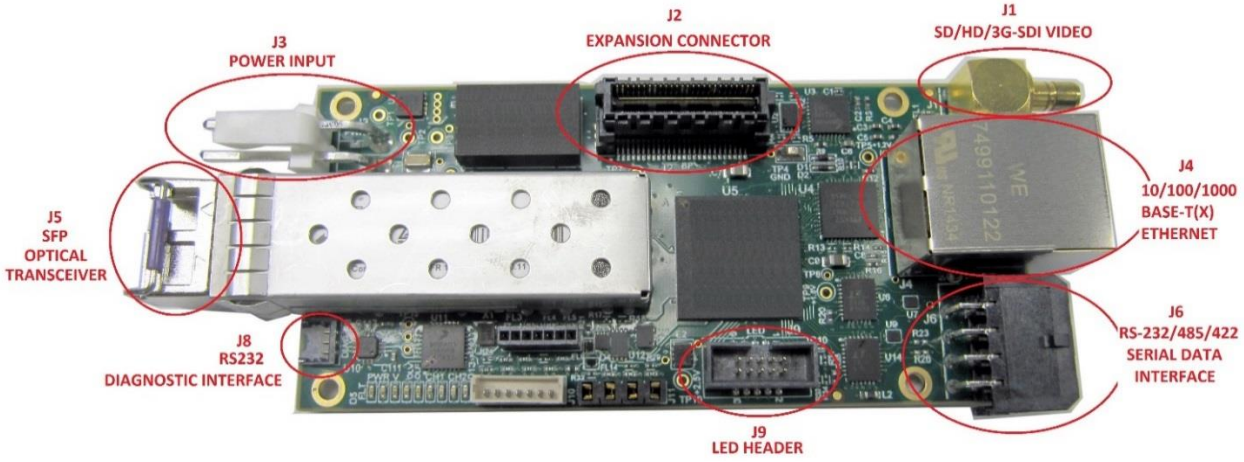

Figure 4-1: 914-HDE Top View

4.1 914-HDE Versions

Depending on system requirements, different 914-HDE versions may be ordered. Each version supports different optical bandwidths and expansion cards. Version upgrades are possible, please contact Moog Focal for availability. For more information regarding the expansion cards, system bandwidth capabilities, and system configurations, please consult sections 6.0 and 3.3.

Table 4-1: 914-HDE Versions

Version	Available Bandwidth	Serial Channels	Ethernet	Video	Supported Expansion Channels
L1	1.8 Gb/s	2x RS-232/485/422	1x 10/100/1000 Mb/s *	1x HD/SD-SDI	4x LS
M1	3.5 Gb/s	2x RS-232/485/422	1x 10/100/1000 Mb/s **	1x 3G/HD/SD-SDI	4x LS 4x MS***
H1	5.6 Gb/s	2x RS-232/485/422	1x 10/100/1000 Mb/s	1x 3G/HD/SD-SDI	4x LS 4x MS***

* 1000 BASE-T is not supported by default. If HD-SDI video is not required, this feature can be traded for 1000 BASE-T in L1 versions via the diagnostic GUI under the Ethernet options tab.
** In M1 version both 3G-SDI and full bandwidth gigabit Ethernet cannot be supported simultaneously. While 3G-SDI video is passing through the system, the maximum available bandwidth for Ethernet is 350Mb/s.
*** MS expansion channels have limited available bandwidth, especially when 3G-SDI is active.

4.2 914-HDE Power

Power to the 914-HDE card is provided through connector J3, Molex P/N 09-75-2024. The mating plug is Molex P/N 26-03-4020 with crimps P/N 08-52-0113. The pinout is provided in the table and figure below.

Table 4-2: Power Connector Pinout

Pin #	Function
1	GND
2	VCC

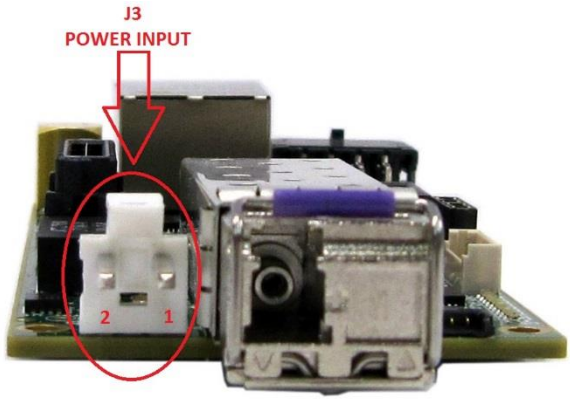

Figure 4-2: Power Input Connector Location

The recommended input voltage range is 4.5 VDC to 13.0 VDC (typically +5 VDC regulated). Nominal power consumption is 5 W, increasing to 5.5 W at 60° C ambient temperature. This power consumption does not include expansion card power requirements. Power leads should be AWG 18 – 20. Refer to section 10.5 for more details on the system electrical and environmental specifications.

The onboard surface mount fuse, F1, is rated to 2A and is not intended to be field replaceable. If the power fuse is blown, the card should be evaluated for damage by the factory or trained service personnel prior to any repair.

4.3 914-HDE HD Video Channel

The 914-HDE card has one video port, supporting 3G/HD/SD-SDI video conforming to SMPTE 259M-C, SMPTE 292M, and SMPTE 424M-A/B. On the remote card the video is an input, and on the console it is an output.

The connector is a Mini SMB jack, Amphenol P/N 142146-75. Recommended mating plug is Cinch P/N 131-8403-101, although other 75 Ω Mini SMB plugs may be suitable. Cabling should be RG-179, 75 Ω coaxial type. Video latency through the mux/demux system is less than 50 μs, not including fiber delays of 5 ns/m.

Figure 4-3: Mini SMB Jack - Amphenol P/N 142146-75

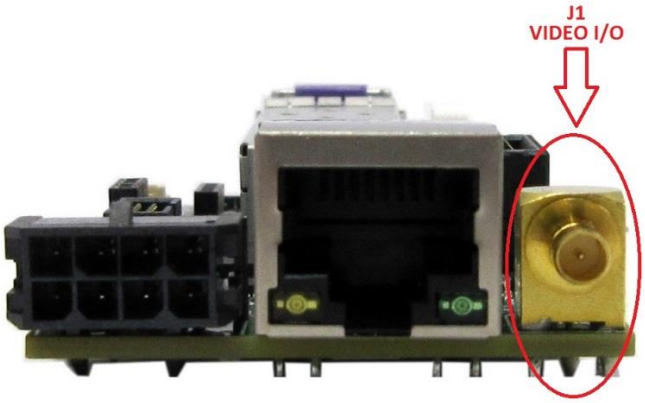

Figure 4-4: Video Channel 1 Connector Location

4.4 914-HDE Serial Data Ports

The 914-HDE has two non-isolated serial ports supporting RS-232, RS-485 or RS-422 signaling protocols. These three protocols may be configured by the user in the field via the 914 Diagnostic GUI. TTL and PPS are factory options. All data rates are supported up to 2.5 Mbaud for RS-485 and RS-422 and up to 500 KBaud for RS-232. Each port can support completely independent serial data links with independent baud rates. By default, RS-485 and RS-422 inputs are terminated differentially with an on-board 120 Ω resistor that can be disabled via software configuration. Latency through the Mux/Demux system is less than 50 μs, not including fiber delays of 5 ns/m.

For RS-485 which is a half-duplex protocol, a programmable turn-around time is implemented. The default turn-around time (timeout between Tx and Rx) is set to 1 ms. Serial port settings, including protocol, timeouts, and terminations may be accessed and changed via the Model 914 Diagnostic GUI.

The serial port connector is Molex Micro-fit P/N 43045-0800. The mating plug is Molex Micro-fit P/N 0430250800 with Molex crimps P/N 0430300010. The pinout is detailed in Table 4-4. Tx refers to transmit data from the 914-HDE to the external equipment. Rx refers to receive data into the 914-HDE from the external equipment. Data coming into the RS-422 RX lines at the remote, for example, will exit from the RS-422 TX lines at the console.

Table 4-3: Serial Data Port Numbering

Port Number	Reference Designator
1	J6 (lower pin row)
2	J6 (upper pin row)

Table 4-4: Serial Data Connector Pinout

REF.	PIN				MODE		
					RS-232	RS-485	RS-422
J6	CH1	1	CH2	5	RS232-RX	DO NOT CONNECT	RX 422+
		2		6	GND	GND	RX 422-
		3		7	DO NOT CONNECT	RS485+	TX 422+
		4		8	RS232-TX	RS485-	TX 422-

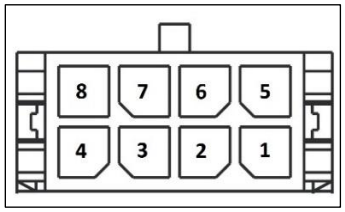

Figure 4-5: Molex Micro-fit P/N 43045-0800

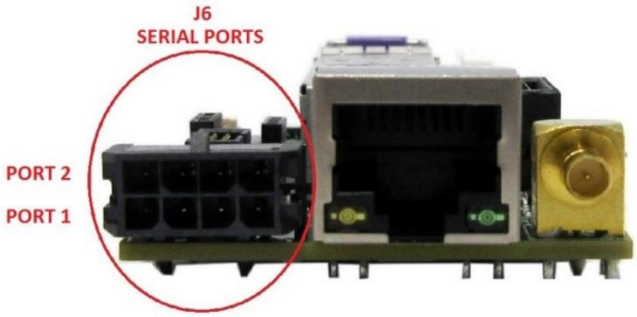

Figure 4-6: Serial Ports 1 and 2

4.5 914-HDE Ethernet Port

The 914-HDE provides an un-switched, low latency 10/100/1000 BASE-T(X) Ethernet link through the optical port. The part is default configured for 10/100 BASE-T(X) in the L1 version, and 10/100/1000 BASE-T(X) for M1 and H1 versions. Auto-negotiate settings can be accessed via the Model 914 Diagnostic GUI. A standard 8P8C (RJ45) modular jack provides the mechanical interface for the Ethernet port. The port is auto MDI/MDIX capable, and supports jumbo frames up to 9000 bytes.

An optional “Link Fault Pass Through” can be enabled. This feature will disconnect the Ethernet link if the far side is not linked. Therefore the system must be linked on both sides for the Ethernet link to be established. Enabling or disabling this feature is done through the diagnostic GUI.

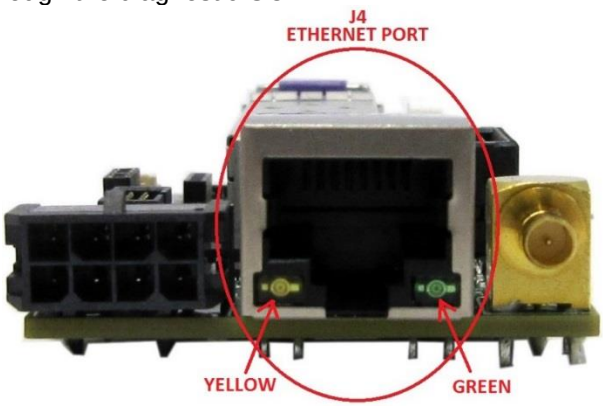

Figure 4-7: Ethernet Port

Integrated LEDs show Ethernet Link Status as shown in Table 4-5.

Table 4-5: Ethernet LEDs

LED Status		Function
Green	Yellow	
OFF	OFF	No Link
ON	OFF	Linked at either 1000 BASE-T or 10 BASE-T
ON	ON	Linked at 100 BASE-TX
FLASHING	OFF	Link Activity at either 1000 BASE-T or 10 BASE-T
FLASHING	ON	Link Activity at 100 BASE-TX

End-to-end latency through the multiplexer is a calculation adding a fixed electronic latency to the Ethernet frame time which is a function of the frame length, and the optical latency which is a function of distance. Adding all three together gives a total latency figure.

Table 4-6: Ethernet Latency

Latency Component / Link Speed	10 Mb/s	100 Mb/s	1000 Mb/s
FEL (Fixed Electronic Latency)	30 µs	6 µs	3 µs
FT (Frame Time)	# Bytes * 0.8 µs	# Bytes * 0.08 µs	# Bytes * 0.008 µs
OL (Optical Latency)	5 µs / km	5 µs / km	5 µs / km

Latency = FEL + FT + OL

4.6 914-HDE Diagnostic LEDs

The 914-HDE card includes 9 on-board diagnostic LEDs. A description and location of each LED is provided in Table 4-7 and Figure 4-8.

Table 4-7: 914-HDE Diagnostic LEDs

Reference Designator	Color	Description
D5	Red	Indicates a power fault when lit. A power fault is encountered when the input voltage falls outside of the supported range of 4.5 to 13.5 V. Recommended input voltage is 5 VDC. When this LED is lit, the card is not powered properly and will not function.
D6	Green	Indicates that the card is powered properly when lit.
D7	Green	Indicates a valid video signal is present when lit
D8	Green	Indicates a valid optical link is being received. (data frames are present)
D9	Red	Indicates that insufficient optical power is present at the receiver.
D10	Green	Flashing LED indicates serial channel 1 is transmitting to external equipment.
D11	Yellow	Flashing LED indicates serial channel 1 is receiving from external equipment.
D12	Green	Flashing LED indicates serial channel 2 is transmitting to external equipment.
D13	Yellow	Flashing LED indicates serial channel 2 is receiving from external equipment.

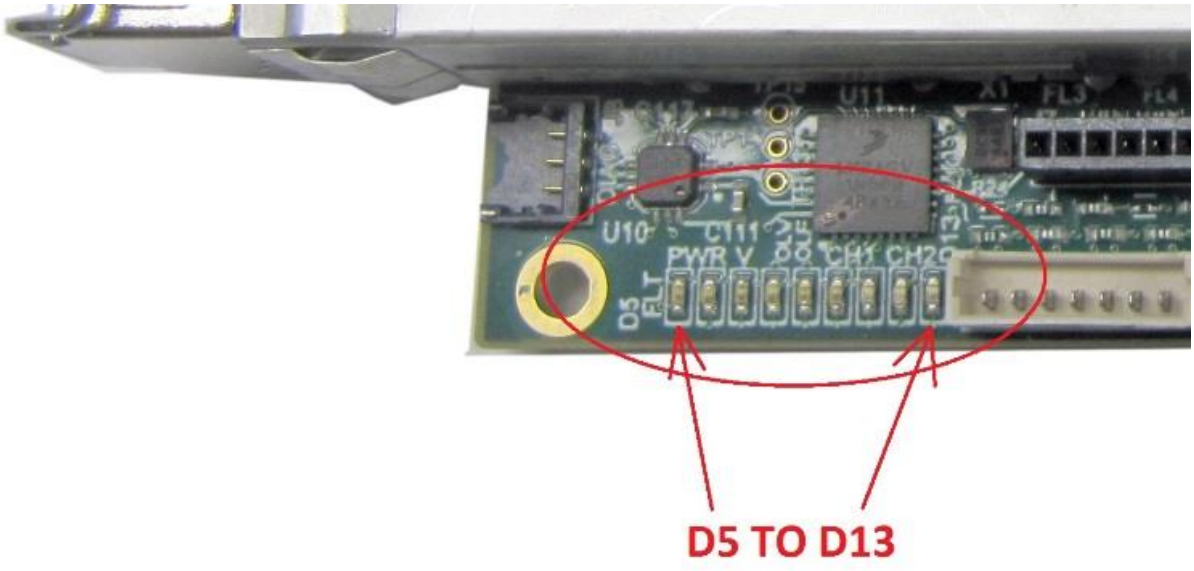

Figure 4-8: Diagnostic LEDs

4.7 914-HDE Diagnostic LED Header

The 914-HDE card includes a 10-pin header capable of driving 8 LEDs. This is useful for LED integration into an enclosure. Each LED pin is driven low to turn on an LED, and includes a 267 ohm resistor in series to limit the current draw. Maximum current draw per LED pin is 8 mA.

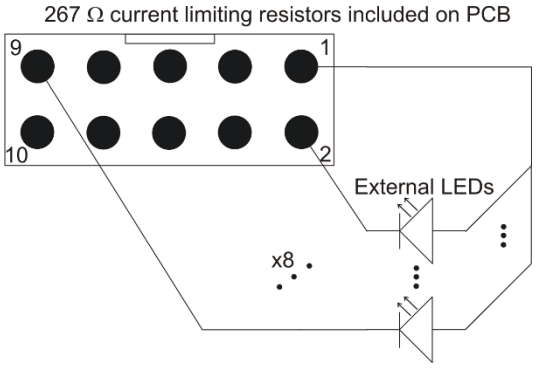

Figure 4-9: External LED Circuit Diagram

This header may optionally become an input via the diagnostic GUI with firmware revisions greater than B1.

The LED header J9 is FCI P/N 20021521-00010T1LF, and the mating part is FCI P/N 20021444-00010T1LF. This can be used with most 0.050" (1.27mm) spacing ribbon cables.

Table 4-8: 914-HDE Diagnostic LED Header Pinout

Pin	Name	Description
1	3.3V	3.3V This pin can be used to drive the LEDs, Maximum current is 0.5A.
2	LINK	Indicates a valid optical link is being received. Active low.
3	LINK FAULT	Indicates that insufficient optical power is present. Active low.
4	VIDEO	Indicates a valid video signal is present when lit. Active low.
5	ETHERNET	Indicates that an Ethernet link is established locally. Active low.
6	SER1 RX	Flashing LED indicates serial channel 1 receive activity. Active low.
7	SER1 TX	Flashing LED indicates serial channel 1 transmit activity. Active low.
8	SER2 RX	Flashing LED indicates serial channel 2 receive activity. Active low.
9	SER2 TX	Flashing LED indicates serial channel 2 transmit activity. Active low.
10	GND	Ground

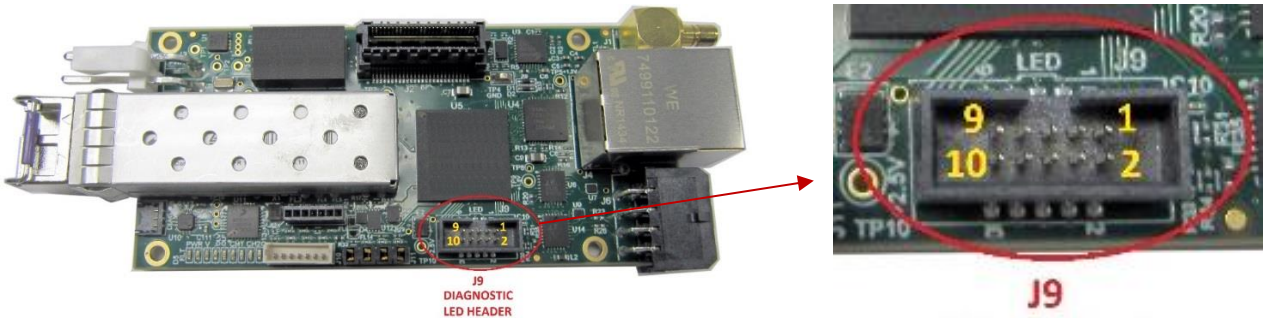

Figure 4-10: Diagnostic LED Header

4.8 914-HDE Optics

An SFP or SFP+ transceiver provides the optical interface for the 914-HDE. Many options exist including:

- Singlemode or multimode fiber
- Bi-directional 1310/1550 nm transceivers (L1 and M1 versions)
- Bi-directional 1270/1330 nm transceivers (H1 version)
- CWDM wavelengths (L1, M1 or H1 versions)
- Non-standard optical budgets

Due to the high data rates, singlemode fiber is standard. Multimode fiber is only suitable for very short links (< 300m). Contact Moog Focal for multimode options. Typical link budgets for single mode fiber are 20dB for bi-directional single fiber or 24dB for dual fiber CWDM. Moog Focal has compatible CWDM modules that can be mounted and stacked with 914-HDE systems. Please refer to section 8.0.

4.8.1 914-HDE Flux Budget Calculation

When specifying an optical system, it is important to analyze system losses and fiber link distances in order to calculate the required optical configuration. The following table shows a sample flux budget calculation for a system with multiple ST bushings, a 10 km singlemode fiber link and a FORJ. Actual losses can vary widely from this, each system flux budget calculation must use data based on actual parts in use.

Table 4-9: Sample Flux Budget Calculation

Component	Uplink (1310 nm)	Downlink (1550 nm)	Unit
Typical Output Power	-1.0	-1.0	dBm
Connector	0.3	0.3	dB
Connector	0.3	0.3	dB
Fiber Optic Rotary Joint	4.0	4.0	dB
Connector	0.3	0.3	dB
Connector	0.3	0.3	dB
Cable (for 10 km SMF length)	4.0	3.0	dB
Connector	0.3	0.3	dB
Connector	0.3	0.3	dB
Total Losses	**9.8**	**8.8**	dB
Received Power	**-10.8** (=-1.0 dBm - 9.8 dB)	**-9.8** (=-1.0 dBm - 8.8 dB)	dBm
Dispersion Penalty	1.0	1.0	dB
Required Receive Sensitivity	**-11.8**	**-10.8**	dBm
Typical Receive Sensitivity	-21.0	-21.0	dBm
Available Margin	**9.2**	**10.2**	dB

Assumptions:

Fiber Loss	0.4 dB/km @ 1310 nm; 0.3 dB/km @1550 nm (single mode fiber - SMF).
Connector (ST/PC)	0.3 dB/conn
FORJ Loss (Max.)	4.0 dB

4.8.2 Optical Safety

All lasers used in the 914-HDE system are Class I laser devices per IEC-60825 unless otherwise specified in installation or configuration drawing. No special control measures or warning labels are required, although any needless exposure of the eye should be avoided as a matter of good practice, and **fibers should never be viewed with magnifying instruments, e.g. fiber scopes, while optical power is present.** Note that the optical wavelengths are in the infrared range, so not visible, but magnifying instruments can still cause damaging levels to the eye.

5.0 Model 914-X Series Diagnostic GUI

The 914-X Series has advanced diagnostics available over a dedicated RS-232 port on the **console 914-HDE motherboard**. This one port gives access to all* 914 cards in the 914-X Series system, including those at the remote side if the fiber optic link is established. This diagnostic link is critical during the setup phase of any system, as it gives access to the settings of any port in the system. This is useful to configure serial port protocols, Ethernet negotiation settings, and any special video settings, for example. ***Do not connect directly to the REMOTE 914-HDE RS232 diagnostic port for configuration purposes, as the settings will not be retained.***

*914-HDV2 has its own diagnostic port

Figure 5-1 shows a typical setup between a 914 card and a PC to obtain diagnostics information from both console and remote ends.

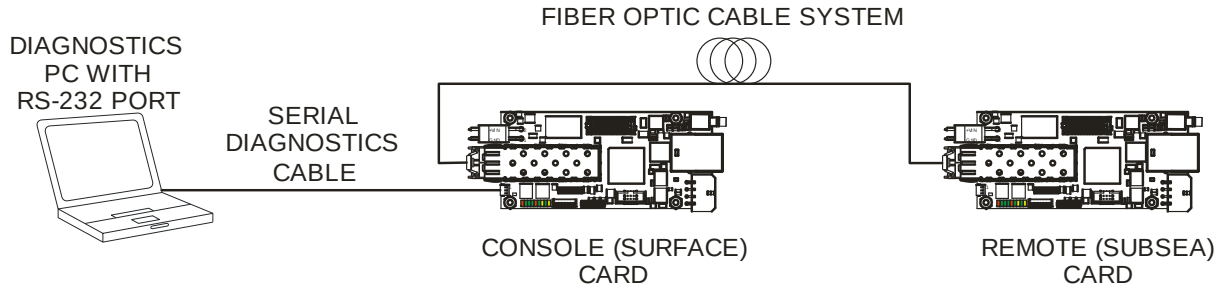

Figure 5-1: Basic Diagnostics Setup

The diagnostics serial port configuration is as follows:

- Speed: 115200 baud
- Data bits: 8
- Stop bits: 1
- Parity: None
- Flow Control: None

Included with every 914-X Series card is a pigtailed jumper for the RS-232 diagnostic port, as shown in the figure below. This cable plugs into J8 on the console 914-HDE PCBA. To install the cable, the plug is pressed down into the connector and should be epoxied in place for permanent connection. Extra cables provide firmware update access for individual cards.

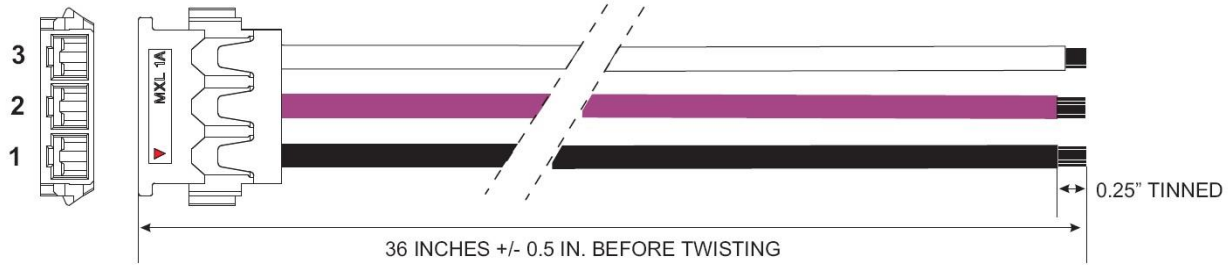

Figure 5-2: 914-HDE Diagnostic Interface Cable

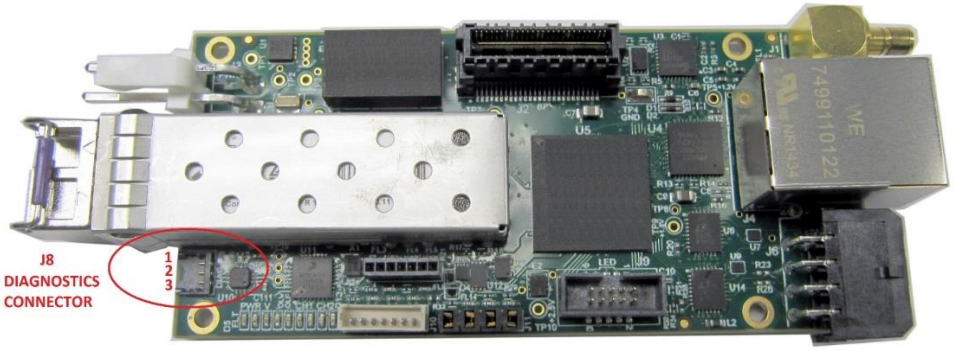

Figure 5-3: 914-HDE Diagnostic Connector

Table 5-1: J8 Diagnostic Connector Pinout

Pin Number	Colour	Function
1	Black	GND
2	Violet	RS-232 Tx (Data from 914-HDE to PC GUI)
3	White	RS-232 Rx (Data from PC GUI)

Table 5-2: Diagnostic Connector Part Numbers

J8	Part Number
Connector	Molex 0781710003
Mating Plug	Molex 0781720003

5.1 Installing the Model 914-X Series Diagnostic GUI

Check for the latest software release on the Moog Focal website: http://www.moog.com/focal/914-x-series and search for 914-0401-00.

Install the software on a computer with Microsoft Windows 7 (or newer Microsoft OS) and a serial (COM) port connected to the 914-HDE diagnostic port. Microsoft .NET version 4.0 or greater must be installed on the host computer. Installation of the Model 914 diagnostic GUI will involve copying the compressed software package to a local drive, then uncompressing to “C:\Focal\”. Follow the instructions in the “Installation.txt” file and open the "Model914.exe" file. Once installed, open the software and press the (+) at the top left corner to set up the COM link.

The following section is an overview of the diagnostic GUI.

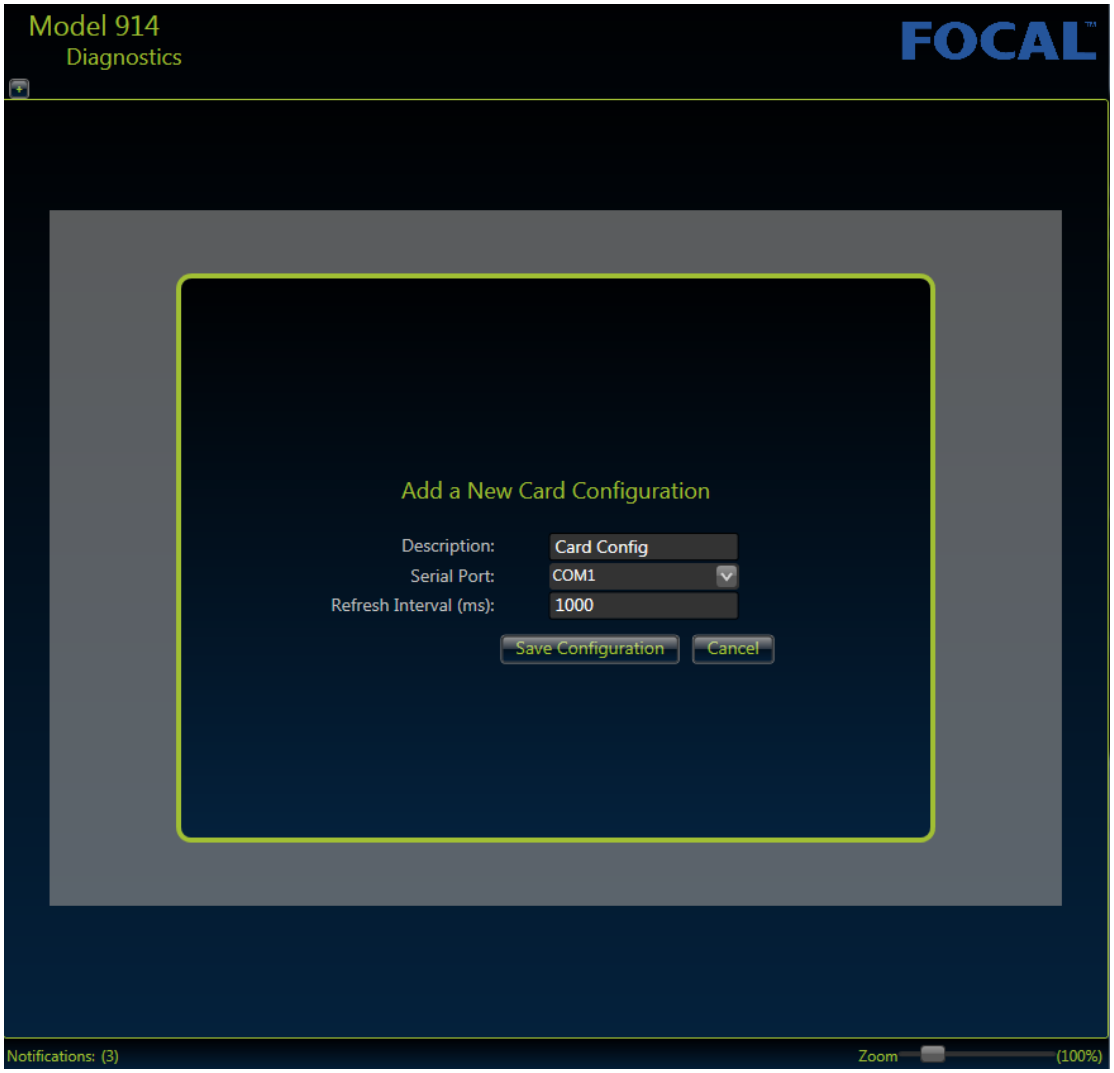

Figure 5-4: Diagnostic GUI Start Screen

Once the COM port is setup, press “Start Data Refresh” at the bottom of the screen.

If a successful link to the 914-HDE is established, a green heart will be seen at the top left of the screen near the COM port listing. If the heart appears red, the link has not been established. Verify the COM port number and the wiring harness to the PCBA and ensure power is applied to the 914-HDE.

When the link is established, click on the “Model 914 – Console” and “Model 914 Remote” text to pull up a list of card features, including the card info as displayed in Figure 5-5.

Figure 5-5: 914-HDE Card Info

5.1.1 914-HDE Diagnostic Status Display

Navigating through the drop down tabs and expansion buttons allows more system information to be extracted. Figure 5-6 shows all the system voltages as well as the FPGA junction temperature. A green background indicates that the observed status is within the normal range. Red backgrounds indicate potential problems that need to be addressed. Yellow backgrounds give warnings.

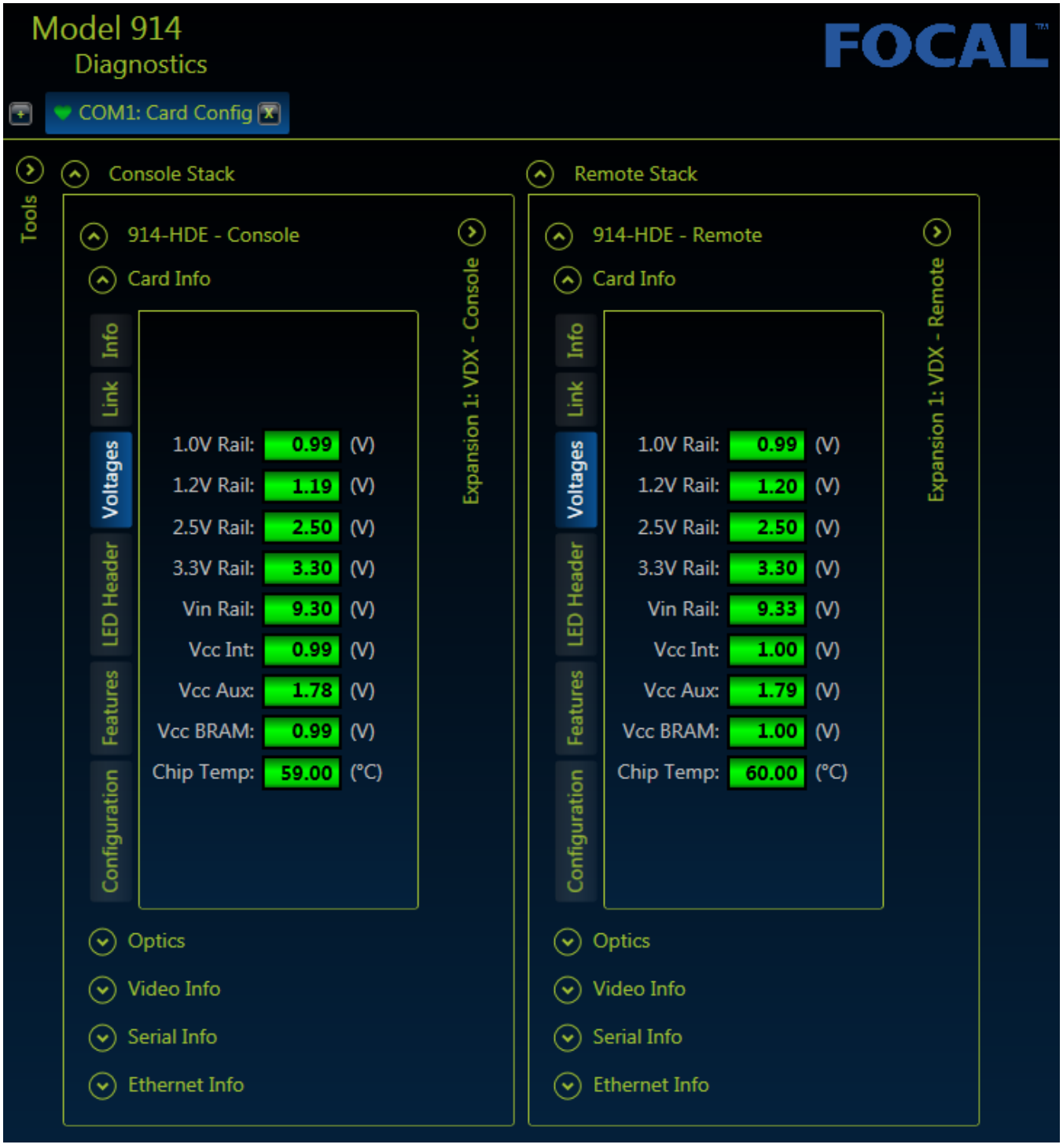

Figure 5-6: 914-HDE Voltage and Junction Temperature Information

Figure 5-7 shows the optical link status, including information provided by the optical transceiver, such as transmit and receive optical power and transceiver temperature.

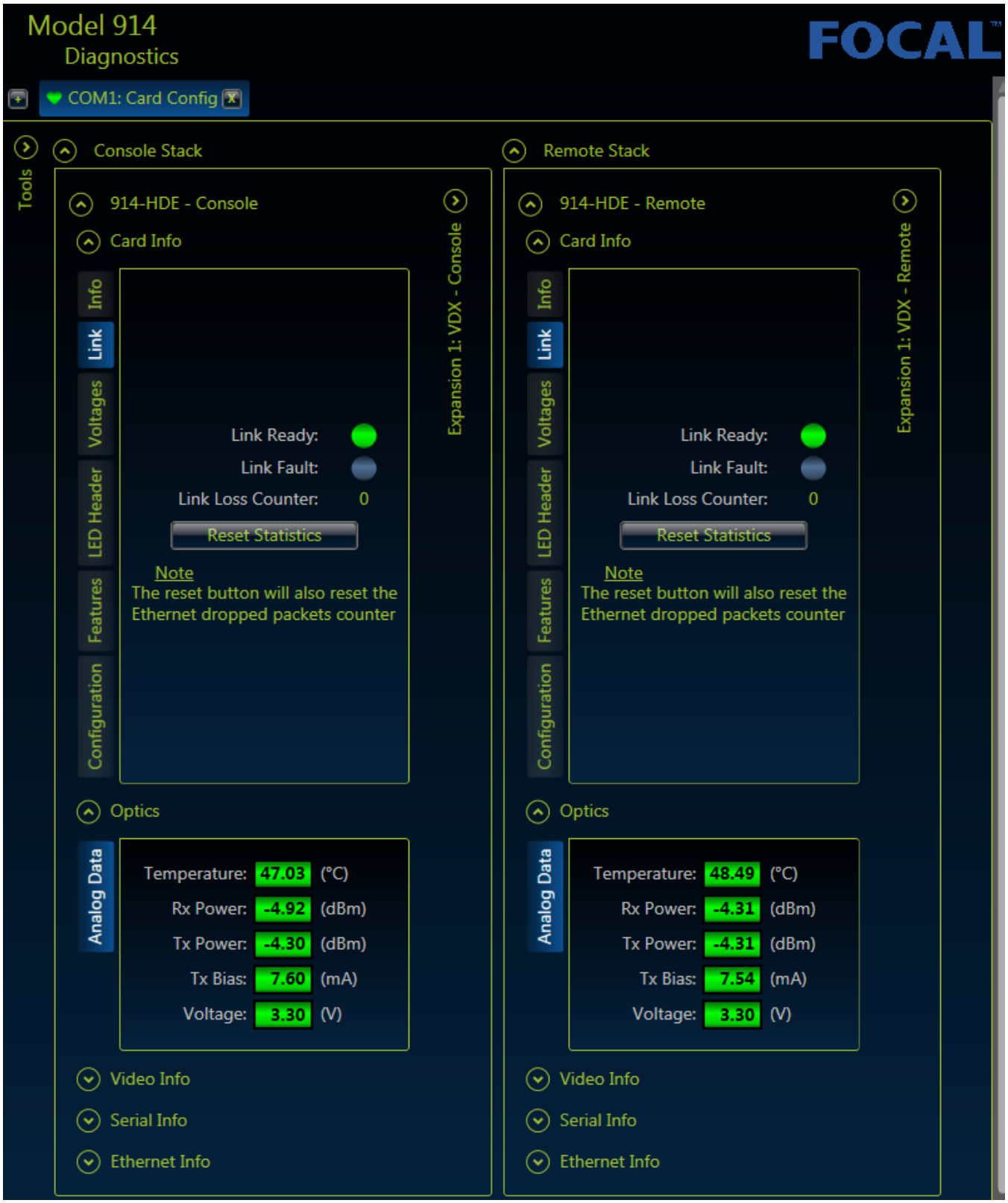

Figure 5-7: 914-HDE Optical Link Status

Figure 5-8 shows the current status of each input / output signal (video, serial and Ethernet). Receive serial activity is shown in yellow to match the LEDs on the 914-HDE.

Figure 5-8: 914-HDE Signal Status

5.1.2 914-HDE Serial Port Configuration

Figure 5-9 shows how to configure each serial port. Select the desired protocol, termination and timeout (if applicable). Press “Apply” to save the changes. These settings are non-volatile and do not need to be re-configured each time the 914-HDE is powered.

Typical Settings: (Refer to Section 4.4)

- RS-485: 1 ms timeout; terminations enabled
- RS-422: terminations enabled
- RS-232: No options.

Figure 5-9: 914-HDE Serial Port Configuration

5.1.3 914-HDE Ethernet Port Configuration

Figure 5-10 shows how to configure the Ethernet port auto-negotiation settings. By default the system will auto-negotiate to the highest possible speed, but these settings are useful to ensure both side negotiate to the same speed and duplex if they did not automatically do this.

Ethernet link speed mismatches should be avoided. Typically newer PCs will link at 1G at the console side and older Ethernet equipment at the remote side might link at 100M. In this case, the console and remote cards should be set to 100M and the PC should be forced to 100M to ensure that all elements in the Ethernet link are set at the same speed.

Figure 5-10: 914-HDE Ethernet Settings

6.0 914-X Series Expansion Cards

The 914-HDE motherboard is a full multiplexing system capable of supporting up to 8 expansion cards simultaneously through a multi-gigabit board-to-board expansion connector. A separate backplane card is not required. Moog Focal has developed a family of compatible expansion cards that allow the user to specify more signals without adding more fibers. This reduces cost and size as compared to adding media converters or additional multiplexer cards. The expansion connector has 4 medium speed channels and 4 low speed channels available.

The expansion connector provides for 21/32” (16.67 mm) spacing between cards when directly stacked together. For tight spaces and/or larger stacks, Moog Focal can provide high speed ribbon cables to allow cards to sit up to 18” (46 cm) apart. Please refer to Section 10.3 for more information.

6.1 914-VDX

The 914-VDX (video and serial data expansion card) provides 2 channels of analog (composite) video and 4 channels of non-isolated serial data (RS-232, RS-485, RS-422). The video channels are compatible with both NTSC and PAL standards. Diagnostics from this card are provided to the 914-HDE and are available to the Model 914-X Series Diagnostic GUI. This expansion card requires up to 550 Mb/s of bandwidth from the 914-HDE motherboard. This expansion card requires 1 medium speed expansion channel.

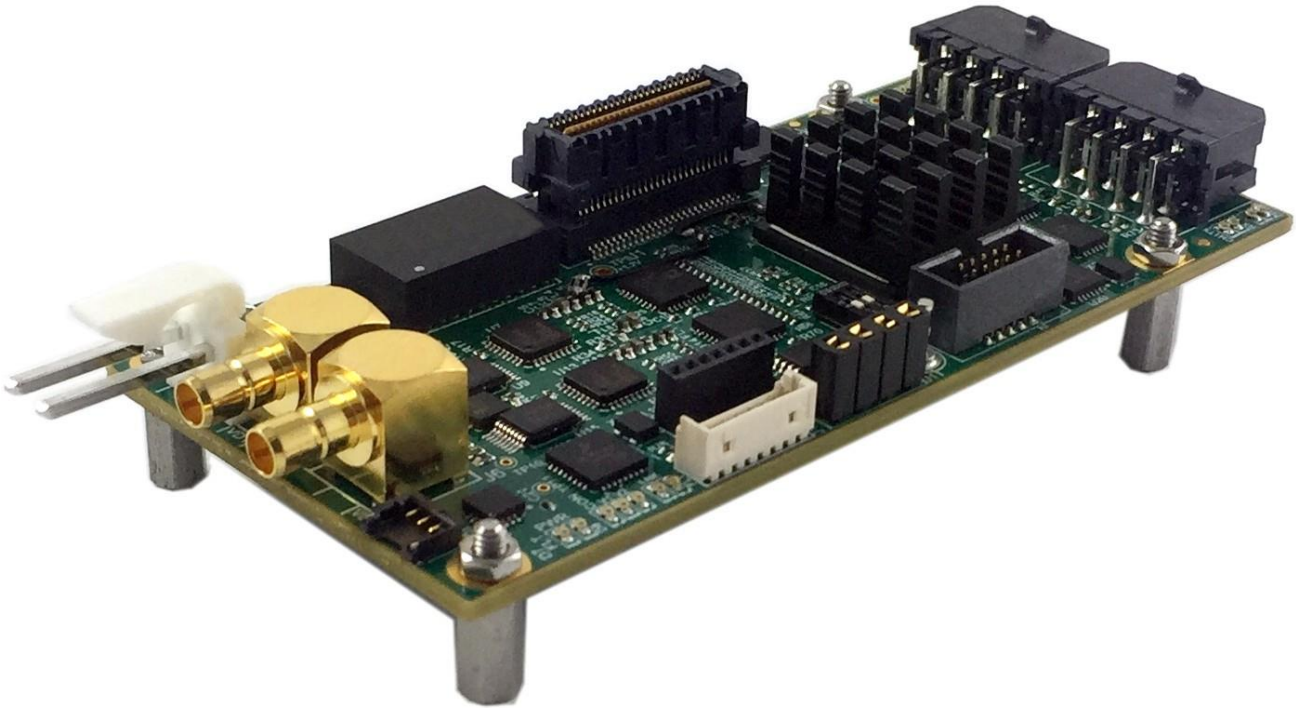

Figure 6-1: 914-VDX

6.1.1 914-VDX Serial Data Ports

The 914-VDX has four non-isolated serial ports supporting RS-232, RS-485 or RS-422 signaling protocols. These three protocols may be configured by the user in the field via the 914 Diagnostic GUI. TTL and PPS are factory options. All data rates are supported up to 1.25 Mbaud for RS-485 and RS-422 and up to 500 KBaud for RS-232. Each port can support completely independent serial data links with independent baud rates. By default, RS-485 and RS-422 inputs are terminated differentially with an on-board 120 Ω resistor that can be disabled via software configuration. Latency through the Mux/Demux system is less than 500 μs, not including fiber delays of 5 ns/m.

For RS-485 which is a half-duplex protocol, a programmable turn-around time is implemented. The default turn-around time (timeout between Tx and Rx) is set to 1 ms. Serial port settings, including protocol, timeouts, and terminations may be accessed and changed via the Model 914 Diagnostic GUI.

The serial port connector is Molex Micro-fit P/N 43045-0800. The mating plug is Molex Micro-fit P/N 0430250800 with Molex crimps P/N 0430300010. The pinout is detailed in Table 6-2. Tx refers to transmit data from the 914-VDX to the external equipment. Rx refers to receive data into the 914-VDX from the external equipment. Data coming into the RS-422 RX lines at the remote, for example, will exit from the RS-422 TX lines at the console.

Table 6-1: Serial Data Port Numbering

Port Number	Reference Designator
1	J5 (lower pin row)
2	J5 (upper pin row)
3	J3 (lower pin row)
4	J3 (upper pin row)

Table 6-2: Serial Data Connector Pinout

REF.	PIN				MODE		
					RS-232	RS-485	RS-422
J6	CH1	1	CH2	5	RS232-RX	DO NOT CONNECT	RX 422+
		2		6	GND	GND	RX 422-
		3		7	DO NOT CONNECT	RS485+	TX 422+
		4		8	RS232-TX	RS485-	TX 422-

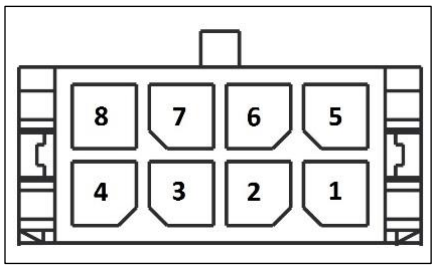

Figure 6-2: Molex Micro-fit P/N 43045-0800

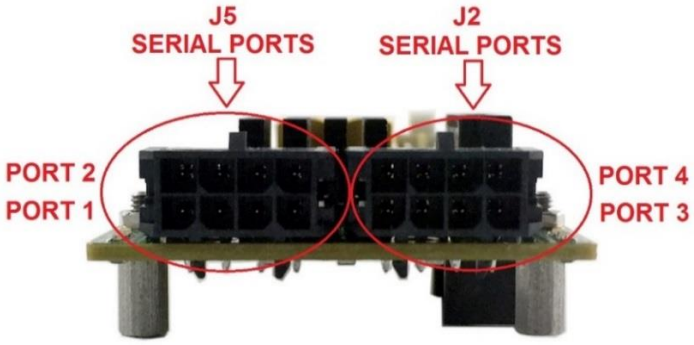

Figure 6-3: VDX Serial Ports

6.1.2 914-VDX Composite Video Channels

The 914-VDX has two NTSC or PAL compatible composite video channels. The channel direction (input vs output) is set up from the Model 914 Diagnostic GUI. Each channel uses approximately 250 Mb/s of available bandwidth from the 914-HDE. No bandwidth is used if the video input is unplugged, or if that channel has been disabled via the Diagnostic GUI. Latency through the Mux/Demux system is less than 500 μs, not including fiber delays of 5 ns/m.

Coaxial shielding on the connectors is directly tied to ground, care must be taken to ensure a common ground to all video equipment or isolation must be installed external to the 914-VDX. The video signal is AC coupled on the PCBA.

The connector is a Mini SMB jack, Amphenol P/N 142146-75. Recommended mating plug is Cinch P/N 131-8403-101, although other 75 Ω Mini SMB plugs may be suitable. Cabling should be RG-179, 75 Ω coaxial type. Video latency through the mux/demux system is less than 25 μs, not including fiber delays of 5 ns/m.

Figure 6-4: Mini SMB Jack - Amphenol P/N 142146-75

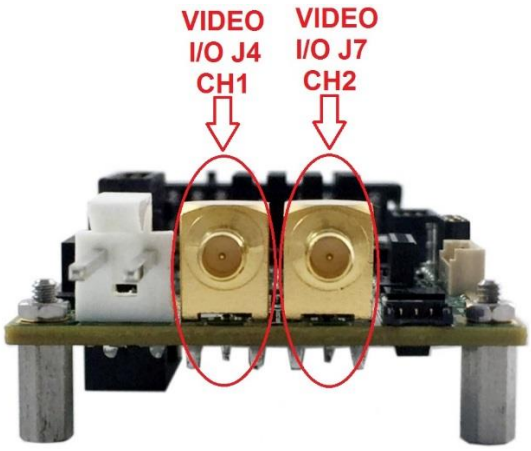

Figure 6-5: Video Connector Locations

6.1.3 914-VDX Power

Power to the 914-VDX card is provided via the expansion connector. Power input connect J3 ***should not be used*** during normal operation with the 914-VDX. It can optionally be used for standalone operation during firmware updates or configuration.

If the 914-VDX is to be self-powered, this is accomplished via connector J3, Molex P/N 09-75-2024. The mating plug is Molex P/N 26-03-4020 with crimps P/N 08-52-0113. The pinout is provided in the table and figure below.

Table 6-3: Power Connector Pinout

Pin #	Function
1	GND
2	VCC

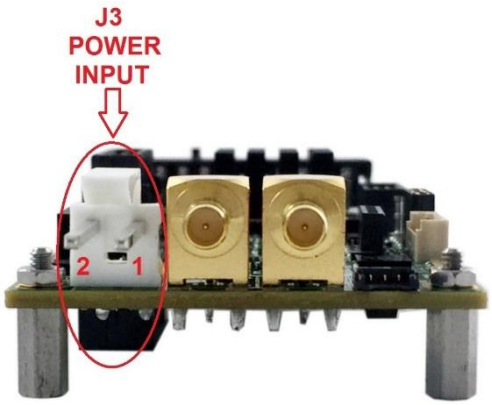

Figure 6-6: Power Input Connector Location

The recommended input voltage range is 4.5 VDC to 13.0 VDC (typically +5 VDC regulated). Nominal power consumption is 5 W, increasing to 5.5 W at 60º C ambient temperature. Power leads should be AWG 18 – 20.

The onboard surface mount fuse, F1, is rated to 2A and is not intended to be field replaceable. If the power fuse is blown, the card should be evaluated for damage by the factory or trained service personnel prior to any repair.

6.1.4 914-VDX Diagnostic LEDs

The 914-VDX card includes 15 on-board diagnostic LEDs. A description and location of each LED is provided in Table 4-7 and Figure 4-8.

Table 6-4: 914-VDX Diagnostic LEDs

Reference Designator	Color	Description
D1	Green	Flashing LED indicates serial channel 3 is transmitting to external equipment.
D2	Yellow	Flashing LED indicates serial channel 3 is receiving from external equipment.
D3	Green	Flashing LED indicates serial channel 4 is transmitting to external equipment.
D4	Yellow	Flashing LED indicates serial channel 4 is receiving from external equipment.
D7	Red	Indicates a power fault when lit. A power fault is encountered when the input voltage falls outside of the supported range of 4.5 to 13.5 V. Recommended input voltage is 5 VDC. When this LED is lit, the card is not powered properly and will not function.
D8	Green	Indicates that the card is powered properly when lit.
D9	Green	Indicates the 914-VDX is configured for Console mode.
D10	Green	Indicates a valid video signal is present on channel 1 when lit
D11	Green	Indicates a valid video signal is present on channel 2 when lit
D12	Green	Indicates a valid expansion link is being received. (data frames are present)
D13	Red	Indicates the expansion link is in fault condition. (little or no valid data is present)
D14	Green	Flashing LED indicates serial channel 1 is transmitting to external equipment.
D15	Yellow	Flashing LED indicates serial channel 1 is receiving from external equipment.
D16	Green	Flashing LED indicates serial channel 2 is transmitting to external equipment.
D17	Yellow	Flashing LED indicates serial channel 2 is receiving from external equipment.

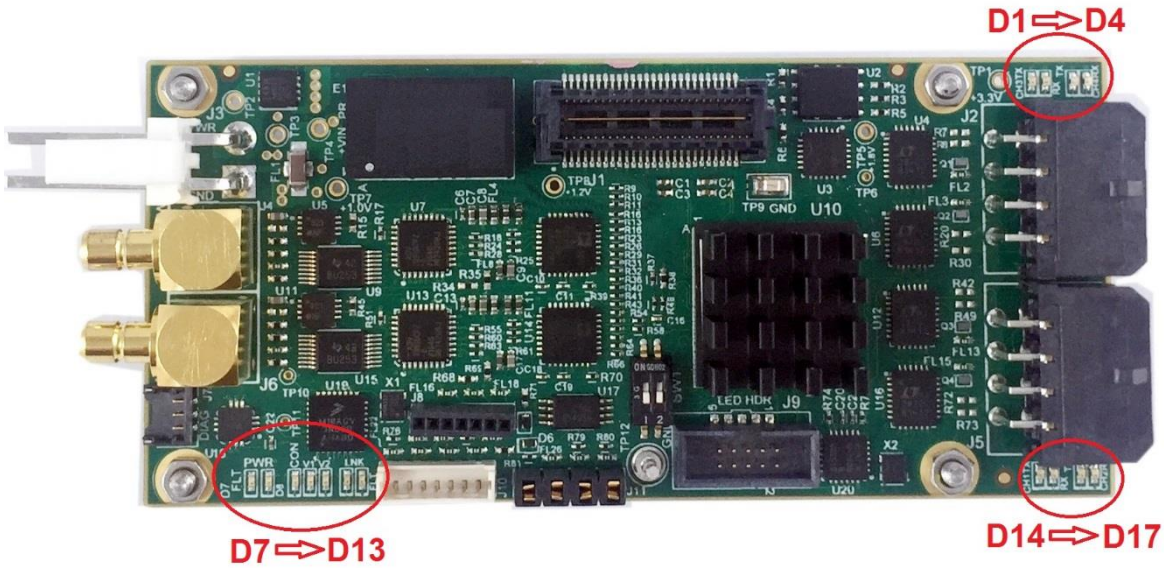

Figure 6-7: VDX Diagnostic LEDs

6.1.5 914-VDX Diagnostic LED Header

The 914-VDX card includes a 10-pin header capable of driving 8 LEDs. This is useful for LED integration into an enclosure. Each LED pin is driven low to turn on an LED, and includes a 267 ohm resistor in series to limit the current draw. Maximum current draw is 8 mA. Refer to section 4.7 for a sample connection diagram.

Serial data activity header pins can be configured for Tx (Transmit Activity), Rx (Receive Activity), or both (Default) via the diagnostic GUI.

The LED header is FCI P/N 20021521-00010T1LF, and the mating part is FCI P/N 20021444-00010T1LF. This can be used with most 0.050" (1.27mm) spacing ribbon cables.

Table 6-5: 914-VDX Diagnostic LED Header Pinout

Pin	Name	Description
1	3.3V	3.3V This pin can be used to drive the LEDs, Maximum current is 0.5A.
2	VIDEO CH1	Indicates a valid video signal is present on channel 1 when lit. Active low.
3	VIDEO CH2	Indicates a valid video signal is present on channel 2 when lit. Active low.
4	SER1 RX	Flashing LED indicates serial channel 1 activity. Active low.
5	SER1 TX	Flashing LED indicates serial channel 2 activity. Active low.
6	SER2 RX	Flashing LED indicates serial channel 3 activity. Active low.
7	SER2 TX	Flashing LED indicates serial channel 4 activity. Active low.
8	EXPANSION LINK	Indicates a valid expansion link is present. Active low.
9	EXPANSION LINK FAULT	Indicates that the expansion link is in a fault condition. Active low.
10	GND	Ground, non-isolated, connected to 914-HDE input voltage ground.

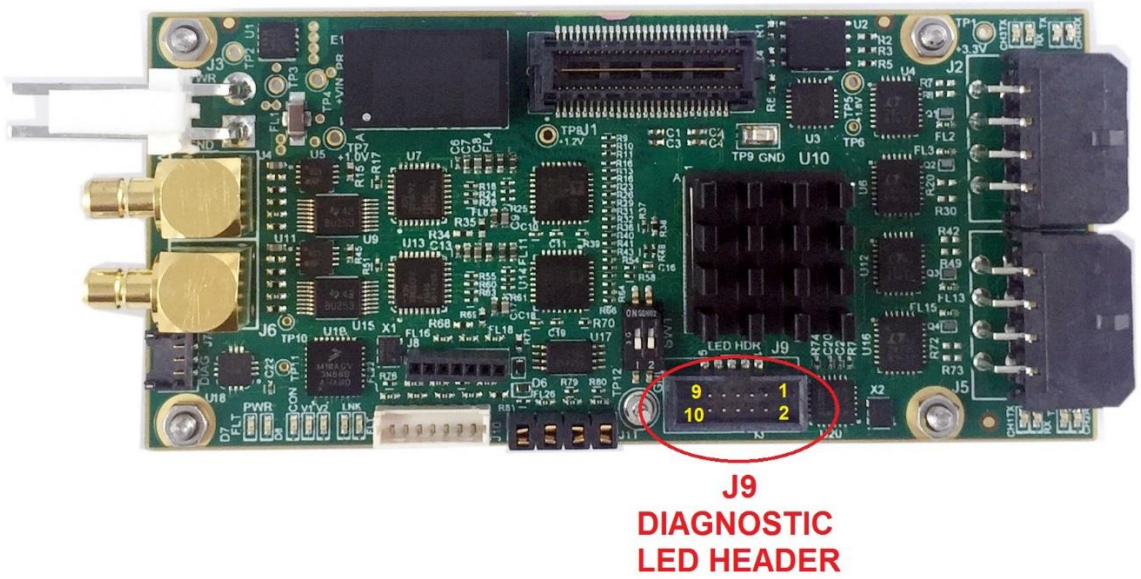

Figure 6-8: Diagnostic LED Header

6.1.6 914-VDX Expansion Channel Configuration

Up to four 914-VDX cards may be stacked on each 914-HDE, depending on available optical bandwidth. Dip switch SW1 configures which expansion channel each card uses. The card closest to the 914-HDE must be configured for expansion channel 1, with each subsequent card configured for the next channel in succession. No channels may be skipped.

Table 6-6: 914-VDX Expansion Channel Configuration

SW1[1:2]	Setting
OFF, OFF	Expansion channel 1
ON, OFF	Expansion channel 2
OFF, ON	Expansion channel 3
ON, ON	Expansion channel 4

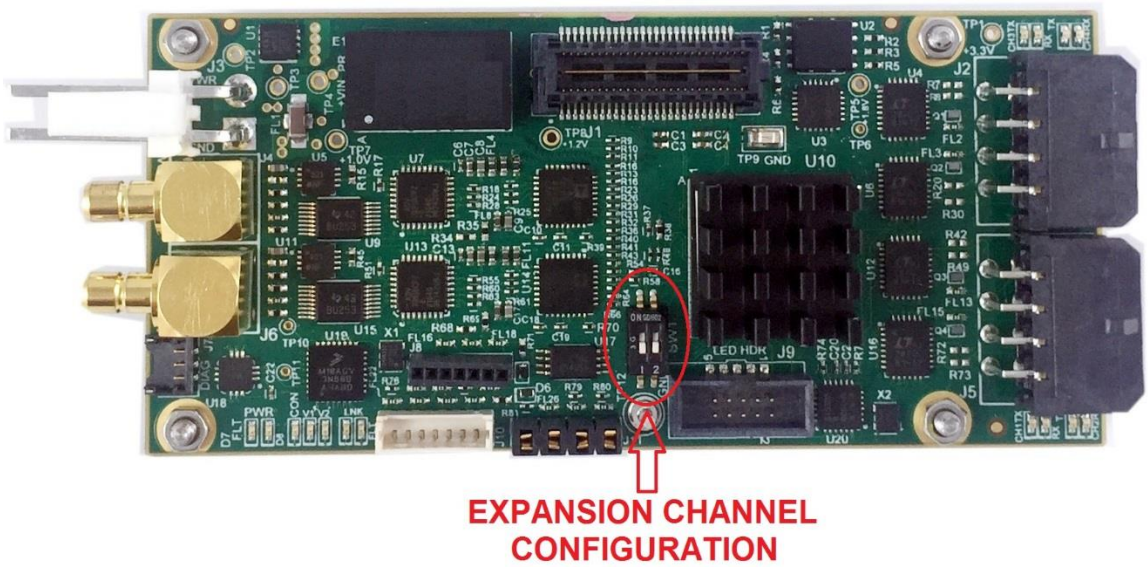

Figure 6-9: Diagnostic LED Header

Figure 6-10: SW1 Position and Orientation

6.1.7 914-VDX Configuration

By default, all 914-VDX cards are shipped with these settings:

- Remote configuration
- Both video channels are inputs and enabled
- All serial channels are set to RS232

To change these settings, connect the console 914-HDE to the 914 Diagnostic GUI via a local COM port. Ensure a stable optical link is present and the cards are stacked together in the correct order with the correct expansion settings as per the previous section.

From the GUI, click on the “Card Info” then “Configuration” tab as shown in Figure 6-11. Typically the console stack side needs to be changed from the default remote with video inputs, to console with video outputs. Once the desired “new” settings are selected, press apply to save them to the card.

The Driver Voltage indicates the drive strength for the expansion interface. For 914-VDX cards that are distant from the 914-HDE (either stacked at expansion channel 2+, or are using a high speed ribbon cable) it may be necessary to boost this from the default setting of 682 mV. **This setting should never be set below 682 mV**.

Figure 6-11: 914-VDX Video Configuration

6.1.8 914-VDX Serial Port Configuration

To alter the serial port settings from the GUI, click on the “Serial Info” then “Config” tab as shown in Figure 6-12. Select new settings on a port by port basis and press apply. Each setting can take up to 10 seconds to save in non-volatile memory (EEPROM).

Figure 6-12: 914-VDX Serial Port Configuration

6.1.9 914-VDX Diagnostics

In a similar manner to the 914-HDE, the 914-VDX has available diagnostics from the GUI including all voltages and the junction temperature of the FPGA. Any value shown in green is operating within normal specification. Values in red or yellow should be examined.

Figure 6-13: 914-VDX Voltages and Temperature

6.2 914-EX

The 914-EX (Ethernet expansion card) provides an additional two (2) 10/100/1000 BASE-T(X) ports to a 914-HDE system. These ports are multiplexed into the 914-HDE optical data stream. This design is switchless ensuring no mixing of Ethernet traffic between ports, i.e. data input to port 1 is an output on port 1 at the far side of the optical link. Diagnostics from this card are provided to the 914-HDE and are available to the Model 914 Diagnostic GUI.

The 914-EX can use a single medium speed expansion channel for up to 1000 Mb/s of bandwidth dynamically shared between the two Ethernet ports, or two medium speed expansion channels allowing for a full 1000 Mb/s of bandwidth per Ethernet port. Care must be taken to ensure the 914-HDE motherboard optical interface has sufficient bandwidth to support the Ethernet traffic. Actual bandwidth requirements are based on the external devices connected to the Ethernet ports.

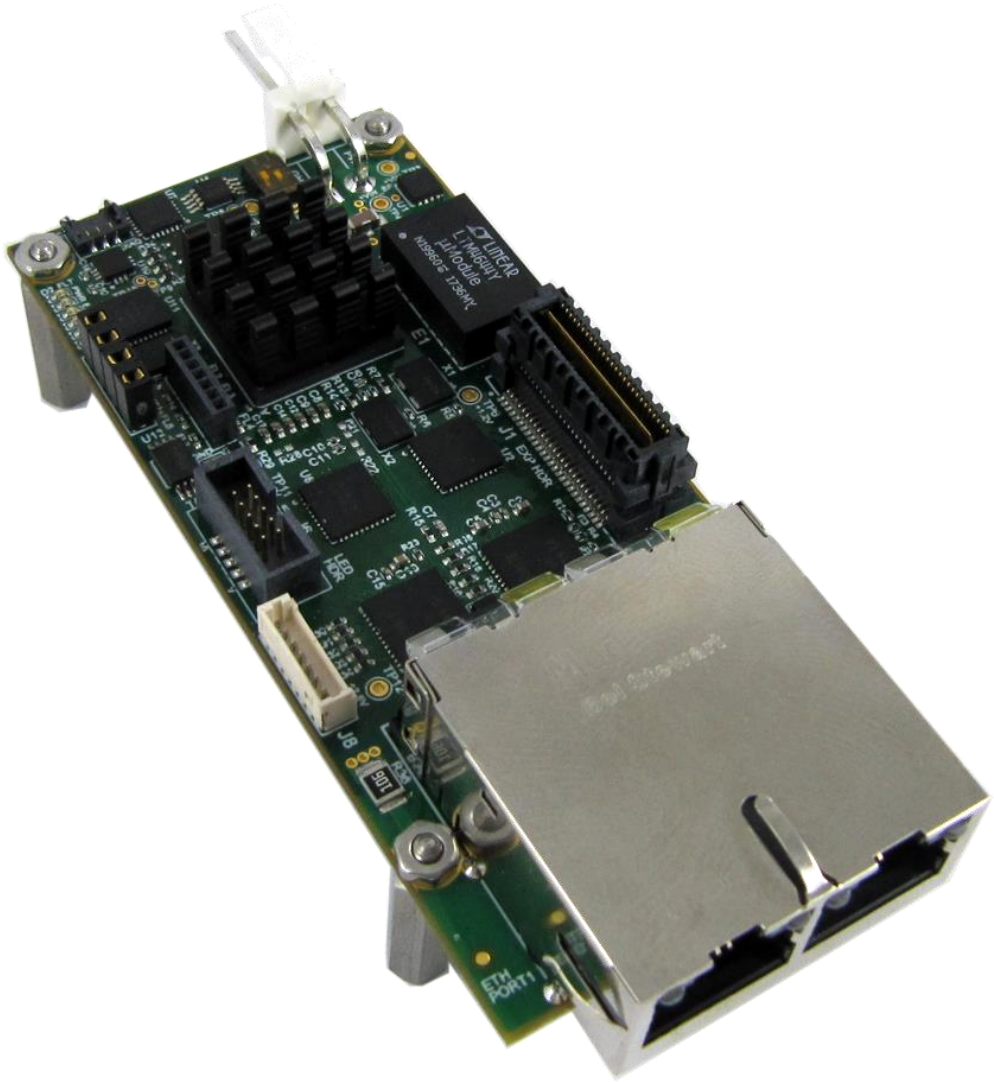

Figure 6-14: 914-EX

6.2.1 914-EX Ethernet Ports

The 914-EX provides two un-switched, low latency 10/100/1000 BASE-T(X) Ethernet links through the 914-HDE optical port. Both ports are default configured for 10/100/1000 BASE-T(X) auto-negotiation. Auto-negotiate settings can be accessed via the Model 914 Diagnostic GUI when connected to the console 914-HDE diagnostic port. A standard 8P8C (RJ45) modular jack provides the mechanical interface for the Ethernet port. The port is auto MDI/MDIX capable, and supports jumbo frames up to 9000 bytes.

An optional “Link Fault Pass Through” can be enabled on a per port basis. This feature will disconnect the Ethernet link if the far side is not linked. Therefore the system must be linked on both sides for the Ethernet link to be established. Enabling or disabling this feature is done through the diagnostic GUI.

The 914-EX combines the traffic of both Ethernet ports along with diagnostic information onto a single medium speed expansion channel to the 914-HDE. This bandwidth is dynamically shared between the 2 Ethernet ports allowing for throughput up to 950 Mb/s.

Optionally the 914-EX can be specified to use 2 medium speed expansion channels. This doubles the bandwidth of the Ethernet ports and is ideal for high bandwidth video over IP or GigE vision applications. Since the 914-HDE motherboard multiplexes the Ethernet data from the 914-EX card and other expansion cards in the system the total system bandwidth (BW) usage must be considered and be at or under the maximum optical bandwidth available. Refer to section 3.2 for detailed information 914-X series card BW usage.

End-to-end latency through the multiplexer is a calculation adding a fixed electronic latency to the Ethernet frame time which is a function of the frame length, and the optical latency which is a function of distance. Adding all three together gives a total latency figure.

Table 6-7: Ethernet Latency

Latency Component / Link Speed	10 Mb/s	100 Mb/s	1000 Mb/s
FEL (Fixed Electronic Latency)	40 µs	12 µs	15 µs
FT (Frame Time)	# Bytes * 0.8 µs	# Bytes * 0.08 µs	# Bytes * 0.008 µs
OL (Optical Latency)	5 µs / km	5 µs / km	5 µs / km

Latency = FEL + FT + OL

6.2.2 914-EX Ethernet RJ45 LEDs

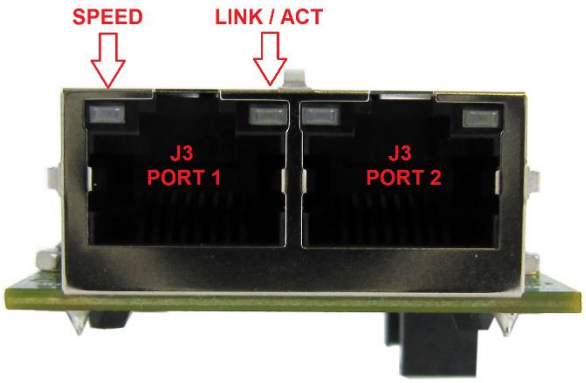

Figure 6-15: Ethernet Ports

Integrated LEDs show Ethernet Link Status as shown in Table 4-5.

Table 6-8: Ethernet LEDs

LED Status		Function
Left Green/Orange	Right Yellow	
OFF*	X	10 BASE-T
ORANGE	X	100 BASE-TX
GREEN	X	1000 BASE-T
X	ON	LINKED
X	FLASHING	LINKED WITH ACTIVITY

* Speed indication only valid when link LED is on or flashing.

6.2.3 914-EX Power

Power to the 914-EX card is provided via the expansion connector J9. Power input connect J2 ***should not be used*** during normal operation with the 914-EX. It can optionally be used for standalone operation during firmware updates or configuration.

If the 914-EX is to be self-powered, this is accomplished via connector J2, Molex P/N 09-75-2024. The mating plug is Molex P/N 26-03-4020 with crimps P/N 08-52-0113. The pinout is provided in the table and figure below.

Table 6-9: Power Connector Pinout

Pin #	Function
1	GND
2	VCC

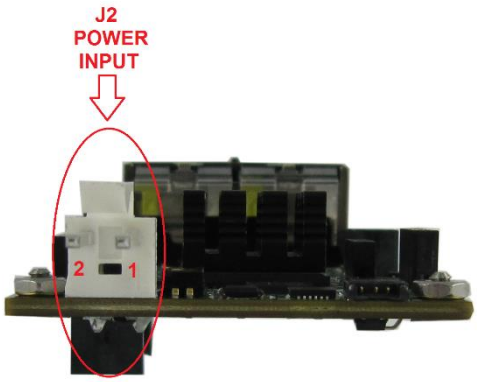

Figure 6-16: Factory Power Input Connector Location

The recommended input voltage range is 4.5 VDC to 13.0 VDC (typically +5 VDC regulated). Nominal power consumption is 3.5 W, increasing to 4.2 W at 60° C ambient temperature with both ports linked at 1000 BASE-T. Power leads should be AWG 18 – 20.

The onboard surface mount fuse, F1, is rated to 2A and is not intended to be field replaceable. If the power fuse is blown, the card should be evaluated for damage by the factory or trained service personnel prior to any repair.

6.2.4 914-EX Diagnostic LEDs

The 914-EX card includes 6 on-board diagnostic LEDs. A description and location of each LED is provided in Table 4-7 and Figure 4-8.

Table 6-10: 914-EX Diagnostic LEDs

Reference Designator	Color	Description
D2	Red	Power Fault. Only lit if power is sourced via J2 and input voltage is outside nominal 4.5 to 13.0 VDC.
D3	Green	Power. Lit when powered.
D4	Red	Primary Expansion channel fault. No link established to partner card via 914-HDE across the optical link.
D5	Green	Primary Expansion channel link. Valid link established to partner card via 914-HDE across the optical link.
D6	Red	Secondary Expansion channel fault. No link established to partner card via 914-HDE across the optical link.
D7	Green	Secondary Expansion channel link. Valid link established to partner card via 914-HDE across the optical link.

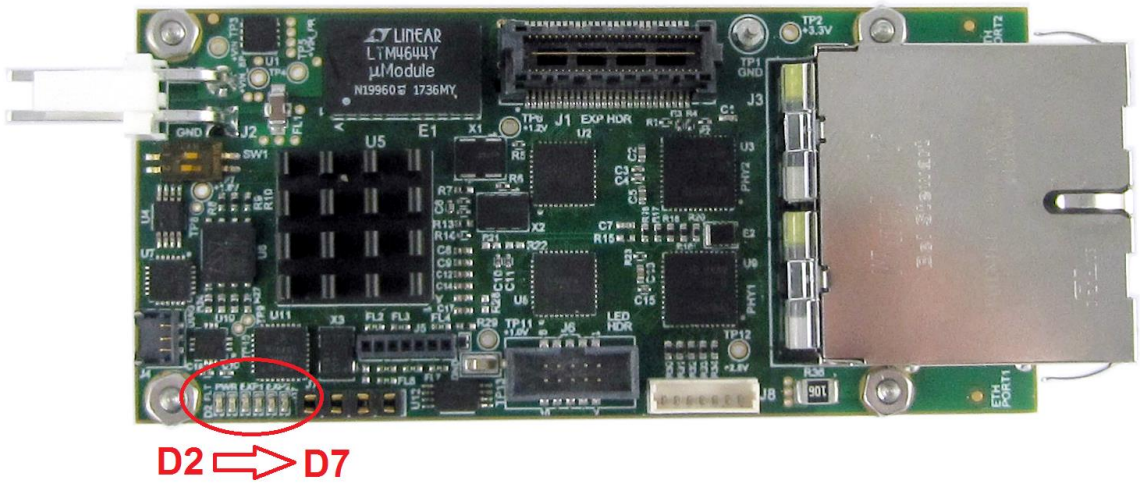

Figure 6-17: 914-EX Diagnostic LEDs

6.2.5 914-EX Diagnostic LED Header

The 914-EX card includes a 10-pin header capable of driving 8 LEDs. This is useful for LED integration into an enclosure. Each LED pin is driven low to turn on an LED, and includes a 267 ohm resistor in series to limit the current draw. Maximum current draw is 8 mA. Refer to section 4.7 for a sample connection diagram.

The LED header is FCI P/N 20021521-00010T1LF, and the mating part is FCI P/N 20021444-00010T1LF. This can be used with most 0.050" (1.27mm) spacing ribbon cables.

Table 6-11: 914-EX Diagnostic LED Header Pinout

Pin	Name	Description
1	3.3V	3.3V This pin can be used to drive the LEDs, Maximum current is 0.5A.
2	EXPANSION 1 LINK	Primary Expansion channel link. Valid link established to partner card via 914-HDE across the optical link. Active low.
3	EXPANSION 1 FAULT	Primary Expansion channel fault. No link established to partner card via 914-HDE across the optical link. Active low.
4	EXPANSION 2 LINK	Secondary Expansion channel link. Valid link established to partner card via 914-HDE across the optical link. Active low.
5	EXPANSION 2 FAULT	Secondary Expansion channel fault. No link established to partner card via 914-HDE across the optical link. Active low.
6	ETHERNET PORT 1 ACTIVITY	Activity present on Ethernet port 1. Active low.
7	ETHERNET PORT 1 LINK	Ethernet port 1 is linked. Active low.
8	ETHERNET PORT 2 ACTIVITY	Activity present on Ethernet port 2. Active low.
9	ETHERNET PORT 2 LINK	Ethernet port 2 is linked. Active low.
10	GND	Ground, non-isolated, connected to 914-HDE input voltage ground.

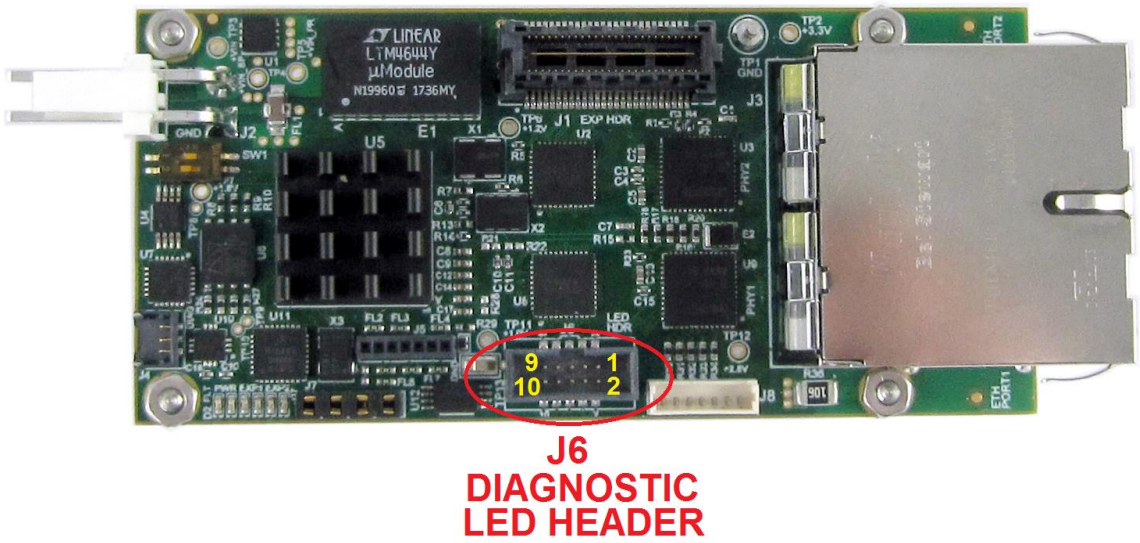

Figure 6-18: Diagnostic LED Header

6.2.6 914-EX Expansion Channel Configuration

Up to four 914-EX cards giving up to 8 additional Ethernet ports may be stacked on each 914-HDE, depending on available optical bandwidth. Dip switch SW1 configures which expansion channel each card uses. The card closest to the 914-HDE must be configured for expansion channel 1, with each subsequent card configured for the next channel in succession. No channels may be skipped.

Table 6-12: 914-EX Expansion Channel Configuration

SW1[1:2]	Setting
OFF, OFF	Expansion channel 1
ON, OFF	Expansion channel 2
OFF, ON	Expansion channel 3
ON, ON	Expansion channel 4

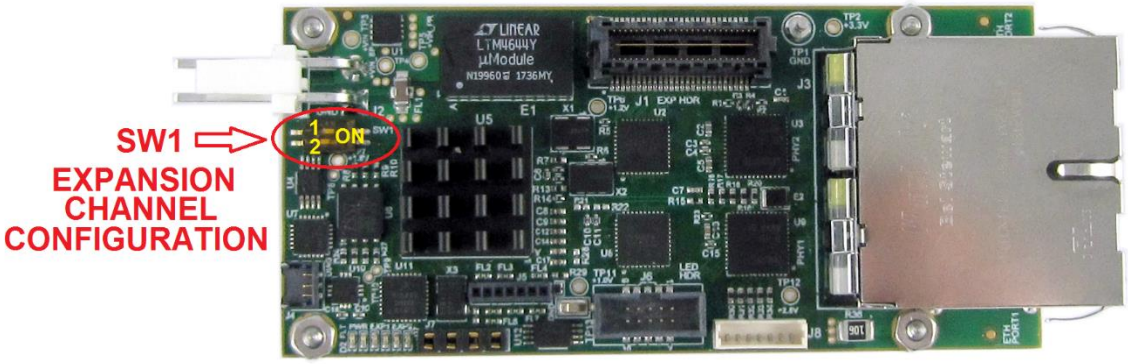

Figure 6-19: Diagnostic LED Header

Figure 6-20: SW1 Position and Orientation

6.2.7 914-EX Configuration

By default, all 914-EX cards are shipped with these settings:

- Remote configuration
- Both Ethernet ports set to auto-negotiate all speeds (10/100/1000M) and duplex settings (full/half)
- Link fault pass-through disabled.

To change these settings, connect the console 914-HDE to the 914 Diagnostic GUI via a local COM port. Ensure a stable optical link is present and the cards are stacked together in the correct order with the correct expansion settings as per the previous section.

From the GUI, click on the “Card Info” then “Configuration” tab as shown in Figure 6-11. Since a 914-X Series system requires a remote and console card and all 914-EX cards are shipped by default as remote, the user **MUST** configure the 914-EX card that is installed at the console side as a console 914-EX (step 1). Once the desired “new” settings are selected, press apply to save them to the card (step 2). Console cards should always be viewed on the left side of the GUI.

The Driver Voltage indicates the drive strength for the expansion interface. For 914-EX cards that are distant from the 914-HDE (either stacked at expansion channel 2+, or are using a high speed ribbon cable) it may be necessary to boost this from the default setting of 682 mV. **This setting should never be set below 682 mV.**

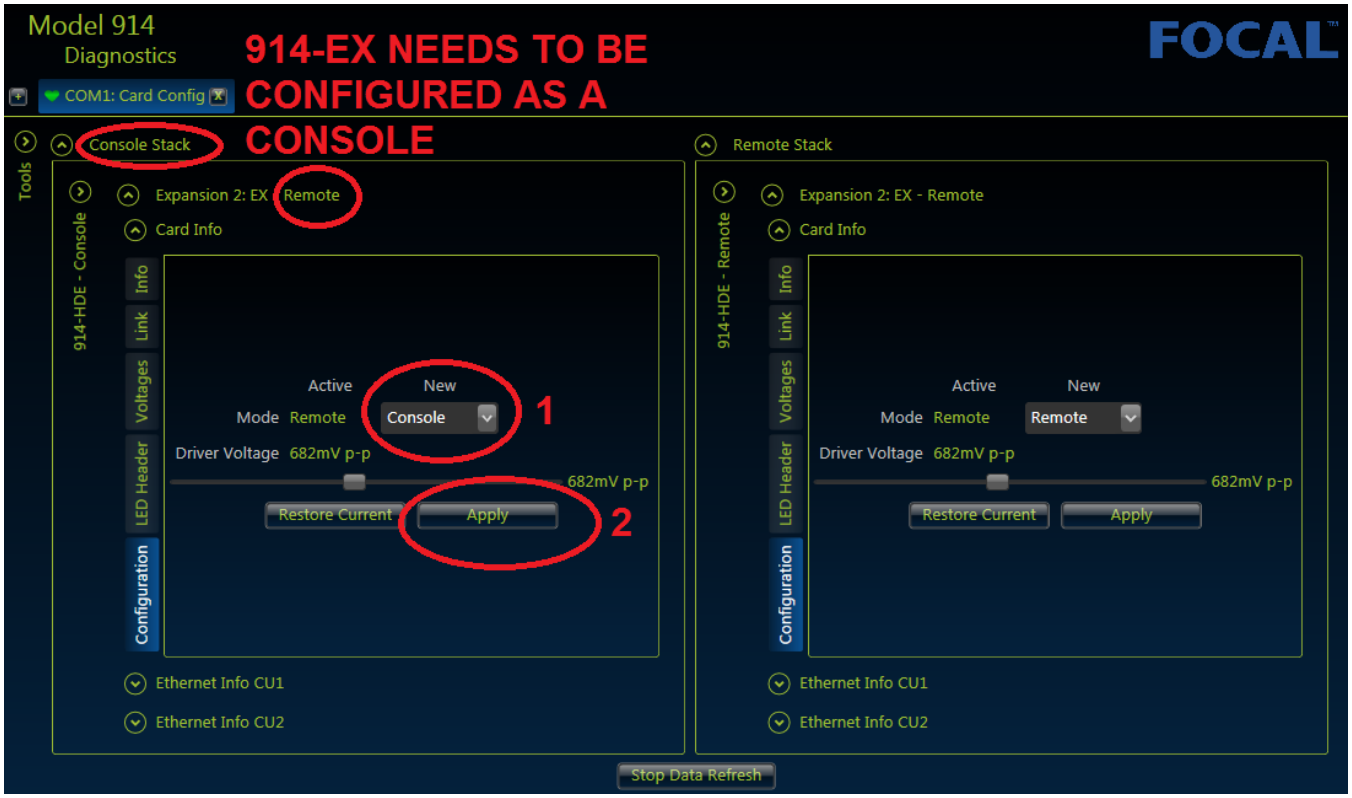

Figure 6-21: 914-EX Location Configuration

6.2.8 914-EX Ethernet Port Configuration

To alter the Ethernet port 1 settings from the GUI, click on “Ethernet Info Cu1” then “Settings” tab as shown in Figure 6-12. Press ON or OFF for the desired settings and wait for each change to take effect. Figure 6-22 shows a Console Ethernet port 1 that has 1000 BASE-T negotiation disabled. The process to alter Ethernet port 2 settings is the same, but in the “Ethernet info Cu2” GUI section.

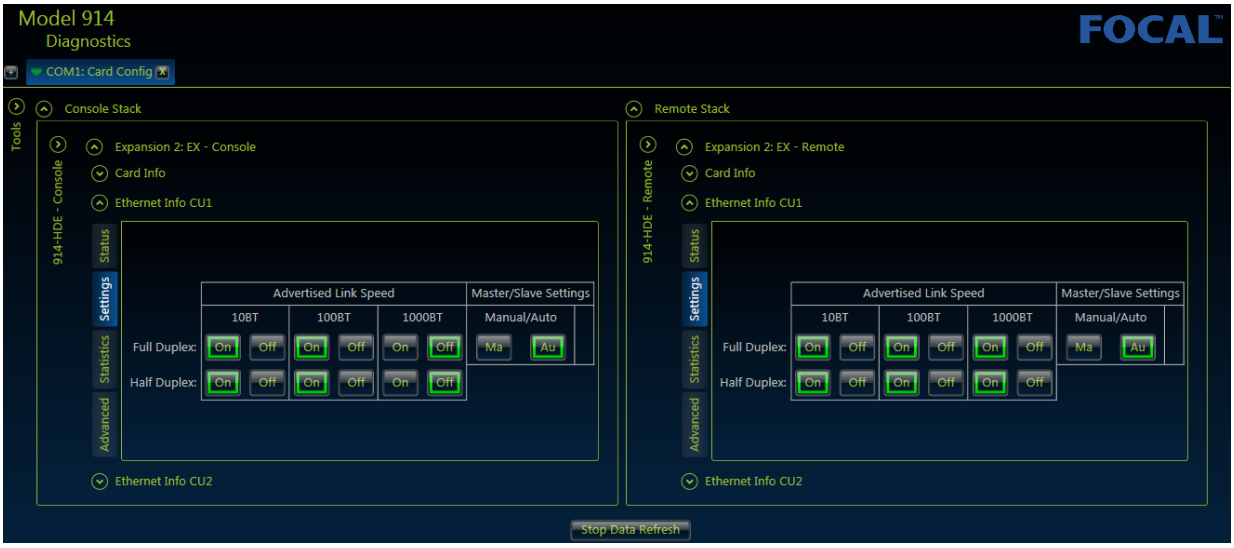

Figure 6-22: 914-EX Ethernet Port Configuration

Current Ethernet port link status is shown in the GUI in the “Status” tab as shown in Figure 6-23.

Figure 6-23: 914-EX Ethernet Port Link Status

6.2.9 914-EX Diagnostics

In a similar manner to the 914-HDE, the 914-EX has available diagnostics from the GUI including all voltages and the junction temperature of the FPGA. Any value shown in green is operating within normal specification. Values in red or yellow should be examined.

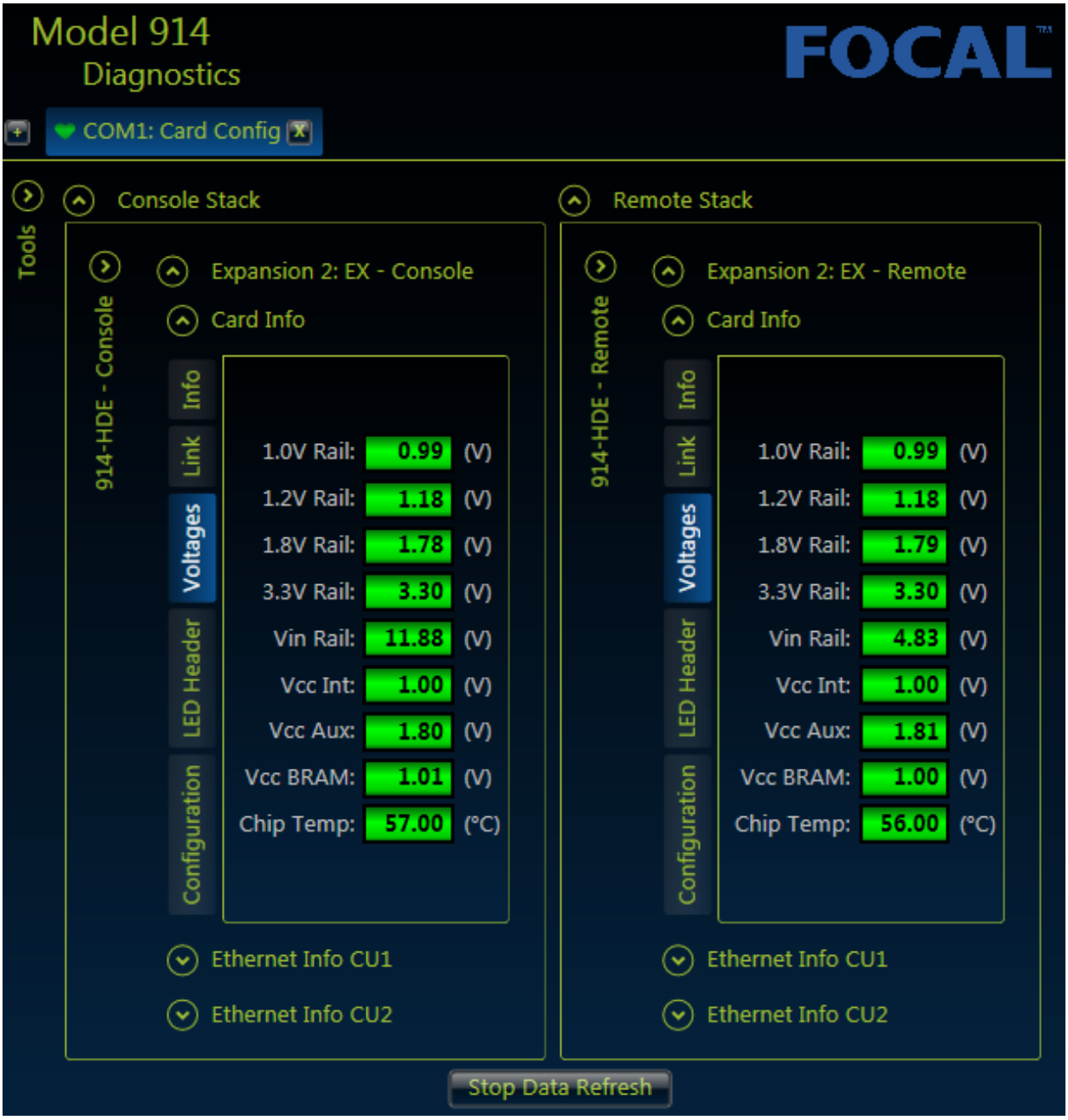

Figure 6-24: 914-EX Voltages and Temperature

6.3 914-AX

The 914-AX (Adaptable Interface Board Expansion) is an adaptor board to provide one data channel which can support a range of existing AIB (Adaptable Interface Board) modules. These boards provide simple single channel interface add-ons for serial data, sonar data, TTL signals, CAN bus or hydrophones. These ports are multiplexed into the 914-HDE optical data stream. This expansion card bandwidth is included with the baseline 914-HDE bandwidth, and uses 1 of the 4 Low Speed (LS) expansion channels.

Figure 6-25: 914-AX

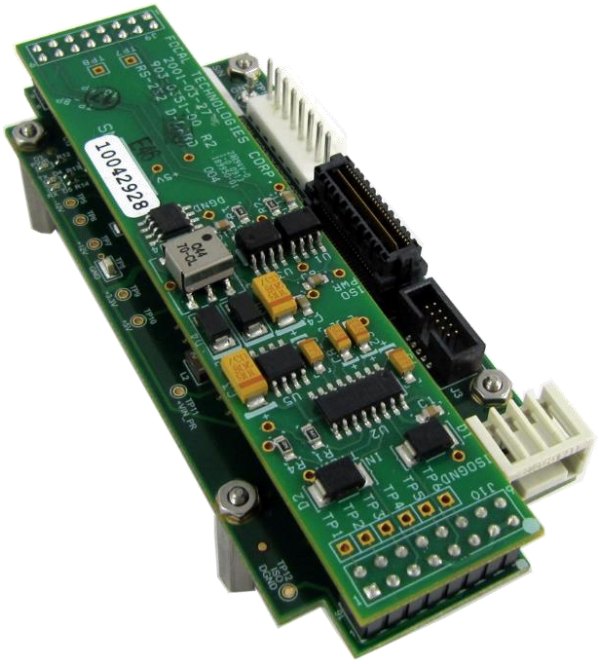

Figure 6-26: 914-AX with AIB-232 Module (example)

Figure 6-26 shows an example where one (1) isolated RS-232 channel can be added via the on-board expansion connector to the 914-HDE card. As shown, the small AIB module is plugged on top of the 914-AX card. Access to the isolated RS-232 channel is via the 4-pin WAGO connector (shown at the bottom right corner).

6.3.1 914-AX AIB Module Options

Table 6-13: AIB Module Options

Module ID	AIB 485	AIB 485	AIB 485	AIB 232	AIB HYDRO	AIB ARCNET	AIB MS900	AIB CANBUS
Signal	RS-485	RS-422	TTL	RS-232	Hydro-phone	Tritech ARCNET	MS900 Sonar	CAN bus
AIB Module Part Number	903-0252-00	903-0252-00	903-0252-01	903-0251-00	903-0244-00	903-0261-00	903-0250-00	903-0297-00

Please refer to 700-0271-00 AIB Plug-in Module User Guide for details and configurations.

6.3.2 914-AX AIB Module Installation

When installing an AIB module onto the 914-AX across connectors J5 and J6, always ensure the white dots on both the AIB module and the 914-AX line up for proper orientation.

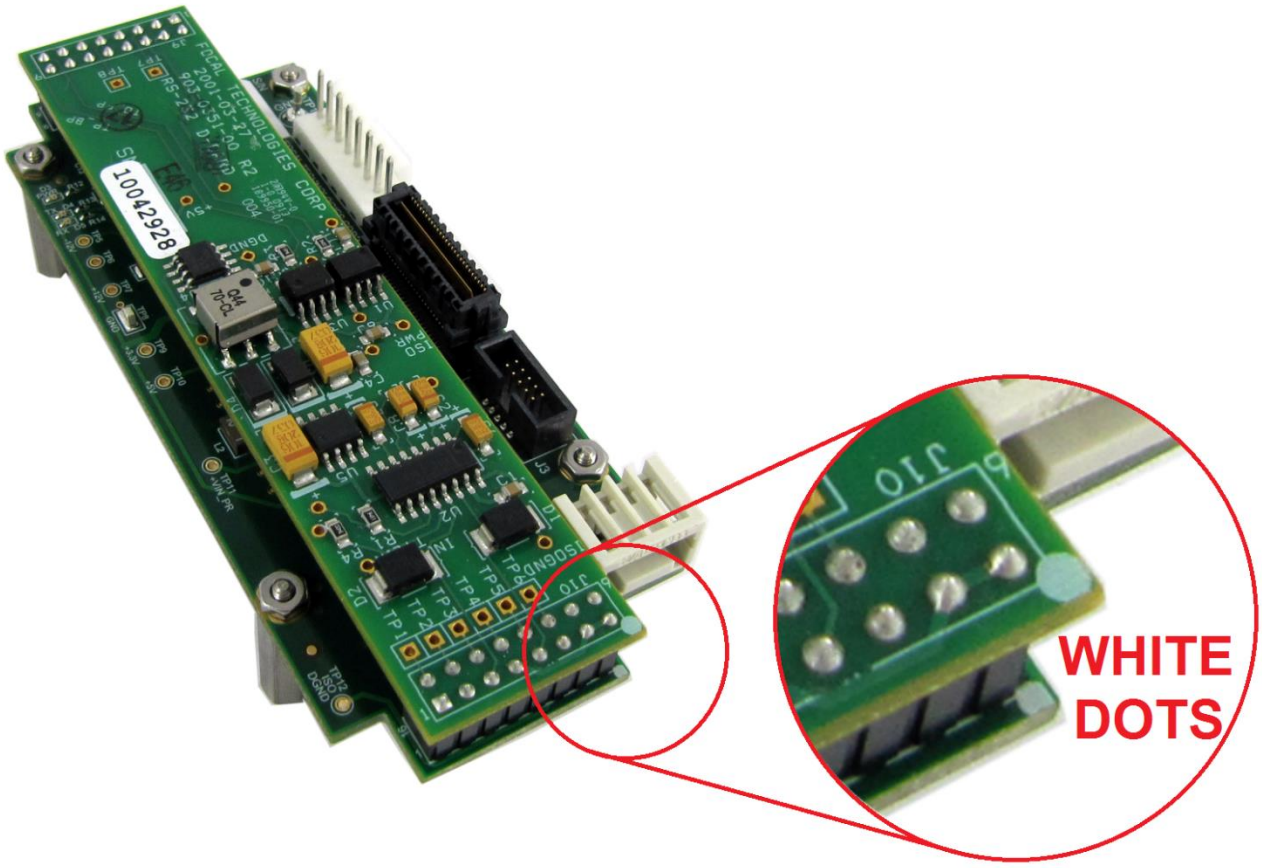

Figure 6-27: AIB Module Orientation

6.3.3 914-AX Interface Connector

The pinout of the WAGO connector P/N 733-364 on the 914-AX card is dependent on the installed AIB module.

Table 6-14: 914-AX Interface Connector Pinouts

PIN	AIB-485 (RS-485)	AIB-485 (RS-422)	AIB-485 (TTL)	AIB-232 (RS-232)	AIB-HYDRO (ANALOG)	AIB-ARCNET (TRITECH)	AIB-MS900 (SONAR)	AIB-CANBUS (CAN bus)
1	A (+)	+RX	INPUT	ISOGND	CHASSIS	CHASSIS	CHASSIS	CAN H
2	B (-)	-RX	N/C	RXD	N/C	LAN A	N/C	CAN L
3	N/C	+TX	OUTPUT	TXD	HYDRO-	LAN B	SONAR	BUS (GND)
4	N/C	-TX	ISOGND	CHASSIS	HYDRO+	N/C	SONAR	Shield

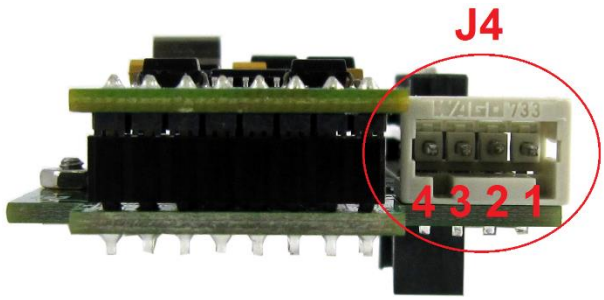

Figure 6-28: 914-AX WAGO Connector

Headers for the external connections are all four-pin, right-angled 733 series WAGO connectors (mating WAGO connectors are P/N 733-104). Pin locations of the WAGO headers are shown in Figure 6-28. Corresponding pins of the mating connector, use cage clamps rather than screw terminals to hold wires in place. External wires should be 20-28 AWG stranded conductors with 0.22” - 0.24” stripped ends. The clamp for each pin can be opened up by inserting either a WAGO tool or a small screwdriver in the hole immediately above the wire hole.

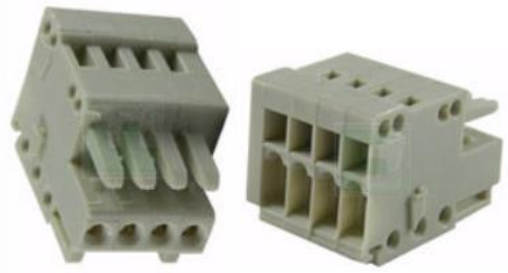

Table 6-15: 914-AX WAGO Connector Mating Plug

6.3.4 914-AX Diagnostic LEDs

The 914-AX card includes 3 on-board diagnostic LEDs. A description and location of each LED is provided in Table 4-7 and Figure 6-29.

Table 6-16: 914-AX Diagnostic LEDs

Reference Designator	Color	Description
D3	Green	Power. Lit when power is received via the expansion connector.
D4	Green	AIB Tx data. Tx refers to transmit from the 914-AX.
D5	Yellow	AIB Rx data. Rx refers to receive at the 914-AX.

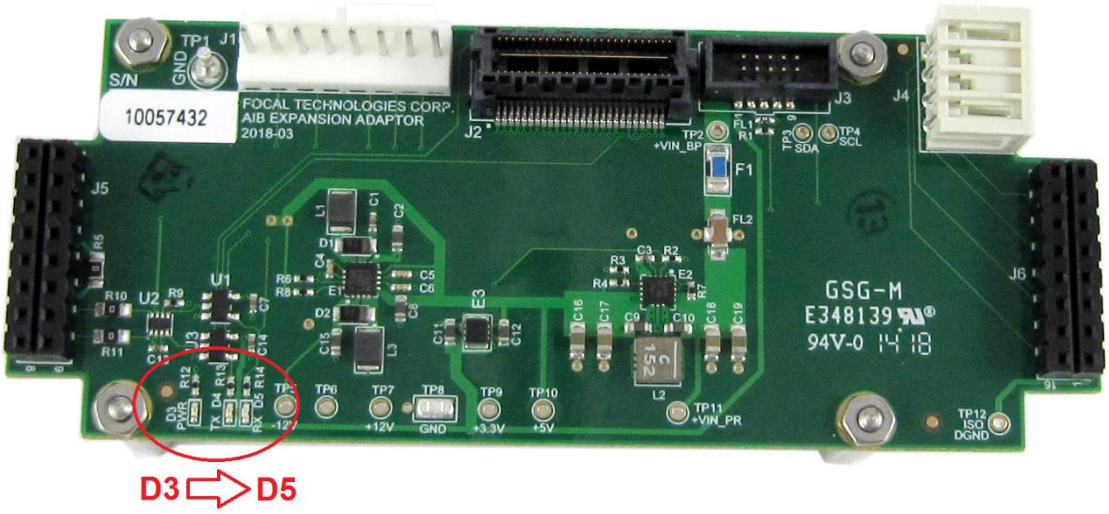

Figure 6-29: 914-AX Diagnostic LEDs

6.3.5 914-AX Diagnostic LED Header

The 914-AX card includes a 10-pin header capable of driving 8 LEDs. This is useful for LED integration into an enclosure. Each LED pin is driven low to turn on an LED, and includes a 267 ohm resistor in series to limit the current draw. Maximum current draw is 8 mA. Refer to section 4.7 for a sample connection diagram.

The LED header is FCI P/N 20021521-00010T1LF, and the mating part is FCI P/N 20021444-00010T1LF. This can be used with most 0.050" (1.27mm) spacing ribbon cables.

Table 6-17: 914-AX Diagnostic LED Header Pinout

Pin	Name	Description
1	3.3V	3.3V This pin can be used to drive the LEDs, Maximum current is 0.5A.
2	AIB TX DATA	Data is transmitting from the AIB module. Active low.
3	AIB RX DATA	Data is received at the AIB module. Active low.
4	N/C	N/C
5	N/C	N/C
6	N/C	N/C
7	N/C	N/C
8	N/C	N/C
9	N/C	N/C
10	GND	Ground, non-isolated, connected to 914-HDE input voltage ground.

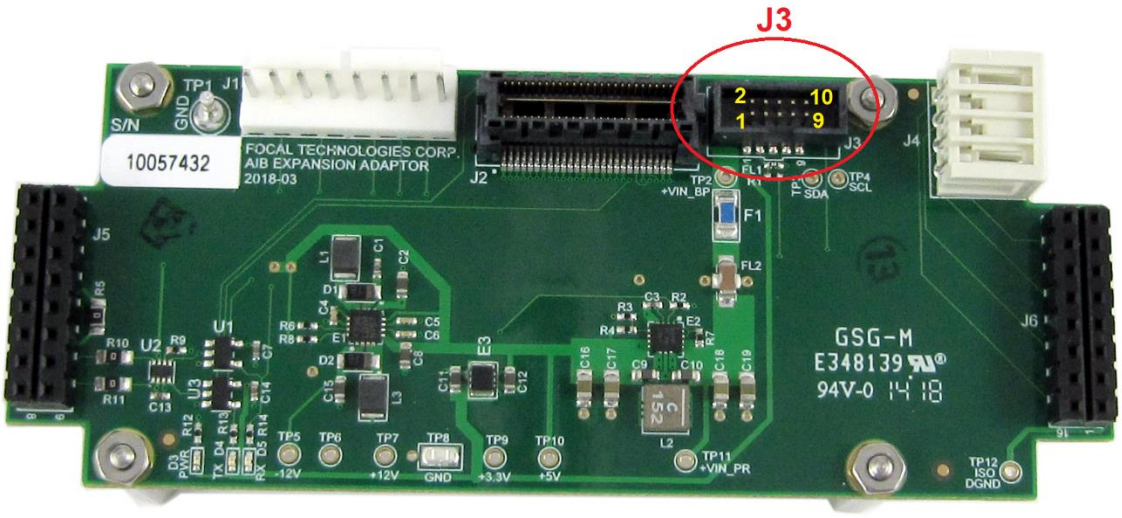

Figure 6-30: 914-AX Diagnostic LED Header

6.3.7 914-AX Configuration and Diagnostics

The 914-AX does not require any specific configuration, however, the installed AIB module may require configuration. Please refer to the AIB Plug-In Modules User's Guide 700-0271-00 for configuration details specific to the installed AIB module.

Up to four 914-AX with associated AIB modules may be added to a 914-HDE system. The 914-AX closest to the 914-HDE will show up as channel one in the diagnostic GUI. Tx and Rx activity status may be observed via the 914-HDE diagnostics in the "Low Speed Expansion" tab.

Figure 6-31: 914-AX Data Activity

6.4 914-DX (Preliminary Information)

The 914-DX provides 6 channels of isolated serial data. The serial channels are isolated in pairs and can each be individually configured for RS-232, RS-485 or RS-422. The 914-DX does not require additional bandwidth from the 914-HDE as it is already included with the standard 914-HDE bandwidth calculation. Diagnostics from this card are provided to the 914-HDE and is available to the Model 914 Diagnostic GUI. This expansion card requires 1 low speed expansion channel. Consult factory for more information.

6.5 Custom 914-X Series

The 914-HDE expansion connector has been designed to enable future upgrades and addition of new 914-X Series cards that can be developed in the future to support other types of electrical signals or protocols. Please contact Moog Focal to discuss other applications or custom board needs.

7.0 914 Media Converters

Media converters provide conversion of high bandwidth signals to fiber on a 1:1 basis. These are useful additions to systems as upgrades, or act as standalone optical converters for simple systems with only a single data type.

Media converter cards may be added to a 914-HDE system using the same standoffs and 21/32" (16.67 mm) spacing as other 914-HDE system cards when directly stacked together. Media converter cards do not require an electrical link to 914-HDE system cards, or other media converter cards other than the fiber optic link when using a CWDM module.

7.1 914-HDV2

The Moog Focal Model 914-HDV2 is a standalone media converter solution for one or two 3G/HD/SD-SDI video feeds per card. This card has the same form factor and mounting requirements as the rest of the 914-HDE series, and can have the optical signals combined with a 914-HDE system via available optical CWDM cards.

The compact size and high optical budget make the 914-HDV2 an ideal solution for long distance transmission of uncompressed low latency video signals. 4K video over dual link 3G-SDI is supported using a single 914-HDV2, and multiple 914-HDV2 cards may be combined for transmission of 4K video over quad link 3G-SDI.

Figure 7-1: 914-HDV2

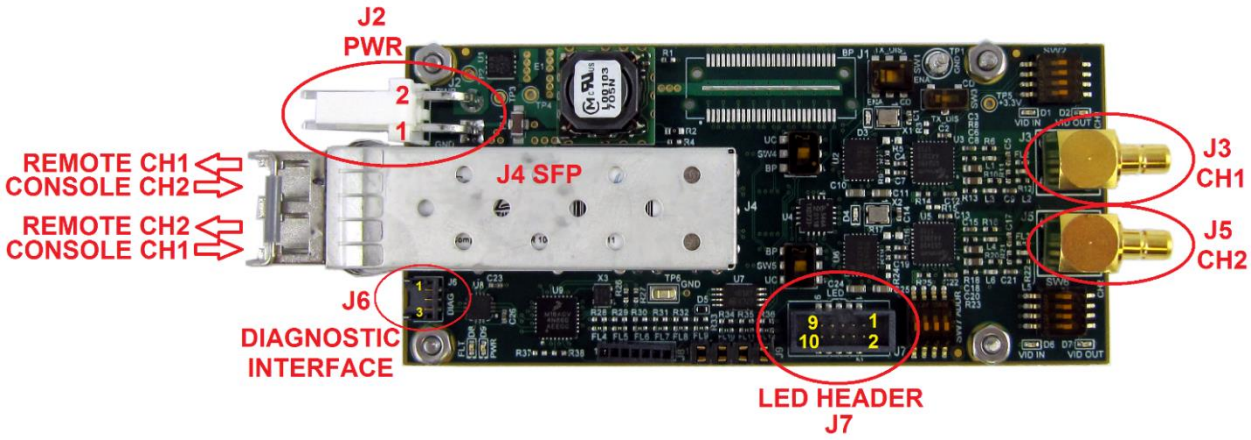

Figure 7-2: 914-HDV2 Interface Locations and Pin Numbering

7.1.1 914-HDV2 Video Connections

The 914-HDV2 card has two video ports, supporting 3G/HD/SD-SDI video conforming to SMPTE 259M-C, SMPTE 292M, and SMPTE 424M. On the remote card the video channels are inputs, and on the console they are outputs.

The connectors are a Mini SMB jack, Amphenol P/N 142146-75. Recommended mating plug is Cinch P/N 131-8403-101, although other 75 Ω Mini SMB plugs may be suitable. Cabling should be RG-179, 75 Ω coaxial type. Video latency through the media converter system is less than 1 μs, not including fiber delays of 5 ns/m.

Figure 7-3: Mini SMB Jack - Amphenol P/N 142146-75

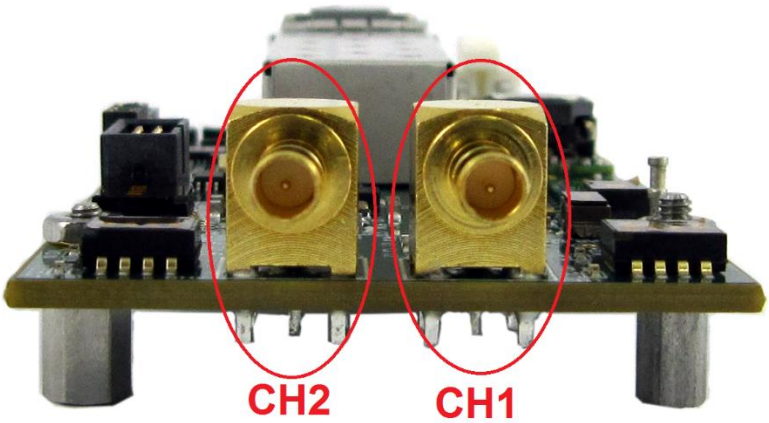

Figure 7-4: Video I/O Locations

7.1.2 914-HDV2 Optical Connections

914-HDV2 cards typically use dual transmitter optics at the remote end, and dual receivers at the console. Note that the channel nomenclature is inverted when switching configurations.
For single channel 914-HDV2 configurations, the CH1 location (only) should be used.

All versions of the 914-HDV2 use high powered optical transceivers, a minimum link loss or attenuation of 10 dB is suggested.

Bushings on the SFP optical transceiver are standard LC. Fiber type is singlemode.

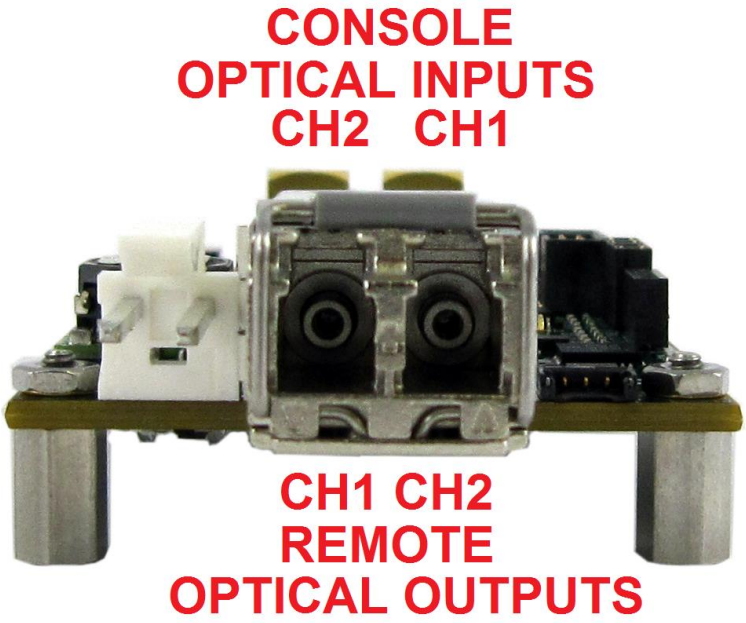

Figure 7-5: 914-HDV2 Optical Interface

7.1.3 914-HDV2 Power

Power to the 914-HDV2 card is provided through connector J2, Molex P/N 09-75-2024. The mating plug is Molex P/N 26-03-4020 with crimps P/N 08-52-0113. The pinout is provided in the table and figure below.

Table 7-1: Power Connector Pinout

Pin #	Function
1	GND
2	VCC

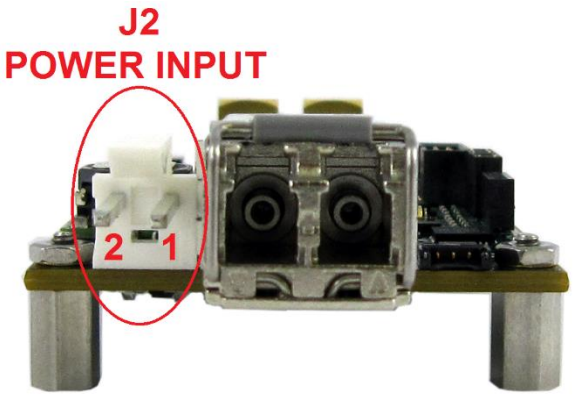

Figure 7-6: Power Input Connector Location

The recommended input voltage range is 4.5 VDC to 13.0 VDC (typically +5 VDC regulated). Nominal power consumption is 2.8 W, increasing to 3.2 W at 60º C ambient temperature. Power leads should be AWG 18 – 20.

The onboard surface mount fuse, F1, is rated to 2A and is not intended to be field replaceable. If the power fuse is blown, the card should be evaluated for damage by the factory or trained service personnel prior to any repair.

7.1.4 914-HDV2 Configuration

The 914-HDV2 is configured via dip switches, and not by software. Dip switches are pre-set to the appropriate settings based on the as shipped configuration and part number. MSA refers to single video channel assemblies using standard SFP transceivers, non-MSA refers to dual uni-directional transceivers that are default for the 914-HDV2. There are hardware differences between the MSA and non-MSA boards, do not alter the switch settings without consulting Moog Focal. The exception is SW2 and SW6 EQ and CD settings. This can be tuned to the video resolution and cable lengths as required.

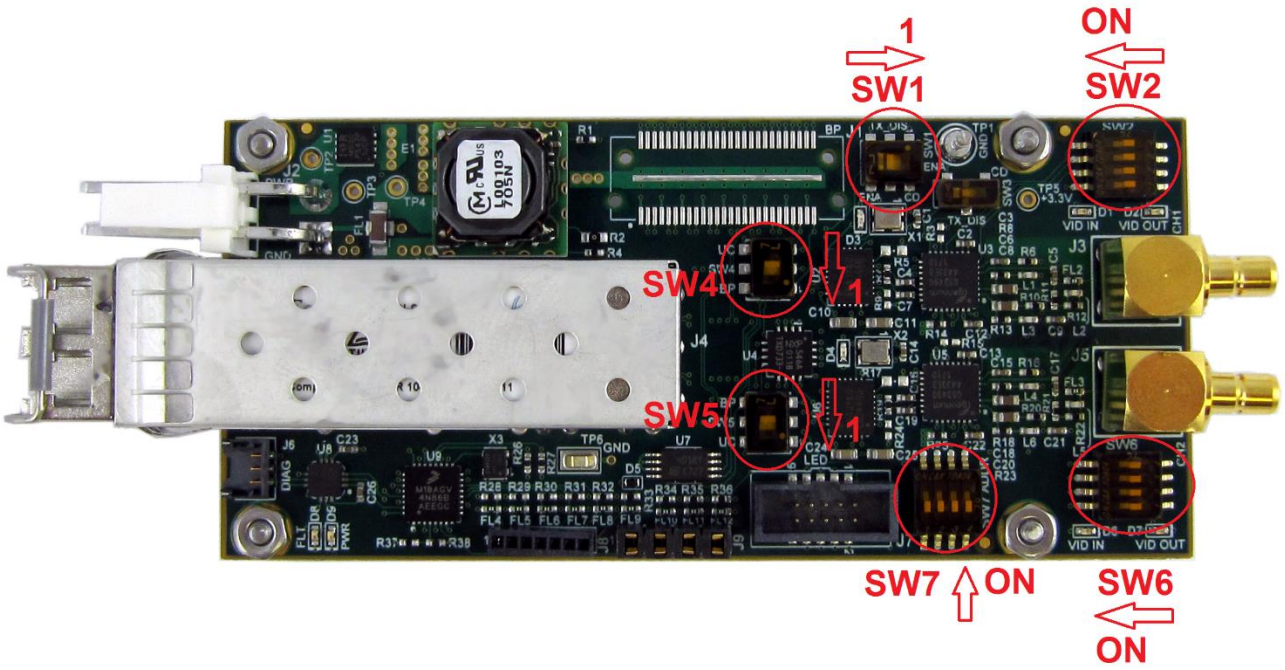

Figure 7-7: 914-HDV2 Configuration Dip Switches

Table 7-2: SW1 - SFP Transmitter Disable Non-MSA Mode

Function	SW1 Position
SFP Transmitter Disabled when no video is present (**default**)	1
SFP transmitter is always enabled, or MSA mode	2

Table 7-3: SW3 - SFP Transmitter Disable MSA Mode

Function	SW3 Position
SFP Transmitter Disabled when no video is present (**default**)	1
SFP transmitter is always enabled	2

Table 7-4: SW4 and SW5 Factory Programming Mode

Function	SW4 Position	SW5 Position
Factory Programming Mode	1	1
Diagnostics Mode (**default**)	2	2

Table 7-5: SW7 - DIAGNOSTICS IN MSA OR NON-MSA

Function	SW7[1]	SW7[2]	SW7[3]	SW7[4]
Diagnostics Mode (**default**)	OFF	OFF	OFF	N/A
Non-MSA Mode (**default**)	N/A	N/A	N/A	OFF
MSA Mode	N/A	N/A	N/A	ON

Table 7-6: SW2 (Channel 1) and SW6 (Channel 2): Input EQ or Output Cabled Driver Settings

Function	SWx[1]	SWx[2]	SWx[3]	SWx[4]
Video Output CD Mode	OFF (**CONSOLE**)	N/A	N/A	N/A
Video Input EQ Mode	ON (**REMOTE**)	N/A	N/A	N/A
EQ Gain Normal	N/A	OFF (**DEFAULT**)	N/A	N/A
EQ Gain Boost 6dB	N/A	ON	N/A	N/A
EQ Enabled	N/A	N/A	OFF (**DEFAULT**)	N/A
EQ Bypass	N/A	N/A	ON	N/A
Cable driver in SD Mode	N/A	N/A	N/A	OFF
Cable driver in HD Mode (console)	N/A	N/A	N/A	ON (**DEFAULT**)

7.1.5 914-HDV2 Diagnostic LED Header

The 914-HDV2 card includes a 10-pin header capable of driving 8 LEDs. This is useful for LED integration into an enclosure. Each LED pin is driven low to turn on an LED, and includes a 267 ohm resistor in series to limit the current draw. Maximum current draw is 8 mA.

The LED header is FCI P/N 20021521-00010T1LF, and the mating part is FCI P/N 20021444-00010T1LF. This can be used with most 0.050" (1.27mm) spacing ribbon cables.

Table 7-7: 914-HDV2 Diagnostic LED Header J7 Pinout

J7 Pin	Name	Description
1	3.3V	3.3V This pin can be used to drive the LEDs, Maximum current is 0.5A.
2	RX OPT LINK	Receive Optical Link Valid (MSA SFP only). Active low.
3	VID CH1 CD	Video Channel 1 Carrier Detect. Remote side only. Active low.
4	VID CH2 CD	Video Channel 2 Carrier Detect. Remote side only. Active low.
5	FAULT	Fault. (no SFP, No I2C diagnostics) Active low.
6	RX OPT LINK CH2	Receive Channel 2 Optical Link Valid (non-MSA SFP only). Active low.
7	RX OPT LINK CH1	Receive Channel 1 Optical Link Valid (non-MSA SFP only). Active low.
8	VID CH1 VALID	Video Channel 1 output is valid. Console only. Active low.
9	VID CH2 VALID	Video Channel 2 output is valid. Console only. Active low.
10	GND	Ground

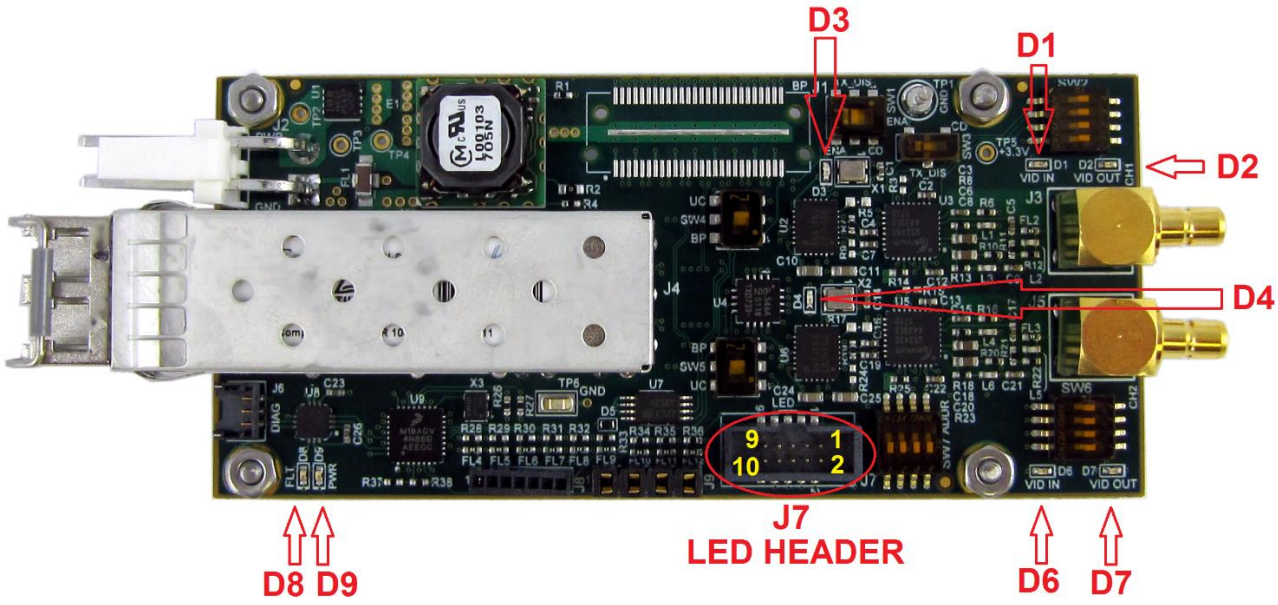

Figure 7-8: 914-HDV2 Diagnostic LEDs and LED Header

7.1.6 914-HDV2 Diagnostic LEDs

The 914-HDV2 card includes 8 on-board diagnostic LEDs. A description and location of each LED is provided in Figure 7-8 and Table 7-8.

Table 7-8: 914-HDV2 Diagnostic LEDs

LED	Description	Colour
D1	Video channel 1 input valid (remote)	Yellow
D2	Video channel 1 output valid (console)	Green
D3	Video channel 1 lock detect (remote)	Green
D4	Video channel 2 lock detect (remote)	Green
D6	Video channel 2 input valid (remote)	Yellow
D7	Video channel 2 output valid (console)	Green
D8	Power Fault. Outside of +4.5 V to +13.0 V range.	Red
D9	Power Good	Green

7.1.7 914-HDV2 Diagnostics

914-HDV2 has its own GUI and diagnostic connection separate from the 914-HDE motherboard. This diagnostic GUI cannot alter settings, nor can it access remote side diagnostics. It does give information regarding the health of the fiber links, the status of the video channels, and some standard board level diagnostics including voltages and temperatures. It also gives software access to all LED status.
Access to the RS232 diagnostic interface is via connector J6. Please refer to Section 5.0 for more information regarding this connector, pinout and cabling.
914-HDV2 diagnostic GUI part number is 914-0415-00 available via the Moog Focal website.

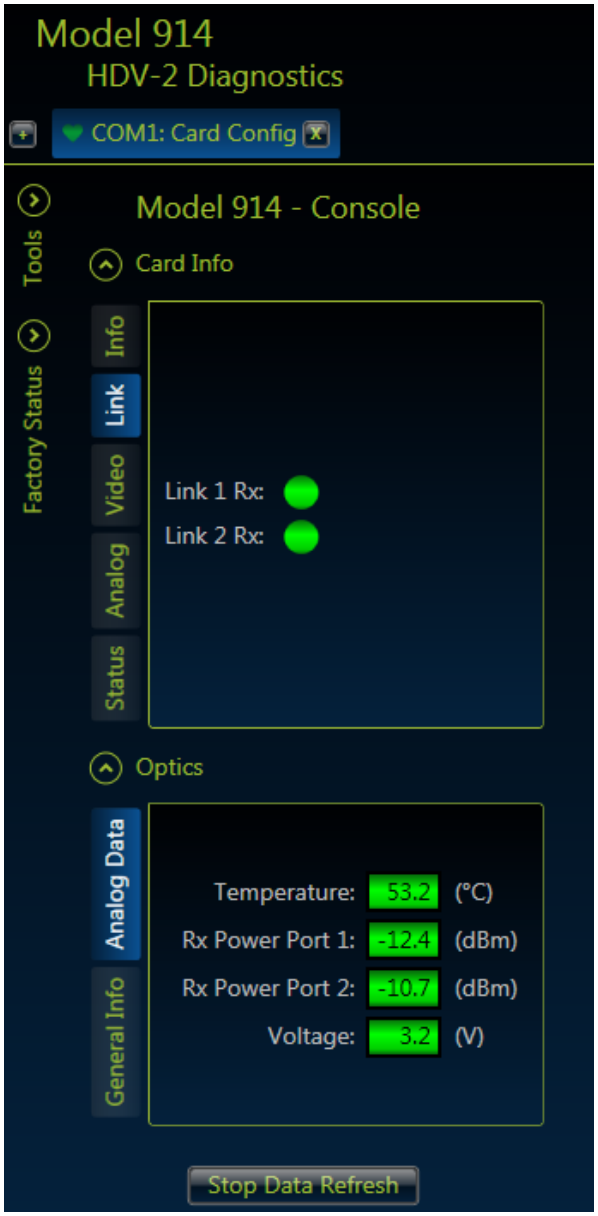

Figure 7-9: 914-HDV2 Optical Diagnostics

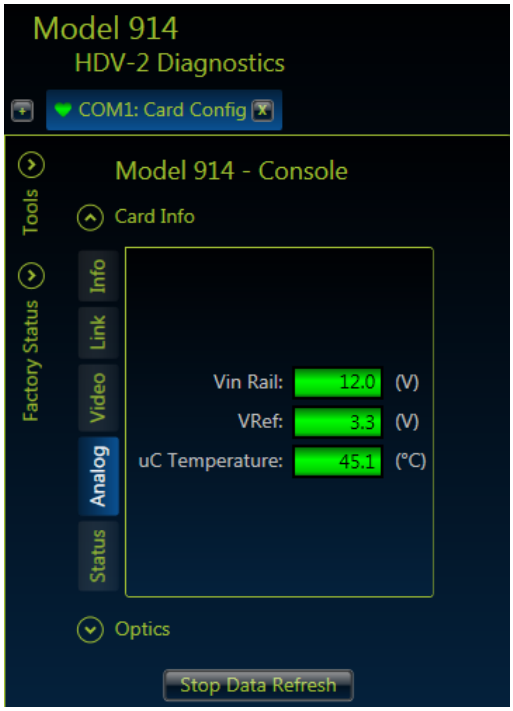

Figure 7-10: 914-HDV2 PCBA Diagnostics

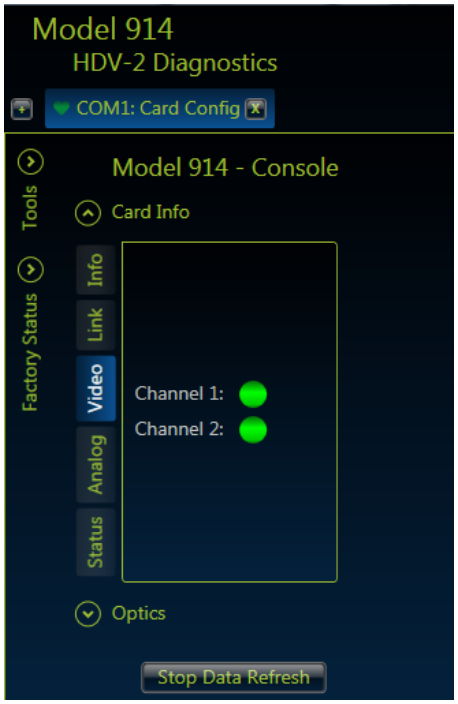

Figure 7-11: 914-HDV2 Video Diagnostics

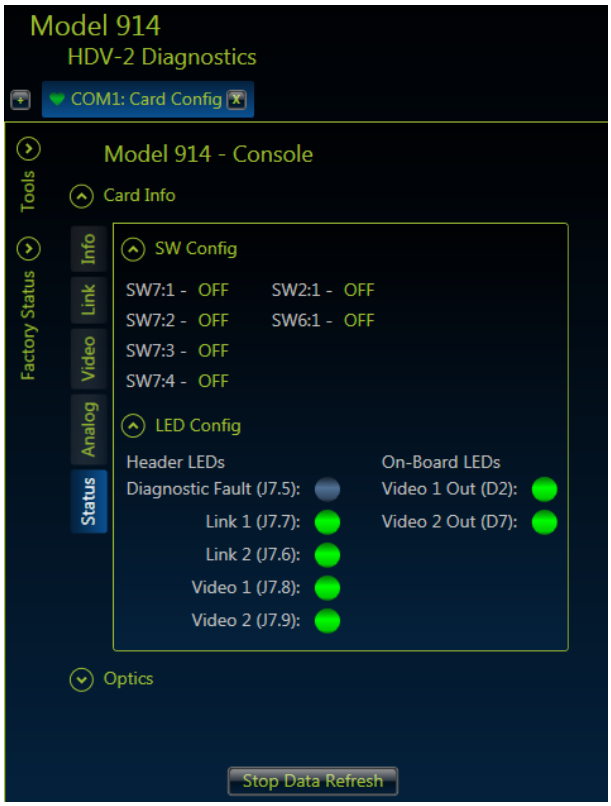

Figure 7-12: 914-HDV2 LED Diagnostics

8.0 914 Optical Cards

8.1 914-CWDM

The 914-CWDM allows a standard 1310 / 1550 nm bidirectional single fiber system to be upgraded with two new wavelengths. The standard upgrade is for 1471 / 1491 nm which can be used for a second 914-HDE system or for a 914-HDV2 dual HD video upgrade.

8.2 914-CWDM-4R1

The 914-CWDM-4R1 allows four standard red band wavelengths to be combined onto a single fiber. A blue band bypass is optional for system upgrades. 1471 / 1491 / 1511 / 1531 nm are the four multiplexed wavelengths. Other wavelength options are possible. Contact Moog Focal for part numbers.

8.3 914-CWDM-8R

The 914-CWDM-8R allows all eight standard red band wavelengths to be combined onto a single fiber. A blue band bypass is optional for system upgrades.
1471 / 1491 / 1511 / 1531 / 1551 / 1571 / 1591 / 1611 nm are the eight multiplexed wavelengths (red band).

8.4 914-SPLIT

The single fiber link can be split onto 2 fibers for communication and fiber redundancy. Please contact Moog Focal for details.

8.5 914-FOS

Redundant fiber systems integrate a switch to choose which fiber is active. Please contact Moog Focal for details.

9.0 Moog Focal Optical Transceivers

Moog Focal OEM SFP optical transceivers are available for sparing, replacements, and upgrades. Pressure tolerant versions of the 4.25 Gbps SFPs are available.

Table 9-1: SFP Optical Transceiver Options

	4.25 Gbps Bi-Directional SFP	4.25 Gbps CWDM SFP	10.3 Gbps Bi-Directional SFP	10.3 Gbps CWDM SFP
Wavelengths (nm)	1310 / 1550	All 18 CWDM wavelengths	1270 / 1330	All 8 red CWDM wavelengths
Connector Type	Single LC bi-directional	Dual LC Tx / Rx	Single LC bi-directional	Dual LC Tx / Rx
Fiber Type	Singlemode	Singlemode	Singlemode	Singlemode
Min bit rate (Gbps)	0.125	0.125	0.6	0.6
Max bit rate (Gbps)	4.25	4.25	10.3	10.3
Max Distance (km)	10	10	10	10
Optical budget (dB)	20	24	20	23
Tx Power (dBm) min	0	0	0	0
Rx Sensitivity (dBm)	- 20	-24	-20	-23
Case Operating temperature (C)	-40 to +85	-20 to +85	-40 to +85	-20 to +75
Available as pressure tolerant	Yes Max 3000 PSI	Yes Max 6000 PSI	No	No
Compatibility	914-HDE L1/M1	914-HDE L1/M1	914-HDE H1	914-HDE H1

Refer to Section 13.9 for part numbers.

10.0 914-X Series System Installation and Operation

10.1 Installation

The 914-X Series is intended to be installed in an enclosure with access to conductive cooling, or in an environment with airflow. 914-X Series is designed to ensure low power consumption and tolerance of wide operating temperatures. It is, however, the responsibility of the system integrators to ensure that adequate cooling is provided to the units. In particular, the optical transceiver (J5) must not exceed a case temperature of +85 °C and the FPGA, U5, should not exceed a junction temperature of +100 °C as reported by the diagnostic GUI. To accomplish this, it is recommended to provide direct conductive cooling to the four mounting holes. Recommended mounting hardware is #2-56 type and is included with the cards. Ensure any mating hardware (standoffs, nuts, washers) are fully clear of any onboard parts, solder joints, and electrical traces. Thermally conductive hardware is recommended for mounting the card stacks. The mounting holes are electrically isolated from the system ground and are connected to a thermal layer in the PCB. These mounting holes should be used to provide conductive cooling to the PCB.

Stacking height for expansion cards is 16.00 mm to 17.22 mm. Nominal height should be minimum 16.15 mm (0.636”) to take into account component tolerances. A 4.00 mm (minimum) standoff should be used under the 914-HDE to ensure bottom side components have sufficient clearance. Standard 5/32” standoffs are supplied with the 914-HDE for mounting, along with 21/32” standoffs for expansion and media converter cards. Thermal gap material should be used under the 914-HDE to further extract heat from the card.

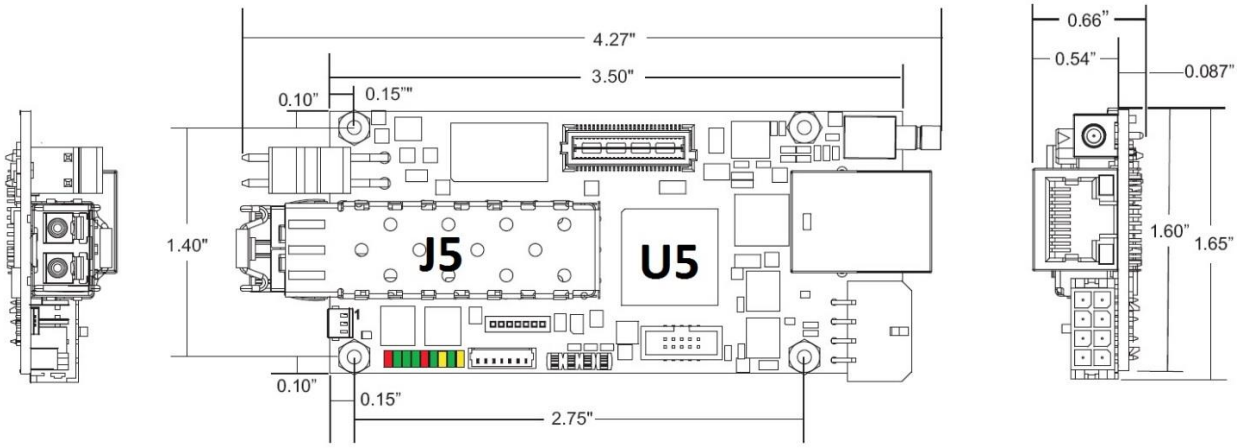

Figure 10-1: 914-HDE Dimensions

When mounting, disassembling, or reassembling the 914-HDE (and stack), ensure that no fibers are subjected to bends in excess of those held by the natural routing of the fibers. The minimum bend radius of the fibers should be no less than 25 mm, though single partial bends may be less than this – as low as 15 mm – without damaging the fiber. Allowable long term values for bend radius are dependent on the fiber type and environment. Avoid even temporary bends with a radius less than 15 mm, which may affect the long-term reliability of the fiber.

To ensure that the system maintains link and reliability through high shock and/or vibration environments, it is recommended to secure the fiber LC connectors in the transceiver bushings using MIL-A-46146 equivalent RTV, such as Dow Corning 3145 clear RTV. RTV may also be applied to power and data connectors, if required.

10.2 Card Stacking

Expansion cards are stacked using the expansion connectors as a high speed backplane system. Ensure the orientation of the cards match, and observe the genders of the expansion connectors. Male connectors are always on the top (component) side of the board, and female connectors on the bottom.

1. Bench level testing of the 914-HDE system should be performed prior to permanent installation of the cards using Loctite and/or epoxy. This will allow all interfaces to be configured and tested with the user equipment prior to committing to the assembled hardware configuration.
2. Mounting order:
    a. **Top card**: Optical card(s) [914-CWDM; 914-FOS; 914-SPLIT]
    b. Media converter card(s) [914-HDV2]
    c. Low speed expansion card(s) [914-AX; 914-DX]
    d. Medium speed expansion Card(s) [914-VDX; 914-EX]
    e. **Base card**: Motherboard [914-HDE]
3. Install the 914-HDE Motherboard to a suitable mounting plate.
    a. Use the 5/32” standoffs with thermal gap material under the card to provide a good conductive cooling path to the mounting plate and/or enclosure.
    b. Alternatively ensure there is adequate airflow to provide cooling to the 914-HDE Motherboard.
    c. If no expansion cards are required, install the supplied nuts with Loctite 290 (or similar).
    d. If expansion cards are required, move to step 4.
4. Install the supplied 21/32” standoffs with Loctite 242 (or similar) to the 914-HDE or 914 card directly under the next expansion card.
    a. Stack the expansion card carefully onto the expansion header while lining up the standoffs to the mounting holes. The card should seat directly down on all sides simultaneously with little resistance.
    b. Optionally install a 914-HDE high speed ribbon cable with Loctite SI 595 CL RTV for expansion connector retention. Refer to Section 10.3 for details.
        i. Complete the first card with supplied nuts and Loctite 290 or similar.
        ii. Start the next stack with the male end of the ribbon cable epoxied to the bottom side female expansion connector. Use Loctite SI 595 CL RTV to retain this connector in place.
        iii. Start the new stack with supplied 21/32” standoffs.
    c. Repeat step 4 for each Expansion card.
5. Complete the stack with supplied nuts and Loctite 290 (or similar) to retain the top card.

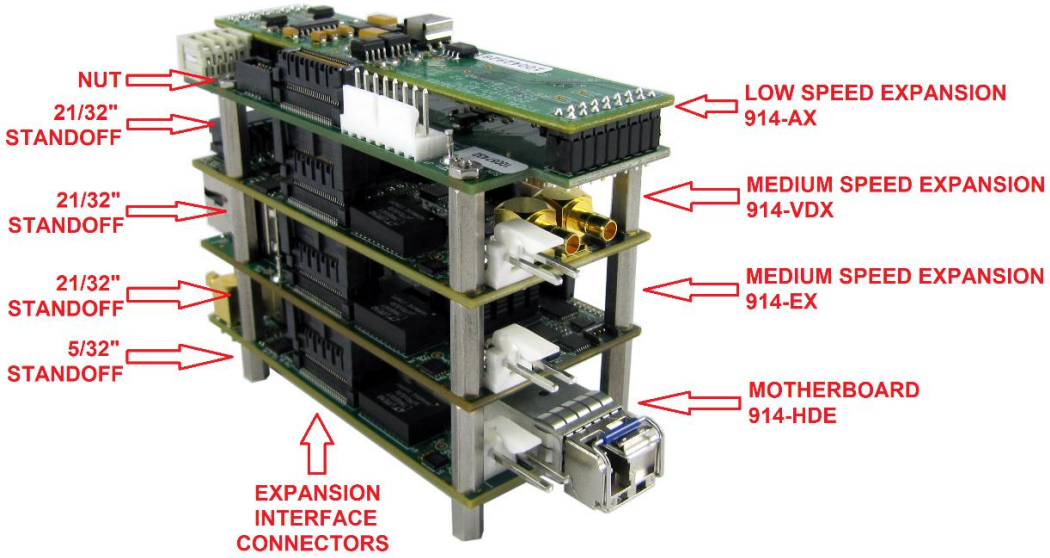

Figure 10-2: 914-X Series System Stack

10.3 914-X Series Expansion Interface Ribbon Cables

When specifying a large stack to fit into a small enclosure or pressure bottle, it may be desirable to break the stack into smaller pieces. This can be accomplished with Moog Focal 914-X Series expansion interface high speed ribbon cables. Specify lengths from 3” to 18” with orientations for inline mounting vs side-to-side mounting.

Figure 10-3: 914-X Series Expansion Interface High Speed Ribbon Cable

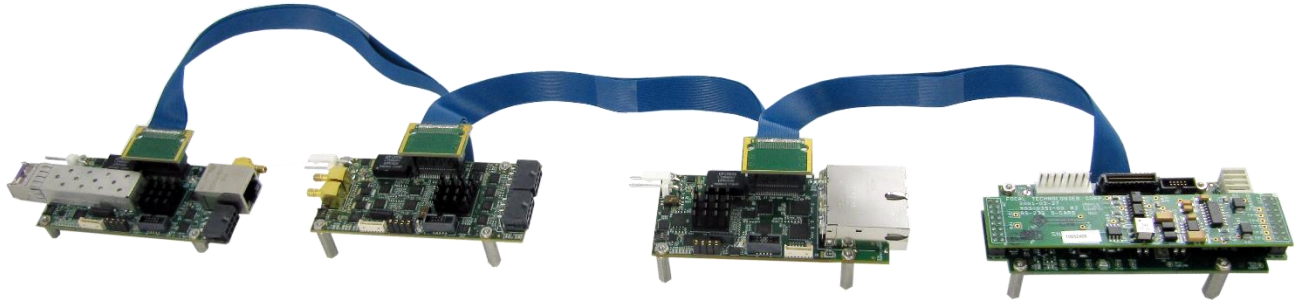

Figure 10-4: 914-X Series Linear (inline) Layout

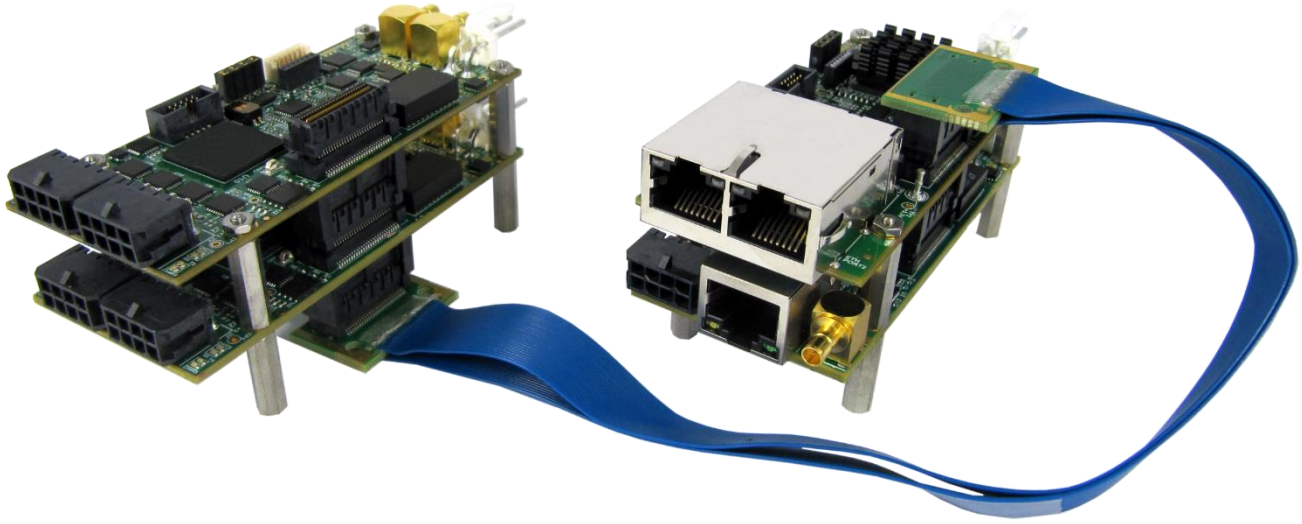

Figure 10-5: 914-X Series System Dual Stack (side-to-side) Layout

Many other configurations are possible, these are representative examples.

10.4 914-X Series Bench Test

Basic Link Operation

Basic operation of the uplink (remote to console) and downlink (console to remote) can be verified in a bench test simply by connecting fiber jumpers between the optical transceivers. The number of jumpers and the optical attenuation required depends on the optical configuration of the system under test. In some optical configurations, it may be required to use 5 or 10 dB optical attenuators placed between the fiber bushings on the mux (remote) card and the bushings on the demux (console) card to ensure the optical receivers are not saturated. Complete a flux budget calculation for your system, referring to the optical transmit power and receive overload level to determine whether optical attenuation is required or not.

After power is applied to the 914-HDE, the power LED D6 should be on (green). A red Link Fault LED D9 indicates insufficient received optical power, typically due to excessive loss in the fiber link. Excessive loss may be caused by poor fiber connections (contaminated bushings, damaged fiber, damaged ferrules) or excessive fiber bends.

CARE MUST BE TAKEN WHILE HANDLING FIBER. DO NOT TOUCH THE TIP OF THE FIBER CABLE (FERRULE) SINCE CONTAMINATION WILL OCCOUR. ALL FIBER CONNECTIONS MUST BE INSPECTED AND VERIFIED TO BE CLEAN PRIOR TO FINAL INSTALLATION.

If the basic optical link is present (LED D8 is on), there should be data continuity through the multiplexer system to provide video and serial data links.

Optical Power Budget Test

1. To verify the console to remote flux budget (downlink), measure the transmit power of the console card by connecting the optical output directly to a calibrated optical power meter using a short, low-loss, test jumper. (Ensure the correct fiber type is used. All fibers must be of the same type. e.g. for SM normally 9 um core, for MM 50 um or 62.5 um core)

2. Remove the test jumper and install a variable optical attenuator (VOAT) between the console and remote cards.

3. Adjust the VOAT until the red Link LED on either one of the modules turns on, then reduce the loss to the point where both green link LEDs are continuously on. A stable serial data connection is a good reference point.

4. Measure the received optical power at the remote side by connecting that end of the VOAT to the optical power meter. The difference between the transmit power previously measured and this receive measured power is an estimate of optical power budget. A spool of fiber used with the VOAT can also be used to simulate dispersion effects over long cable lengths.

5. Repeat steps 1-4 with connections reversed to verify the remote to console (uplink) optical budget.

10.5 914-X Series Electrical and Environmental Specifications

The tables below summarize the electrical power requirements and environmental specifications of standard products. Cards can be configured and/or screened at the factory for extended performance, such as higher operational temperatures.

Table 10-1: Electrical Specification

Electrical Specification	Min	Typ	Max	Units
Power Voltage (In)	4.5	5	13.0	Volts
Power 914-HDE		5.0	6.0*	Watts
Power 914-VDX**		2.9	3.6*	Watts
Power 914-EX**		3.5	4.2*	Watts
Power 914-AX**		0.1****	1.15*	Watts
Power 914-HDV2		2.8	3.2*	Watts

Table 10-2: Environmental Specification

Environmental Specification	Min	Typ	Max	Units
Temperature Range (Operational)	-10		+60***	Celsius
Temperature Range (Storage)	-50		+85	Celsius
Humidity			85% RH, non-condensing	
Shock			30 g, 11 ms half sine, 3 axes	g
Vibration			5 g, 25-1000 Hz, 3 axes	g, Hz

* The maximum power is with a 12V input at +60ºC.
** This power is in addition to the 914-HDE, all stacked cards and their associated power ratings must be combined to calculate a total system power rating.
*** Higher operational temperatures are possible by using thermal management to ensure electronic parts do not exceed a case temperature of +85ºC.
**** 914-AX power is highly dependent on the AIB module installed.

Input amperage must not exceed 4 A, if close to 20 W is required, the power supply must use a higher nominal voltage e.g. 12 V.

10.6 914-X Series Maintenance

The unit requires no routine maintenance or calibration for the specified performance. Maintenance of the units is limited to cleaning the various components using the methods described below.

Dust or dirt on the cards can be blown off using compressed air. If severe contamination of the cards should occur, they can be removed and cleaned using distilled water. Cards must be thoroughly dried before reapplying power.

In order to maintain optical performance, please refer to the following optical considerations.

Optical Considerations

1. **Observe the bend radius of fiber optic cables at all times**
   When mounting, disassembling, or reassembling the cards in your system, ensure that no fibers are subjected to bends in excess of those held by the natural routing of the fibers. The minimum bend radius of the fibers should generally be no less than 25 mm, though single loops may be less than this – as low as 15 mm – without damaging the fibers. Keep in mind that allowable values are dependent on the type of fiber and the environment, and cable manufacturers typically specify the minimum bend radius. Avoid even temporary bends with a radius less than 15 mm, which may induce cracks that affect long-term reliability of the fibers. In general, fiber jumpers and pigtails should be periodically inspected for damage, such as nicks in the jackets or excessive bends.

2. **Ensure fiber optic components are of the same type**
   All jumpers, cables, connectors, couplers, and Fiber Optic Rotary Joints (FORJs) used in the external optical system connecting the remote to console multiplexer must use the same type of fiber.

The 914-X Series system has singlemode SFP transceivers installed and therefore all components in the fiber link should also be singlemode, typically Corning SMF-28 (9/125 µm) or equivalent. A single mismatched jumper in the system may cause intermittent or persistent optical link errors. Do not rely on cable jacket or connector colors alone to determine the type of optical fiber.

3. Use clean connectors

It is critical to ensure all fiber connectors are clean and free of dirt and debris. Even a small amount of dirt or fluid contaminant may degrade link performance, and most reported optical link problems are due simply to poor or contaminated optical connections.

- Keep protective dust covers on fiber connectors and bushings when not in use.
- Do not touch the white ceramic ferrules of the connectors with bare hands or objects, other than cleaning materials.
- Prior to making a fiber connection, clean the barrel and tip of the ferrule using a suitable solvent, such as reagent grade isopropyl alcohol, and a lint free optics cleaning tissue, such as *Kimwipes® EX-L*. Carefully dab any dirt or debris off the face of the ceramic ferrules. Excessive dirt may need to be cleared with pressurized air from a can prior to wiping the ferrule to avoid scratching the fiber itself. Do not used air from a compressor as it may be contaminated with oil.
- During mating or unmating of fiber connectors with bushings, keep the connector aligned as straight as possible. Avoid side loading the ceramic ferrule, which can crack the internal alignment sleeve in the bushing.
- It is recommended that each fiber connector is inspected with a handheld fiber microscope prior to final assembly to ensure there are no scratches, pits, debris, or fluid contamination on the fiber face.

	**NEVER** look into the end of a fiber when it is plugged into a transceiver or active fiber, especially when using a magnifying instrument, such as a fiber microscope.

Figure 10-6 shows an LC connector which is a small form-factor fiber optic connector that uses a 1.25 mm ferrule and incorporates a push-and-latch design similar to an RJ-45 connector. **Error! Reference source not found.** shows an ST fiber optic connector that uses a 2.5 mm ferrule. The ST connector is latched into place by twisting to engage a spring-loaded bayonet socket.

Figure 10-6: LC connector

Figure 10-7: ST connector

4. Maintain good optical connections

SFP optical transceivers typically have a transmit and receive optical bushing (LC type), which requires dual fiber operation. The transmit side (Tx) and the receiver side (Rx) of a dual LC port SFP is shown in the figure below.

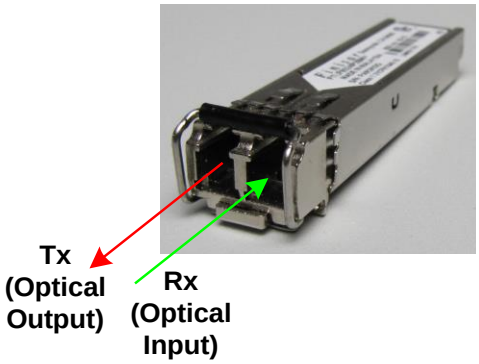

Figure 10-8: SFP Transceiver (Dual LC)

5. **Maintain proper optical power levels**

   Optical receivers will experience errors if the received optical power is too low. Ensure the total optical losses of the components in the external cable system (jumpers, cable, connectors, couplers, FORJ, etc.) are less than the specified optical power budget of your system. For any detailed measurements or trouble-shooting a calibrated optical power meter should be used.

   Optical receivers can also saturate and experience errors if the received optical power is *too high*, especially when using high power transceivers. Use a 5 or 10 dB fixed attenuator in line with each fiber during bench tests or with short, low loss links to ensure a minimum level of attenuation is present. A variable optical attenuator (VOAT) can also be used for testing. In some high power systems, receivers can actually be damaged by excessive optical power, so a fixed attenuator is recommended even with a VOAT.

10.7 914-X Series System Product Handling

General Handling

Care must always be taken during the handling of the 914-X Series cards to ensure product integrity. The following guidelines should be observed while working with the card:

- Handle products at an ESD safe workstation with a clean surface.
- Ensure fibers are not crimped or moved away from their intended routes.
- Ensure any disconnected optical connectors are cleaned immediately prior to reconnection.
- Do not exceed the recommended minimum fiber bend radius, even momentarily.
- Mishandling may cause damage to the optical transceiver, video or serial connectors, or internal components. The multiplexers must always be handled appropriately during installation, operation, maintenance, storage, and transportation to ensure safe and problem free operation.
- Any visible damage or evidence of loose parts requires removal of the multiplexer from operation and investigation by qualified service personnel.

10.8 914-X Series Accessories

914 accessory kits are available from Focal, these include mating cables for all interfaces. Please contact your local Moog Focal representative for more information including orderable part numbers.

10.9 914-X Series Dimensions

10.9.1 914-HDE

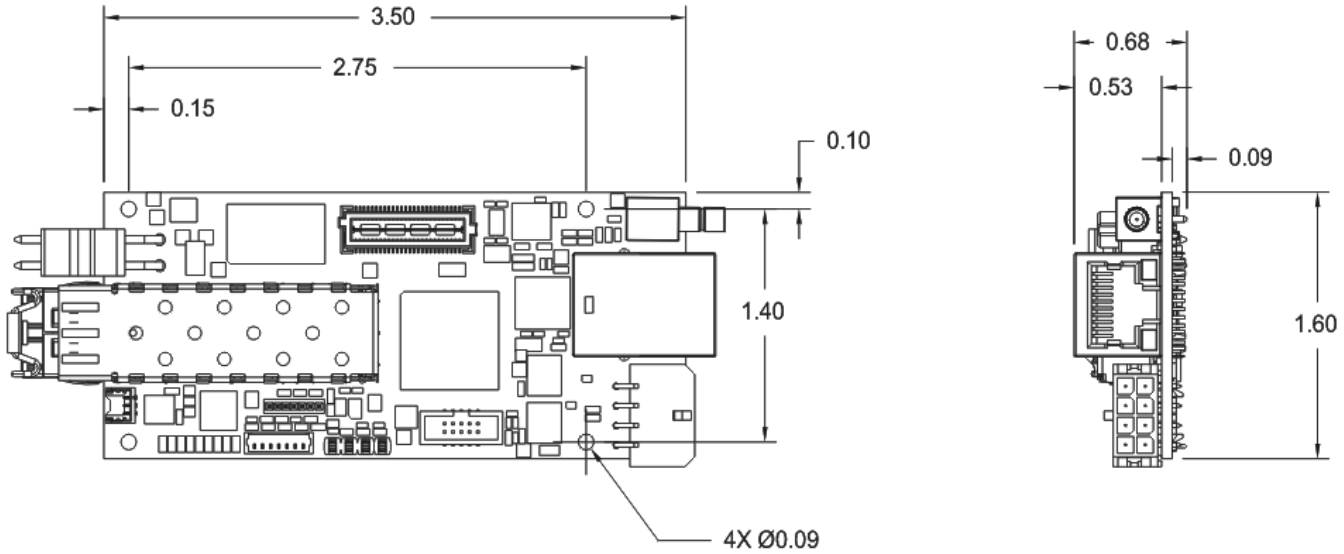

Figure 10-9: 914-HDE Dimensions (inches)

10.9.2 914-VDX

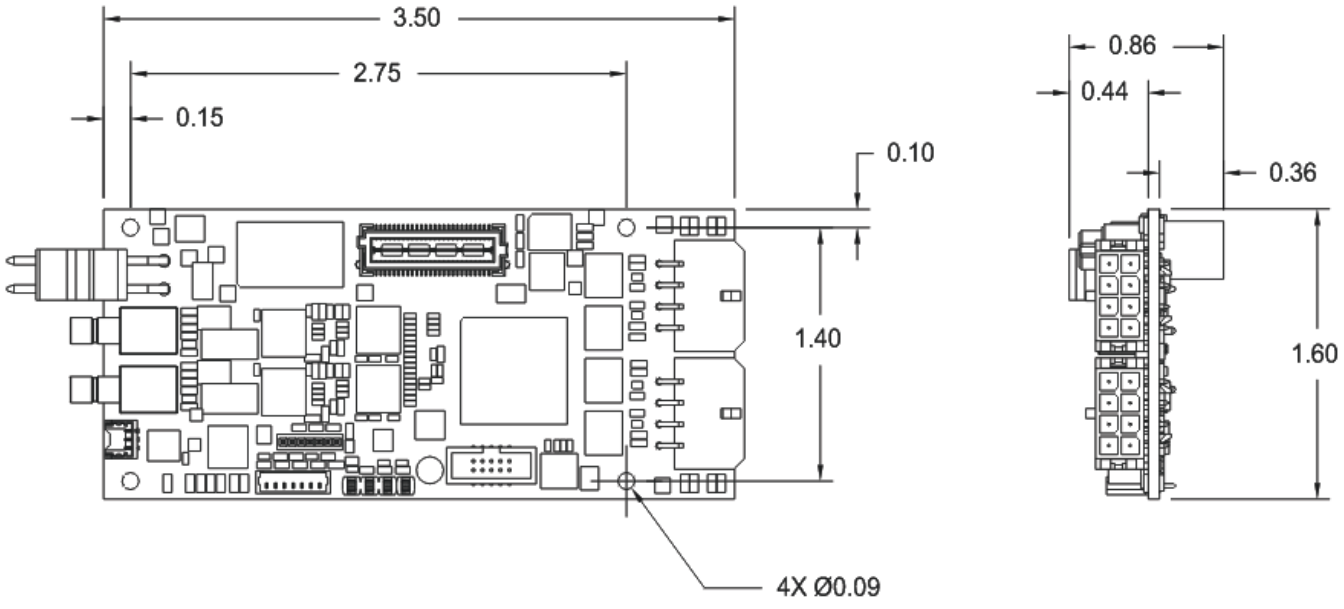

Figure 10-10: 914-VDX Dimensions (inches)

10.9.3 914-EX

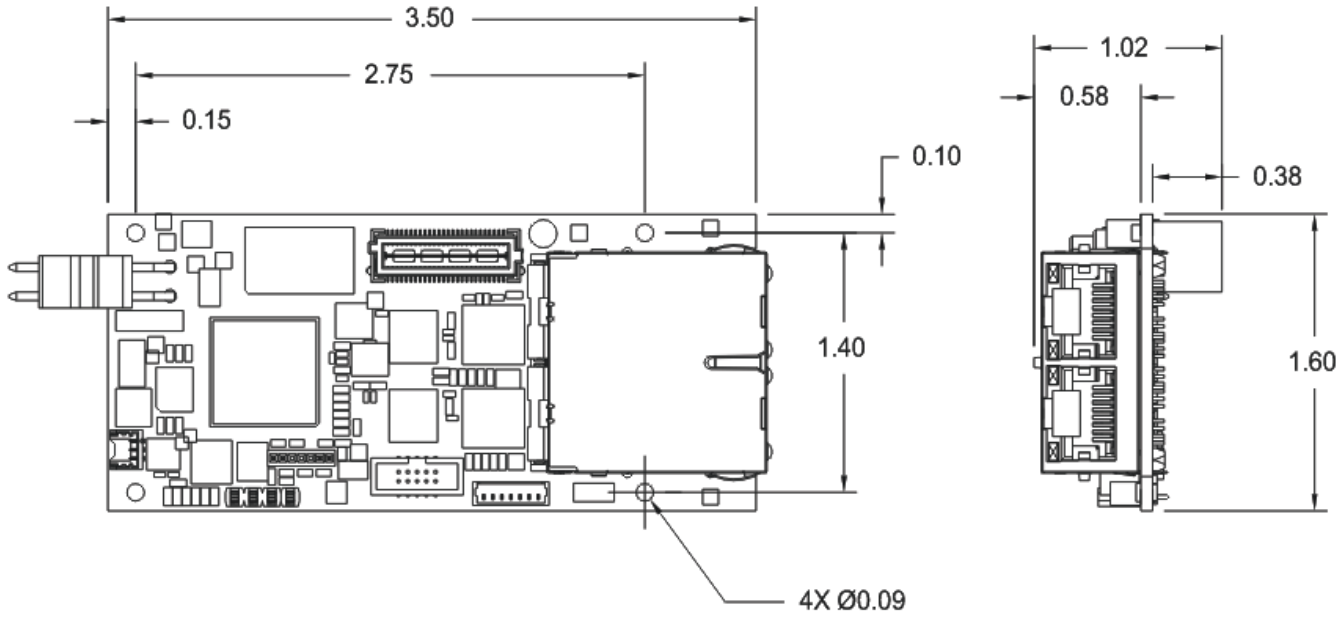

Figure 10-11: 914-EX Dimensions (inches)

10.9.4 914-AX

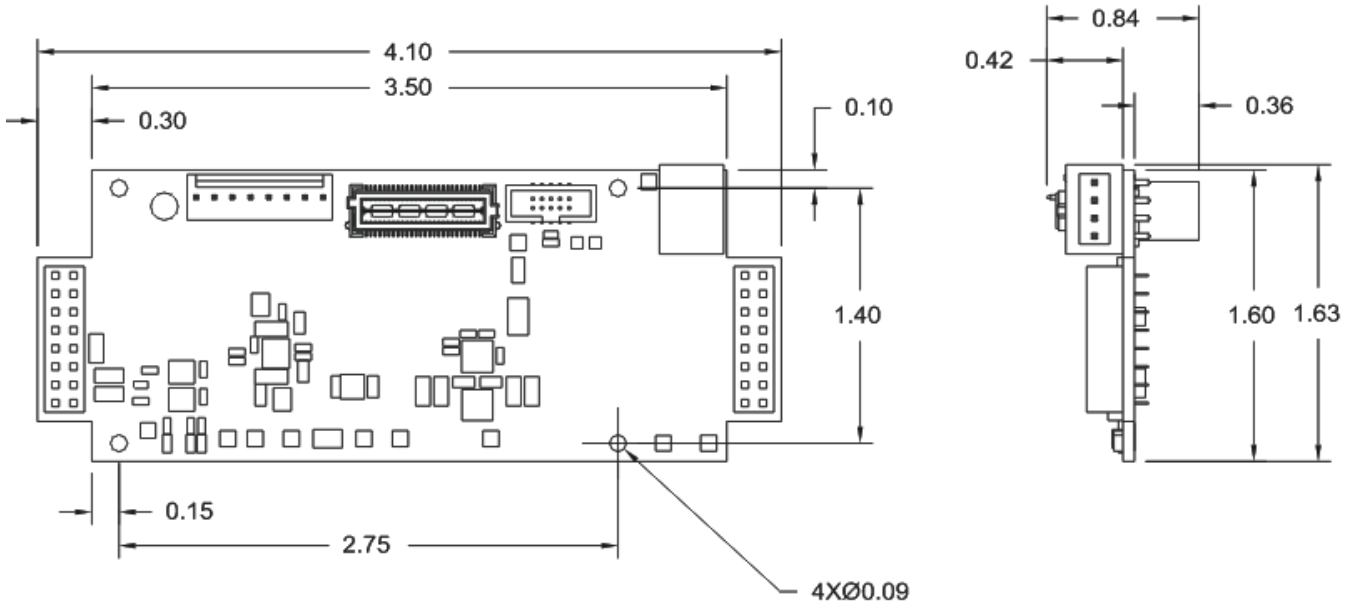

Figure 10-12: 914-AX Dimensions (inches)

10.9.5 914-HDV2

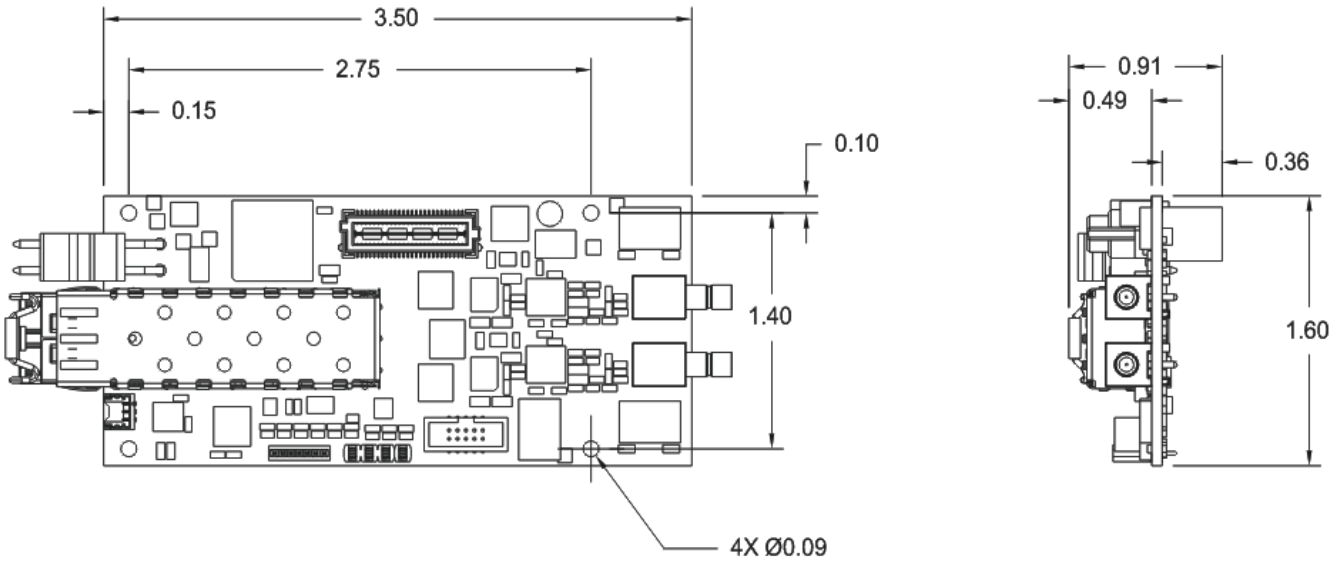

Figure 10-13: 914-HDV2 Dimensions (inches)

10.10 Connector Part Numbers

Table 10-3: Connector Part Numbers

Card	Type	Mfr. Name	On-Board P/N [Description]	Mating P/N [Description]
914-HDE	Power	Molex	09-75-2024 [2-pin]	26-03-4020 [plug] 08-52-0113 [Crimps]
	Video	Amphenol	142146-75 [SMB]	131-8403-101 [Cinch 75 ohm SMB plug, other SMB plugs will work, RG179 cabling is recommended]
	Ethernet	Wurth Elektronik	7499110122 [RJ45]	Standard 8P8C RJ45 plug; CAT5 or better cabling.
	Serial Data	Molex	43045-0800 [8-pin Microfit]	0430250800 [plug] 0430300010 [crimps]
	LED Header	FCI	20021521-00010T1LF [10-pin; 2 row]	20021444-00010T1LF [plug compatible with most 10 wire 0.05“ spacing ribbon cables]
	Diagnostics	Molex	0781710003 [3-pin]	0781720003 [3-pin plug]
914-VDX	Power	Molex	09-75-2024 [2-pin]	26-03-4020 [plug] 08-52-0113 [Crimps]
	Video	Amphenol	142146-75 [SMB]	131-8403-101 [Cinch 75 ohm SMB plug, other SMB plugs will work, RG179 cabling is recommended]
	Serial Data	Molex	43045-0800 [8-pin Microfit]	0430250800 [plug] 0430300010 [crimps]
	LED Header	FCI	20021521-00010T1LF [10-pin; 2 row]	20021444-00010T1LF [plug compatible with most 10 wire 0.05“ spacing ribbon cables]
	Diagnostics	Molex	0781710003 [3-pin]	0781720003 [3-pin plug]
914-EX	Power	Molex	09-75-2024 [2-pin]	26-03-4020 [plug] 08-52-0113 [Crimps]
	Ethernet	Bel Fuse	0826-1X2T-23-F [Dual RJ45 Array]	Standard 8P8C RJ45 plug; CAT5 or better cabling.
	LED Header	FCI	20021521-00010T1LF [10-pin; 2 row]	20021444-00010T1LF [plug compatible with most 10 wire 0.05“ spacing ribbon cables]
	Diagnostics	Molex	0781710003 [3-pin]	0781720003 [3-pin plug]
914-AX	Data	WAGO	733-364 [4-pin 2.5 mm]	733-104 [4-socket plug]
	LED Header	FCI	20021521-00010T1LF [10-pin; 2 row]	20021444-00010T1LF [plug compatible with most 10 wire 0.05“ spacing ribbon cables]
	Diagnostics	Molex	0781710003 [3-pin]	0781720003 [3-pin plug]
914-HDV2	Power	Molex	09-75-2024 [2-pin]	26-03-4020 [plug] 08-52-0113 [Crimps]
	Video	Amphenol	142146-75 [SMB]	131-8403-101 [Cinch 75 ohm SMB plug, other SMB plugs will work, RG179 cabling is recommended]
	LED Header	FCI	20021521-00010T1LF [10-pin; 2 row]	20021444-00010T1LF [plug compatible with most 10 wire 0.05“ spacing ribbon cables]
	Diagnostics	Molex	0781710003 [3-pin]	0781720003 [3-pin plug]

10.11 Signal Specifications

Table 10-4: Signal Specifications

Signal / Parameter		Min.	Typ.	Max.	Units
Diagnostics	RS-232		115		KBaud
Digital Video	SD/HD/3G-SDI	270	1485	2970	Mb/s
	Latency* (914-HDE)	20	25	30	µs
	Latency* (914-HDV2)			1	µs
Ethernet	Speed	10	100	1000	Mb/s
	Latency* (914-HDE)	3**	6**	30**	µs
	Latency* (914-EX)	15**	12**	40**	µs
Serial Data	RS-232 Data Rate			500	KBaud
	RS-485/422 Termination		120	open	Ω
	RS-485/422 Data Rate (914-HDE)			2500	KBaud
	RS-485/422 Data Rate (914-VDX)			1250	KBaud
	RS-485/422 Data Rate (914-DX)			500	KBaud
	Latency* (914-HDE)			50	µs
	Latency* (914-VDX)			500	µs
	Latency* (914-DX)			500	µs
Composite Video **NTSC/PAL**	Input Level		1	1.4	V
	Output Level		1	1.4	V
	Input / Output Impedance		75		Ω
	Digital Resolution		10		bits
	Signal to Noise Ratio		58		dB
	Differential Gain		1.4	2	%
	Differential Phase		0.6	1	Deg.
	Luminance Nonlinearity		4.0	6.0	%
	Latency*			500	µs
AIB Plug-in Modules	Latency*			50***	µs

* Latency figures comprise end-to-end electronic latency. Fiber optic latency of 5 µs/km is not included.
** Ethernet Latency is one frame time at the given Ethernet link speed plus the latency expressed in the table. Minimum latency is for 1000BASE-T, typical for 100BASE-TX, and maximum for 10BASE-T.
***Does not include latency through the AIB plug-in modules. Specifications for the AIB plugin modules are contained in the 700-0271-00 user guide.

11.0 Firmware Updates

If the factory has recommended a firmware update, these are the instructions to perform the update via the diagnostic interface.

1. Receive both the 914-0401-01_FW_UPDATER_GUI_Release.7z installer and the new firmware revision *.bin from Focal.
2. Decompress the 914-0401-01_FW_UPDATER_GUI_Release.7z file to the computer you plan to use to update the 914 cards. If the file you received contains an ‘x’ in the file extension, remove it.
3. Save the firmware *.bin file to the same computer
4. Connect the diagnostic port on the card to be updated to a COM port on the computer as per section 3 of this manual:
    a. J8 on the 914-HDE
    b. J7 on the 914-VDX
    c. J4 on the 914-EX
5. Ensure the card is powered OFF.
6. Run the “Model914FWUpdater.exe” application.
7. Select the COM port that is connected to RS232 Diagnostic of the 914 card.
8. Select the Model # to be updated (914-HDE, VDX, etc...).
9. Select “Clear Flash”.
10. Select the firmware *.bin file.
11. Press “Start FW Update”.
12. Power up the 914 card.
13. Wait for the update to complete (several minutes).
14. Power down the 914 card (it must be power cycled to take effect).
15. Repeat for all 914 cards that require an update, linked pairs must both have the same firmware version.

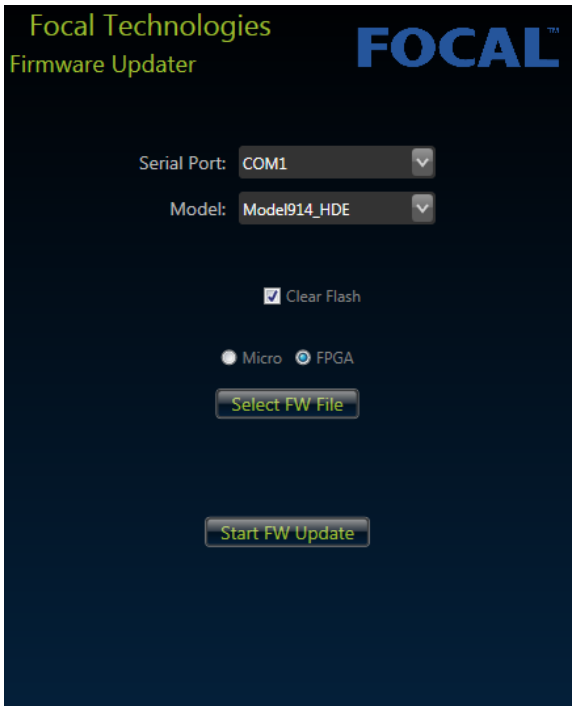

Figure 11-1: Firmware Update GUI

11.1 Firmware Compatibility

Table 11-1 shows compatible revisions in rows. Each row is only compatible with other products and revisions in that row.

Contact Moog Focal regarding non-standard updates of older products, or for compatible expansion cards for 914-HDE Rev 2 cards.

Table 11-1: Firmware Revisions

Release Dates	914-HDE Rev 2	914-HDE Rev 3	914-VDX	914-EX	914-DX
2015/09	A0	-	-	-	-
2015/11	A1	-	-	-	-
2015/12	A2	-	-	-	-
2016/03	B0	-	-	-	-
2016/06	B1	C1	-	-	-
2017/07	-	C2	A1	-	-
2017/11	-	C3	-	-	-
2018/05	-	C4	A2	A0	-

12.0 Feature Upgrades

If a feature upgrade has been purchased, these are the installation instructions. Feature upgrades allow 914-HDE L1 cards to be upgraded to M1 version, as an example. Contact Focal for upgrade options for your cards.

1. Obtain Feature upgrade codes from Focal, there are 2 codes: Unlock Code and Feature Code. Both codes are 16 digit hexadecimal alpha numeric numbers
2. Open the 914-HDE diagnostic GUI with the Console 914-HDE connected to a local COM port as per manual section 3.
3. Use the “Tools” slide over menu on the left side, and select the “Configuration Tool”.
4. Enter both the Unlock and Feature Code, and select the destination card (remote or console), then press “Apply”
5. Both remote and console cards can be upgraded from the console side, there is no need to directly access the remote card, but it must be powered and have a valid optical link to receive the upgrade.

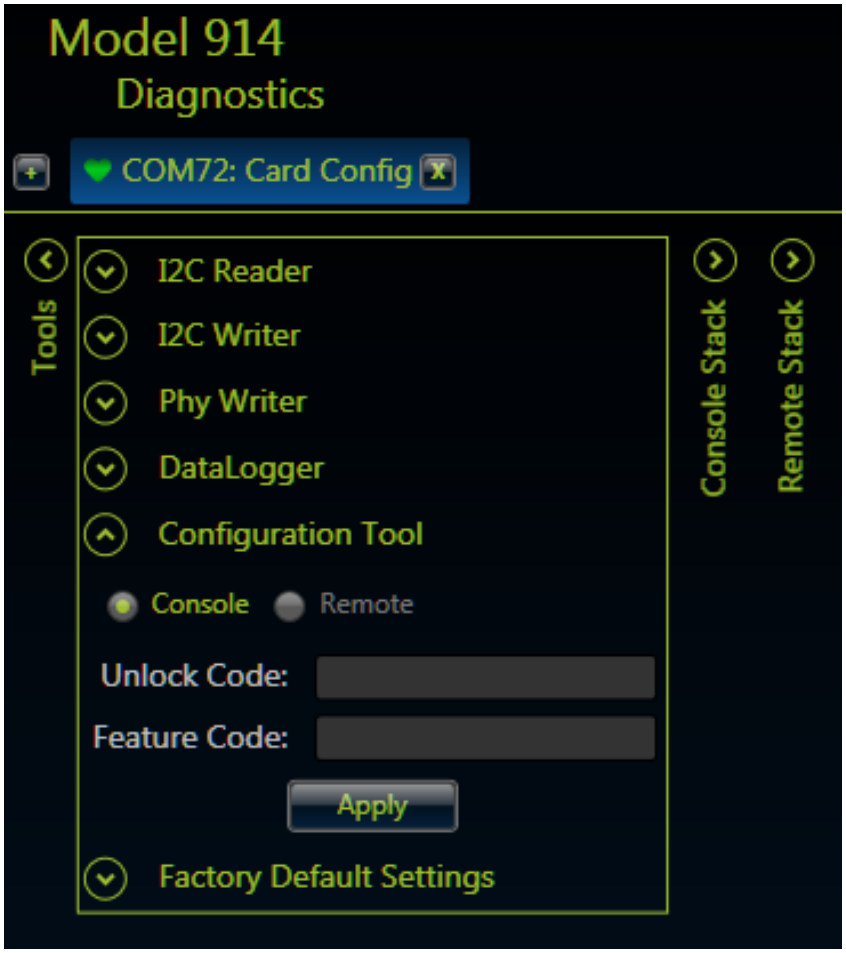

Figure 12-1: Feature Update Via Configuration Tool

13.0 Part Numbers

13.1 914-HDE Motherboard Part Numbers

914-HDE cards are typically specified in pairs of remote and console sides of the system. Pairs must have the same version (L1, M1 or H1), and compatible (different) optical wavelengths. Single fiber bi-directional systems put the lower wavelength (1310 or 1270 nm) at the remote, and the higher wavelength (1550 or 1330 nm) at the console. CWDM wavelengths must be compatible with the chosen CWDM module, and must be unique between remote and console cards, or from any other optical component in the system.

Table 13-1: 914-HDE Part Numbers

Part Number	Description
914-0023-13-CYZZ**	Remote Configuration, 1310 nm, SM, bidi single fiber, L1*** Version, 20dB
914-0023-XX*-CYZZ**	Remote Configuration, 1XX0 nm, SM, CWDM dual fiber, L1*** Version, 24 dB
914-0023-99-CYZZ**	Remote Configuration, No SFP, L1*** Version
914-0024-15-CYZZ**	Console Configuration, 1550 nm, SM, bidi single fiber, L1*** Version, 20 dB
914-0024-XX*-CYZZ**	Console Configuration, 1XX0 nm, SM, CWDM dual fiber, L1*** Version, 24 dB
914-0024-99-CYZZ**	Console Configuration, No SFP, L1*** Version
914-0026-13-CYZZ**	Remote Configuration, 1310 nm, SM, bidi single fiber, M1*** Version, 20 dB
914-0026-XX*-CYZZ**	Remote Configuration, 1XX0 nm, SM, CWDM dual fiber, M1*** Version, 24 dB
914-0026-99-CYZZ**	Remote Configuration, No SFP, M1*** Version
914-0027-15-CYZZ**	Console Configuration, 1550 nm, SM, bidi single fiber, M1*** Version, 20 dB
914-0027-XX*-CYZZ**	Console Configuration, 1XX0 nm, SM, CWDM dual fiber, M1*** Version, 24 dB
914-0027-99-CYZZ**	Console Configuration, No SFP, M1*** Version
914-0029-12-CYZZ**	Remote Configuration, 1270 nm, SM, bidi single fiber, H1*** Version, 20 dB
914-0029-XX*-CYZZ**	Remote Configuration, 1XX0 nm, SM, CWDM dual fiber, H1*** Version, 23 dB
914-0029-99-CYZZ**	Remote Configuration, No SFP, H1*** Version
914-0030-13-CYZZ**	Console Configuration, 1330 nm, SM, bidi single fiber, H1*** Version, 20 dB
914-0030-XX*-CYZZ**	Console Configuration, 1XX0 nm, SM, CWDM dual fiber, H1*** Version, 23 dB
914-0030-99-CYZZ**	Console Configuration, No SFP, H1*** Version
914-0037-13-CYZZ**	Remote Configuration, 1310 nm, SM, bidi single fiber, L1*** Version, 20 dB, PT3K****
914-0037-XX*-CYZZ**	Remote Configuration, 1XX0 nm, SM, CWDM dual fiber, L1*** Version, 24 dB, PT6K****
914-0038-13-CYZZ**	Remote Configuration, 1310 nm, SM, bidi single fiber, M1*** Version, 20 dB, PT3K****
914-0038-XX*-CYZZ**	Remote Configuration, 1XX0 nm, SM, CWDM dual fiber, M1*** Version, 24 dB, PT6K***

* Refer to Table 13-3
** Refer to Table 13-5
*** Refer to Table 13-4

Table 13-2: 914-HDE Included Accessories

Quantity	Description
1	Power harness, 6', pigtailed
1	RS-232 Diagnostic cable, 6", pigtailed
4	#2-56, 3/16", 21/32" tall standoff
4	#2-56, 3/16", 5/32" tall standoff
4	#2-56, hex nut

Table 13-3: 914-HDE CWDM Options

XX	Description	CWDM Band	Status
27	1271 nm optical transmitter	Blue	Special Order
29	1291 nm optical transmitter	Blue	Special Order
31	1311 nm optical transmitter	Blue	Special Order
33	1331 nm optical transmitter	Blue	Special Order
35	1351 nm optical transmitter	Blue	Special Order
37	1371 nm optical transmitter	Blue	Special Order
39	1391 nm optical transmitter	Blue	Special Order
41	1411 nm optical transmitter	Blue	Special Order
43	1431 nm optical transmitter	Blue	Special Order, Not recommended
45	1451 nm optical transmitter	Blue	Special Order, Not recommended
47	**1471 nm optical transmitter**	**Red**	**Recommended, compatible with 914-CWDM**
49	**1491 nm optical transmitter**	**Red**	**Recommended, compatible with 914-CWDM**
51	1511 nm optical transmitter	Red	Recommended
53	1531 nm optical transmitter	Red	Recommended
55	1551 nm optical transmitter	Red	Upgrade
57	1571 nm optical transmitter	Red	Upgrade
59	1591 nm optical transmitter	Red	Upgrade, not for use with Moog Focal OMS
61	1611 nm optical transmitter	Red	Upgrade, not for use with Moog Focal OMS

- Red wavelengths are recommended, particularly 1471 to 1571 nm.
- 1591 and 1611 nm wavelengths are not recommended for use with the Moog Focal Optical Monitoring System (OMS).
- When configuring a system, it is best to choose adjacent wavelengths and not to mix red band with blue band wavelengths.

Table 13-4: 914-HDE Factory Versions

Feature	Parameter	L1	M1	H1
Video	Speed	HD/SD	3G/HS/SD	3G/HD/SD
Ethernet	Speed (Mb/s)	10/100/1000*	10/100/1000**	10/100/1000
Serial Ch1	Format	RS232, RS485, RS422		
Serial Ch2	Format	RS232, RS485, RS422		
LS Expansion Channels	Quantity	4		
MS Expansion Channels	Quantity	0	4***	4***
Optical Bandwidth	Gb/s	1.8	3.5	5.6

* L1 Version Supports HD-SDI or 1000 BASE-T, default is to support HD-SDI. This can be changed via the 914-HDE Diagnostic GUI

** M1 Version supports 3G-SDI or 1000 BASE-T. When 3G-SDI is plugged, Ethernet is limited to 300Mb/s bandwidth.

*** Limited to available optical bandwidth. Refer to Section 3.3.

Table 13-5: 914-HDE Factory Configurations

Setting Option	Video Setting	Ethernet Setting	Serial Channel 1 Setting	Serial Channel 2 Setting
BLANK (Default)	Enabled*	Auto-Negotiate**	RS232	
C001	Enabled*	Auto-Negotiate**	RS485	
C002	Enabled*	Auto-Negotiate**	RS422	
C003	Enabled*	Auto-Negotiate**	RS232	RS485
C004	Enabled*	Auto-Negotiate**	RS232	RS422
C005	Enabled*	Auto-Negotiate**	RS485	RS422
C010	Enabled*	100 BASE-TX Full Duplex Only	RS232	
C011	Enabled*	100 BASE-TX Full Duplex Only	RS485	
C012	Enabled*	100 BASE-TX Full Duplex Only	RS422	
C013	Enabled*	100 BASE-TX Full Duplex Only	RS232	RS485
C014	Enabled*	100 BASE-TX Full Duplex Only	RS232	RS422
C015	Enabled*	100 BASE-TX Full Duplex Only	RS485	RS422
C020 L1 Version Only	SD-SDI Only	Auto-Negotiate up to 1000 BASE-T	RS232	
C021 L1 Version Only	SD-SDI Only	Auto-Negotiate up to 1000 BASE-T	RS485	
C022 L1 Version Only	SD-SDI Only	Auto-Negotiate up to 1000 BASE-T	RS422	
C023 L1 Version Only	SD-SDI Only	Auto-Negotiate up to 1000 BASE-T	RS232	RS485
C024 L1 Version Only	SD-SDI Only	Auto-Negotiate up to 1000 BASE-T	RS232	RS422
C025 L1 Version Only	SD-SDI Only	Auto-Negotiate up to 1000 BASE-T	RS485	RS422

* HD/SD-SDI enabled for L1 version, 3G/HD/SD-SDI enabled for M1/H1 versions.
** 10/100 BASE-T(X) default for L1 version, 10/100/1000 BASE-T(X) for M1/H1 versions.

Notes:

1. Factory configuration options represent “as shipped” settings.
2. Users may alter all allowable configurations via 914-HDE Diagnostic GUI based on 914-HDE version: L1, M1 or H1.
3. Default configuration is recommended for spare assemblies.
4. Other factory settings are possible, contact Moog Focal for more options.
5. Configurations other than the default are subject to a surcharge.

13.2 914-VDX Part Numbers

Table 13-6: 914-VDX Part Numbers

Part Number	Description
914-0039-00-CYZZ*	Standard 914-VDX
914-0039-01-CYZZ*	914-VDX PT6K**

* Refer to Table 13-8
** PT6K refers to Pressure Tolerant Assembly rated to 6000 PSI

Table 13-7: 914-VDX Included Accessories

Quantity	Description
1	RS-232 Diagnostic cable, 6”, pigtailed
4	#2-56, 3/16”, 21/32” tall standoff

Table 13-8: 914-VDX Factory Configuration Options

Remote	Console	Serial Channel 1 Setting	Serial Channel 2 Setting	Serial Channel 3 Setting	Serial Channel 4 Setting
Blank	C100	RS232			
C001	C101	RS485*			
C002	C102	RS422**			
C003	C103	RS232			RS485*
C004	C104	RS232		RS485*	
C005	C105	RS232	RS485*		
C006	C106	RS232			RS422**
C007	C107	RS232		RS422**	
C008	C108	RS232	RS422**		
C009	C109	RS485*			RS422**
C010	C110	RS485*		RS422**	
C011	C111	RS485*	RS422**		
C012	C112	RS232		RS485*	RS422**
C013	C113	RS232	RS485*		RS422**
C014	C114	RS232	RS485*	RS422**	

* RS485 has differential 120 ohm terminations enabled with a timeout of 1 ms
** RS422 has differential terminations enabled

Notes:

1. Factory configuration options represent “as shipped” settings.
2. Users may alter all configurations via 914-HDE Diagnostic GUI in combination with DIP switches.
3. Default configuration is recommended for spare assemblies
4. SW1 is always set to [OFF, OFF] for expansion channel 1. Ensure systems with multiple expansion cards have unique channel settings.
5. Other factory settings are possible, contact Moog Focal for more options.
6. Configurations other than the default are subject to a surcharge.

13.3 914-EX Part Numbers

Table 13-9: 914-EX Part Numbers

Part Number	Description
914-0040-00-CYZZ*	Standard 914-EX
914-0040-01-CYZZ*	914-EX PT6K**

* Refer to Table 13-11
** PT6K refers to Pressure Tolerant Assembly rated to 6000 PSI

Table 13-10: 914-EX Included Accessories

Quantity	Description
1	RS-232 Diagnostic cable, 6”, pigtailed
4	#2-56, 3/16”, 21/32” tall standoff

Table 13-11: 914-EX Factory Configuration Options

Remote	Console	Ethernet Port 1 Setting	Ethernet Port 2 Setting	Link Fault Passthrough
Blank	C100	10/100/1000 BASE-T(X)		Disabled
C001	C101	10/100/1000 BASE-T(X)	100 BASE-TX	
C002	C102	10/100/1000 BASE-T(X)	10 BASE-T	
C003	C103	100 BASE-TX		
C004	C104	100 BASE-TX	10 BASE-T	
C005	C105	10 BASE-T		
C010	C110	10/100/1000 BASE-T(X)		Enabled
C011	C111	10/100/1000 BASE-T(X)	100 BASE-TX	
C012	C112	10/100/1000 BASE-T(X)	10 BASE-T	
C013	C113	100 BASE-TX		
C014	C114	100 BASE-TX	10 BASE-T	
C015	C115	10 BASE-T		

Notes:

1. Factory configuration options represent “as shipped” settings.
2. Users may alter all configurations via 914-HDE Diagnostic GUI in combination with DIP switches.
3. Default configuration is recommended for spare assemblies
4. SW1 is always set to [OFF, OFF] for expansion channel 1. Ensure systems with multiple expansion cards have unique channel settings.
5. Other factory settings are possible, contact Moog Focal for more options.
6. Configurations other than the default are subject to a surcharge.

13.4 914-AX Part Numbers

Table 13-12: 914-AX Part Numbers

Part Number	Description
914-0041-00	Standard 914-AX
914-0041-01	914-AX PT6K*

* PT6K refers to Pressure Tolerant Assembly rated to 6000 PSI

Table 13-13: 914-AX Included Accessories

Quantity	Description
4	#2-56, 3/16”, 21/32” tall standoff

13.5 AIB Module Part Numbers

Please refer to 700-0271-00 AIB Plug-In Modules User Guide for module details and configuration.

Table 13-14: AIB Module Part Numbers

Part Number	Card ID	Description
903-0251-00	AIB 232	RS232 Interface
903-0251-01	AIB TRIG	Modified RS232 for +5 to +25 V for trigger signals.
903-0252-00	AIB 485/422	RS485/RS422 Interface
903-0252-01	AIB TTL	TTL Interface, 0 to +5 V TTL signals
903-0261-00	AIB-ARCNET	Tritech ARCNET compatible interface
903-0244-00	AIB-HYDRO	Default hydrophone gain of 36 dB
903-0244-01	AIB-IRIG	Modified for IRIG-B
903-0244-02	AIB-HYDRO	Provides 12 V to the hydrophone, gain is bypassed
903-0250-00	AIB-MS900	MS900 Analog Sonar Interface
903-0250-01	AIB-MS900L	MS900 Analog Sonar Low Frequency Interface
903-0297-00	AIB-CANBUS	CAN bus interface, up to 1 Mb/s supported

13.6 914-DX Part Numbers (Preliminary)

Table 13-15: 914-DX Part Numbers

Part Number	Description
914-0042-00-CYZZ*	Standard 914-DX
914-0042-01-CYZZ*	914-DX PT6K**

* Refer to Table 13-17
** PT6K refers to Pressure Tolerant Assembly rated to 6000 PSI

Table 13-16: 914-DX Included Accessories

Quantity	Description
1	RS-232 Diagnostic cable, 6”, pigtailed
4	#2-56, 3/16”, 21/32” tall standoff

Table 13-17: 914-DX Factory Configuration Options

Remote	Console	Serial Channel 1 Setting	Serial Channel 2 Setting	Serial Channel 3 Setting	Serial Channel 4 Setting	Serial Channel 5 Setting	Serial Channel 6 Setting
Blank	C100	RS232					
C001	C101	RS485*					
C002	C102	RS422**					
C003	C103	TTL					
C004	C104	RS232				RS485*	
C005	C105	RS232		RS485*			
C006	C106	RS232				RS422**	
C007	C107	RS232		RS422**			
C008	C108	RS485*				RS422**	
C009	C109	RS485*		RS422**			
C010	C110	RS232				TTL	
C011	C111	RS232		TTL			
C012	C112	RS485*				TTL	
C013	C113	RS485*		TTL			
C014	C114	RS422**				TTL	
C015	C115	RS422**		TTL			
C016	C116	RS232		RS485*		RS422**	
C017	C117	RS485*		RS422**		TTL	
C018	C118	RS232		RS485*		TTL	
C019	C119	RS232		RS422**		TTL	

* RS485 has 120 ohm differential terminations enabled with a timeout of 1 ms
** RS422 has 120 ohm differential terminations enabled

Notes:

1. Factory configuration options represent “as shipped” settings.
2. Users may alter all configurations via 914-HDE Diagnostic GUI in combination with DIP switches.
3. Default configuration is recommended for spare assemblies
4. SW1 is always set to [OFF, OFF] for LS expansion channel 1. Ensure systems with multiple LS expansion cards have unique channel settings.
5. Other factory settings are possible, contact Moog Focal for more options.
6. Configurations other than the default are subject to a surcharge.

13.7 914-HDV2 Part Numbers

Table 13-18: 914-HDV2 Part Numbers

Part Number	Description	Status
Dual Channel Options		
914-0031-00	HDV2 Console non-MSA dual video output; 1260 nm to 1620 nm optical inputs	Recommended
914-0032-00	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1271 nm and Ch2 1291 nm	Special Order
914-0032-01	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1311 nm and Ch2 1331 nm	Special Order
914-0032-02	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1351 nm and Ch2 1371 nm	Special Order
914-0032-03	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1391 nm and Ch2 1411 nm	Special Order
914-0032-04	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1471 nm and Ch2 1491 nm; Recommended for use with 914-CWDM	Recommended
914-0032-05	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1511 nm and Ch2 1531 nm	Recommended
914-0032-06	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1551 nm and Ch2 1571 nm	Recommended
914-0032-07	HDV2 Remote non-MSA dual video input; CWDM output wavelengths: Ch1 1591 nm and Ch2 1611 nm	Recommended***
Single Channel Options		
914-0033-00	HDV2 Console MSA single video output; 1260 nm to 1620 nm optical input	Recommended
914-0034-XX*	HDV2 Remote MSA single video input; CWDM output wavelength: Ch1 1XX1 nm	See Table 13-20
914-0035-XX*	HDV2 Remote MSA single video input; CWDM output wavelength: Ch1 1XX1 nm PT6K**	See Table 13-20

* XX Refer to Table 13-20
** PT6K refers to Pressure Tolerant Assembly rated to 6000 PSI
*** Not for use with Moog Focal OMS (Optical Monitoring System)

Table 13-19: 914-HDV2 Included Accessories

Quantity	Description
1	Power harness, 6', pigtailed
1	RS-232 Diagnostic cable, 6", pigtailed
4	#2-56, 3/16", 21/32" tall standoff
4	#2-56, 3/16", 5/32" tall standoff
4	#2-56, hex nut

Table 13-20: 914-HDV2 CWDM Options

XX	Description	CWDM Band	Status
27	1271 nm optical transmitter	Blue	Special Order
29	1291 nm optical transmitter	Blue	Special Order
31	1311 nm optical transmitter	Blue	Special Order
33	1331 nm optical transmitter	Blue	Special Order
35	1351 nm optical transmitter	Blue	Special Order
37	1371 nm optical transmitter	Blue	Special Order
39	1391 nm optical transmitter	Blue	Special Order
41	1411 nm optical transmitter	Blue	Special Order
43	1431 nm optical transmitter	Blue	Special Order, Not recommended
45	1451 nm optical transmitter	Blue	Special Order, Not recommended
47	1471 nm optical transmitter	**Red**	**Recommended, compatible with 914-CWDM**
49	1491 nm optical transmitter	**Red**	**Recommended, compatible with 914-CWDM**
51	1511 nm optical transmitter	Red	Recommended
53	1531 nm optical transmitter	Red	Recommended
55	1551 nm optical transmitter	Red	Upgrade
57	1571 nm optical transmitter	Red	Upgrade
59	1591 nm optical transmitter	Red	Upgrade, not for use with Moog Focal OMS
61	1611 nm optical transmitter	Red	Upgrade, not for use with Moog Focal OMS

Notes:

1. Other dual wavelength CWDM options are possible. Contact Moog Focal for details.
2. Single channel remote assemblies can be linked to dual channel console assemblies. This is useful in pressure tolerant systems where two 914-HDV2 PT cards can link to a single console 914-HDV2.

13.8 914-X Series Optical Card Part Numbers

Table 13-21: 914 Optical Card Part Numbers

Part Number	Card ID	Sales ID	Description
914-0017-04	914-CWDM	914-CWDM-SM2+4-R1-P0F	CWDM (1471/1491) + 1310/1550 Bypass
914-0017-09	914-SPLIT	914-SPLIT-SM-NSP0F	Singlemode Optical Splitter, 1x2
914-0017-10	914-FOS	914-FOS-SM-NSP0F	Singlemode Optical Switch, 2x1
914-0017-11	914-CWDM-4R1	914-CWDM-SM4+N-R5-P0F	CWDM 4CH (1471/1491/1511/1531)
914-0017-12	914-CWDM-8R	914-CWDM-SM8+N-R7-P0F	CWDM 8CH (1471/1491/1511/1531/1551/1571/1591/1611)

13.9 SFP Optical Transceiver Part Numbers

Table 13-22: 914 Standard Optical SFP Part Numbers

Part Number	Description	CWDM band
4.25 Gbps Bidi		
EL-W0637	4.25G; Tx 1310 nm / Rx 1550 nm; single fiber bi-directional SFP	
EL-W0638	4.25G; Tx 1550 nm / Rx 1310 nm; single fiber bi-directional SFP	
4.25 Gbps CWDM		
EL-W0674	4.25G; Tx 1271 nm dual fiber CWDM SFP	Blue
EL-W0675	4.25G; Tx 1291 nm dual fiber CWDM SFP	Blue
EL-W0676	4.25G; Tx 1311 nm dual fiber CWDM SFP	Blue
EL-W0677	4.25G; Tx 1331 nm dual fiber CWDM SFP	Blue
EL-W0678	4.25G; Tx 1351 nm dual fiber CWDM SFP	Blue
EL-W0679	4.25G; Tx 1371 nm dual fiber CWDM SFP	Blue
EL-W0680	4.25G; Tx 1391 nm dual fiber CWDM SFP	Blue
EL-W0681	4.25G; Tx 1411 nm dual fiber CWDM SFP	Blue
EL-W0682	4.25G; Tx 1431 nm dual fiber CWDM SFP	Blue
EL-W0683	4.25G; Tx 1451 nm dual fiber CWDM SFP	Blue
EL-W0642	4.25G; Tx 1471 nm dual fiber CWDM SFP	Red
EL-W0643	4.25G; Tx 1491 nm dual fiber CWDM SFP	Red
EL-W0644	4.25G; Tx 1511 nm dual fiber CWDM SFP	Red
EL-W0645	4.25G; Tx 1531 nm dual fiber CWDM SFP	Red
EL-W0646	4.25G; Tx 1551 nm dual fiber CWDM SFP	Red
EL-W0647	4.25G; Tx 1571 nm dual fiber CWDM SFP	Red
EL-W0648	4.25G; Tx 1591 nm dual fiber CWDM SFP	Red
EL-W0649	4.25G; Tx 1611 nm dual fiber CWDM SFP	Red

Notes:

1. Blue wavelength CWDM SFPs are special order items.
2. Refer to Section 9.0 for SFP specification.

Table 13-23: 914 Pressure Tolerant Optical SFP Part Numbers

Part Number	Description
4.25 Gbps Bidi Pressure Tolerant	
925-5004-00	4.25G; Tx 1310 nm / Rx 1550 nm; single fiber bi-directional SFP; 3000 PSI; LC Conn.
925-5004-01	4.25G; Tx 1550 nm / Rx 1310 nm; single fiber bi-directional SFP; 3000 PSI; LC Conn.
925-5004-02	4.25G; Tx 1310 nm / Rx 1550 nm; single fiber bi-directional SFP; 3000 PSI; ST Conn.
925-5004-03	4.25G; Tx 1550 nm / Rx 1310 nm; single fiber bi-directional SFP; 3000 PSI; ST Conn.
4.25 Gbps CWDM Pressure Tolerant	
925-5000-27	4.25G; Tx 1271 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-29	4.25G; Tx 1291 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-31	4.25G; Tx 1311 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-33	4.25G; Tx 1331 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-35	4.25G; Tx 1351 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-37	4.25G; Tx 1371 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-39	4.25G; Tx 1391 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-41	4.25G; Tx 1411 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-43	4.25G; Tx 1431 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-45	4.25G; Tx 1451 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-47	4.25G; Tx 1471 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-49	4.25G; Tx 1491 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-51	4.25G; Tx 1511 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-53	4.25G; Tx 1531 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-55	4.25G; Tx 1551 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-57	4.25G; Tx 1571 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-59	4.25G; Tx 1591 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.
925-5000-61	4.25G; Tx 1611 nm; dual fiber CWDM SFP; 6000 PSI; LC Conn.

Notes:

1. Pressure tolerant SFPs are special order items.
2. Refer to Section 9.0 for SFP specification.

13.10 914-X Series High Speed Ribbon Cable Part Numbers

Table 13-24: 914-X Series High Speed Ribbon Cable Part Numbers

Part Number	Description	Orientation
914-5105-09	EXP HS RIBBON 9" INLINE	Inline
914-5105-12	EXP HS RIBBON 12" INLINE	Inline
914-5106-03	EXP HS RIBBON 3" SIDE-TO-SIDE	Side – to – Side
914-5106-06	EXP HS RIBBON 6" SIDE-TO-SIDE	Side – to – Side

Notes:

1. Inline orientation are designed for a linear line of 914-X Series cards down the length of a narrow enclosure such as a pressure bottle. The narrow ends of each card would face each other.
2. Side-to-Side orientation ribbon cables are designed for a sideways orientation of cards, wide ends beside each other. This is useful for larger enclosures such as 19” rack enclosures.
3. The length is measured connector to connector on the ribbon cable, this does not imply card-to-card spacing.
4. Other lengths are available up to 18”, please contact Moog Focal.
5. Included accessory hardware allow for the completion of one stack and the start of the next.

Table 13-25: 914-X Series High Speed Ribbon Cable Included Accessories

Quantity	Description
4	#2-56, 3/16”, 21/32” tall standoff
4	#2-56, hex nut

14.0 Troubleshooting

This section contains valuable information that can help users solve common problems while setting up or using a 914-X Series system. The Model 914-X Series Diagnostic GUI is an essential troubleshooting tool. It allows users to quickly identify problems. **Setting up the GUI and connecting it to the *console* 914-HDE card is a required first step**. Please refer to section 5.0 for Diagnostic GUI installation and operation instructions.

Here are some common problems, and potential solutions:

1. Diagnostic GUI is not connecting to the 914-HDE
    a. Check connection status to Header J8 on the console 914-HDE card. Any loose connections? Any shorts? Verify pinout as per Section 5.0.
    b. Verify the COM port used in the GUI, does it match the one connected to the 914-HDE?
    c. Is the GUI installed up to date? Check the Focal website and look for 914-0401-00: http://www.moog.com/products/multiplexers-media-converters/focal-multiplexer-product-line/multiplexer-technical-documents.html
    d. Is the 914-HDE powered up with 5 V or 12 V? Is the power LED D6 lit?

2. The card I want to see in the 914 Diagnostic GUI is not showing up.
    a. Press “Stop” and then “Start” at the bottom of the GUI to refresh the displayed cards.
    b. Restart the GUI, re-establish the COM port connection.
    c. Verify that the cards have compatible firmware versions per Section 0.
    d. Verify the optical link in the link tab in the GUI, or by the LEDs on the PCBA.
    e. Verify the switch settings of the expansion cards.
    f. Verify power status via LEDs.

3. Power issues:
    a. Verify that power is only supplied to the 914-HDE motherboard or 914-HDV2 media converter. 914-X Series Expansion cards draw their power from the 914-HDE motherboard.
    b. Verify that the green power LED D6 is lit on the 914-HDE. The power fault LED D5 is lit red during over, under or reverse voltage events.
    c. For larger stacks using more power, voltage drop can occur over the power leads. Verify the power received at the 914-HDE is greater than 4.5 V. If not:
        i. Use heavier gauge wire
        ii. Increase voltage: 12 V is best for systems that require > 20 W
        iii. Use shorter power leads
    d. Verify voltage rails and inputs via the diagnostic GUI.
    e. Ensure the power supply is rated for at least 50% more power than required by the 914-X Series system.

4. Optical issues:
    a. Verify received optical power via the GUI in the SFP tab. All values should have green backgrounds to indicate acceptable levels. The optical loss in each direction should be similar.
    b. Refer to Section 10.6 for more details regarding Optical fiber care and maintenance.
    c. Too much optical power is a saturation condition. Attenuation is required in the fiber link.
    d. Too little optical power could be due to:
        i. Dirty fiber contacts and bushings
        ii. Bent or broken fibers
        iii. Fiber type mismatches
        iv. Non-functional 914-HDE at the far side
        v. Fiber length is too long
        vi. Malfunctioning Fiber Optic Rotary Joint

5. General Configuration Issues – Configurations not being saved
    a. Diagnostic connection must be to the 914-HDE Console unit only. Do not connect directly to the 914-HDE remote card.
    b. Ensure that each card is correctly configured for Console vs Remote before attempting to configure other settings.
    c. A stable optical link must be present to configure remote cards.
    d. A stable expansion link must be present to configure expansion cards.

6. Video Issues:
    a. Does the GUI report video on both ends?
    b. Are the video cards configured properly for remote vs console, and is the video input vs output direction configured. This information can be found via the GUI.
    c. Is the Optical link working?
    d. Verify power status of both ends of the system.
    e. Are the firmware revisions of the cards compatible? Refer to Section 0.
    f. Are the card versions compatible? M1 to M1? L1 to L1?
    g. If no video is present at the remote side:
        i. Check cabling at the remote side.
        ii. Verify power status.
        iii. Ensure composite video is plugged to the 914-VDX card.
        iv. Ensure SDI video is plugged into the 914-HDE card.
        v. Ensure the cards are configured for video input at the remote via the 914 Diagnostic GUI.
    h. If video is present at the remote, but not at the console:
        i. Verify that the optical link is valid.
        ii. Verify video channel is configured for video output at the console via the 914 Diagnostic GUI.
    i. If video is present at both ends of the system, but not displayed:
        i. Ensure video monitors are on and compatible with the video input.
        ii. 3G-SDI video should only be used in M1 version with no 914-VDX or 914-EX cards and Ethernet limited to 100 Mb/s.

7. Ethernet Issues:
    a. Ethernet issues often are attributed to negotiation settings mismatches.
    b. Are both ends of the system linked? Verify this in the GUI. If not linked:
        i. Verify the auto-negotiate settings of each end, ensure they match the connected equipment.
        ii. The ports are auto-MDI/X. Ensure proper cabling and pinout.
        iii. Ensure cabling is no longer than 100m
    c. Ethernet channels are linked, but frames are dropped:
        i. Check connection status in GUI, are both ends linked at the same speed? If not, force the links to be the same speed.
        ii. Is the GUI reporting dropped frames? If so, too much bandwidth is required by your system. The cards can have their versions upgraded from L1 to M1, or M1 to H1. Verify required bandwidth using guidelines from Section 3.3.
        iii. Is 3G-SDI video passing through the system? This leaves limited bandwidth available for all other signals in the M1 version. No 914-VDX or 914-EX cards may be stacked on the M1 version of the 914-HDE when 3G-SDI video is required.
    d. Are the firmware revisions of the cards compatible? Refer to Section 0.
    e. Are the card versions compatible? M1 to M1? L1 to L1?

8. Serial Port Issues
    a. Is the correct protocol configured for the channel in question? On both ends of the system?
    b. Is the correct half of the connector used for each channel: the lower row is the first channel, the upper row is the second channel.
    c. For non-isolated ports: is the equipment connected powered from the same ground reference as the 914-HDE stack?
    d. Tx is output from the 914, Rx is received (input) to the 914. Are these crossed?
    e. For RS485/422: Is the +/- polarity swapped?
    f. For RS485: Is the timeout configured for the port appropriate for the baud rate of the attached equipment? Slower data rates typically require longer timeouts. The timeouts represent the turnaround time of the half duplex protocol to change from Rx to Tx and vice-versa.
    g. Is differential termination required for RS422/485? This can be enabled and disabled via the GUI. In a multi-drop RS485 network, only the final node requires termination. The 914-HDE serial ports default to enabling the 120 ohm on-board termination, this must be disabled if termination already exists in the system.

9. Overheating issues
    a. What is the junction temperature of each FPGA in the system (one per card)? None should exceed 100 C (red) in the GUI.
    b. What is the measured temperature of the optical transceiver? Does it enter the yellow or red zones in the GUI?
    c. If excess temperature is an issue, better thermal management is required:
        i. Better conductive cooling via mounting standoffs. All 914-X Series cards have a thermal plane in the PCB connected to the mounting holes. This thermal plane is isolated from digital ground and may be conductively tied to the installed enclosure for cooling purposes.
        ii. Thermal spreaders can be attached to hot components
        iii. Thermal gap pad can be installed below the 914-HDE motherboard to push heat to the enclosure, if any.
        iv. In surface systems, airflow should be applied.

10. 914-VDX / 914-EX Expansion channel shows faults
    a. Alter the Driver Voltage for the faulty card in the configuration settings tab in the GUI. Reduce the voltage for short expansion links, increase for longer links. The minimum should be 682 mV.
    b. Are the firmware revisions of the cards compatible? Refer to Section 0.

11. 914-VDX Serial Data LEDS are constantly flashing when nothing is plugged in
    a. Firmware revision incompatibility. Refer to Section 0.
    b. Expansion channel corruption, check #10.
    c. Optical link issues.

12. Unknown problem:
    a. Are all cards in the system shown in the GUI? If not, why? Check #2 above.
    b. Using the 914 Diagnostic GUI, open and close tabs looking for anything **'RED'**, this indicates a problem that should be addressed.
        i. Voltage
        ii. Temperature
        iii. Optical power
        iv. Dropped Ethernet Frames
        v. Optical link problems
        vi. Expansion link problems

14.1 Moog Focal Technical Support Contact Information

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