ViaLiteHD
C-Band RF Fibre Optic Link

User Guide

HRx-C-HB-2

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Pulse Power & Measurement Ltd, 65 Shrivenham Hundred Business Park, Watchfield, Swindon, Wiltshire SN68TY, UK
Tel +44 (0)1793 784389 Fax +44 (0)1793 784391 Email sales@vialite.com Web www.vialite.com

Instrument Care and Safety Information

*Please read the whole of this section before using your **ViaLiteHD** product. It contains important safety information and will enable you to get the most out of your Fibre Optic Link.*

Electrical Safety

The ***ViaLiteHD*** chassis is a Safety Class 1 product (having metal case directly connected to earth via the power supply cable).

When operating the equipment note the following precautions:

- Hazardous voltages exist within the equipment. There are no user serviceable parts inside; the covers should only be removed by a qualified technician.
- There are no user replaceable fuses in the chassis mounted equipment. Replacement should only be carried out by a ***ViaLite Communications*** technician.
- The chassis earth stud SHOULD be connected to the safety earth.
- When using a 2 pin power supply cable the chassis earth stud MUST be connected to the safety earth.
- The ***ViaLiteHD*** Power Supply Modules do not have an isolating switch on the mains voltage inlet. For this reason, the ***ViaLiteHD*** Chassis must be installed within easy reach of a clearly labelled dual pole mains isolation switch, which supplies the equipment.

ESD Precautions

The ***ViaLiteHD*** RF Fibre Optic Link is equipped with high frequency active electronics, without the correct handing they will be susceptible to damage.

Precautions for handling electro-static sensitive devices should be observed when handling all ***ViaLiteHD*** modules.

- Technicians should ensure that they use effective personal grounding (i.e. ESD wrist strap etc.) when servicing the equipment.
- Any equipment or tools used should be grounded to prevent static charge build-up.

Good practice should be observed at all times for reference see relevant standards. EN 61340-5-1, “Protection of Electronic Devices from Electrostatic Phenomena – General Requirements”

Optical Safety

The ***ViaLiteHD*** RF Fibre Optic Transmitters contain optical sources (usually laser diodes) operating at nominal wavelengths of 1270nm to 1610nm.

These devices are rated as EN60825-1:2007 as CLASS 1 radiation emitting devices. A class 1 laser is safe under all conditions of normal use.

When operating the equipment note the following precautions:

- Never look into the end of an optical fibre directly or by reflection either with the naked eye or through an optical instrument.
- Never leave equipment with radiating bare fibres – always cap the connectors.
- Do not remove equipment external covers when operating.

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1 Introduction

The ***ViaLiteHD*** RF Fibre Optic Links (FOLs) are a family of fibre optically coupled link systems designed for the transmission of RF analogue signals over long distances for the communications market. ***ViaLiteHD*** is a product brand manufactured by Pulse Power and Measurement Ltd (PPM). ***ViaLite Communications*** is a division of Pulse Power and Measurement Ltd (PPM).

This handbook covers the following ***ViaLiteHD*** RF Link part numbers:

- C-Band Transmitter modules (electrical – optical converter) with part numbers starting
  - HRT-C
- C-Band Receiver modules (optical - electrical converter) with part numbers starting
  - HRR-C

For complete information and product familiarisation, this handbook should be read in conjunction with all other relevant handbooks for your ***ViaLiteHD*** system.

1.1 The C-Band

The ***ViaLiteHD*** RF Fibre Optic C-Band Links are designed to cover the extended C-Band frequency range (uplink and downlink) of 3.4 GHz to 7.1 GHz.
Usable performance can be utilised beyond this range encompassing 500 MHz to 8GHz (see the relevant characterisation data in section 3).

1.2 Typical deployment

A typical system operates as follows.

The user's RF electrical signal is input to the transmitter module, which contains RF signal conditioning and laser control circuitry. The module modulates the intensity of a beam of light with the RF signal which then travels through an optical fibre to the receiver module. The distance between transmitter and receiver can range from 1m to 100km; distances in excess of 100km can be achieved with more complex optical transport systems, depending on the system specified. The receiver module converts the modulated light back into an electrical signal, which is available at the output of the module.

The C-band link is also designed for use in Dense wavelength division multiplexed (DWDM) systems. In this scenario, multiple links each operating on a different wavelength of light are combined in a multiplexer and sent down a single optical fibre path. At the receiving end, a de-multiplexer separates the wavelengths for the corresponding receivers. See section 4.2 for wavelength options when considering the transmitters. Receiver modules however are wideband and will respond to any wavelength of light passed to them.

ViaLite Communications offer a design service for complex DWDM requirements including supply of optical multiplexers, optical amplifiers, optical switches and dispersion compensators. On-site commissioning and installation support is also available.

1.3 Care of fibre optic connectors

When the fibre optic cables are not connected, it is essential that the cable and equipment connectors are protected by the dust caps provided with the system. Failure to do so may result in damage to the fibre ends, which are critical to the system performance. Please refer to section 0 for fibre optic cable handling details.

2 Setting up and understanding the fibre optic link

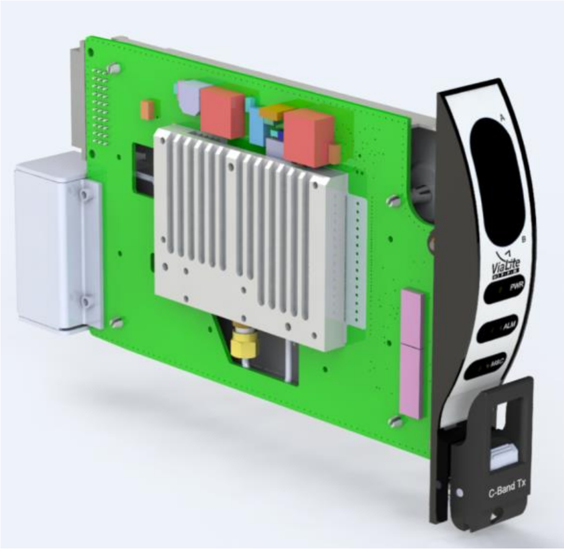
This section describes the connections between your RF fibre optic transmitter (electrical – optical converter) and receiver (optical - electrical converter) modules, and the operation of both modules in a system.

Please read fully all relevant documents for information on installing your ***ViaLiteHD*** equipment before commissioning your RF fibre optic link system.

2.1 Module operation

2.1.1 5HP standard plug-in modules

All ***ViaLiteHD*** plug-in modules are hot-swappable, so it is not necessary to power-down the chassis before inserting a module. All standard optical connectors are retained by the module, so it will be necessary to either disconnect any cables or have a sufficiently long service loop when removing modules.



To install a 5HP standard module and matching interface plate
- The protective covers on the connectors may be left in place.
- Push the release button of the module handle down and simultaneously pull the top of the handle towards you.
- Align the module upright and perpendicular to the front face of the chassis so that the PCB slides into the “crow’s feet” card guides top and bottom.
- Gently push the module down its guide, applying pressure via the handle, you may also apply pressure between the LED and test connector (where test connector is fitted as these are not available on all module types).
- As the module is fully mated the top of the handle should snap back and lock in position.
- The pawls of the handle should be fully engaged in the matching slots.
- If power is applied to the chassis the module power LED should light as soon as the module is fully inserted
- Remove protective covers and connect any interface cables

To remove a 5HP Standard module
- Disconnect any cables if necessary
- Push the release button of the module handle down and simultaneously pull the top of the handle forwards.
- Apply pressure via the handle and gently withdraw the module from the chassis.

2.1.2 RF connectors

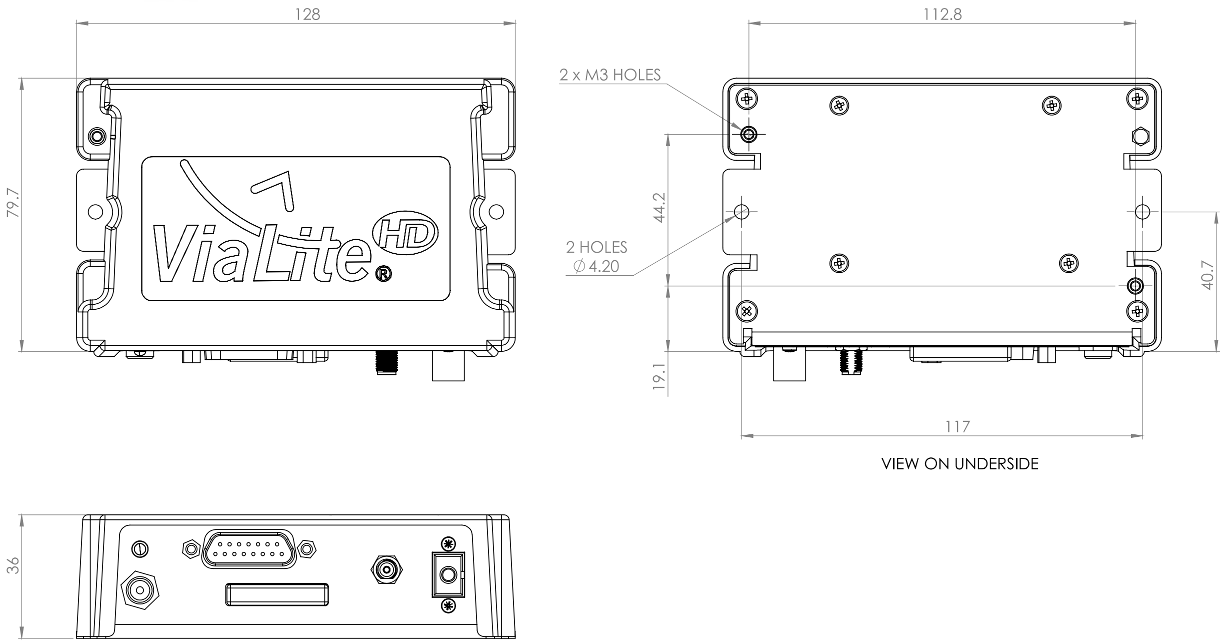
ViaLiteHD C-Band link products are fitted with 50 Ohm female SMA connectors.

The SMA connector is a semi-precision sub-miniature RF and microwave connector and to maintain performance up to 8GHz, ensure that when not in use, the supplied RF connector dust caps are fitted. If any dust or dirt is visible within the connector body, cleaning with compressed air before mating is advised.

When attaching cables to these RF connectors, a torque wrench should be used to guarantee tightening to 1.0 Nm.

2.1.3 Purple link modules

The Purple Link is a small, C-Band RF over fibre module available for both the transmitter and receiver. The 15-way D-type connector provides connectivity for the Tx or Rx alarms, I2C setup using the ***ViaLiteHD*** Programming Kit(HRx-HD-DEV103) and the external power supply (optional HPS-CS-4).



2.2 Fibre optic cable & connectors

All ***ViaLiteHD*** RF modules use single-mode (9µm/125µm) cable terminated in a range of optical connectors detailed below. Cross-site fibre optic cables are available from ***ViaLite Communications*** as either standard patch leads or heavy-duty multicore cables.

Warning!

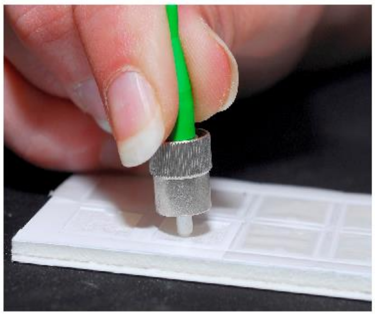
Angle polished (APC) and standard (PC) connector must not be confused.
The two connector types are not interchangeable and mating one with the other will damage both the cable and the module connectors.
The specification of optical connector is critical to the performance of the complete fibre optic link. System performance can only be guaranteed with fibre optic cables and connectors supplied by ***ViaLite Communications***.
When FC/APC connectors are specified they must be "narrow key width"

2.2.1 Connecting and disconnecting

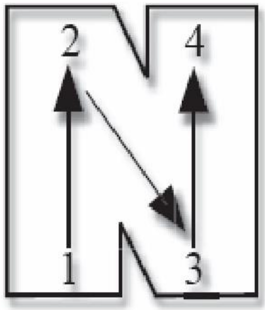
Before connecting optical fibres to the module or to each other, ensure that the mating connectors are clean (see below).

2.2.2 Cleaning optical connectors, cleaning before every use

Optical connectors MUST be cleaned before use, even where they have been protected with dust caps.
A large percentage of performance issues can be attributed to dirty fibres.



- Peel the plastic cover from an unused 'N' cleaning pad.
- Hold the connector between your thumb and forefinger
- Clean the connector using firm pressure by swiping in a pendulum motion through each segment of the 'N' shape, following the diagram
- Do not swipe over the same space twice.



For more details please read the cleaning instruction which accompanies the connector cleaning kit. Details can also be found on the CD supplied with your equipment.

2.2.3 Cleaning optical connectors, high levels of contamination

If there are performance issues that are not resolved by basic cleaning, then the following procedure should be used. If the level of contamination is high it will be necessary to repeat this procedure.

Cleaning items required

- Lint free fibre cleaning tissues and/or cleaning sticks (normal cosmetic tissues produce dust and are not acceptable).
- Reagent grade Isopropyl Alcohol (IPA).
- Air duster or filtered compressed air line.

Cable Connector Cleaning

- Dampen a patch of cleaning tissue with IPA and clean all surfaces of the plug ferrule.

- Using a dry cleaning tissue, dry the ferrule and clean the end face.
- Using the air duster, blow away any residue from the end of the connector.

Module Female Receptacle Cleaning (only recommended if problems are being experienced)

- Either use an optical cleaning stick or twist a cleaning tissue to form a stiff probe, moisten either with IPA. Gently push the probe into the receptacle and twist around several times to dislodge any dirt.
- Repeat the above process with a dry tissue.
- Using the air duster, blow away any residue from the receptacle.

Important Notes

- IPA is flammable. Follow appropriate precautions / local guidelines when handling and storing.
- IPA can be harmful if spilt on skin. Use appropriate protection when handling.
- It should only be necessary to clean the female receptacles on the modules if problems are being experienced.

Warning!

Never inspect an optical fibre or connector with the naked eye or an instrument unless you are convinced that there is no optical radiation being emitted by the fibre. Remove all power sources to all modules, and completely disconnect the optical fibres.

2.2.4 FC/APC Connectors

To connect FC/APC optical connectors follow these steps:

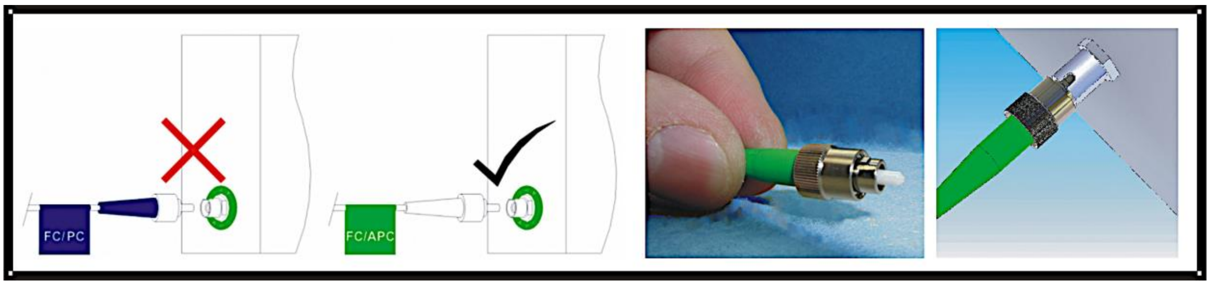
- Remove the dust caps and align the white ceramic centre ferrule on the cable connector with the mating receptacle.
- There is a key (lug) on the side of the ferrule, which must match the keyway (gap) in the receptacle shroud.
- When they are aligned, gently push the plug home.
- Finger tighten the knurled collet nut onto the threaded receptacle.

To disconnect follow these steps:

- Using fingers fully unscrew the knurled collet nut, gently withdraw the connector.
- Replace the dust caps on both the receptacle and the cable plug.

Warning!

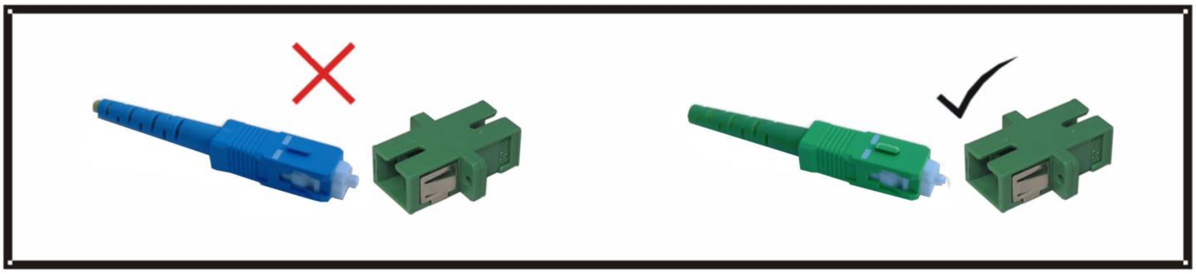
It is possible to tighten the knurled collet without aligning the lug and gap. This will result in poor light transmission. Check that the lug and gap are aligned before tightening the knurled collet



2.2.5 SC/APC Connectors

To connect SC/APC optical connectors follow these steps:
- Remove the plug protective cover.
- Align the connector keyway slot in the adaptor to the key of the plug.
- Gently push the plug-into the adapter until a click is heard and the connector locks.

To disconnect follow these steps:
- Grip the body of the plug and gently pull the plug from the adaptor, replace the protective cover.



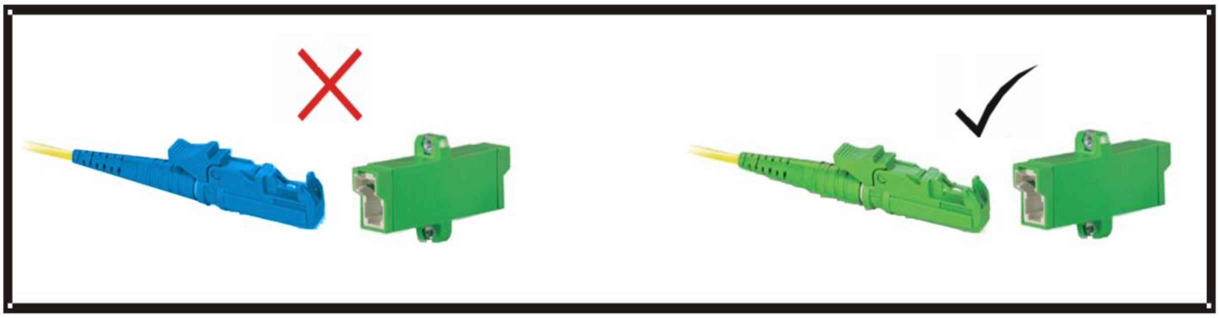
Only connect SC/APC cable to SC/APC receptacles.

2.2.6 E2000/APC Connectors

All ***ViaLiteHD*** E2000 connectorised modules use E2000/APC. Clean the plug before inserting.

To connect E2000/APC optical connectors:-
- Gently push the plug-into the E2000/APC adapter.
- The cover will automatically disengage.
- Push until a click is heard and the connector locks.

To disconnect:-
- To disconnect, depress the lever at the rear of the connector and withdraw the connector.
- The protective cover automatically engages when removed.



Only connect E2000/APC cable to E2000/APC adaptors.

2.2.7 Minimum bend radius

Because optical fibre is made of glass, it is important not to subject it to excessive stress. For this reason, each type of cable has a minimum bend radius (MBR) specification, beyond which the cable cannot be bent without permanent damage occurring. Systems using longer wavelength (i.e. 1550nm) are less tolerant to small bend radii.

The minimum bend radius of standard SMF28 fibre optic cable fitted to ***ViaLiteHD*** modules is 50mm. MBR specifications for ***ViaLite Communications*** supplied fibre optic cables are given in the ***ViaLite Classic*** and ***ViaLiteHD*** System Handbooks Lxx-HB and Hxx-HB respectively.

2.3 Using the RF link module

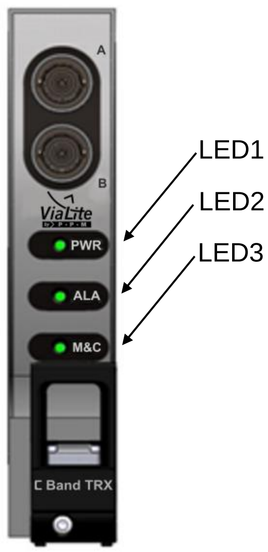
2.3.1 Connecting the module

Connect the transmitter module to the power source, cross-site fibre optic cable and RF signal as described in section 2.1. The RF input signal applied to the signal connector should be within the maximum and minimum signal levels given in the datasheet.

2.3.2 Front panel indicators, plug-in modules

Each plug-in module has three front panel LEDs for indication of the state of the module. The following table shows the operation of the front panel LEDs which are dependent on module type.

	Colour	Plug-in Transmitter	Plug-in Receiver
LED1	GREEN	NORMAL	
	Flashing GREEN	Programming	Programming
	RED	Not used	Not used
	No light	TX PSU fail	RX PSU fail
LED2	GREEN	NORMAL	
	Flashing RED fast	TX Alarm	Not used
	Flashing RED slow	Not used	RX Alarm
	RED	Not used	Not used
LED3	GREEN	I2C enabled	
	Flashing GREEN	I2C active	
	AMBER	I2C disabled	



2.3.3 LED indicator, purple modules

These modules are fitted with a single LED for indication of the state of the module.

	Colour	Blue link	Yellow link
LED	GREEN	Normal	
	RED	Alarm	
	No Light	No power	

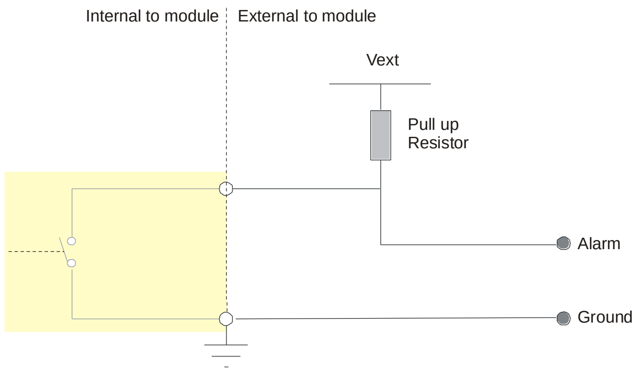
2.3.4 Module summary alarm

Each module has a single summary alarm, which registers the status of the module. Activation of this alarm registers an internal fault and the module should be replaced with a spare and returned to your local ***ViaLiteHD*** representative. The alarm state should be accompanied by a fault status on one of the front panel status LEDs.

The summary alarm is indicated by use of open drain logic. The alarm logic is OPEN when in an ALARM state and SHORT when in a NORMAL (non-alarm) state. The module will remain in an ALARM state until the ALARM condition is cleared, there is no latching.

2.3.5 Connecting to the summary alarm

The alarm output pin should be connected to a suitable current source (a positive voltage via a 10kohm pull-up resistor is adequate). When the module is in a working (non-alarm) state, the alarm output pin is short circuited to ground by the module. If the module enters an alarm state, the alarm pin is released to a high impedance state and current is no longer drawn from the constant current source. In the case of a positive voltage and pull-up resistor, the voltage on the alarm output pin will rise to indicate the alarm state. It follows that, if a module is removed from the chassis, the alarm will be raised for that module position.



The capability of the open collector is dependent on the module that provides it. The typical capability of the Open Collector/Drain is 50mA maximum current sink and 15V maximum voltage (Vext).

Note: Modules fitted in a chassis may have their alarm lines pull up by other chassis equipment, such as switch, splitter, summary alarm or SNMP and web controller modules.

2.3.6 Received light level (RLL) alarm

Receiver modules, monitor the average incoming received light level (RLL), if the power drops below a pre-set threshold the module will generate an RLL alarm.

- The RLL alarm threshold is set for a nominal input power of -15.0dBm
    - Nominal optical loss of 25.0dB @ 10.0dBm (10mW) TX

Under normal operating conditions the RLL alarm accuracy is +/-2dB; and +/-4dB under extreme conditions.

2.3.7 Module analogue monitor

Each plug-in module has either one or two analogue monitor ports. These allow simple DC indication of the status of either lasers or photodiodes fitted in the RF modules. The analogue monitor is available on the chassis connector, see the chassis handbook. The analogue monitor functions are dependent on the type of module. The monitor function(s) provided are shown in the table below.

Function	Single Transmitter	Single Receiver
Analogue monitor A	Not Used	Received light level
Analogue monitor B	Laser bias monitor	Not Used

The performance of the analogue monitors is as follows

Monitor type	Operation
TX analogue, current monitor output	**$V_{IFL} = 25 \times I_{FWD}$** V_{IFL} = Voltage output of the current monitor, in volts I_{FWD} = Average bias current of laser diode, in amps **Note:** Normal operating range I_{FWD} is 0 – 120mA
RX analogue, received light level output	**$V_{RLL} = 4.00 – [\ 0.15 \times (\ 10.0 - P_{OPT}\ )\ ]$** V_{RLL} = Voltage output of the received light level (RLL) monitor, in volts P_{OPT} = Optical input power, in dBm Note: Optical transmitter power is assumed to be +10dBm

2.3.8 High power and DWDM transmitter modules, thermal load

All DWDM modules have active thermal control to stabilise their laser operating wavelength. This requirement produces additional heat loading in their deployed environments. For this reason extra consideration is needed when planning the installation and deployment of these systems.
If the installed environment temperature is uncontrolled, there exists the possibility that at high temperature, operating efficiency will be reduced. Furthermore, if the active thermal control is unable to maintain laser operating temperature, a major alarm and module shutdown will ensue.

To maintain full operational temperature and efficiency we suggest that you take the following actions.

- Do not place DWDM transmitters adjacent to each other
- When using a 3U chassis if more than 4 modules are fitted, forced air cooling should be used (flow rate ~100CFM or more)
- If housing DWDM transmitters in an outdoor housing contact ***ViaLite Communications*** for more details

2.3.9 Operating in gain control modes

Modules can be operated in four different gain control modes when operated with an SNMP and Web controller module (***ViaLiteHD*** part number HRC-3).
The SNMP and Web controller module is required for configuring the AGC modes which operate by varying the RF gain of the card in 0.5dB steps in response to measurements of either optical or RF power.
Manual control is also available; this can be set using the hardware DIP switches.

For more information on this feature, please see section 2.13 of the ***ViaLiteHD*** SNMP controller handbook, HRC-3-HB.

2.4 Controlling RF modules

ViaLiteHD RF links are factory set and ready to operate. However, they can be software controlled (where an SNMP module is used in the same chassis) or manually controlled via the DIP switches fitted on each module.

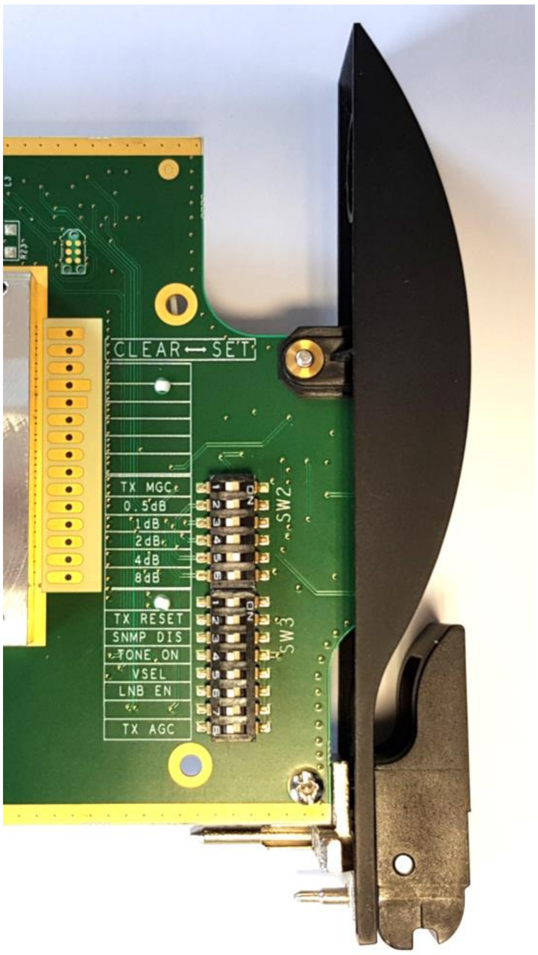
2.4.1 Manual control, MGC

The plug-in modules can be manually configured to set various operational parameters. The dual in line package (DIP) switches SW1, SW2, SW3 control configuration and are located on the bottom side of the PCB. These switches can be accessed by withdrawing the module by approximately one-third of its length. Two sets of switches will be installed depending on the type of module. Details of the function of each switch are given in the section below.

2.4.2 Manual control, DIP switch functions

Located on the bottom side of the module board, three DIP switches (SW1 to 3) provide manual control of various functions. SW1 and SW2 are dedicated to manual gain control (MGC). Once TX_MGC_ON or RX_MGC_ON is switched on, internal RF attenuators can be set directly to a desired level. SW3 is used to control various common control functions.

All intelligent modules will be delivered with DIP switches all set to OFF (clear). Only special manual gain control modules will be delivered with the DIP switches set to factory calibrated gain settings.



Single Transmitter

Single Receiver

SW1 Top DIP switch bank

Single transmitter HRT	**Single receiver HRR**
Not fitted	RXMGC
Not fitted	RX – 0.5dB
Not fitted	RX – 1dB
Not fitted	RX – 2dB
Not fitted	RX – 4dB
Not fitted	RX – 8dB

SW2 Middle DIP switch bank

Single transmitter HRT	**Single receiver HRR**
TXMGC	Not fitted
TX – 0.5dB	Not fitted
TX – 1dB	Not fitted
TX – 2dB	Not fitted
TX – 4dB	Not fitted
TX – 8dB	Not fitted

SW3 Bottom DIP switch bank

Single transmitter HRT	**Single receiver HRR**
TX rst	TX rst (not used)
RX rst (not used)	RX rst
SNMP dis	SNMP dis
Tone	Tone (not used)
VSEL	VSEL (not used)
LNB	LNB (not used)
TXAGC	TXAGC(not used)
RXAGC (not used)	RXAGC

When viewed in the orientation illustrated, switching the DIP to the LEFT is OFF (clear) and to the RIGHT is ON (set)

2.4.2.1 DIP switches - receiver MGC

The RF gain within the receiver function is the sum of all gain settings on SW1. The RF gain can be changed in nominal steps of 0.5dB.
For special manual gain control modules record the factory setting of each gain step; this is the preset gain of the receiver.

- RXMGC ON = Manual gain control, OFF = Software control or at default setting
- RX – 0.5dB ON = Gain increased by 0.5dB nominal, OFF= no gain increase
- RX – 1dB ON = Gain increased by 1dB nominal, OFF= no gain increase
- RX – 2dB ON = Gain increased by 2dB nominal, OFF= no gain increase
- RX – 4dB ON = Gain increased by 4dB nominal, OFF= no gain increase
- RX – 8dB ON = Gain increased by 8dB nominal, OFF= no gain increase

When MGC is not in use, manual attenuation has to be set to zero, i.e. all poles with the same switch should return to OFF position. Failure to do so may prevent the module from controlling the gain correctly.

2.4.2.2 DIP switches - transmitter MGC

The RF gain within the transmitter function is the sum of all attenuator settings on SW2. The RF gain can be changed in nominal steps of 0.5dB.
For special manual gain control modules record the factory setting of each gain step; this is the preset gain of the transmitter.

- TXMGC ON = Manual gain control, OFF = Software control or at default setting
- TX – 0.5dB ON = Gain increased by 0.5dB nominal, OFF= no gain increase
- TX – 1dB ON = Gain increased by 1dB nominal, OFF= no gain increase
- TX – 2dB ON = Gain increased by 2dB nominal, OFF= no gain increase
- TX – 4dB ON = Gain increased by 4dB nominal, OFF= no gain increase
- TX – 8dB ON = Gain increased by 8dB nominal, OFF= no gain increase

When MGC is not in use, manual attenuation has to be set to zero, i.e. all poles with the same switch should return to OFF position. Failure to do so may prevent the module from controlling the gain correctly.

2.4.2.3 Manual gain control example

In this example we consider a receiver. The factory set values will typically be in the mid-range of the allowable gain setting range, to allow the operator to both increase and decrease the gain of the unit if desired.

- Factory preset: TX–0.5dB =ON; TX–1dB =OFF; TX–2dB =ON; TX–4dB =ON; TX–8dB =OFF.
- This is a total gain of 0.5 + 2 + 4 = 6.5dB [this will be the factory preset gain]

The operator wishes to increase the gain by 3dB from factory preset gain, he must increase the DIP switch set gain from 6.5dB to 9.5dB

- The new gain setting desired will be 9.5dB, made from the following steps 0.5 + 1 + 8, therefore set the switches as shown below
- TX – 0.5dB = ON; TX – 1dB = ON; TX – 2dB = OFF; TX – 4dB = OFF; TX – 8dB = ON.
- The new gain is now set to 9.5dB

Note: The gain of the link is the sum of the transmitter module and receiver module gains.

2.4.2.4 DIP switches - control

If you wish to use manual control we advise that you record the initial setting of each switch, this is the preset configuration of the module. SW3 control functions are common to the whole module. The on-board micro controllers can be manually reset by using TX_RESET and/or RX_RESET, they must return to the OFF (clear) position to initiate the actual reset sequence.

Switching on SNMP_dis will disable the module I2C bus for that module. In this case, SNMP controller or other I2C hosts will be unable to talk to the module.

RF auto gain control (AGC) function can be activated by setting TX_AGC_ON and RX_AGC_ON to ON (set) position. However, AGC mode will be overridden by MGC mode if both modes are selected. These will override module internal soft gain control. Some modules will have control functions indicated that are not used, such as RX_rst in a single transmitter module. Switches for these “not used” positions should always be left in the OFF (clear) position.

- TX rst Reset TX microcontroller by moving switch from OFF > ON > OFF, ensure that it is returned to the OFF position**
- RX rst Reset RX microcontroller by moving switch from OFF > ON > OFF, ensure that it is returned to the OFF position**
- SNMP_dis ON = I2C bus disabled (module cannot be remotely accessed), OFF = I2C bus enabled
- Tone ON = 22kHz tone present, OFF = 22kHz tone disabled
- VSEL ON = Internal module LNB PSU voltage set to 18V, OFF = Internal module LNB PSU voltage set to 13V
- LNB ON = Internal module LNB PSU enabled, OFF = Internal module LNB PSU disabled
- TXAGC* ON = TX AGC control function activate, OFF = TX AGC control function disabled
- RXAGC* ON = RX AGC control function activate, OFF = RX AGC control function disabled

* Not available on manual control modules

** Card must be powered to perform the reset action, removing power will also reset a module

2.4.3 Changing module RF gain

The link performance specifications apply when modules are operated in the factory preset configuration. However, the gain of the modules can be changed to suit customer requirements.

The performance of the transmitter is highly dependent on the laser diode. Changing transmitter and receiver gain will affect the sensitivity and linearity of the module. Detail of these effects are provided in section 3.

2.4.4 Software control - via SNMP controller

ViaLiteHD RF links can be controlled via a ***ViaLiteHD*** SNMP control module when fitted in the same chassis, see the SNMP controller module handbook for further details. The SNMP module offers control via both a web interface and SNMP.

Remember if you wish to use software control the manual attenuation has to be set to zero, i.e. all poles of the switch should return to the OFF position. Failure to do so may prevent the module from controlling the gain correctly.

2.5 LNA/LNB and BUC DC feeds

The C-band modules have an option to present a DC voltage at the RF connector to power any connected equipment capable of receiving its power this way.

Warning!

Precautions must be taken to ensure that any connected equipment is tolerant of the DC voltages supplied.

2.5.1 LNA/LNB feed - transmitter modules

Transmitter modules may be used to provide a power feed via the RF connection to a preceding low noise amplifier (LNA) or low noise block down converter (LNB).
The voltage source for this function can be supplied externally via a chassis connection or from the module's on-board voltage generator

The external DC paths (option 3) of a module may be accessed via the chassis connector for plug-in modules (see your chassis handbook) or the 15 way D-Type connector for the purple modules.
The LNA/LNB option can be determined from the part number.

Modules in this range offer a variety of feed options, shown below.
0 No LNA feed
1 Internally generated +5 ± 0.5V at 80mA
2 Internally generated +12 ± 1V at 300mA
3 External Feed from chassis connector 0 to +28V at 350mA
5 Internally generated +13.4 ± 1 or +18.5 ± 1 selectable 350mA (up to 7.1GHz)
L Internally generated +13.4 ± 1 or +18.5 ± 1 selectable 700mA (up to 6.0GHz)

2.5.2 LNA/LNB feed efficiency - plug-in modules

The power consumption of a transmitter is specified without allowance for LNA/LNB power. When calculating power consumption the module efficiency of the LNA/LNB power supply at full load is 89% typically and 80% minimum

2.5.3 LNA/LNB voltage boost - plug-in modules

The output voltage of any module equipped with an internal 13/18/22 volt power supply (option "5" and "L") can have its output voltage increased to allow for cable losses, the output voltage is increased by +1V nominally. This is implemented using the modules software configuration. This option is NOT available on units equipped with +5V, +12V or external voltage feeds.

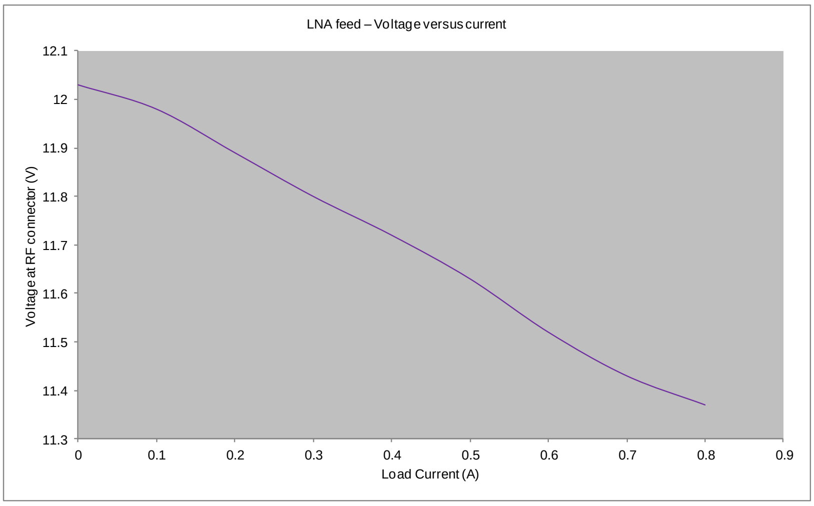
2.5.4 LNA feed - Purple link modules

Modules in this range offer an internally generated +5V or +12V feed and external feed only.

2.5.5 LNA feed – Voltage versus current characteristic

The LNA voltage is fed via a wideband choke (providing RF isolation) a low value resistor (used for current monitoring) and a resettable fuse (providing protection). These elements add a series impedance of approximately one ohm. The graph below shows how the voltage current characteristic of a typical module with 12 volts fed to into the LNA feed via an external feed from the module connector "LNA feed" pin.

When using LNA/LNB feeds care must be taken to allow for voltage drops through the input feed network as well as voltage drops in the output feed network. For example RG58 may have a resistance of up to 0.2 ohms per meter; this varies greatly between different types and constructions of cable.



Voltage measured at RF connector versus load current, input voltage 12V

NOTE: the graph shows the module operating beyond its specification limit to illustrate the margin of safe operation, it should not be operated beyond its specification limit.

2.5.6 BUC feed - receiver modules

Receiver modules may optionally provide block up converter (BUC) power feeds. These provide a DC path to the receiver RF output to provide power to a BUC or other connected module. The external DC paths (option 3) of a module may be accessed via the chassis connector for Plug-in modules (see your chassis handbook).

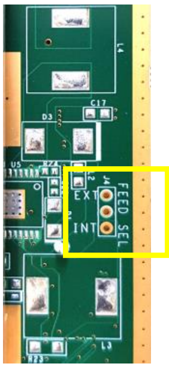
0 No LNA feed
1 Internally generated +5 ± 0.5V at 80mA
2 Internally generated +12 ± 1V at 300mA

3 External Feed from chassis connector 0 to +28V at 350mA
5 Internally generated +13.4 ± 1 or +18.5 ± 1 selectable 350mA (up to 7.1GHz)
L Internally generated +13.4 ± 1 or +18.5 ± 1 selectable 700mA (up to 6.0GHz)

2.5.7 Manual configuration of LNA/LNB and BUC feeds, plug-in modules

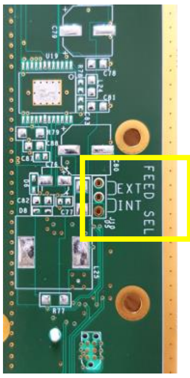
Some modules can be configured either by jumper or by switch to provide an LNA/LNB or BUC feed either from an internally generated voltage or from the rear connector in the ***ViaLiteHD*** chassis. The diagram below shows how these are set.

Units with LNA/ LNB internal power supplies (options 1, 2, and 5) will be delivered set to “internal”. Units with external LNA power (option 3) will be set to “external”. Units with no LNA/LNB or BUC feed (option 0) will normally have no headers fitted to positions J15 or J16.



TX

J4 (LNB)
up = external
down = internal
open = not connected



RX

J10 (BUC)
up = external
down = internal
open = not connected

Manual configuration of LNA/LNB/BUC DC power feeds

2.6 <u>Module Interface ratings</u>

2.6.1 Susceptibility to DC pulses from *ViaLiteHD* receivers

All receiver modules will create a 1-2Vpeak DC transient from the RF output at start up into a 50Ω load (approximately 5V into a 1MΩ load). This may cause failure in some very sensitive spectrum analysers or similar equipment. Please check before connecting your equipment. Contact ***ViaLite Communications*** for more details.

2.6.2 Protection of *ViaLiteHD* equipment from DC pulses

All modules have AC coupled inputs and/or outputs and will be sensitive to large transients (>5V) applied at the RF connector. This may result in permanent damage to the modules, particularly to low frequency or wideband modules. DVB-T and L-Band HTS modules are designed to survive non repetitive DC pulse of up to 36V. To increase protection, BUC feed option “B” can be specified for GPS receiver modules to increases their robustness to DC pulses see section 2.5.6. Contact ***ViaLite Communications*** for more details.

2.6.3 Logic interface, TTL 5V

Absolute maximum voltage rating	-0.5 to +5.5V	No damage
Input, Logic Low (max)	<0.8V	
Input, Logic High (min)	>2.0V	
Output, Logic Low (max)	<0.4V no load	

Output, Logic High (min)	>4.8V no load
Drive capability	1k ohms
Short circuit protection	No

2.6.4 Logic interface, I2C

Absolute maximum voltage rating	-0.3 to +5.3V	No damage
Input, Logic Low (max)	<1.5V	
Input, Logic High (min)	>3.5V	
Output, Logic Low (max)	<0.6V no load	
Output, Logic High (min)	>4.3V no load	
Drive capability	1k ohms	
Short circuit protection	No	

2.6.5 Logic interface, Open Drain, output

For details of operation see 2.6.3

Operational pull up voltage	0 to 15V	No damage
Maximum load current	50mA	
Short circuit protection	No	

Note: Negative voltage on the output will be clamped by the FET body diode; you must ensure that these do not exceed current rating.

Note: When fitted in a chassis with a controller card (i.e. SNMP and web controller or summary alarm card) the alarm lines maybe loaded and pulled up, see chassis handbook

Note: When fitted in a chassis or enclosure adjacent to a RF switch or RF splitter card, alarm lines maybe loaded and pulled up, see chassis handbook

2.6.6 Power interface, +12V, input

Nominal input voltage	12V
Maximum operational voltage range	11.5 to 13V

Purple OEM Module include two options for the external power interface, either by the standard 15 way D connection OR via a dedicated 2.5mm concentric / barrel power port, centre positive. These two interfaces are internal diode or to prevent power being back driven.

2.6.7 Analogue interface, laser diode bias, output

For details of operation see 2.6.7

Typical output voltage	1.25V for 50mA bias current
Typical output voltage range	0 to 2.5V
Maximum output voltage range	-5 to +5V
Short circuit protection	No

2.6.8 Analogue interface, photodiode received light level, output

For details of operation see 2.6.8

Typical output voltage	4.0V at 10 dBm optical input power
Typical output voltage range	1 to 4V
Maximum output voltage range	0 to +5V
Short circuit protection	No

2.6.9 Internally generated LNB power supply and tone

Voltage set to LOW	
Nominal output voltage	13.4V, Output select = LOW
Output voltage range	12.4 to 14.4V
Current rating	700mA per channel for single transmit channel
Short circuit protection	Yes
Voltage set to HIGH	
Nominal output voltage	18.5V, Output select = HIGH
Output voltage range	17.5 to 19.5V
Current rating	700mA per channel for single transmit channel
Short circuit protection	Yes
Voltage BOOST active	
Nominal output Voltage increased	1V, Output boost = ENABLE
Voltage when set to AUX	
Nominal output voltage	22V, AUX mode = ON
Output voltage range	21 to 23V
Current rating	150mA per channel for single transmit channel
Short circuit protection	Yes
TONE active	
Nominal output level	0.6Vp-p, Tone Gen = ACTIVE
Output range	0.4 to 1.2Vp-p
Nominal frequency	22kHz
Frequency accuracy	20 to 24 kHz

2.6.10 RF connectors

Maximum RF input power, no damage	+13 dBm continuous, 25 dBm (5 min max)
Maximum usable input power	Gain Setting Dependent (+1 dBm to -15 dBm typ)
Maximum RF output power	+15 dBm typ

2.6.11 Optical connections

Maximum optical input power, no damage	+16 dBm
Maximum usable input power	+10 dBm
Optical output power	+10 dBm typical for 10mW Transmitter

2.6.12 Purple OEM module Connector

Pin Number	Signal Name	Description
1	12V_IN	12 Volt input, 11.5V to 13V nominal, 2A rated
2	TX/RX Alarm	Alarm output from TX and RX modules
3	LD_MON	Receive Light Level monitor
4	SDA	I2C Data connection
5	SCL	I2C Clock input from master device
6	LNA_FEED	Option for external LNA feed input on Optical TX module. Only used if Internal feed is not specified
7	No Connect	
8	No Connect	
9	No Connect	
10	No Connect	
11	No Connect	
12	Ground	Ground connection
13	No Connect	
14	No Connect	
15	No Connect	

3 System integration

3.1 Link loss budget calculations

The link gain (transmitter RF input level to receiver RF output level) depends on the following factors:

- Optical loss (due to connector insertion loss and optical fibre loss).
- Transmitter gain setting.
- Receiver gain setting.

The actual link gain can be determined as follows:

Link gain = Transmitter Gain + Receiver Gain – (2 x optical loss) [dB]

(Where optical loss = connector insertion losses + fibre losses)

3.2 Optical loss versus gain

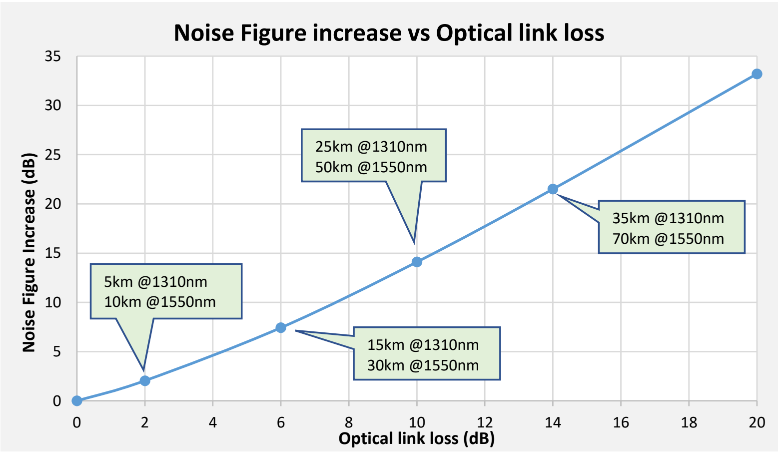
The additional electrical insertion loss in dB resulting from optical losses is equal to 2 times that of the optical loss in dB. This is due to the physics of the optical-to-electrical conversion process in the receiver. For example, a 1dB increase in optical insertion loss will result in a 2dB decrease in RF signal at the output of the optical receiver.
For single-mode fibre (e.g. SMF28), the optical loss at the 1310nm operating wavelength of the ***ViaLiteHD*** link is 0.4dB/km. For 1550nm operating wavelength, the optical loss is 0.2dB/km.
This can increase if the fibre is under excessive tension, compression or is bent into a small radius.
For clean, undamaged single-mode connectors, optical insertion loss is typically 0.2dB per interface.

Note: The losses at the optical connections of the transmitter and receiver are allowed for during manufacture of the module, and may be ignored during link gain calculations.
For short links (<250m) containing no additional optical connectors, and in which the fibre is not subject to any strain, the optical path loss can be ignored.

3.3 Optical loss versus noise figure

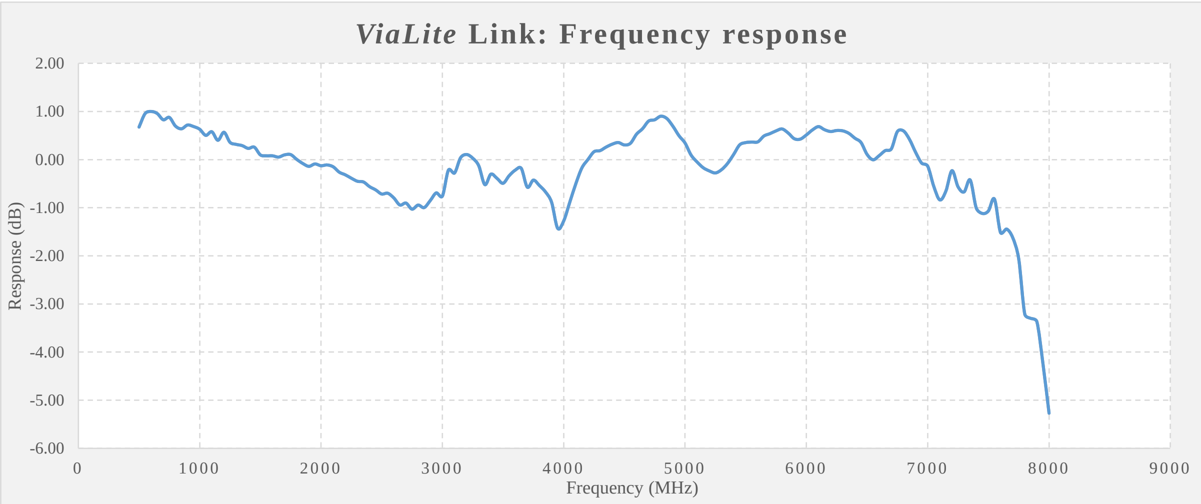
As the optical loss increases there will be a corresponding increase in noise, the chart below shows the approximate relationship of optical loss to noise figure increase for a standard L-Band HTS link. Below are graphs that shows the change in noise figure of some popular link types. For links with high power transmitters see section 0.

Note: If you operate the ***ViaLiteHD*** modules in RLL AGC mode it is possible to mask optical loss variations, but this is not always desirable.



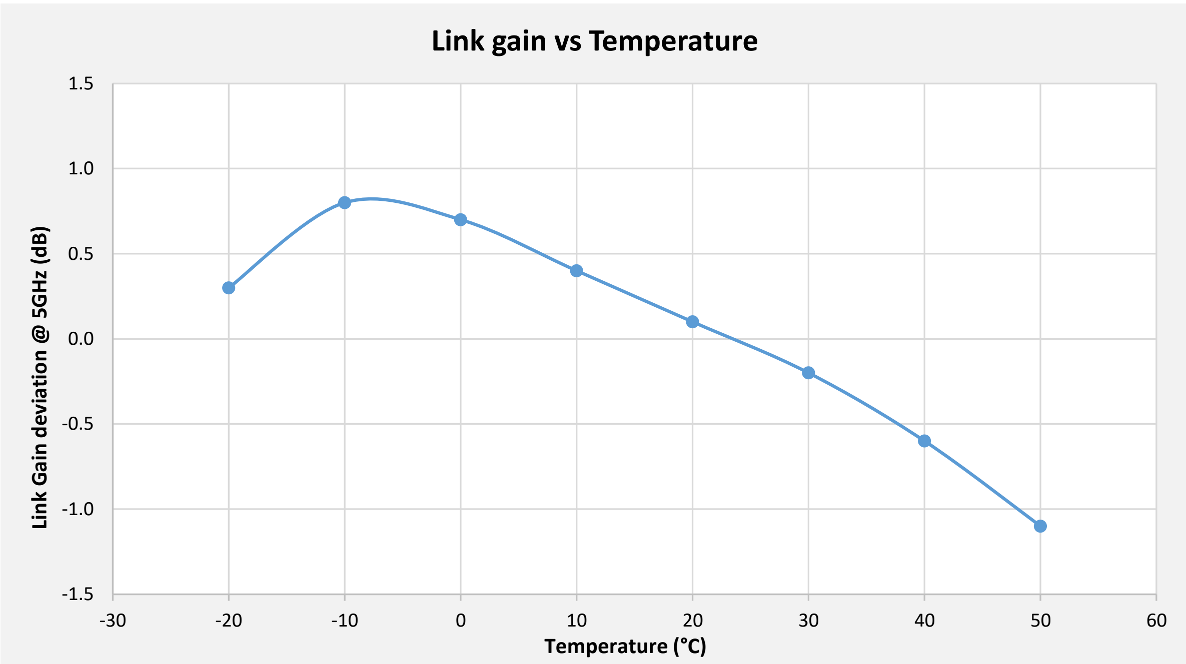
3.4 Gain

The Gain of a ***ViaLiteHD*** C-Band Link is generally consistent with frequency in the designated downlink and uplink bands. Useable gain and performance can be found in a wide range from 500MHz to 8 GHz. Below is the data for a High Gain link pair (TX=0dB, RX=15dB)



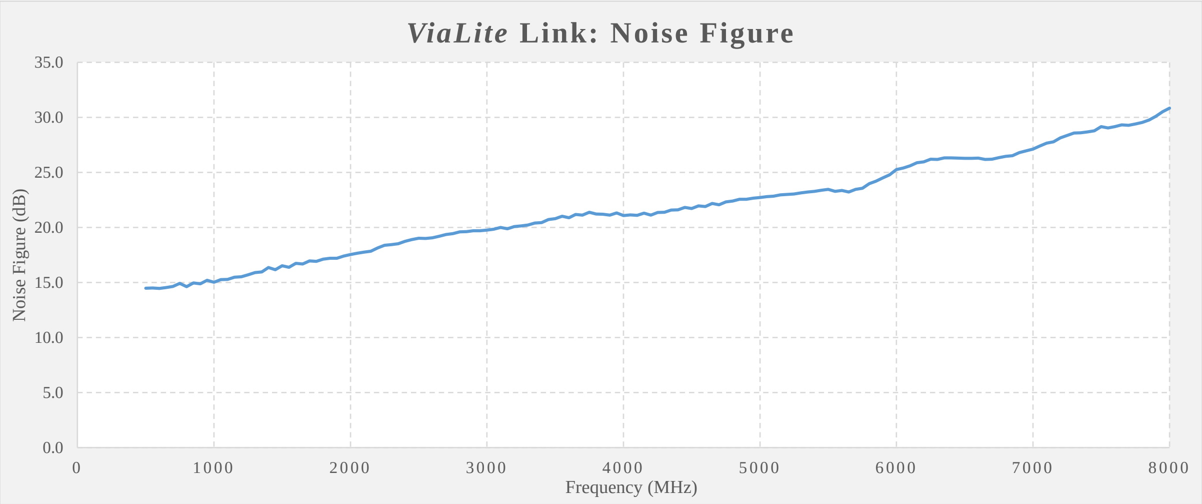
3.4.1 Effect of temperature on gain

The gain of a ***ViaLiteHD*** C-Band Link generally reduces as temperature increases. The graph below shows change in RF gain versus the room temperature gain.



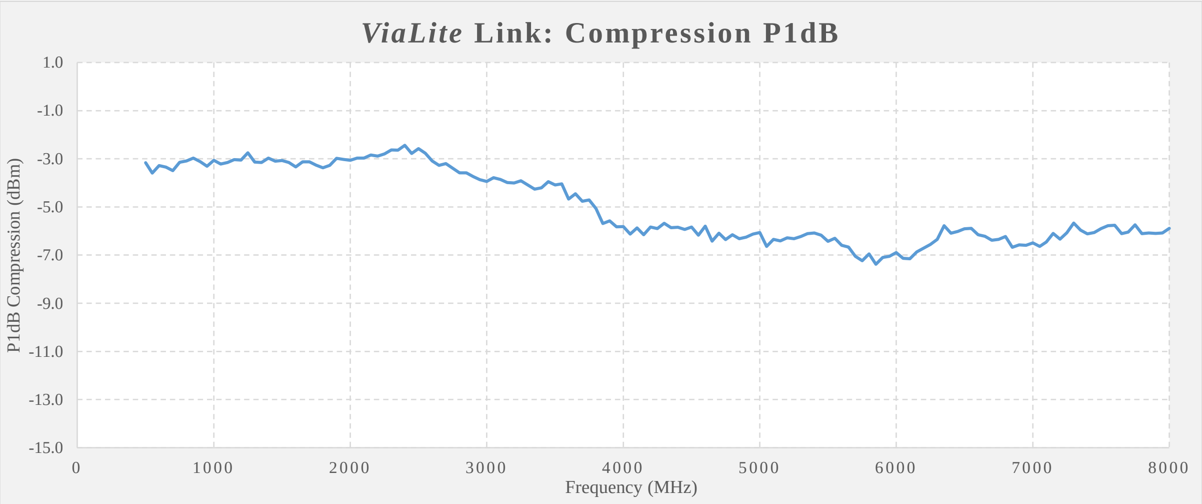
3.5 Noise Figure

The noise Figure of a ***ViaLiteHD*** C-Band Link generally increases with frequency resulting in a lower noise figure for the downlink than the uplink. The nominal Noise Figure can be raised or lowered as a trade off with linearity when commissioning a system to best align with the signal levels present.
Below is the data for a High Gain link pair (TX=0dB, RX=15dB)



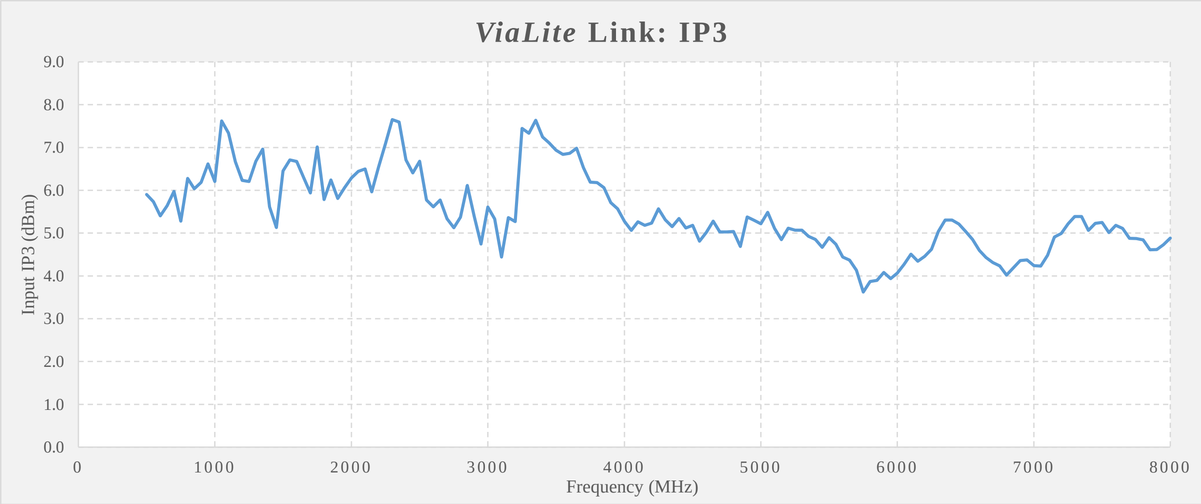
3.6 Linearity (P1dB compression)

The P1dB Compression point of a ***ViaLiteHD*** C-Band Link is generally consistent with frequency.
The nominal P1dB compression point can be raised or lowered as a trade-off with noise figure when commissioning a system to best align with the signal levels present.
Below is the data for a High Gain link pair (TX=0dB, RX=15dB)



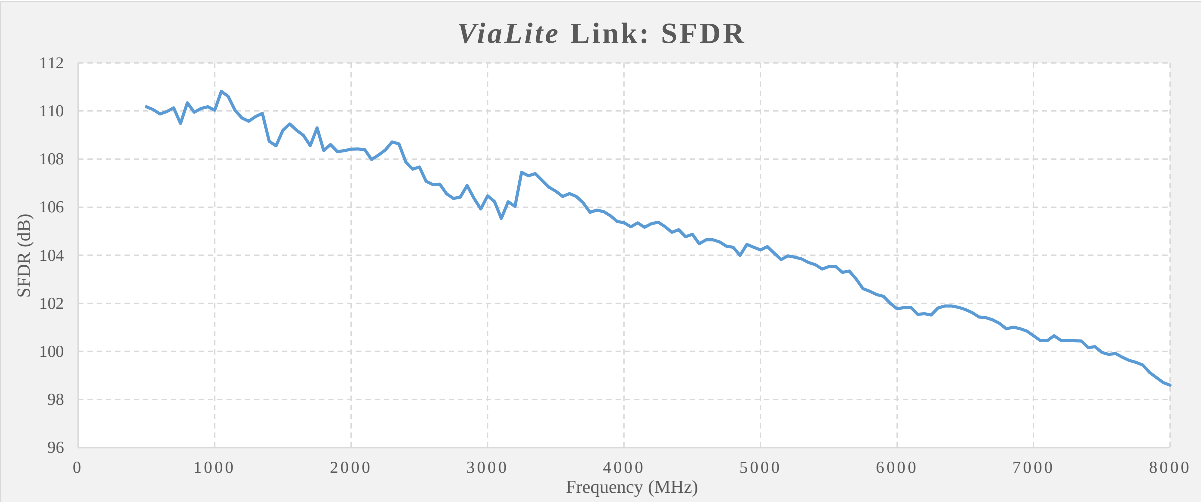
3.7 Linearity (IP3 intermodulation)

The IP3 Compression point of a ***ViaLiteHD*** C-Band Link is generally consistent with frequency.
The nominal point can be raised or lowered as a trade-off with noise figure when commissioning a system to best align with the signal levels present.
Below is the data for a High Gain link pair (TX=0dB, RX=15dB)



3.8 Spurious Free Dynamic Range (SFDR)

The SFDR of a ***ViaLiteHD*** C-Band Link is generally lower at higher frequencies due to the impact of the Noise Figure increasing with frequency.
When altering the gain of the transmitter in order balance the link Noise Figure and linearity, the SFDR is largely unaffected.
Below is the data for a High Gain link pair (TX=0dB, RX=15dB)



3.9 Link delay

The ***ViaLiteHD*** link introduces a small amount of delay to the system, similar to the contribution of an amplifier. The typical delay contribution is shown below. You should also account for delay through RF and fibre cables as these are likely to be much higher than the delay in the link fibre optic modules.

• Fibre optic link transmit and receive pair		13.5ns
• Fibre optic cable		5ns per meter, check manufactures specification
• RF cable		3.5– 5.5 ns per meter dependent on cable type.
	LMR-195	4.0 ns per meter
	LMR-400	3.9 ns per meter
	LMR-500	3.9 ns per meter
	LMR-600	3.9 ns per meter
	RG-58	5.1 ns per meter, dependent on dielectric
	RG-59	4.1 ns per meter, dependent on dielectric
	RG-213	5.1 ns per meter
	RG-316	4.2 ns per meter

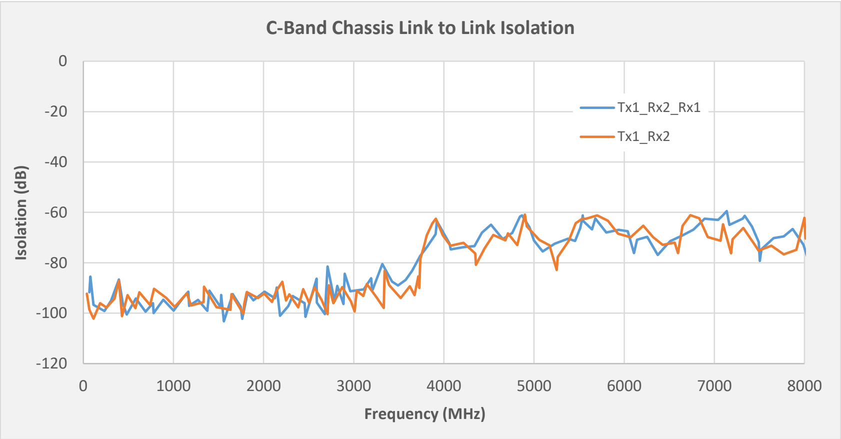
Delays quoted are typical for these cable types, construction of cables of the same type will vary between manufacturers (i.e. foam/ PTFE/ solid polyethylene dielectric). If delay is critical please check your manufacturer's cable specification or electrically test the cables.

3.10 RF isolation

ViaLiteHD cards are designed to offer excellent isolation between slots in a chassis mounted system. The sensitive components and RF circuitry of ***ViaLiteHD*** C-band link modules are well shielded

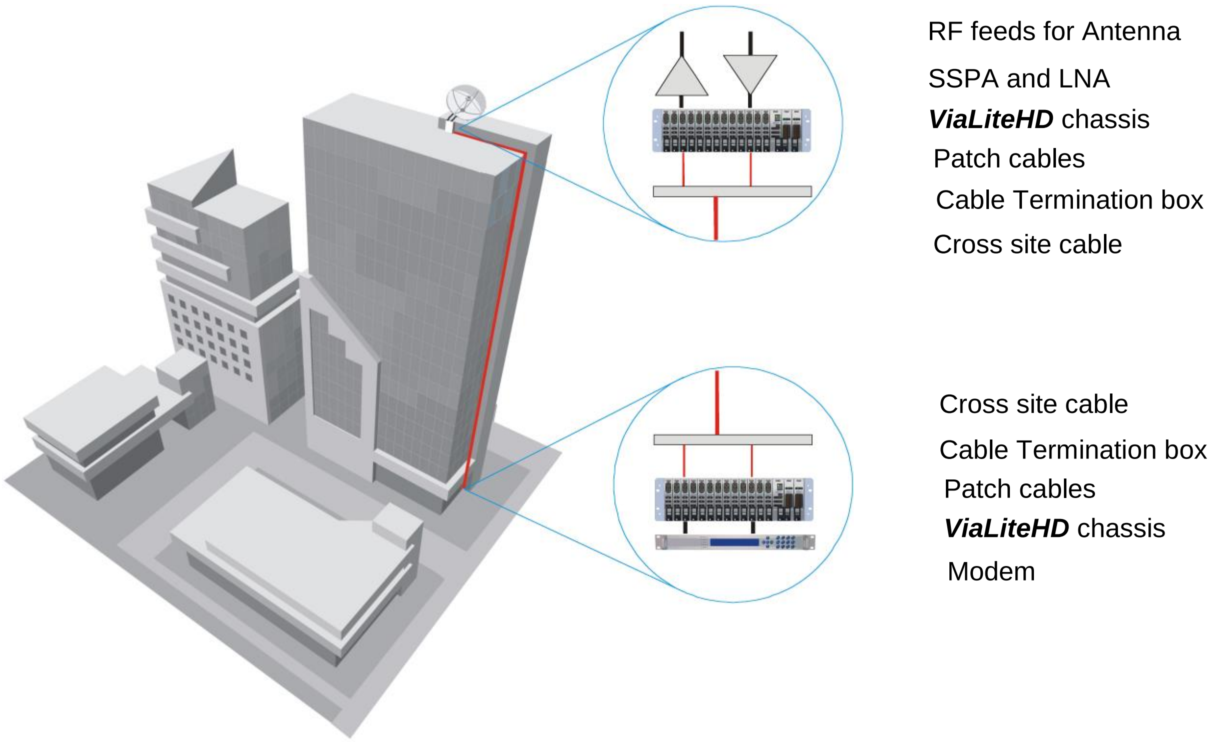
3.10.1 RF isolation, plug-in cards

Measurements of two C-Band links in adjacent slots of a ***ViaLiteHD*** 3U chassis show better than 60dB isolation.



3.11 Typical system configuration with fixed gain modules

The diagram below illustrates a typical communications system configuration.



The link gain for the fixed gain systems depends solely on the optical fibre loss from transmitter to receiver. There is a Received Light Level (RLL) analogue monitor output on the receiver modules which can be used to measure the light from the transmitter reaching the receiver during operation. The RLL threshold alarm (which is triggered when the RLL drops below a preset level) can be used to determine if the optical link has been damaged or degraded.

3.12 Commissioning of a communications link

This commissioning procedure illustrates the processes required to install and set up a communications link with gain control. The example describes the commissioning of a C-Band HTS inter-facility link.

We will be considering the installation of the following system.

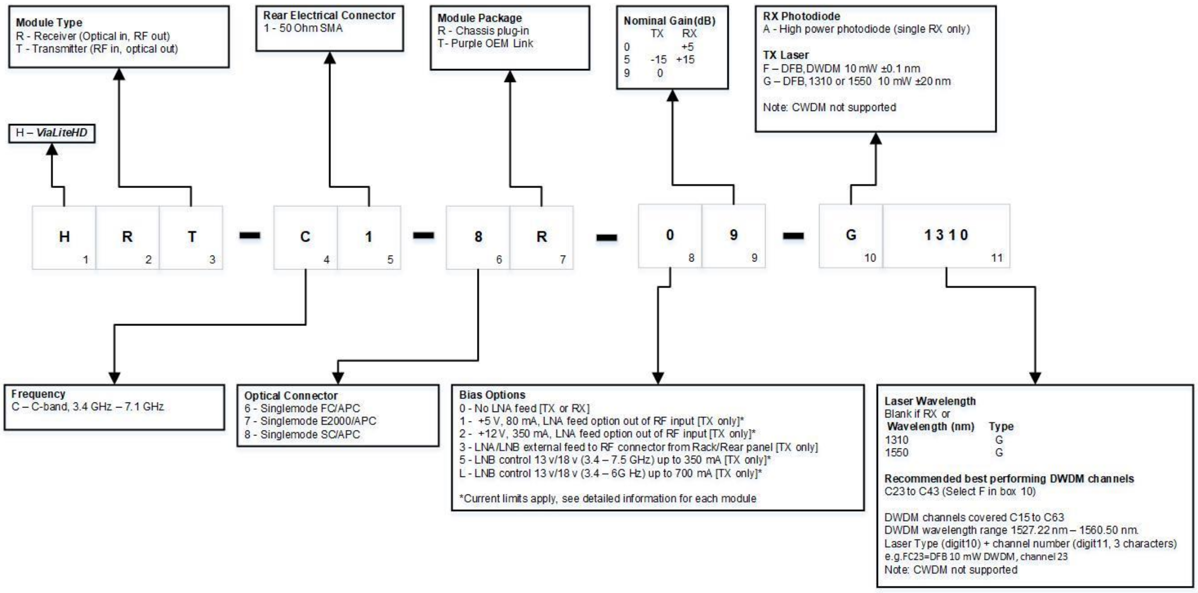
A LNA provides an output signal in the C- band. The signal must be conveyed over 1500m of fibre, through a bulkhead at each station, to the modem. An alarm must trigger if the optical path is damaged.

1. Install the link, connecting all optical patch cords and cross-site fibre optic cables. Clean ALL optical connectors BEFORE mating with the modules.
2. Power up the equipment and allow 15 minutes to warm up.
3. Ensure that the RF power into the transmitter module is set to optimum for your system. Use a broadband RF power meter for this measurement. Typically this is the input level at which the link's intermodulation distortion (IMD) is ~ -40dBc. This value of input power can be calculated from your datasheet, it is typically 8dB less than the input P1dB.
4. Calculate the approximate optical attenuation in the fibre path. In our case, we have two bulkhead connectors @ 0.2dB each, 1500m of optical fibre @ 1310nm = 0.6dB, giving a total of 1dB of optical loss. The total RF gain of the system should be the nominal link gain minus 2x the optical loss.

5. Confirm that the RF output from the receiver is correct (to within measurement accuracy). If the loss is much higher (> 3dB) than calculated, the most likely explanation is dirt on the optical connectors. If this is the case, clean each connection in turn until the required system gain is restored.

4 Part numbering

4.1 Part numbering matrix



Note: Options are dependent on module type.
Not all combinations of options are available.
Contact ***ViaLite Communications*** for more details.

4.2 Part numbering, DWDM wavelengths

Channel	Frequency (GHz)	Wavelength (nm)
C16	191600	1564.6788
H16	191650	1564.2706
C17	191700	1563.8626
H17	191750	1563.4548
C18	191800	1563.0472
H18	191850	1562.6399
C19	191900	1562.2327
H19	191950	1561.8258
C20	192000	1561.4191
H20	192050	1561.0125
C21	192100	1560.6062
H21	192150	1560.2001
C22	192200	1559.7943
H22	192250	1559.3886
C23	192300	1558.9831
H23	192350	1558.5779
C24	192400	1558.1729
H24	192450	1557.7680
C25	192500	1557.3634
H25	192550	1556.9590
C26	192600	1556.5548
H26	192650	1556.1508
C27	192700	1555.7471
H27	192750	1555.3435

Channel	Frequency (GHz)	Wavelength (nm)
C28	192800	1554.9401
H28	192850	1554.5370
C29	192900	1554.1340
H29	192950	1553.7313
C30	193000	1553.3288
H30	193050	1552.9265
C31	193100	1552.5244
H31	193150	1552.1225
C32	193200	1551.7208
H32	193250	1551.3193
C33	193300	1550.9180
H33	193350	1550.5170
C34	193400	1550.1161
H34	193450	1549.7155
C35	193500	1549.3150
H35	193550	1548.9148
C36	193600	1548.5148
H36	193650	1548.1149
C37	193700	1547.7153
H37	193750	1547.3159
C38	193800	1546.9167
H38	193850	1546.5177
C39	193900	1546.1189
H39	193950	1545.7203

Channel	Frequency (GHz)	Wavelength (nm)
C40	194000	1545.3219
H40	194050	1544.9238
C41	194100	1544.5258
H41	194150	1544.1280
C42	194200	1543.7305
H42	194250	1543.3331
C43	194300	1542.9360
H43	194350	1542.5390
C44	194400	1542.1423
H44	194450	1541.7457
C45	194500	1541.3494
H45	194550	1540.9533
C46	194600	1540.5573
H46	194650	1540.1616
C47	194700	1539.7661
H47	194750	1539.3708
C48	194800	1538.9757
H48	194850	1538.5807
C49	194900	1538.1860
H49	194950	1537.7915
C50	195000	1537.3972
H50	195050	1537.0031
C51	195100	1536.6092
H51	195150	1536.2155

Channel	Frequency (GHz)	Wavelength (nm)
C52	195200	1535.8220
H52	195250	1535.4287
C53	195300	1535.0356
H53	195350	1534.6427
C54	195400	1534.2500
H54	195450	1533.8575
C55	195500	1533.4653
H55	195550	1533.0732
C56	195600	1532.6813
H56	195650	1532.2896
C57	195700	1531.8981
H57	195750	1531.5068
C58	195800	1531.1157
H58	195850	1530.7248
C59	195900	1530.3341
H59	195950	1529.9436

Note
Channel numbers beginning with C are on ITU 100GHz grid
Channel numbers beginning with H are on ITU 100GHz offset

5 Maintenance and fault finding guide

Refer to the following table that gives a list of commonly encountered problems and suggested solutions.

Fault	Possible Causes	Solution
Power LED does not illuminate.	Power is not connected to the PSU. Module is not fully inserted.	Connect mains power to the rear of the PSU. Check fuses of power leads. Check module is properly aligned and handle pawls are fully engaged. Check there are no obstructions to the rear such as optical cable protective covers.
Difficulty inserting module.	Incorrect alignment. Incorrect module slot.	Check that the module is correctly fitted in card guides. Check that module is in correct slot. Slots 1-13 for 5HP modules.
Alarm LED in ALARM state.	LNA Feed is in current limit. Laser degraded. Low optical level at receiver.	Check external load. Return to local ***ViaLite Communications*** office. Check optical link for breaks / kinks. Check all optical connectors are clean.
Low signal level.	Gain adjustment set too low. RF feed not connected. Optical loss too high. Incorrect optical connectors Incorrect manual or software gain settings Input power too high	Increase gain setting. Check RF connections. Clean and check Optical connections. Ensure that optical cable matches the type of connectors on you **ViaLiteHD** module, normally cable and connector colours should match. Reset to factory default. Or reset to known good configuration If input power exceeds the modules P1dB, either reduce the input power, reconfigure the module to increase P1dB or replace with a more linear module (lower gain TX).
High intermodulation levels.	Gain adjustment set too high. Incorrect manual or software gain settings	Decrease TX gain setting. Reset to factory default. Or reset to known good configuration.

The ***ViaLiteHD*** range of RF transmitter and receiver modules are precision engineered and calibrated for optimum performance and accuracy before dispatch.

In the event of any problems or queries arising with the equipment, please contact ***ViaLite Communications*** or your local agent.

6 FCC Approval

Information to the user of ***ViaLiteHD*** products:

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

7 Product warranty

ViaLite Communications guarantees its ***ViaLiteHD*** products, and will maintain them for a period of three years from the date of shipment and at no cost to the customer. Extended warranty options are available at the time of purchase.

Please note that the customer is responsible for shipping costs to return the module to ***ViaLite Communications***.

ViaLite Communications or its agents will maintain its ***ViaLiteHD*** products in full working order and make all necessary adjustments and parts replacements during ***ViaLite Communications***' normal working hours provided that the Customer will pay at the rates currently charged by ***ViaLite Communications*** for any replacements made necessary by accident, misuse, neglect, wilful act or default or any cause other than normal use.

Claims must be made promptly, and during the guarantee period.

IMPORTANT: -

Please contact both your selling agent and *ViaLite Communications* prior to returning any goods for warranty or non-warranty repairs. Goods will not be accepted without a valid Goods Return Number (GRN)

PULSE POWER & MEASUREMENT LTD, 65 SHRIVENHAM HUNDRED BUSINESS PARK, SWINDON, SN6 8TY, UK.
TEL: +44 1793 784389 FAX: +44 1793 784391
EMAIL : SALES@VIALITE.COM WEBSITE : WWW.VIALITE.COM