ViaLiteHD

RF Fibre Optic Link

User Guide

HRx-HB-7

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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, Dual Transmitters and Transceivers 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:

- Transmitter modules (electrical – optical converter) with part numbers starting
    - HRT
- Receiver modules (optical - electrical converter) with part numbers starting
    - HRR
- Transceiver modules (optical - electrical converter + electrical – optical converter) with part numbers starting
    - HRX
- Dual Receiver modules (optical - electrical converter + optical - electrical converter) with part numbers starting
    - HRV
- Dual Transmitter modules (electrical – optical converter + electrical – optical converter) with part numbers starting
    - HRU

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

1.1 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.

The light travels through an optical fibre to the receiver module. The distance between transmitter and receiver can range from 1m to 100km; distance 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.

1.2 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 2.2 for fibre optic cable handling details.

1.3 ViaLiteHD and ViaLite Classic compatibility

The RF and optical interfaces of most ***ViaLiteHD*** and ***ViaLite Classic*** are compatible. However the physical size, mounting systems and control of the modules are different, so it will not be possible to fit ***ViaLiteHD*** modules in a ***ViaLite Classic*** chassis or housing and vice versa. However it is possible for chassis of different types to interwork and be used to expand existing systems. Listed below is a brief summary of inter family compatibility.

- RF links — Compatible optical and RF interfaces
- RF + digital — Compatible optical and RF interfaces
    - RS232 — Compatible optical (check impact on optical link budget) and digital interfaces
    - RS422 — Compatible optical (check impact on optical link budget) and digital interfaces
    - RS485 — Compatible optical (check impact on optical link budget) and digital interfaces
- Ethernet — Modules of matching speed have compatible optical and digital interfaces
- Switch — Compatible RF interfaces may need interface cable (no optical interface)
- Splitters — Compatible RF interfaces
- Amplifier — Compatible RF interfaces
- Oscillator — Compatible RF interfaces
- SNMP — RJ45 interfaces maybe connected, control interface is not compatible,

Contact ***ViaLite Communications*** or your local ***ViaLite*** agent for more details.

2 Setting up and understanding the fibre optic link

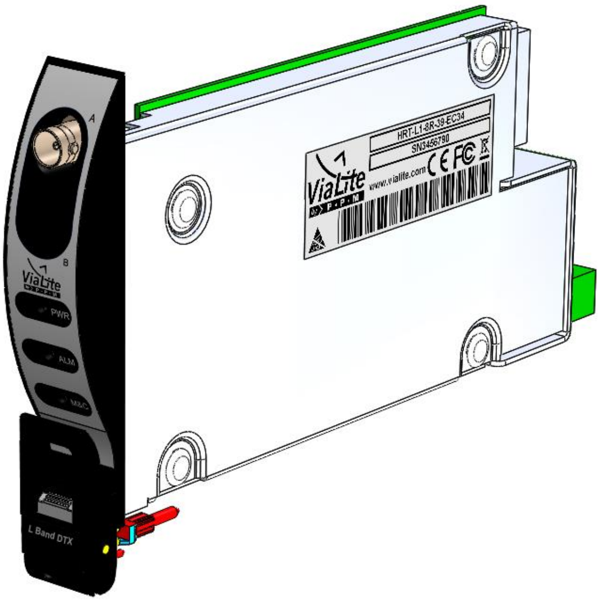
This section describes the connections between your RF fibre optic transmitter (electrical – optical converter) and receiver (optical - electrical converter) modules, and the operation of both modules in a system.

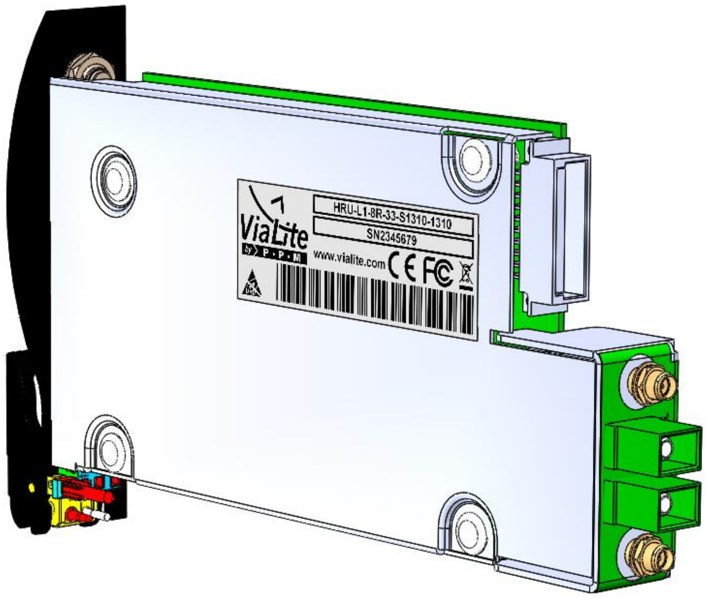
Please read fully all relevant documents for information on installing your ***ViaLiteHD*** equipment before commissioning your RF fibre optic link system.

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

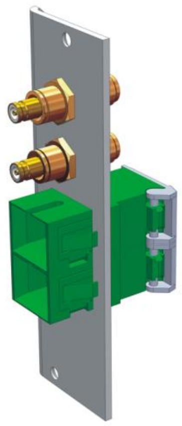
- Disconnect any cables if necessary
- Push the release button of the module handle down and simultaneously pull the top of the handle forwards.
- Apply pressure via the handle and gently withdraw the module from the chassis.

2.1.2 5HP blindmate plug-in modules

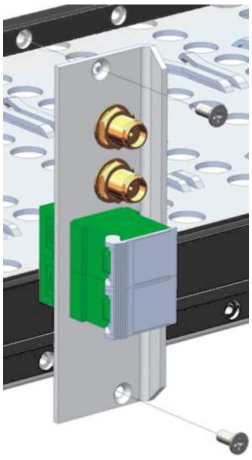
All ***ViaLiteHD*** plug-in modules are hot-swappable, so it is not necessary to power-down the chassis before inserting a module. All blindmate optical connectors are provided with spring loaded covers that will protect the optics of any inserted modules. As there is no cover on the opposite side, mating cables should not be installed until the slot modules are present.

To install a blindmate module and matching interface plate

- Firstly inspect the rear blind-mating plate [1], ensure that the connector barrels are fitted into all RF connectors and are centrally aligned.
- Remove protective covers from the inside face of the optical connector if fitted.
- Ensure that the rear plate is free of any dust and contamination, if necessary clean with filtered compressed air.
- Screw the blind-mating plate into the appropriate slot at the rear of the chassis, using the supplied screws and a “Pozidriv Number 1” screwdriver [2]
- Push the release button of the module handle down and simultaneously pull the top of the handle towards you.
- Remove the protective cover from the modules optical connectors and clean any optical connectors [3]
- 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 (without locking it), you may also apply pressure between the LED and test connector (where test connectors are fitted as these are not available on all module types) [4].
- 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.
- Connect any interface cables to the blind mate plate, at the rear of the chassis.



[1]



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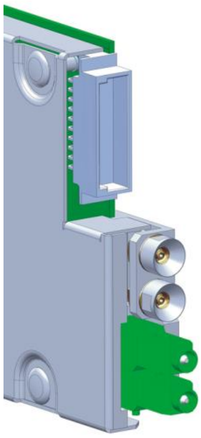

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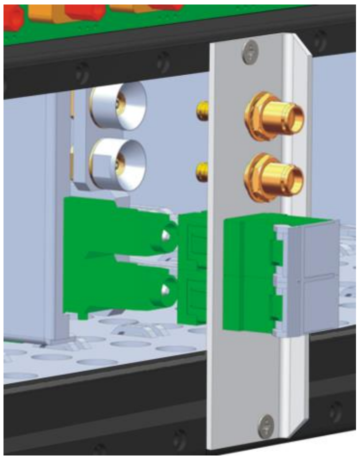


[4]

To remove a blindmate module

- Push the release button of the module handle down and simultaneously pull the top of the handle towards you.
- Apply pressure via the handle and gently withdraw the module from the chassis.
- Check that the RF mating barrel is retained by the chassis blind-mating plate
- All cables with be retained by the chassis case.

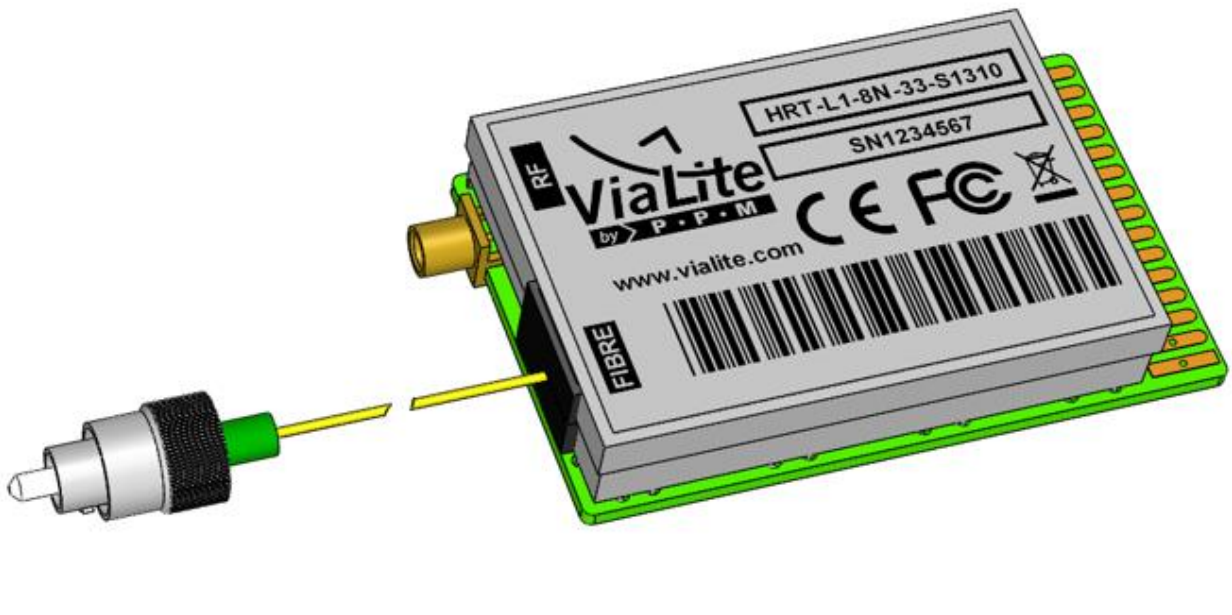
Note: if modules are absent for an extended period there is a chance of the optical fibres being contaminated as the optical mating interface is unprotected. If this happens it will be necessary to clean both the blind-mating adaptor and fibre optic cable.

2.1.3 Blue link modules

The Blue link module is fully enclosed and built with connectorised interfaces with electromagnetic shielding. This allows system integrators and equipment manufacturers an easy route to build RF/optical interfaces into their own equipment. The small form factor and integrated design should allow the module to be easily integrated into end user equipment.

2.1.4 Yellow link modules

The very small form factor Yellow link module has an edge connector for DC and alarm connections, an integrated RF shield, and a very small overall form factor. This allows system integrators and equipment manufacturers to very simply integrate this on a motherboard giving an easy route to build RF/optical interfaces into their own design. The low volume of this module allows it to easily be fitted into existing mechanical housings.



2.2 Fibre optic cable & connectors

2.2.1 Connector and cable types

All ***ViaLiteHD*** RF modules use singlemode (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.

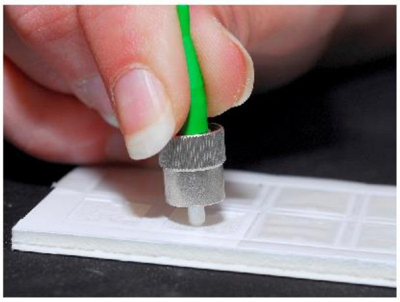
Warning! The specification of optical connector is critical to the performance of the complete fibre optic link. System performance can only be guaranteed with fibre optic cables and connectors supplied by *ViaLite Communications*. When FC/APC connectors are specified they must be "narrow key width"

2.2.2 Connecting and disconnecting

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

2.2.3 Cleaning optical connectors, cleaning before every use

Optical connectors MUST be cleaned before use, even where they have been protected with dust caps. **Most performance issues are due to dirty fibres**.

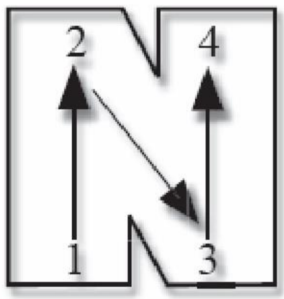


- Peel the plastic cover from an unused "N" cleaning pad.

- 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.

2.2.4 Cleaning optical connectors, high levels of contamination

If there are performance issues that are not resolved by basic cleaning in section 2.2.3, 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 Iso Propyl 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.

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.

2.2.4.1 FC/APC Connectors

All ***ViaLiteHD*** FC connectorised modules use FC/APC (narrow key). Clean the plug before inserting see section 2.2.3.

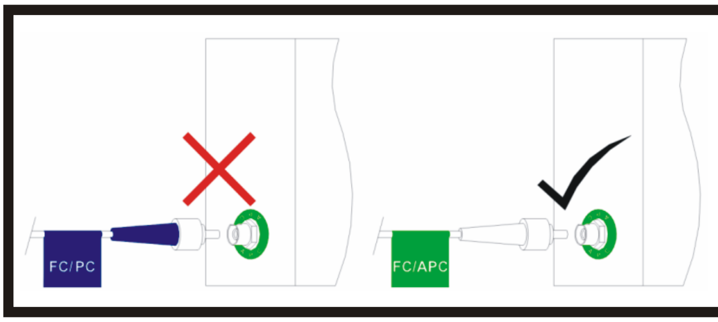
To connect FC/APC optical connectors:-

- 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.

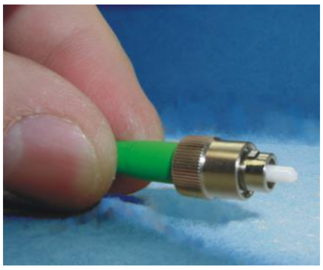
To disconnect:-

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

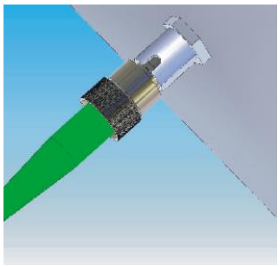
Warning! It is possible to tighten the knurled collet without aligning the lug and gap. This will result in poor light transmission. Check that the lug and gap are aligned before tightening the knurled collet



Only connect FC/APC cable to FC/APC modules



Locate connector key



Align key and keyway

2.2.4.2 E2000/APC Connectors

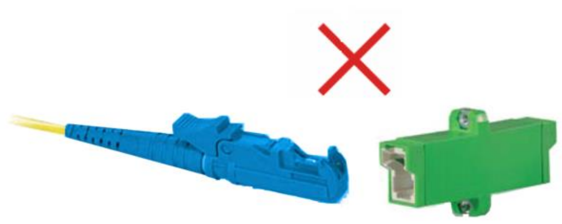
All ***ViaLiteHD*** E2000 connectorised modules use E2000/APC. Clean the plug before inserting see section 2.2.3.

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.

2.2.4.3 SC/APC Connectors (fitted to standard modules)

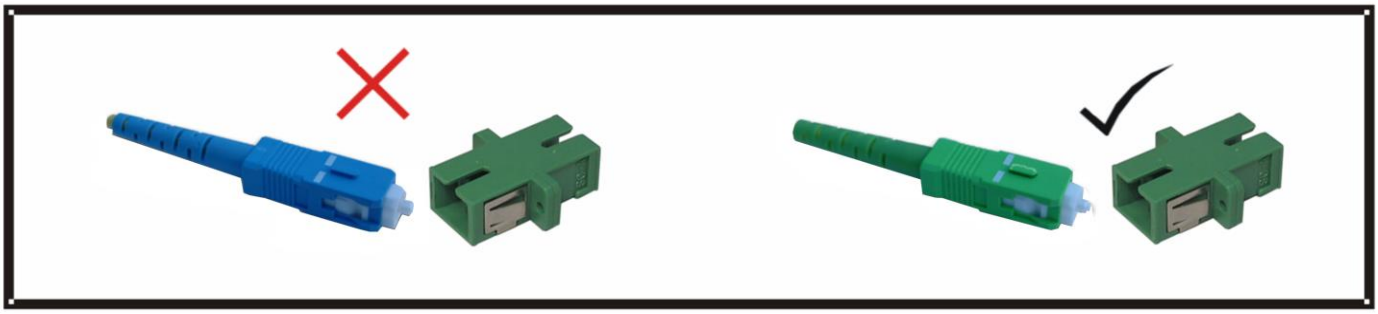
All ***ViaLiteHD*** SC connectorised modules use SC/APC. Clean the plug before inserting see section 2.2.3.

To connect SC/APC optical connectors:-

- 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:-

- 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.

2.2.4.4 SC/APC Connectors (fitted to blindmate modules)

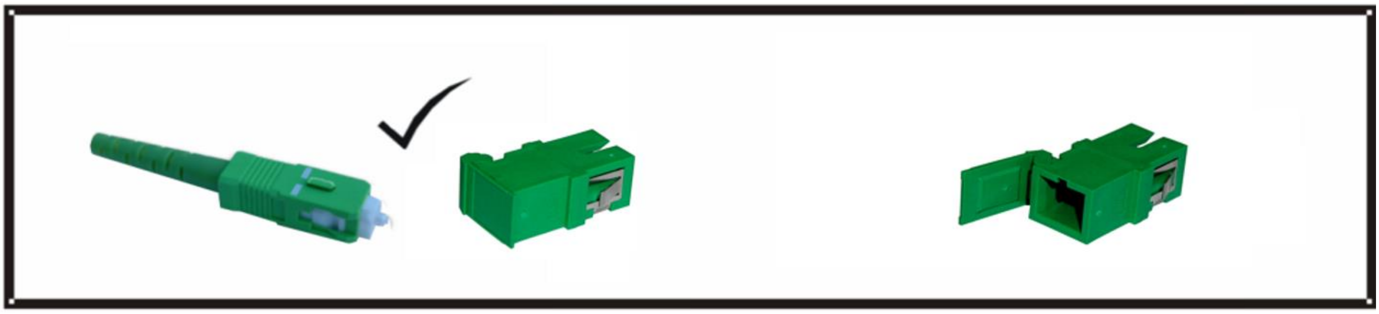
All ***ViaLiteHD*** blindmate connectorised modules use SC/APC optical connectors on the chassis rear interface. Clean the plug before inserting see section 2.2.3.

To connect SC/APC optical connectors:-

- Remove the plug protective cover.
- Open the adaptor sprung 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:-

- Grip the body of the plug and gently pull the plug from the adaptor, replace the protective cover.
- The adaptor sprung cover, will automatically close.



Only connect SC/APC cable to blindmate SC. Position of keyway behind protective cover.

2.2.4.5 LC/APC Connectors

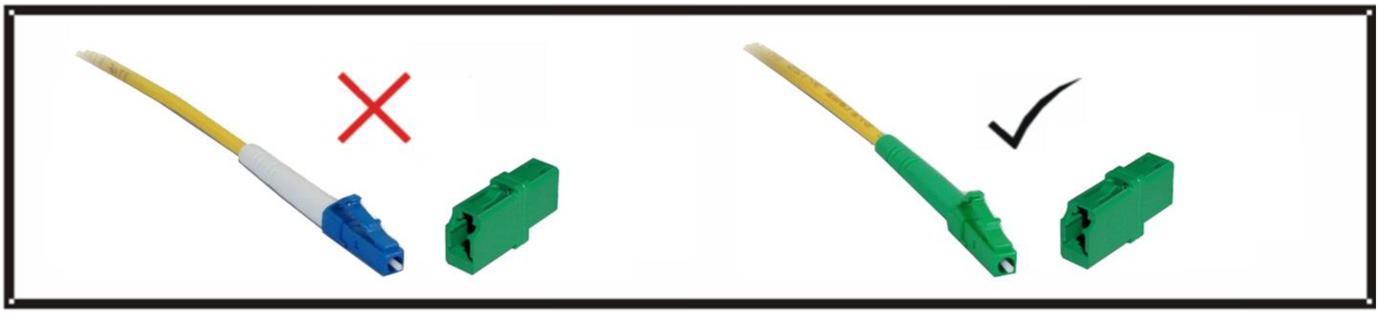
All ***ViaLiteHD*** LC connectorised modules use LC/APC. Clean the plug, before inserting see section 2.2.3.

To connect LC/APC optical connectors:-

- Remove the plug protective cover.
- Align the connector latch to the adaptor.
- Gently push the plug-into the adapter until a click is heard and the latch locks.

To disconnect:-

- Grip the body of the plug and push down on the latch.
- While holding the latch down, gently pull the plug from the adaptor, replace the protective cover.



Only connect LC/APC cable to LC/APC.

2.2.5 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

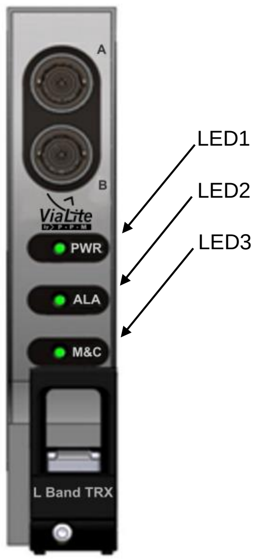
2.3.1 Connecting the module

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 technical specifications in section 6.

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.

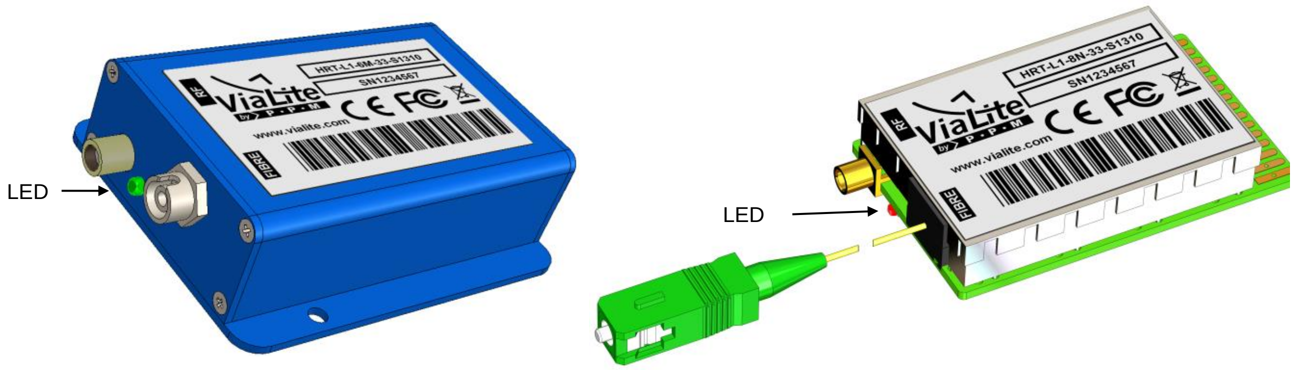
	Colour	Plug-in Single Transmitter	Plug-in Single Receiver	Plug-in Transceiver	Plug-in Dual Transmitter	Plug-in Dual Receiver
LED1	GREEN	Normal				
	Flashing GREEN	Programming	Programming	Programming	Programming	Programming
	RED	Not used	Not used	TX PSU fail	TX2 PSU fail	RX2 PSU fail
	No light	TX PSU fail	RX PSU fail	RX PSU fail	TX1 PSU fail	RX1 PSU fail
LED2	GREEN	Normal				
	Flashing RED fast	TX Alarm	Not used	TX Alarm	TX2 Alarm	RX2 Alarm
	Flashing RED slow	Not used	RX Alarm	RX Alarm	TX1 Alarm	RX1 Alarm
	RED	Not used	Not used	All Alarm	All Alarm	All Alarm
LED3	GREEN	I2C enabled				
	Flashing GREEN	I2C active				
	AMBER	I2C disabled				



2.3.3 LED indicator, Blue link and Yellow link 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	



LED positions for Blue link and Yellow link modules

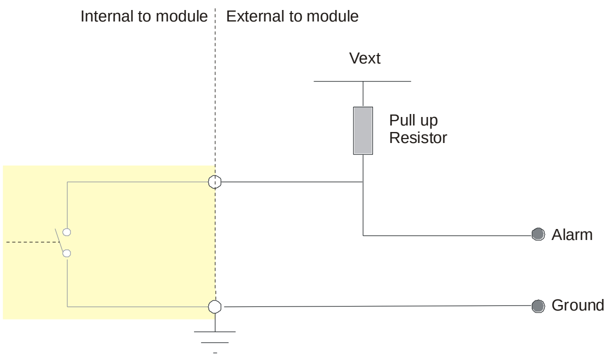
2.3.4 Module summary alarm

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

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

For units with single function optical port (i.e. without WDM see section 2.3.10.1), the pre-set thresholds are shown below

- The RLL alarm threshold is set for a nominal input power of -14.5dBm @ 1310nm
  - Nominal optical loss of 20.0dB @ for a standard DFB 4.5dBm (3mW) TX @ 1310nm
  - Nominal optical loss of 21.5dB @ for a standard DWDM 7.0dBm (5mW) TX @ 1310nm
  - Nominal optical loss of 23.5dB @ for a high power DFB 9.0dBm (8mW) TX @ 1310nm
  - Nominal optical loss of 25.3dB @ for a high power DWDM 10.8dBm (12mW) TX @ 1310nm
- The RLL alarm threshold is set for a nominal input power of -15.0dBm @ 1550nm
  - Nominal optical loss of 20.5dB @ for a standard DFB 4.5dBm (3mW) TX @ 1550nm
  - Nominal optical loss of 22.0dB @ for a standard DWDM 7.0dBm (5mW) TX @ 1550nm
  - Nominal optical loss of 24.0dB @ for a high power DFB 9.0dBm (8mW) TX @ 1550nm
  - Nominal optical loss of 25.8dB @ for a high power DFB 10.8dBm (12mW) TX @ 1550nm

For units with WDM combined optical ports (see section 2.3.10.3), the pre-set thresholds are shown below

- The RLL alarm threshold is set for a nominal input power of -13.5dBm @ 1310nm
  - Nominal optical loss of 19.0dB @ for a standard DFB 4.5dBm (3mW) TX @ 1310nm
  - Nominal optical loss of 20.5dB @ for a standard DWDM 7.0dBm (5mW) TX @ 1310nm
  - Nominal optical loss of 22.5dB @ for a high power DFB 9.0dBm (8mW) TX @ 1310nm
  - Nominal optical loss of 24.3dB @ for a high power DWDM 10.8dBm (12mW) TX @ 1310nm
- The RLL alarm threshold is set for a nominal input power of -14.0dBm @ 1550nm
  - Nominal optical loss of 19.5dB @ for a standard DFB 4.5dBm (3mW) TX @ 1550nm
  - Nominal optical loss of 21.0dB @ for a standard DWDM 7.0dBm (5mW) TX @ 1550nm
  - Nominal optical loss of 23.0dB @ for a high power DFB 9.0dBm (8mW) TX @ 1550nm
  - Nominal optical loss of 24.8dB @ for a high power DFB 10.8dBm (12mW) TX @ 1550nm

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

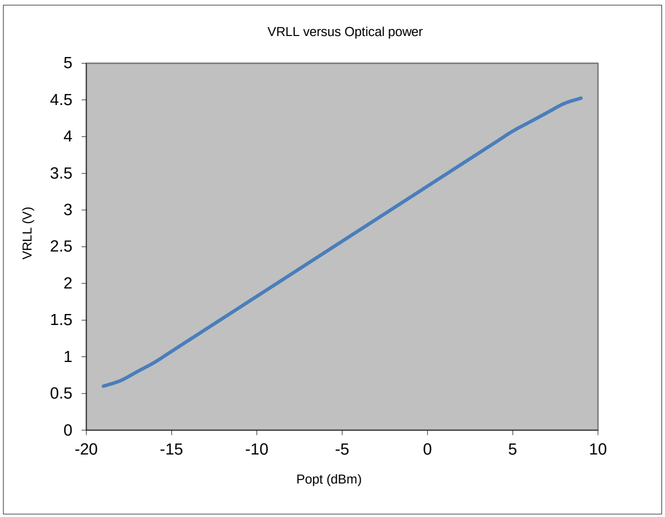
2.3.7 Module analogue monitor

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.

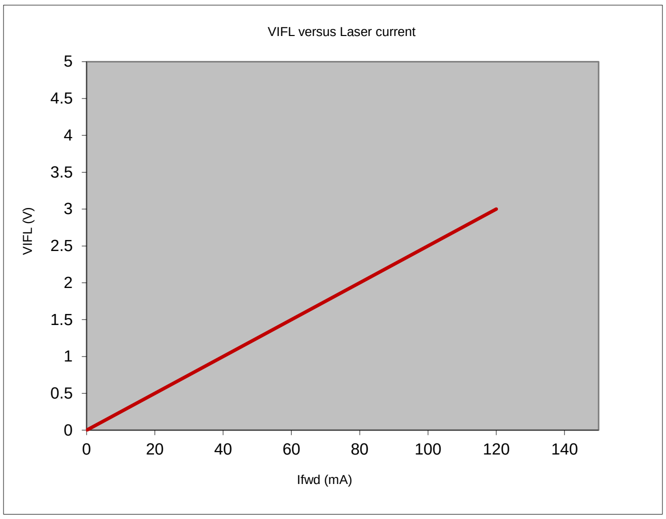
Function	Single Transmitter	Single Receiver	Transceiver	Dual Transmitter	Dual Receiver
Analogue monitor A	Not Used	Received light level	Received light level	Laser bias monitor1	Received light level1
Analogue monitor B	Laser bias monitor	Not Used	Laser bias monitor	Laser bias monitor2	Received light level2

The performance of the analogue monitors is as follows

Monitor type	Operation
TX analogue, current monitor output	**V_{IFL} = 25 x 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 x (4.5 - 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 +4.5dBm for standard links



Analogue monitor: RLL monitor



Analogue monitor: Laser current

2.3.8 RF connectors

ViaLiteHD products are fitted with a range of standard RF connectors. The RF modules are all fitted with FEMALE connectors. When connecting the modules ensure that you have both the correct type and impedance of connector. Listed below are the connector types available.

Front panel test connectors (optional on some plug-in and blindmate modules only)
- BNC 50 ohms bayonet
- BNC 75 ohms bayonet

Rear Input / Output connectors, plug-in modules
- SMA 50 ohms screw on
- BNC 75 ohms bayonet
- F-Type 75 ohms screw on

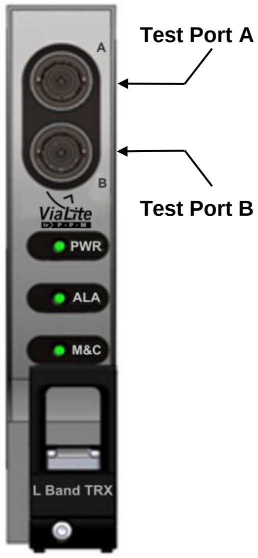
Input / Output connectors Blue link and Yellow link modules

- SMA 50 ohms screw on
- MCX 50 ohms push fit
- MCX 75 ohms push fit

Not all connector types are available on all types of module. If you are unsure of the connector type your module is fitted with this can be determined from the part number (see section 5). Blind-mating modules are fitted with a floating RF connector, mating between the plug-in module and the chassis rear plate. This is a purely internal interface and should not be connected by any means other than via the supplied chassis interface.

Warning! Use of incorrect impedance connectors may also cause intermittent connections and in extreme cases result in physical damage to the connector.
Warning! Use of incorrect impedance connector will result in mismatch increasing the system loss and reducing RF flatness.
Warning! Use of incorrect impedance cable will result in mismatch increasing the system loss and reducing RF flatness.

2.3.9 RF test ports



Some modules are fitted with RF test ports, these modules will have one or two test ports. These ports can be used to provide an indication of the signals being input and output from the rear ports without the need to monitor them directly. The RF impedance of the test port matches that of the rear connector. Standard test ports are either 50 ohm BNC or 75 ohm BNC. A non-standard option of 50 ohm SMA is available, contact ***ViaLite Communications*** for more details.

The port lettering convention for front ports matches that for rear ports. Port A is always the upper port, Port B is always the lower port.

Function	Single Transmitter	Single Receiver	Transceiver	Dual Transmitter	Dual Receiver
Port A	Transmitter	Receiver	Receiver	Transmitter 1	Receiver 1
Port B	Not Used	Not Used	Transmitter	Transmitter 2	Receiver 2

All module types except frequency types “J” and “K”, “L-Band HTS + Reference.

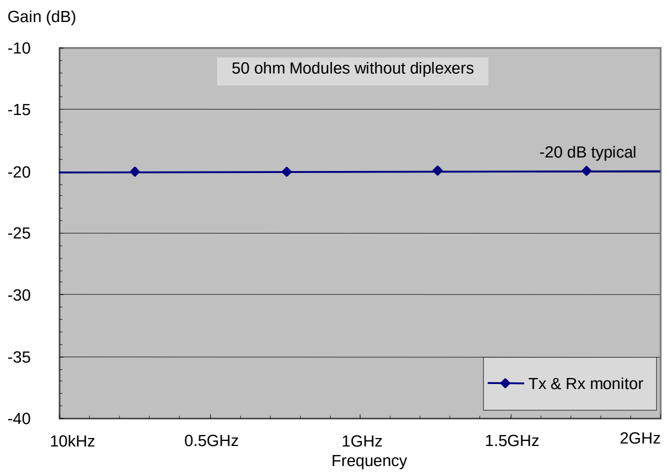
Function	L-Band HTS + reference “J” Transmitter	L-Band HTS + reference “J” Receiver	L-Band HTS + reference “K” Transmitter	L-Band HTS + reference “K” Receiver
Port A	Receiver Reference	Receiver L-Band HTS	Transmitter Reference	Receiver Reference
Port B	Transmitter L-Band HTS	Transmitter Reference	Transmitter L-Band HTS	Receiver L-Band HTS

Frequency types “J” and “K”, L-Band HTS + Reference modules

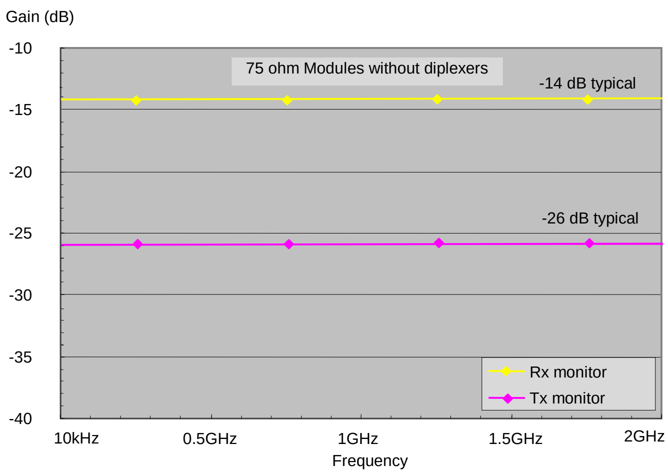
To minimise the impact on the main RF path, the test port is coupled at a low level compared to the main path. The coupling efficiency of the test port relative to the main path is relatively flat versus frequency and can be predicted using the following graphs, which outline typical performance. The graphs show the typical performance of the 4 types of coupling ports from 10kHz to 4GHz, types of test port are.

- 50ohm modules without diplexer (typically -20dB TX and RX)
- 75ohm modules without diplexer (typically -14dB RX and -26dB TX)
- 50ohm modules with diplexer (typically -19dB RX and -21dB TX)
- 75ohm modules with diplexer (typically -13dB RX and -27dB TX)

The operation of the test port is accurate across the specified operating range of the module, see the technical specification section 6. All test ports have a minimum operating frequency of 10kHz, measurements taken below 10kHz will have reduced accuracy. To ensure accurate operation, the signal ports need to be terminated with a well matched load, poor matching will degrade the accuracy of the coupling factor.

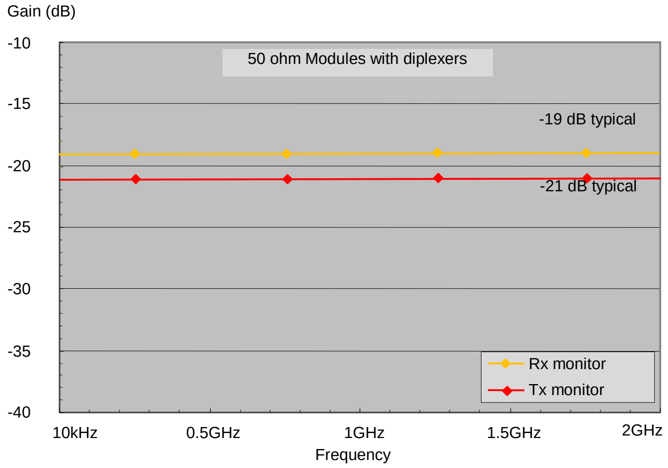


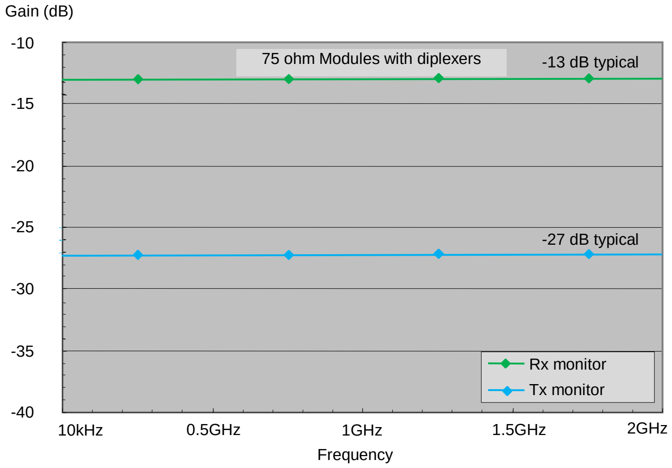
50 ohm wide band test port



75 ohm wide band test port

All module types except those fitted with RF diplexers, coupling factor of front port relative to rear port (dB) versus Frequency (GHz)





50 ohm wide band test port 75 ohm wide band test port
Module types "J" and "K" fitted with RF diplexers, coupling factor of front port relative to rear port (dB) versus Frequency (GHz)

Module Type	**Rear panel connector type** SMA 50 ohm OR BNC 50 ohm			**Rear panel connector type** BNC 75 ohm OR F-Type 75ohm	
	Test Port			Test Port	
	None	BNC50 ohm	SMA50	None	BNC75
B – 70/140MHz IF module, 10-200 MHz	**S**	N	N	**S**	N
D - DVB-T broadcast, 470-860MHz	**S**	N	N	**S**	N
G - GPS, special function, 1000-1800MHz	**S**	N	N	-	-
L – L-Band HTS, 700-2450MHz	N	**S**	N	N	**S**
J – L-Band HTS + Reference, DL 700-2450MHz	N	**S**	N	N	**S**
K – L-Band HTS + Reference, UL 700-2450MHz	N	**S**	N	N	**S**
M - General purpose 10-1350MHz	N	**S**	N	N	**S**
N - General purpose 10-1000MHz	N	**S**	N	N	**S**
S - Wideband 10- 3000MHz	**S**	N	N	-	-
T - Low frequency timing, 0.01-50MHz	**S**	N	N	**S**	N
U - Ultra Wideband 0.002-4200MHz	**S**	X	X	-	-
W - Extra Wideband 10-4200MHz	**S**	X	X	-	-

S = Standard
O = Available option
N = Non-standard, For non-standard options contact ***ViaLite Communications***.
X = Not available
\- = Not used on this module type

Note: Only use the rear RF connections for your input and output signals.

2.3.10 RF and optical rear input and output ports

2.3.10.1 Single function RF and optical rear input and output ports

All ***ViaLiteHD*** modules are fitted with one or two rear RF ports and one or two rear optical ports. These are for the input of RF signals to transmitters and output of RF signals from receivers; output optical signals from transmitters and input optical signals to receivers.

The port lettering convention for rear ports matches that for front ports. The upper of each port is port A and the lower is port B. On single receiver and single transmitter modules the optical and RF port use the outer most positions to maximise accessibility.
Note: All new blindmate modules are supplied with an appropriate chassis interface plate.

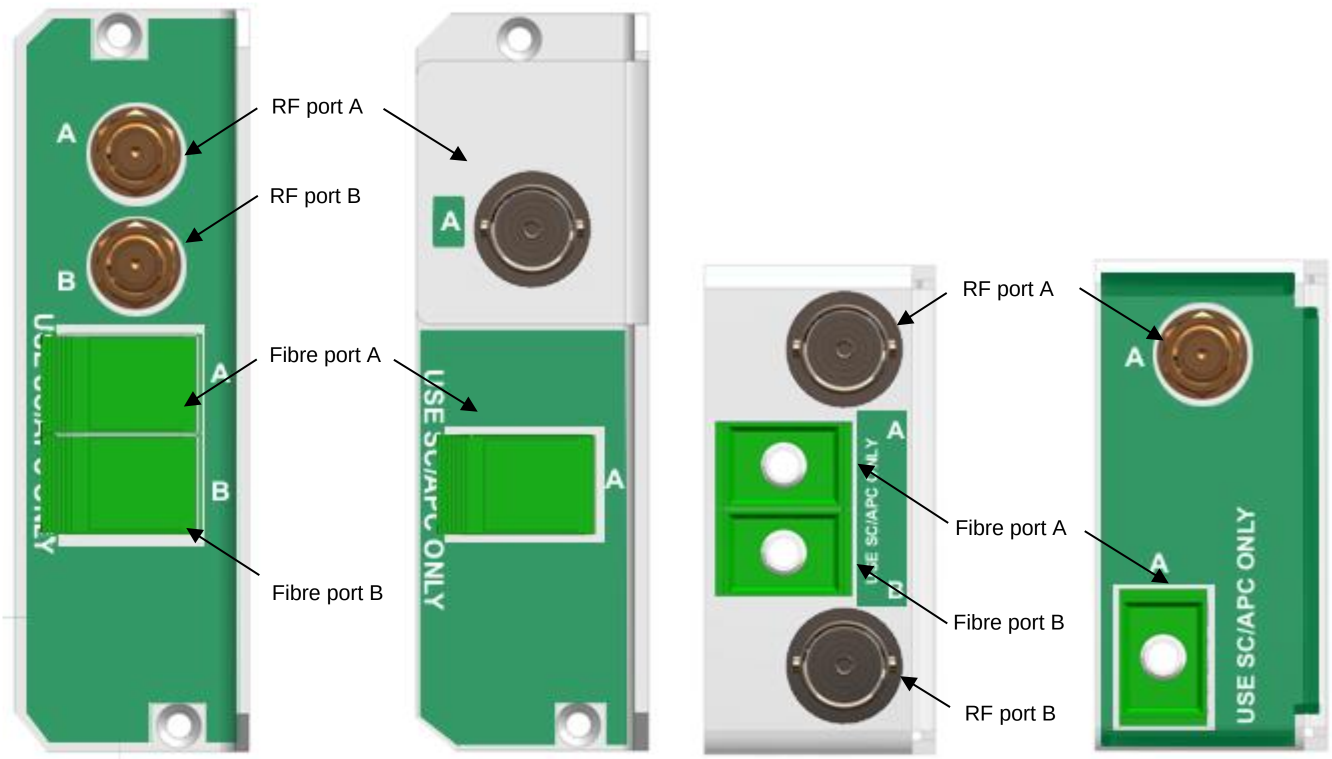
If you wish to pre-populate and cable your blindmate chassis in advance, chassis plates can be purchased as spares, see section 2.3.10.5.

Function	**Single Transmitter**	**Single Receiver**	**Transceiver**	**Dual Transmitter**	**Dual Receiver**
Port A	Transmitter	Receiver	Receiver	Transmitter 1	Receiver 1
Port B	Not Used	Not Used	Transmitter	Transmitter 2	Receiver 2

All module types except frequency types "J" and "K"

Function	L-Band HTS + reference “J” Transmitter	L-Band HTS+ reference “J” Receiver	L-Band HTS + reference “K” Transmitter	L-Band HTS + reference “K” Receiver
Port A	Receiver Reference	Transmitter Reference	Transmitter Reference	Receiver Reference
Port B	Transmitter L-Band HTS	Receiver L-Band HTS	Transmitter L-Band HTS	Receiver L-Band HTS

Frequency types “J” and “K”, L-Band HTS + Reference modules, with two RF ports



Blindmate rear interface
Dual Channel

Blindmate rear interface
Single Channel

Standard rear interface
Dual Channel

Standard rear interface
Single Channel

2.3.10.2 Labelling convention for Dual channel WDM/CWDM units

When ***ViaLiteHD*** dual TX modules are fitted with two different CWDM wavelength channels, they obey the convention that the lower value wavelength is used for the TOP “A” port and higher wavelength is used for the BOTTOM “B” port. An example is shown below.

- Module Type HRU-L1-8D-33-C1550-1570 uses dual channel blindmate interface as shown above, left
- Port A 1550nm on TOP, SC/APC connector
- Port B 1570nm on BOTTOM, SC/APC connector

2.3.10.3 Diplexed RF rear input and output ports

The L-Band HTS + Reference modules can optionally be fitted with internal diplexers these combine the L-Band HTS and Reference channels into a single RF port, the port is normally labelled A+B for easy identification.

Function	L-Band HTS + reference “J” Transmitter	L-Band HTS+ reference “J” Receiver	L-Band HTS + reference “K” Transmitter	L-Band HTS + reference “K” Receiver
Port A+B	Diplexed Receiver Reference plus Transmitter L-Band HTS	Diplexed Receiver L-Band HTS plus Transmitter Reference	Diplexed Transmitter Reference plus Transmitter L-Band HTS	Diplexed Receiver Reference plus Receiver L-Band HTS

Frequency types “J” and “K”, L-Band HTS + Reference modules, with one RF port

2.3.10.4 WDM combined optical rear input and output ports

Modules can be fitted with an optical WDM that combines the two optical channels into a single port, this port would normally be label A+B for easy identification

Function	Transceiver	Dual Transmitter	Dual Receiver
Port A + B	WDM combined Receiver plus Transmitter	WDM combined Transmitter 1 plus Transmitter 2	WDM combined Receiver 1 plus Receiver 2

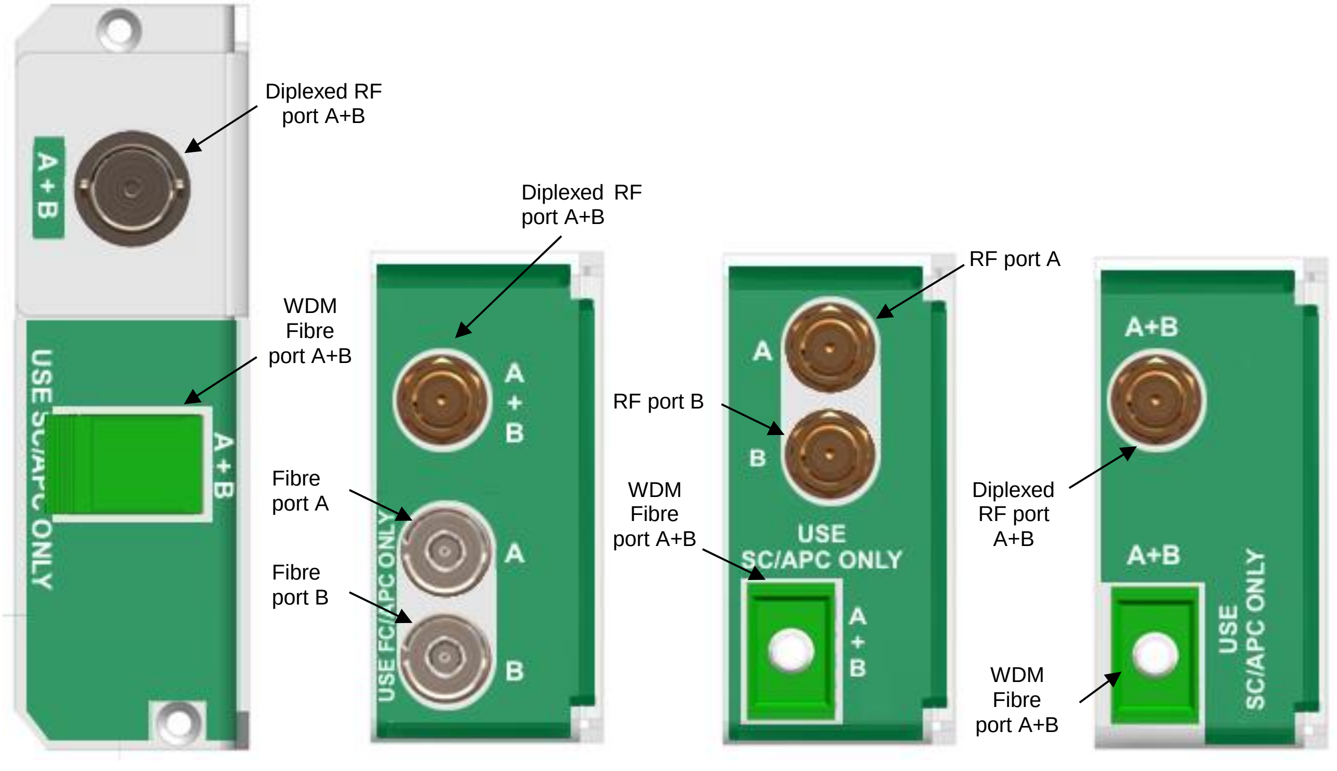
All module types except frequency types “J” and “K”

Function	L-Band HTS + reference “J” Transmitter	L-Band HTS+ reference “J” Receiver	L-Band HTS + reference “K” Transmitter	L-Band HTS + reference “K” Receiver
Port A+B	WDM combined Receiver Reference plus Transmitter L-Band HTS	WDM combined Receiver L-Band HTS plus Transmitter Reference	WDM combined Transmitter Reference plus Transmitter L-Band HTS	WDM combined Receiver Reference plus Receiver L-Band HTS

Frequency types “J” and “K”, L-Band HTS + Reference modules, with one optical port

The additional optical loss introduced by the WDM module and the isolation between the two optical channels, requires that the alarm threshold is reduced to eliminate the chance of the RLL alarm malfunctioning. The typical alarm levels are given in section 2.3.6.

The WDM will reduce the isolation between the two optical paths, the optical isolation will be greater than 20dB, giving a typical RF isolation of 45dB.



Blindmate rear interface
RF Diplexer and WDM optical

Standard rear interface
RF Diplexer with two optical

Standard rear interface
Two RF and WDM optical

Standard rear interface
RF Diplexer and WDM optical

2.3.10.5 Separate blindmate panels

If you wish to pre-populate and cable your blindmate chassis in advance, chassis plates can be purchased as spares, details below.

- PPM part number 85058 ViaLiteHD, Chassis plate, Blindmate, 1 * SMA 50ohms, 1 * SC/APC
- PPM part number 85059 ViaLiteHD, Chassis plate, Blindmate, 2 * SMA 50ohms, 2 * SC/APC
- PPM part number 85060 ViaLiteHD, Chassis plate, Blindmate, 1 * BNC 75ohms, 1 * SC/APC
- PPM part number 85061 ViaLiteHD, Chassis plate, Blindmate, 2 * BNC 75ohms, 2 * SC/APC
- PPM part number 85064 ViaLiteHD, Chassis plate, Blindmate, 1 * F-Type 75ohms, 1 * SC/APC
- PPM part number 85065 ViaLiteHD, Chassis plate, Blindmate, 2 * F-Type 75ohms, 2 * SC/APC
- PPM part number 85066 ViaLiteHD, Chassis plate, Blindmate, 2 * SMA 50ohms
- PPM part number 85067 ViaLiteHD, Chassis plate, Blindmate, 3 * SMA 50ohms

- PPM part number 85068 ViaLiteHD, Chassis plate, Blindmate, 4 * SMA 50ohms
- PPM part number 85069 ViaLiteHD, Chassis plate, Blindmate Duplexed, 1 * SMA 50ohms, 1 * SC/APC
- PPM part number 85070 ViaLiteHD, Chassis plate, Blindmate Duplexed, 1 * BNC 75ohms, 1 * SC/APC
- PPM part number 85071 ViaLiteHD, Chassis plate, Blindmate, 1 * BNC 50ohms, 1 * SC/APC
- PPM part number 85072 ViaLiteHD, Chassis plate, Blindmate, 2 * BNC 50ohms, 2 * SC/APC.
- PPM part number 85073 ViaLiteHD, Chassis plate, Blindmate, 2 * SC/APC

2.3.11 Digital signal ports

Any ***ViaLiteHD*** RF module which is fitted with a digital transmission path, has these digital signal interfaces connected via the chassis backplane (plug-in or blindmate modules) or the main interface connector (Blue link and Yellow link modules). Details of the pin outs are given in the chassis manual for plug-in modules and in section 4.3.2 of this manual for Blue link and Yellow link modules.

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.

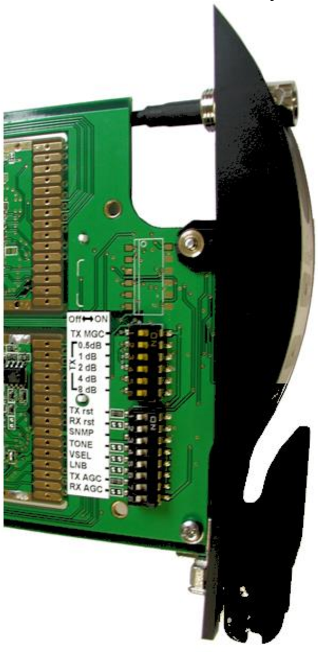
2.4.1 Manual control, MGC

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 or three 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.

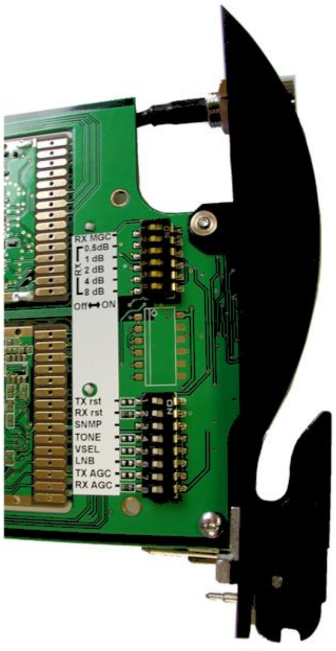
2.4.2 Manual control, DIP switch functions

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.

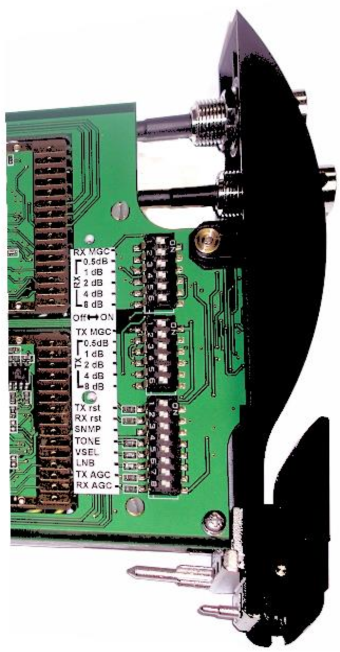
All intelligent modules will be delivered with DIP switches all set to OFF (clear). Only special manual gain control modules will be delivered with the DIP switches set to factory calibrated gain settings.



Single Transmitter



Single Receiver



Transceiver

The switch arrangement for the Dual Transmitter and Dual Receiver look similar to the Transceiver but with the top switch SW1 assigned to (TX1 and RX1 respectively) and the middle switch SW2 assigned to (TX2 and RX2 respectively); details are shown below.

SW1 Top DIP switch bank

Single transmitter HRT	Single receiver HRR	Transceiver HRX	Dual transmitter HRU	Dual receiver HRV
Not fitted	RXMGC	RXMGC	TX1MGC	RX1MGC
Not fitted	RX – 0.5dB	RX – 0.5dB	TX1 – 0.5dB	RX1 – 0.5dB
Not fitted	RX – 1dB	RX – 1dB	TX1 – 1dB	RX1 – 1dB
Not fitted	RX – 2dB	RX – 2dB	TX1 – 2dB	RX1 – 2dB
Not fitted	RX – 4dB	RX – 4dB	TX1 – 4dB	RX1 – 4dB
Not fitted	RX – 8dB	RX – 8dB	TX1 – 8dB	RX1 – 8dB

SW2 Middle DIP switch bank

Single transmitter HRT	Single receiver HRR	Transceiver HRX	Dual transmitter HRU	Dual receiver HRV
TXMGC	Not fitted	TXMGC	TX2MGC	RX2MGC
TX – 0.5dB	Not fitted	TX – 0.5dB	TX2 – 0.5dB	RX2 – 0.5dB
TX – 1dB	Not fitted	TX – 1dB	TX2 – 1dB	RX2 – 1dB
TX – 2dB	Not fitted	TX – 2dB	TX2 – 2dB	RX2 – 2dB
TX – 4dB	Not fitted	TX – 4dB	TX2 – 4dB	RX2 – 4dB
TX – 8dB	Not fitted	TX – 8dB	TX2 – 8dB	RX2 – 8dB

SW3 Bottom DIP switch bank

Single transmitter HRT	Single receiver HRR	Transceiver HRX	Dual transmitter HRU	Dual receiver HRV
TX rst	TX rst (not used)	TX rst	TX1 rst	RX1 rst
RX rst (not used)	RX rst	RX rst	TX2 rst	RX2 rst
SNMP dis	SNMP dis	SNMP dis	SNMP dis	SNMP dis
Tone	Tone (not used)	Tone	Tone	not used
VSEL	VSEL (not used)	VSEL	VSEL	not used
LNB	LNB (not used)	LNB	LNB	not used
TXAGC	TXAGC(not used)	TXAGC	TX1AGC	RX1AGC
RXAGC (not used)	RXAGC	RXAGC	TX2AGC	RX2AGC

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 dual receiver modules, channel 1 is controlled by switches prefixed with RX1 and channel 2 is controlled by switches prefixed with RX2. The function of the switches is otherwise identical.

For special manual gain control modules record the factory setting of each gain step; this is the preset gain of the receiver.

- RXMGC ON = Module under manual gain control, OFF = Module under 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 dual transmitter modules, channel 1 is controlled by switches prefixed with TX1 and channel 2 is controlled by switches prefixed with TX2. The function of the switches is otherwise identical.

For special manual gain control modules record the factory setting of each gain step; this is the preset gain of the transmitter.

- TXMGC ON = Module under manual gain control, OFF = Module under 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.

- The factory set values are 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
** Must be power to perform reset action, removing power will also reset a module

2.4.3 Changing module RF gain

The performance specifications in section 6 are only valid 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.

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 feed

All information in this section refers to fibre optic transmitter, dual transmitter and transceiver modules. LNA voltages are fed out through the TX RF input connector on the modules and can be used to power connected equipment. ***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 provide a lower noise amplifier (LNA) or low noise block down converter (LNB) power feeds. These provide a DC path to the transmitter RF input to provide power to a LNA/LNB or other connected module. The external DC paths (option 3) of a module may be accessed via the chassis connector for plug-in and blindmate modules (see your chassis handbook), the edge connector for Yellow link modules (see section 4.3.2) or the Molex connector of Blue link modules (see section 4.3.3). 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 preset +5 ± 0.5V at 80mA maximum per channel
2 - Internally generated preset +12 ± 1V at 300mA maximum per channel (Limited to 80mA for low frequency “T modules per output)
3 - External Feed from chassis connector 0 to +28V at 350mA per channel (Limited to 80mA for low frequency “T modules per output)*
4 - 20kb/s RS484/422/232 signal channel, No LNA feed
5 - Internally generated +13.4 ± 1 or +18.5 ± 1 or +22 ± 1V selectable LNB voltage, with switchable 22kHz signalling tone.
700mA per channel for single transmit channel (i.e. single transmitter or transceiver module).
350mA per channel for dual transmit channel, 700mA total (i.e. dual transmitter module).
6 - GPS load simulator with internally generated preset +5 ± 0.5V at 80mA maximum per channel
7 - Dual module with RF diplexer, external feed 0 to +28V at 350mA from L-Band HTS TX to diplexed input (L-Band HTS + reference ONLY)
8 - Dual module with RF diplexer and internally generated +13.4 ± 1 or +18.5 ± 1 or +22 ± 1V selectable LNB voltage, with switchable 22kHz signalling tone, at 350mA to diplexed input (L-Band HTS + reference ONLY)
9 - 20kb/s RS485/422/232 channel, External Feed from chassis connector 0 to +28V at 350mA per channel
A - IRIG Low frequency extension (to ~100Hz), No LNA feed
B – Not used as an LNA/LNB feed option
C - 20kb/s TTL channel, No LNA feed

Module Type	Feed options												
	0	1	2	3	4	5	6	7	8	9	A	B	C
B – 70/140MHz IF module, 10-200 MHz	O	O	O	**S***	N	X	X	X	X	N	X	X	N
D - DVB-T broadcast, 470-860MHz	O	N	**S**	N	N	X	X	X	X	N	X	X	N
G - GPS, special function, 1000-1800MHz	O	**S**	O	N	N	X	O	X	X	N	X	X	N
L – L-Band HTS, 700-2450MHz	O	N	N	**S**	N	O	X	X	X	N	X	X	N
J – L-Band HTS + Reference, DL 700-2450MHz	O	N	N	O	N	O	X	O	**S**	N	X	X	N
K – L-Band HTS + Reference, UL 700-2450MHz	O	N	N	O	N	N	X	**S**	N	N	X	X	N
M - General purpose 10-1350MHz	O	N	N	**S***	N	X	X	X	X	N	X	X	N
N - General purpose 10-1000MHz	O	N	O	**S***	N	N	X	X	X	N	X	X	N
S - Wideband 10- 3000MHz	**S**	N	N	N*	N	X	X	X	X	N	X	X	N
T - Low frequency timing, 0.01-50MHz	**S**	O	O	O*	X	X	X	X	X	X	O	X	X
U - Ultra Wideband 0.002-4200MHz	**S**	X	X	X	X	X	X	X	X	X	X	X	X
W - Extra Wideband 10-4200MHz	O	N	N	N*	**S**	X	X	X	X	O	X	X	O

* TX modules fitted with option "3" External Feed; which are capable of operation to 10MHz and below (frequency types B,M,N,S,T,W) should not be used to transmit a 22kHz tone via the external feed, see section 2.5.4

S	= Standard
O	= Available option
N	= Non-standard, For non-standard options contact ***ViaLite Communications***.
X	= Not available

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 "8") 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 External voltage feeds on low frequency capable TX modules

TX modules fitted with an option "3" external feed, which are capable of operation to 10MHz and below (frequency types B,M,N,S,T,W), SHOULD NOT transmit a 22kHz tone. These modules are fitted with a large parallel capacitor between the external voltage feed input and ground, this protects the units from LNA/LNB voltage "switch on" transients which would otherwise damage the unit. This capacitor significantly attenuates the 22kHz tone signal, reducing it below typical operational thresholds at the RF input. This does not affect other option "3" external feed modules which may be used with a 22kHz tone via the external feed (frequency types D,G,L,K), contact ***ViaLite Communications*** for more details.

2.5.5 LNA/LNB Feeds - dual transmitter modules

LNA/LNB power supply feeds are available for dual transmitter modules.

Modules fitted with internally generated power source options "2" (+12V) or "5" and "8" (13/18/22kHz) share a single power source that feeds both bias tees. Hence there will be no low frequency electrical isolation between them.

Modules fitted with internally generated power source option "1" and "6" (+5V) are powered from separately regulated supplies and have a high level of low frequency isolation.

Modules with no LNA feed, options "0", "4", "A" and "C" have no DC connections and hence both inputs are isolated inside the module.

Modules fitted with externally generated power sources are each fed from separate pins, hence both inputs are isolated inside the module.

2.5.6 LNA feed - Blue link and Yellow link modules

Modules in this range offer an internally +5V /+12V feeds and external feed only. Some modules do offer an ability to route a user fed LNA voltage through from their DC input connector. When using some ***ViaLite*** Outdoor Enclosures, external LNA feeds are available via the outdoor enclosure motherboard.

2.5.7 LNA feed – Low frequency "T" module

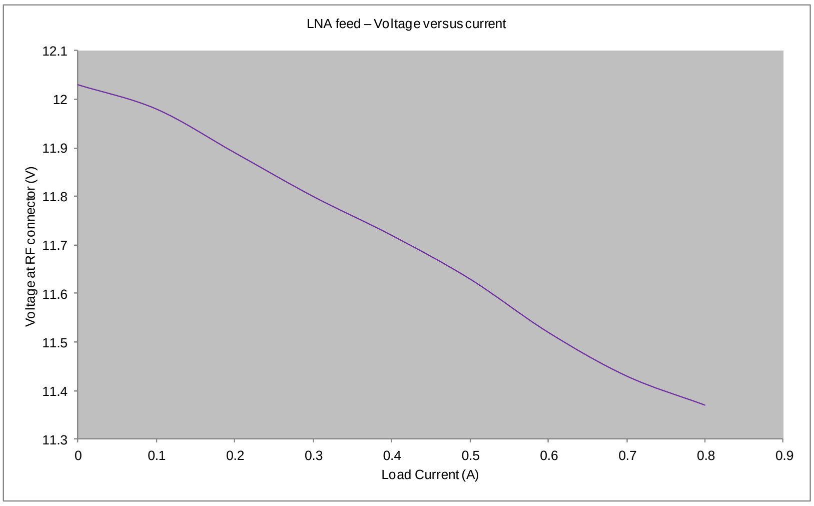
Low frequency "T" modules have the capability of LNA feed, but due to the large value of the inductors used, the maximum current available for any type of LNA feed is 80mA.

Care must be taken not to draw excess current as the bias the bias inductor is not protected by a fuse and gross over rating will cause permanent damage.

2.5.8 LNA feed – Voltage versus current characteristic

The LNA voltage is fed via an inductor (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.

2.6 BUC feed

All information in this section refers to fibre optic receiver, dual receiver and transceiver modules. BUC voltages are fed out through the RX RF output connector on the modules and can be used to power connected equipment. ***Precautions must be taken to ensure that any connected equipment is tolerant of the DC voltages supplied.***

2.6.1 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 and blindmate modules (see your chassis handbook), the edge connector for Yellow link modules (see section 4.3.2) or the Molex connector of Blue link modules (see section 4.3.3). The BUC option can be determined from the part number.

0 - No LNA feed
1 - Internally generated preset +5 ± 0.5V at 80mA maximum per channel
2 - Internally generated preset +12 ± 1V at 300mA maximum per channel (Limited to 80mA for low frequency "T modules per output)
3 - External Feed -36 to +36V at 700mA per channel for single receiver channel (80mA for low frequency "T modules)
External Feed -36 to +36V at 350mA per channel for dual receiver channel (80mA for low frequency "T modules)
4 - 20kb/s RS484/422/232 signal channel, No LNA feed
5 - Internally generated +13.4 ± 1 or +18.5 ± 1 or +22 ± 1V selectable BUC voltage, with switchable 22kHz signalling tone.
700mA per channel for single receiver channel (i.e. single transmitter or transceiver module).
350mA per channel for dual receiver channel, 700mA total (i.e. dual transmitter module).
6 - GPS load simulator
7 - Dual module with RF diplexer, External Feed -36 to +36V at 350mA from L-Band HTS RX to diplexed input (L-Band HTS + reference ONLY)
8 - Dual module with RF diplexer and internally generated +13.4 ± 1 or +18.5 ± 1 or +22 ± 1V selectable BUC voltage, with switchable 22kHz signalling tone, at 350mA to L-Band HTS Receiver channel (L-Band HTS + reference ONLY)
9 - 20kb/s RS485/422/232 channel, External Feed from chassis connector -36 to +36V at 350mA per channel
A - IRIG Low frequency extension (to ~100Hz), No LNA feed
B - Voltage transient protection on output, small value series capacitor, No LNA feed
C - 20kb/s TTL channel, No LNA feed

Module Type	Feed options												
	0	1	2	3	4	5	6	7	8	9	A	B	C
B – 70/140MHz IF module, 10-200 MHz	**S**	N	N	N	N	X	X	X	X	N	X	X	N
D - DVB-T broadcast, 470-860MHz	**S**	N	N	N	N	X	X	X	X	N	X	X	N
G - GPS, special function, 1000-1800MHz	**S**	N	N	N	N	X	O	X	X	N	X	N	N
L – L-Band HTS, 700-2450MHz	**S**	N	N	O	N	O	X	X	X	N	X	N	N
J – L-Band HTS + Reference, DL 700-2450MHz	O	N	N	O	N	O	X	**S**	N	N	X	N	N
K – L-Band HTS + Reference, UL 700-2450MHz	O	N	N	O	N	N	X	**S**	N	N	X	N	N
M - General purpose 10-1350MHz	**S**	N	N	O	N	X	X	X	X	N	X	X	N
N - General purpose 10-1000MHz	**S**	N	N	O	N	N	X	X	X	N	X	X	N
S - Wideband 10- 3000MHz	**S**	N	N	N	N	X	X	X	X	N	X	X	N
T - Low frequency timing, 0.01-50MHz	**S**	N	N	N	X	X	X	X	X	X	O	X	X
U - Ultra Wideband 0.002-4200MHz	**S**	X	X	X	X	X	X	X	X	X	X	X	X
W - Extra Wideband 10-4200MHz	O	N	N	N	**S**	X	X	X	X	O	X	X	O

S	= Standard
O	= Available option
N	= Non-standard, For non-standard options contact ***ViaLite Communications***.
X	= Not available

2.6.2 BUC feed - dual receiver modules

BUC power supply feeds are available for dual receiver modules.

Modules fitted with internally generated power source options “2” (+12V) or “5” and “8” (13/18/22kHz) share a single power source that feeds both bias tees. Hence there will be no low frequency electrical isolation between them.

Modules fitted with internally generated power source option “1” and “6” (+5V) are power from separately regulated supplies and have a high level of low frequency isolation.

Modules with no BUC feed, options “0”, “4”, “A”, “B” and “C” have no DC connections and hence both inputs are isolated inside the module.

Modules fitted with externally generated power sources are each fed from separate pins; hence both outputs are isolated inside the module.

2.6.3 BUC voltage boost - plug-in modules

The output voltage of any module equipped with an internal 13/18/22 volt power supply (option “5” and “8”) 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.

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

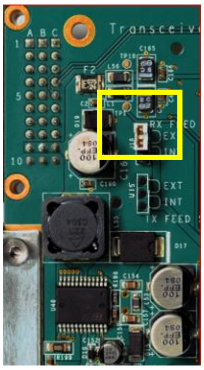
Some modules can be configured either by jumper or by switch to provide an LNA/LNB or BUC feed either from an internally generated voltage or from the rear connector in the ***ViaLiteHD*** chassis. The diagram below shows how these are set.

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

J15 (LNB)
up = external
down = internal
open = not connected

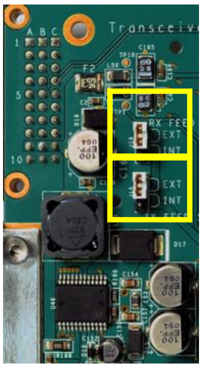
J16 not fitted



RX

J16 (BUC)
up = external
down = internal
open = not connected

J15 not fitted

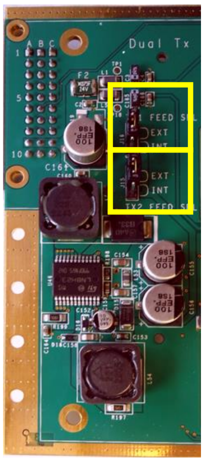


TRX

J16 (BUC)
up = external
down = internal
open = not connected

J15 (LNB)
up = external
down = internal
open = not connected

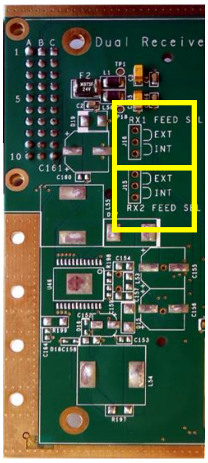
Manual configuration of LNA/LNB/BUC DC power feeds on TX, RX and TRX



DTX

J16 (LNB1)
up = external
down = internal
open = not connected

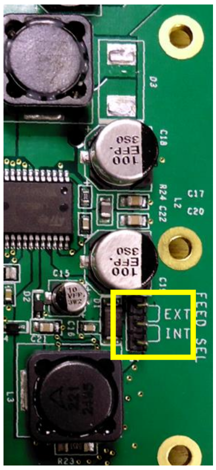
J15 (LNB2)
up = external
down = internal
open = not connected



DRX

J16 (BUC1)
up = external
down = internal
open = not connected

J15 (BUC2)
up = external
down = internal
open = not connected



High power TX

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

Manual configuration of LNA/LNB/BUC DC power feeds on DTX, DRX and high power TX

2.8 Digital channel operation

The digital channel is independent of RF transmission and is capable of transmitting up to 20kbps digital data simultaneously. There are two built-in digital interfaces, one for RS422/485 signals and the other for RS232 or TTL signals. These are available on plug-in or blindmate modules on the chassis rear connector (see chassis handbook and sections 4.2.2 and 4.3.1.2) or directly on the module interface connector (Blue link and Yellow link modules, see sections 4.3.2 and 4.3.3). The link is unidirectional and therefore digital data transmits in the same direction as the RF link only.

Logic low on RTS_485 will shut down the RS422/485 line driver in RS485 application (see relevant RS485 standard for detail). Logic high or open circuit on RTS_485 will enable the line driver in the Rx module.

The digital information is conveyed on a Frequency Shift Keyed (FSK) carrier well below the operating band of the link (at approx. 500kHz). The unit is fitted with internal filtering to heavily attenuate this signal at the RF output. It may however still be observed as a sideband (second order) when measuring higher frequency signals. The carrier sideband will typically be a fixed level below the main carrier at all power levels. The FSK 500kHz carrier will typically be suppressed by 70dBc, relative to RF carrier.

The 500kHz FSK tone can be removed by using software control, selecting the module and setting FSK to “disable”. This can also be implemented using SNMP.

To ensure operation of the digital channel the optical loss between the transmitter and receiver must be 0 – 10dB, operation outside of this range will result in high BER and potentially a total loss of function.

The digital channel option can be selected by digit eight of the part number (also used for LNA/LNB/BUC feed selection) details of the options available are given in sections 2.5, 2.6.1, 5 and 6.

Note: Modules equipped with a digital channel are factory delivered with FSK tone enabled.

2.9 GPS mode operation

GPS band units are equipped with hardware that can provide special GPS functions. They will mimic the operation of an active GPS amplifier through the fibre optic link

2.9.1 GPS transmitter mode operation

Under normal non-fault conditions a ***ViaLiteHD*** GPS link will operate in an identical fashion to all other ***ViaLiteHD*** modules. However the transmitter is equipped with additional hardware that detects the DC current flowing from GPS transmitter RF input to the active GPS antenna.

If the current sunk by the active antenna falls below an alarm threshold of 5mA. (i.e. in the case of the LNA failing) the unit will generate an internal alarm. With GPS mode enabled, the transmitter laser will turn off. This will generate an alarm in the connected receiver module, as the connected unit will have a received light level alarm (RLL). The GPS mode can only be enabled and disabled when the unit is under software control.

Note: GPS Modules are factory delivered with “GPS mode” enabled.

If GPS mode is disabled the laser will be enabled in both alarm and non-alarm modes; irrespective of the antenna feed current if there is no other fault. Some major transmitter faults may also turn off the laser.

2.9.2 GPS receiver mode operation, units equipped with GPS load simulator

Under normal non-fault conditions a ***ViaLiteHD*** GPS link operates very similarly to a normal ***ViaLiteHD*** FOL. With GPS mode enabled, in non-fault conditions it presents a DC load at its RF output. This will typically sink 15mA (for input voltages in the range of 5 to 24V).

When the unit is in a fault condition; either by way of an internal fault, or due to low received light levels from the connected transmitter. It will disable the current sink. For most GPS receivers and time servers this will provide a basic alarm function. If GPS mode is disabled the DC load will be open circuit in both alarm and non-alarm modes.

Note: GPS Modules are factory delivered with "GPS mode" enabled.

2.10 Operating in gain control modes

Modules can be operated in four different gain control mode when operated with an SNMP and Web controller module. The SNMP and Web controller module is required for set up, under normal operation the module is under the control of its on board controller. Manual control is also available; this can be set using the hardware DIP switches.

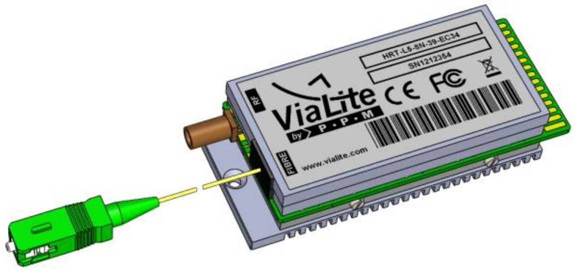
For more information on this feature, please see section 2.13 of the ViaLiteHD SNMP controller handbook, HRC-1-HB.

2.11 High power and DWDM transmitter modules

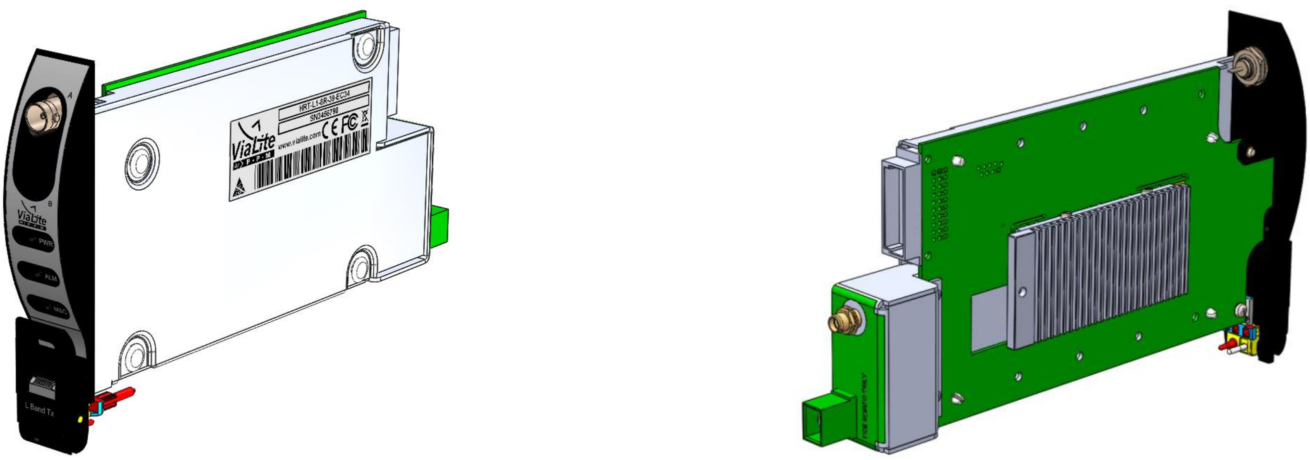
The ***ViaLiteHD*** range includes high optical power thermo-electric cooled (TEC) transmitter modules which use the standard ViaLiteHD hardware and software. The modules are indicated by the use of the laser types (D,E and K), see section 5.

These provide a range of additional features.

- DWDM wavelength selection using 50GHz ITU grid
- High optical power output option offering ranges up to 100km without the need for optical amplification
- Superior temperature performance
- Extended temperature range, up to 70°C
- High optical gains
- Superior linearity and low noise
- Ultra-wide dynamic range
- LNB power options
- Packaging options including plug-in/ blindmate and Yellow link modules
- EN60825-1:2007 as CLASS 1 radiation emitting devices, safe under all conditions of normal use.

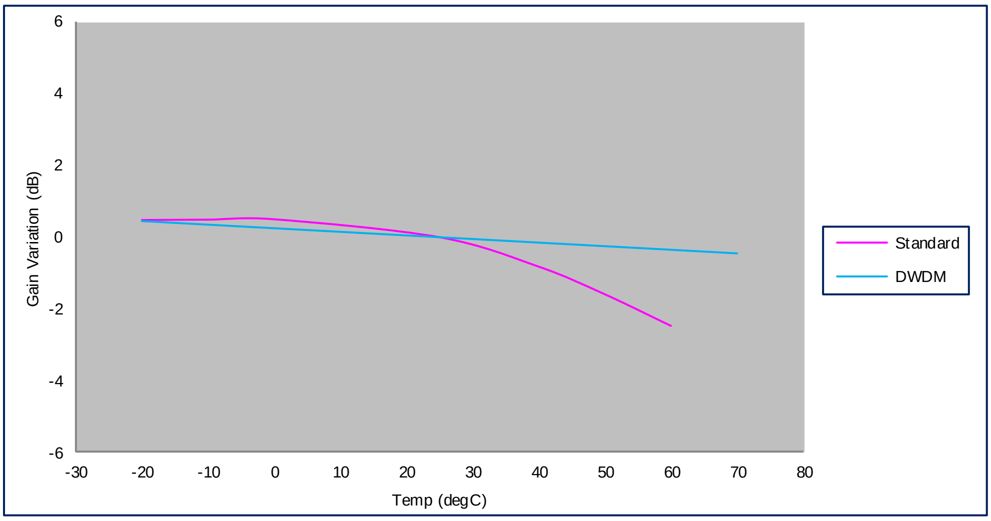


High power Yellow link module

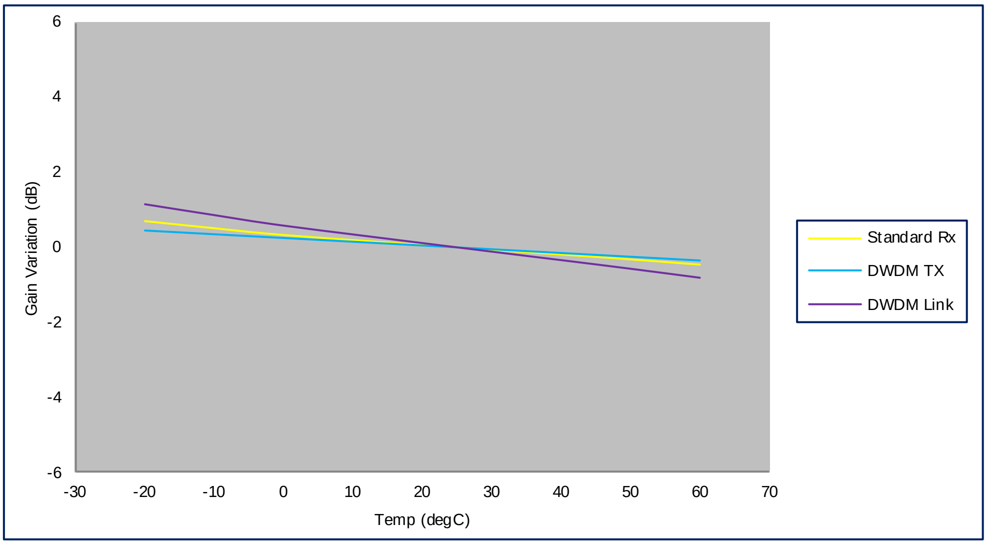


High power Plug-in module

The TEC controller built into the high power laser thermally stabilises the laser, this eliminates a significant amount of the thermal gain variation in the high power transmitter. The graph below shows the gain variation for both a standard and a DWDM transmitter.



Change of Standard transmitter/ DWDM or high power transmitter gain at temperature, at 1.2GHz



Change of Standard receiver/ DWDM transmitter / Link gain at temperature, at 1.2GHz

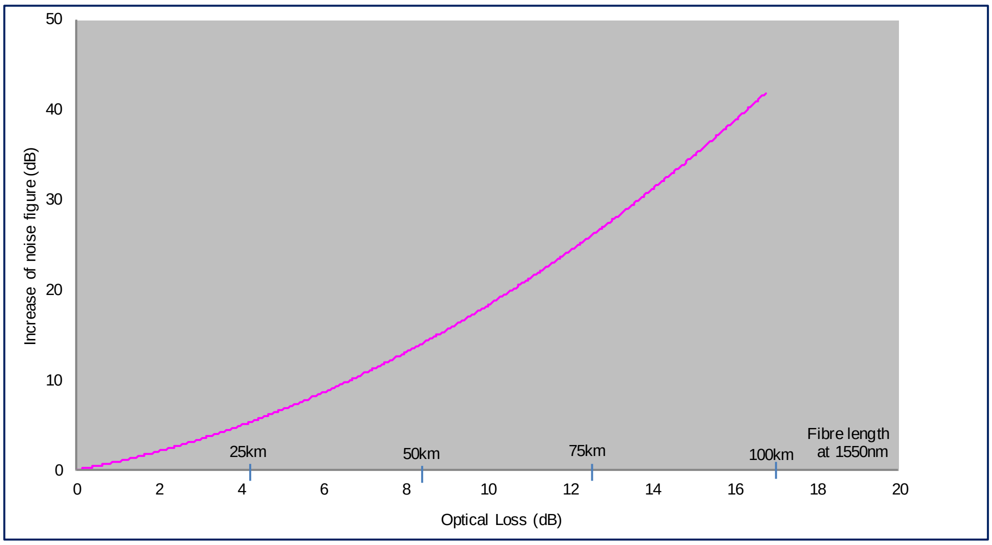
The ***ViaLiteHD*** DWDM transmitter module can be used with a standard ***ViaLiteHD*** receiver module, BUT your optical link budget must ensure that the standard ***ViaLiteHD*** receiver is not optically overdriven. The standard ***ViaLiteHD*** receiver module should have an average optical input of no more than 4mW (6dBm). For applications with lower optical loss the ***ViaLiteHD*** high power receiver should be used. The minimum optical loss is shown in the table below.

	Standard Receiver	**High power "K" receiver**
"D" Transmitter	No less than optical loss 1dB	No minimum link budget
"E" Transmitter	No less than optical loss 5dB	No minimum link budget
"K" Transmitter	No less than optical loss 5dB	No minimum link budget

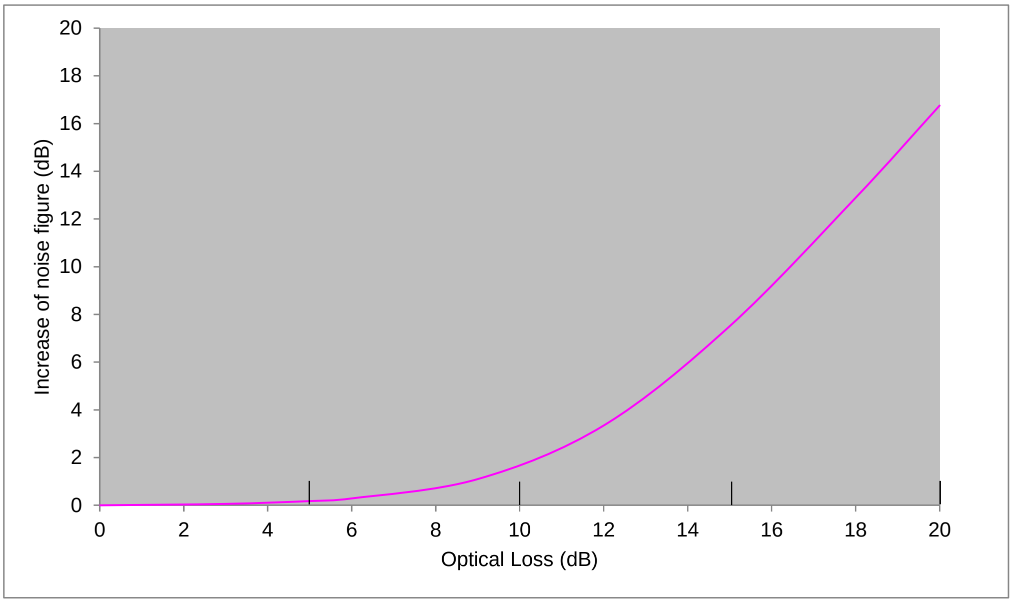
Due to its additional complexity the ***ViaLiteHD*** High power and DWDM transmitter has a reduced number of options.

- It is only available as single transmitter.
- The digital channel option (as described in section 2.8) is not available.
- The input power supply range is more restricted than standard modules, see section 2.16.6. This will not effect the operation of your modules in any ***ViaLiteHD*** chassis but this will affect the voltage supply requirements for Blue link and Yellow link modules.

The high power transmitter will operate at high optical losses, the graph below shows how the noise figure of the optical transmitter increases with increased optical loss and dispersion cause by long cable lengths.



Increase in Noise Figure (dB) due to optical loss and dispersion in a long fibre cable.



Increase in Noise Figure (dB) due to optical loss

Note: Design of a long range fibre optic link may require a complex system to achieve optimum performance. The system can include a range of optical components such as.

- **DMDM multiplexers**
- **DWDM demultiplexers**

The components will be required for combining and uncombining multiple DWDM transmitters, an incorrect choice of components will reduce the effectiveness of your system, particularly the isolation between different DWDM channels.

- **Optical amplifiers such as Erbium Doped Fibre Amplifier (EDFA)**
- **Dispersion Compensating Fibre modules (DCF)**

The use of these additional components will help manage the effect of very long fibres and optimised the performance of you system

ViaLite Communications engineering team will be happy to support your system design.

2.11.1 High power and DWDM transmitter modules, thermal load

All DWDM modules have active thermal control, which produces extra heat load in there deployed environments. For this reason extra consideration is needed when planning the installation and deployment of these systems. As the cooling is active thare is also the possibility that this might cause parasitic heat transfer if not properly controlled, which will reduce its operating efficiency and effective operating temperature range. If the DWDM active cooling TEC is unable to stabilise the laser power will be turned off, operation will only resume if the unit is power cycled.

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

- Do not place DWDM transmitter 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

2.12 L-Band HTS + reference modules

The ViaLiteHD L-Band HTS + reference link is designed for applications which require the transport of both an L-Band HTS (700-2450MHz) and a reference signal (5-20MHz). This is often required where remote equipment shares a common frequency reference, typically 10MHz. The modules transmit L-Band HTS and reference signals have two different optical paths, each optical path is separately modulated to minimise intermodulation distortion between the L-Band HTS and reference signals, to give optimal performance.

The modules are available with the following options.

- Separate L-Band HTS and reference RF ports OR RF diplexer that combines the RF and reference signals to a single RF port.
- Separate optical ports for L-Band HTS and reference OR optical combining using a WDM requiring only a single optical port.
- Switchable LNB power supply with 13V/18V and 22kHz tone.

There are two types of L-Band HTS and reference module; the “J” modules are used on the receive path (downlink) and the “K” modules are used on the transmit path (uplink).

The “J” frequency type, L-Band HTS + reference, receive path (downlink) module is designed for use in a SATCOM downlink. Where the 10MHz signal source is in the equipment room and L-Band HTS signal source is the remote LNB; in this case the two signals are travelling in the opposite directions.

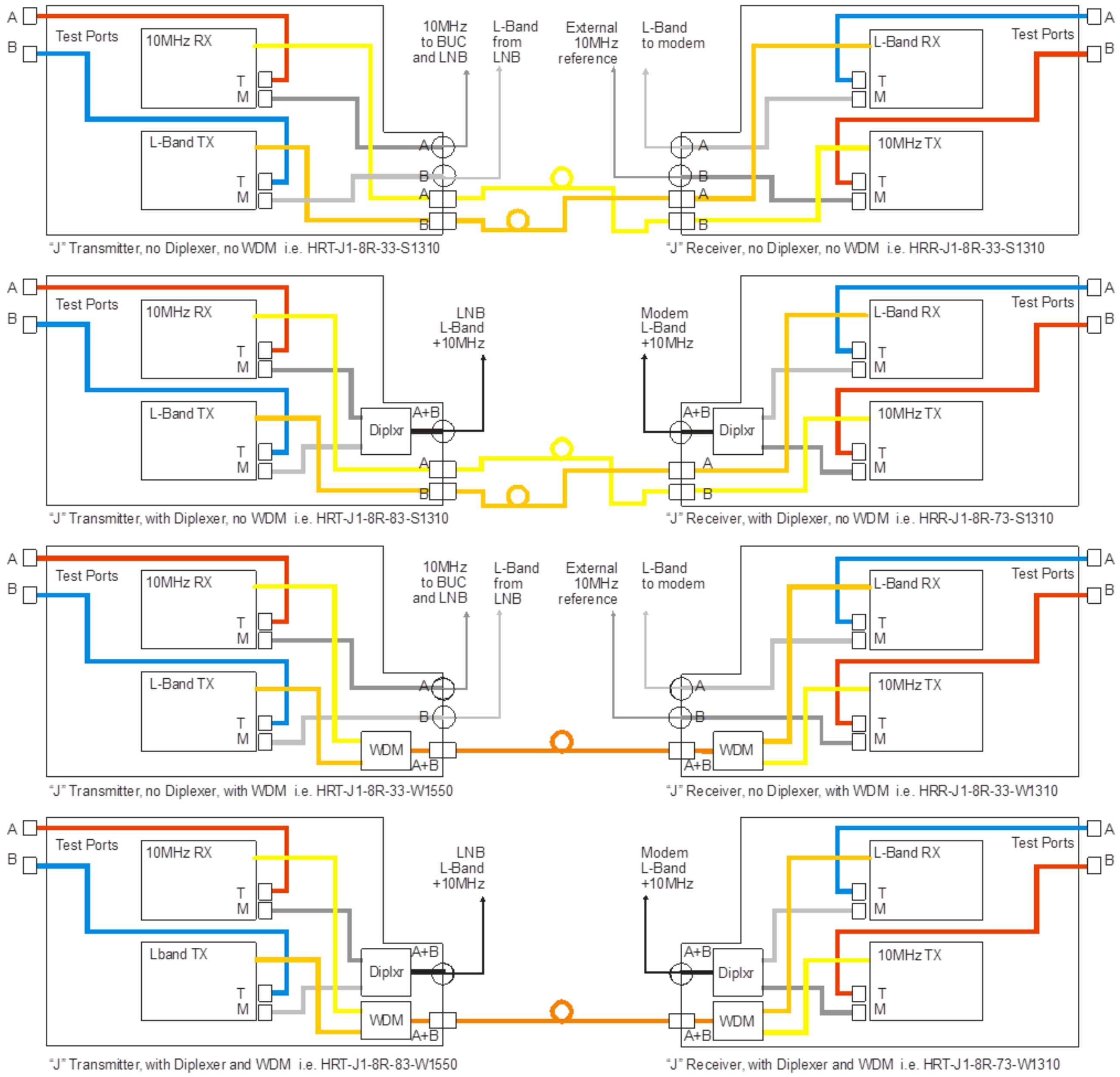
2.12.1 L-Band HTS + reference downlink

When “J” receive path (downlink) modules with WDMs are used the optical paths are configured as below.

- The L-Band HTS optical path uses a 1550nm laser.
- The reference optical path uses a 1310nm laser.
- Receiver paths WDM channels are configured to match.

See sections 2.3.10.3 for additional notes on units fitted with diplexed RF ports.
See sections 2.3.10.4 for additional notes on units fitted with WDM combined ports.

Note: The fibre port of “J” modules without WDMs must be connected A>B and B>A as shown following.
Note: An optical wavelength must be specified for the “J” module RX as it has a laser transmitting the reference signal.
Note: The modules specified gain refers to the L-Band HTS path, the reference path gain is always 0dB with a -25dB TX and +25dB RX.



Remote
Different types of receive path (downlink) “J” module
Equipment room

2.12.2 L-Band HTS + reference uplink

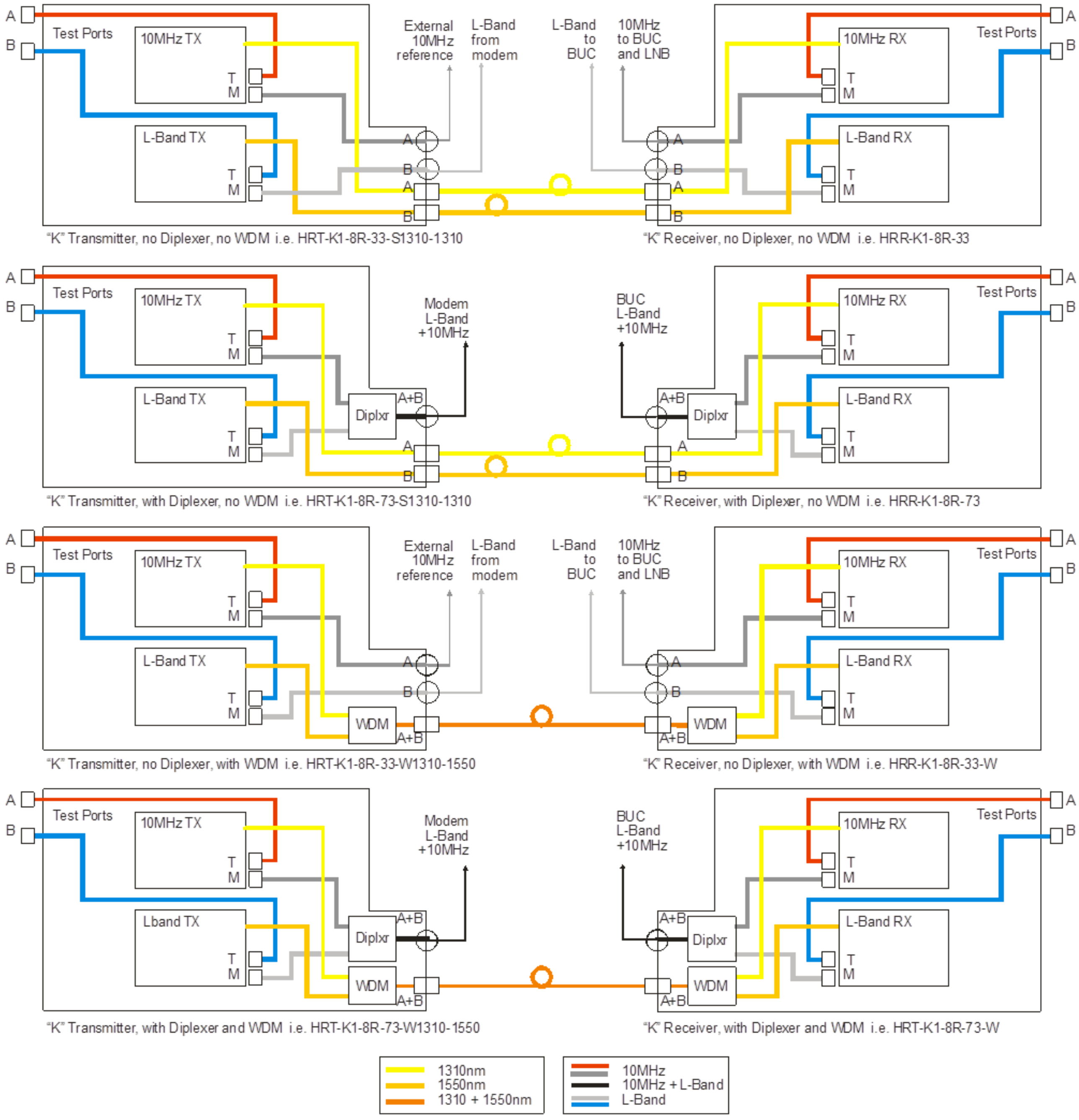
The “K” frequency type, L-Band HTS + reference, transmit path (uplink) module is designed for use in a SATCOM uplink. Where the 10MHz signal source is in the equipment room and L-Band HTS signal sourced is the equipment room modem; in this case the two signals are travelling in the same direction.

When “K” transmit path (uplink) modules with WDMs are used the optical paths are configured as below.

- The L-Band HTS optical path uses a 1550nm laser.
- The reference optical path uses a 1310nm laser.
- Receiver paths WDM channels are configured to match.

Note: The fibre port of “K” modules without WDMs must be connected A>A and B>B as shown following.
Note: The modules specified gain refers to the L-Band HTS path, the reference path gain is always 0dB with a -25dB TX and +25dB RX.

See sections 2.3.10.3 for additional notes on units fitted with diplexed RF ports.
See sections 2.3.10.4 for additional notes on units fitted with WDM combined ports.



Equipment room | Different types of transmit path (uplink) “K” module | Remote

2.13 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.

2.14 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 2.6.1. Contact ***ViaLite Communications*** for more details.

2.15 Low frequency extension for IRIG and timing application

ViaLiteHD timing modules "T" can be equipped with a low frequency extension allowing operation down to frequencies as low as 100Hz, this can be used to transport IRIG timing signal. IRIG format are described by a four digit code, the code is detailed below.
i.e. IRIG B122 is: 100 Bps, Sine wave (amplitude modulated), 1 kHz carrier, and Coded expressions BCD.

Digit 1 – Bit rate
ViaLiteHD RF links with low frequency extensions can carry **all** bit rate types as long as these are "less than" the carrier frequency. They will not carry bit rates equal to the carrier frequency.

Code	Bit rate	Bit time	Bits per frame	Frame time	Frame rate
A	1000 PPS	1 ms	100	100 ms	10 Hz
B	100 PPS	10 ms	100	1000 ms	1 Hz
C	2 PPS	0.5 s	120	1 minute	1/60 Hz
D	1/60 PPS	1 minute	60	1 hour	1/3600 Hz
E	10 PPS	100 ms	100	10 s	0.1 Hz
G	10 000 PPS	0.1 ms	100	10 ms	100 Hz
H	1 PPS	1 s	60	1 minute	1/60 Hz

Digit 2 – Modulation Type
ViaLiteHD RF links with low frequency extensions can carry modulation **types 1 and 2**.
ViaLiteHD serial digital links can be used to carry modulation **type 0 with** frequency carrier **type 0**, such as HRB-1-00-8R-28-L1310.

Code	Modulation
0	(DCLS) Direct Current Level Shift (width coded)
1	Sine wave carrier (amplitude modulated)
2	Manchester modulated

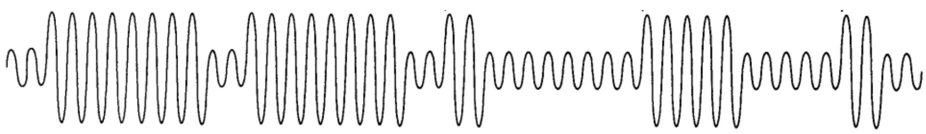
Digit 3 - Carrier frequency
ViaLiteHD RF links with low frequency extensions can operate with carrier frequency of 1kHz and above, supporting **types 2,3,4 and 5.**
ViaLiteHD serial digital links can be used to carry modulation **type 0 with** frequency carrier **type 0**, such as HRB-1-00-8R-28-L1310.

Code	Carrier frequency
0	No carrier (DCLS)
1	100 Hz (10 ms index count interval)
2	1 kHz (1 ms index count interval)
3	10 kHz (100 µs index count interval)
4	100 kHz (10 µs index count interval)
5	1 MHz (1 µs index count interval)

Digit 4 - Coded expressions
ViaLiteHD RF links with low frequency extensions can carry **all** coded expressions types.

Code	Coded expressions
0.	BCD (TOY), CF, SBS
1.	BCD (TOY), CF
2.	BCD (TOY),
3.	BCD (TOY), SBS
4.	BCD (TOY), BCD (Year), CF, SBS
5.	BCD (TOY), BCD (Year), CF
6.	BCD (TOY), BCD (Year)
7.	BCD (TOY), BCD (Year), SBS

BCD (TOY) = Binary coded decimal time of year
CF = control functions
SBS = Straight binary seconds
BCD (Year) = Binary coded decimal year



IRIG B120 format signal

A list of the most popular supported IRIG formats is shown in the table below.

Common supported IRIG signal formats					
A130	B120	D121	E121	G141	H121
A132	B122	D122	E122	G142	H122
A133	B123				

Other formats are also supported please contact ***ViaLite Communications*** for more details.

2.16 <u>Module Interface ratings</u>

2.16.1 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	

2.16.2 Logic interface, RS232

Absolute maximum voltage rating	-15 to +15V	No damage
Input, Logic Low (max)	<0.8V	
Input, Logic High (min)	>2.6V	
Output, Logic Low (max)	<-3.2V no load	
Output, Logic High (min)	>+3.2V no load	
Drive capability	3k ohms	
Short circuit protection	Yes	

2.16.3 Logic interface, RS422/485

Absolute maximum voltage rating	-12 to +12V	No damage
Input, Logic Low (max)	<0.8V	Common mode referenced to GND
Input, Logic High (min)	>2.0V	Common mode referenced to GND
Output, Logic Low (max)	<0.8V at 27 ohms	Common mode referenced to GND
Output, Logic High (min)	>2.0V at 27 ohms	Common mode referenced to GND
Output Differential	>1.5V at 27 ohms	
Output Differential	>2.0V at 50 ohms	
Drive capability	27 ohms	
Short circuit protection	Yes	

2.16.4 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	

2.16.5 Logic interface, Open Drain, output

For details of operation see 2.3.5

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) or if fitted active backplane (ie SATCOM6) 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

2.16.6 Power interface, +12V, input

ALL modules EXCEPT High power TX module

Nominal input voltage	12V
Typical input voltage range	11 to 13V
Maximum operational voltage range	9 to 16V

High power TX module ONLY

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

2.16.7 Analogue interface, laser diode bias, output

For details of operation see 2.16.7

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

2.16.8 Analogue interface, photodiode received light level, output

For details of operation see 2.16.8

Typical output voltage	4.0V at 4.5dB optical input power
Typical output voltage range	1 to 4V
Maximum output voltage range	0 to +5V
Short circuit protection	No

2.16.9 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 (i.e. single transmitter or transceiver module). 350mA per channel for dual transmit channel, 700mA total (i.e. dual transmitter module).
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 (i.e. single transmitter or transceiver module). 350mA per channel for dual transmit channel, 700mA total (i.e. dual transmitter module).
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 (i.e. single transmitter or transceiver module). 150mA per channel for dual transmit channel, 300mA total (i.e. dual transmitter module).
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

2.16.10 RF connectors

Maximum RF input power, no damage	+15dBm typical, check module spec in section 6, or contact ***ViaLite communication***
Maximum usable input power	See module P1dB rating in section 6
Maximum RF output power	+15dBm typical dependent on type and application, contact ***ViaLite communication***

See notes in sections 2.13 and 2.14.

2.16.11 Optical connections

Maximum optical input power, no damage	+8dBm, contact ***ViaLite communication*** for more details
Maximum usable input power	+6 dBm
Optical output power	+4.5dBm typical for standard 3mW TX modules +7dBm typical for DWDM 5mW modules +10.8dBm typical for 12mW modules

2.16.12 Logic interface, TX_AGC_ON and RX_AGC_ON (Yellow link and Blue link modules)

Absolute maximum voltage rating	-0.3 to +5.3V	No damage
Input, Logic Low (max)	<1.5V	
Input, Logic High (min)	>3.5V	
Impedance capability	10k ohms	
Short circuit protection	No	

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 = Nominal Link 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 of the ***ViaLiteHD*** link is 0.2dB/km. This is increased if the fibre is under excessive tension, compression or is bent into a small radius.

For clean, new, undamaged single-mode connectors, the optical insertion loss is typically 0.2dB per connector.

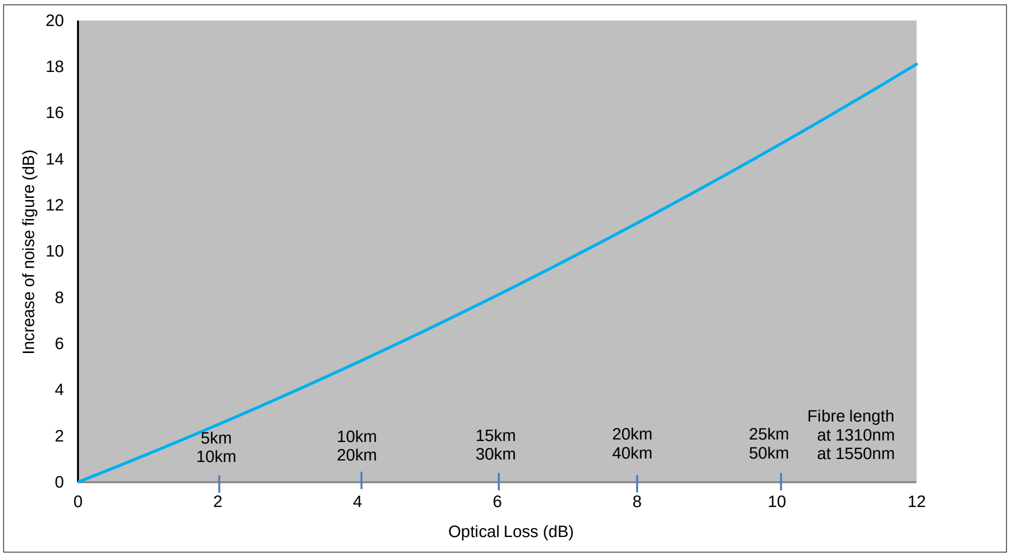
Note: The losses at the optical connections of the transmitter and receiver are allowed for during manufacture of the module, and may be ignored during link gain calculations.

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.

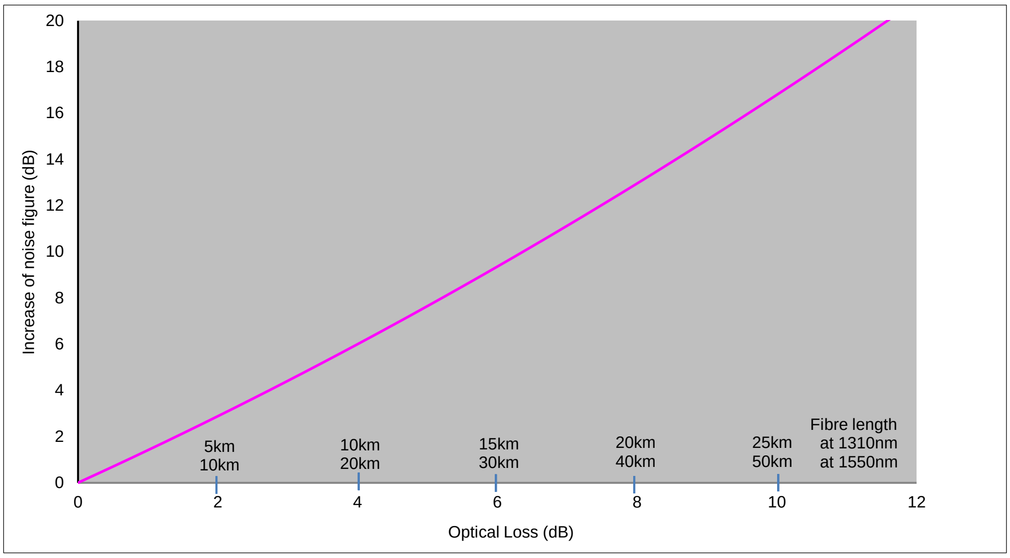
3.3 Optical loss versus noise figure

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.

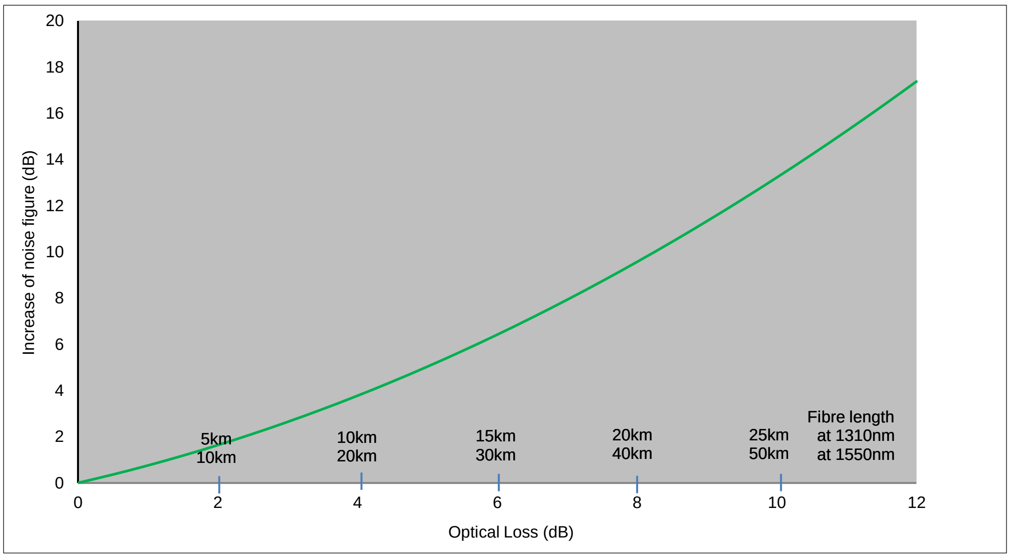
Note: If you operate the ***ViaLiteHD*** modules in RLL AGC mode it is possible to mask optical loss variations, but this is not always desirable.



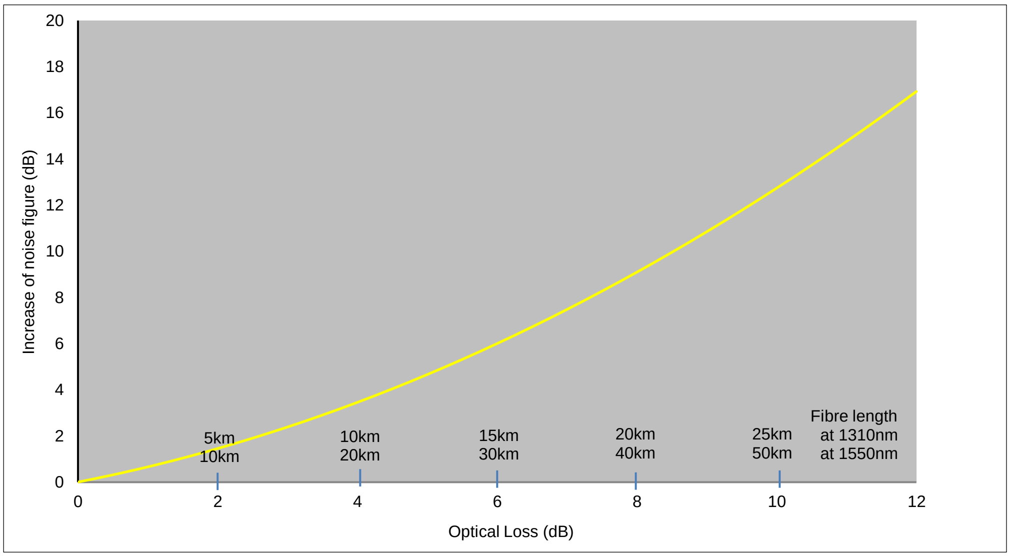
Increase in Noise Figure (dB) versus optical loss (dB); L-Band HTS link -11dB gain transmitter, +20dB gain receiver at 1.2GHz



Increase in Noise Figure (dB) versus optical loss (dB), UHF/VHF link -15dB gain transmitter, +15dB gain receiver at 500MHz



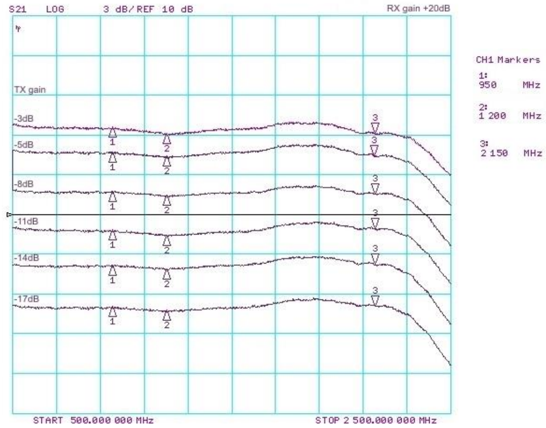
Increase in Noise Figure (dB) versus optical loss (dB), GPS link -5dB gain transmitter, +5dB gain receiver at 1500MHz



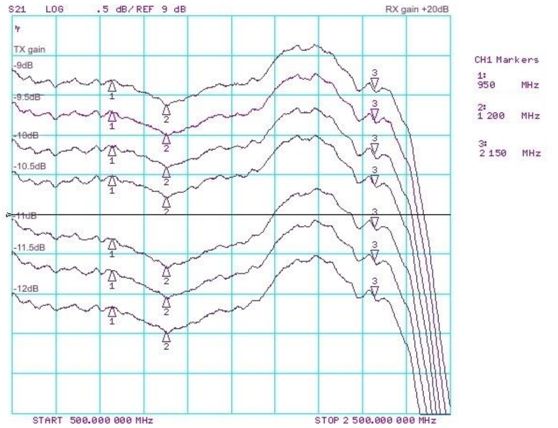
Increase in Noise Figure (dB) versus optical loss (dB), GPS link -5dB gain transmitter, +20dB gain receiver at 1500MHz

3.4 Gain versus frequency response

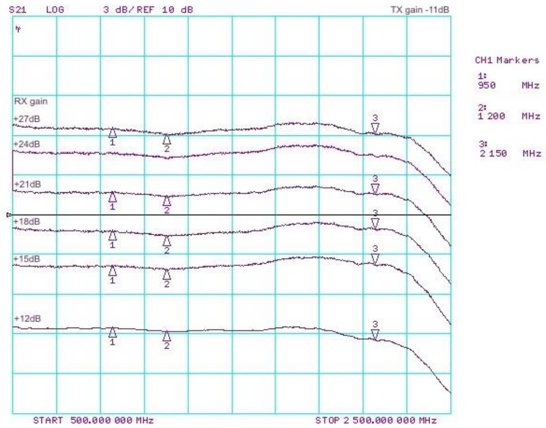
The frequency response is not significantly affected by the gain setting of the attenuators used in ***ViaLiteHD***. These have a flat frequency response over the full operating range of the product. Figures below are typical L-Band HTS modules responses.



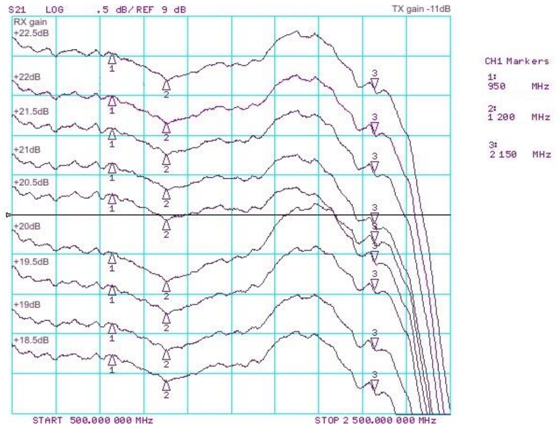
Gain plots versus TX gain (3dB steps) at RX gain 20dB



Gain plots versus TX gain (0.5dB steps) at RX gain 20dB



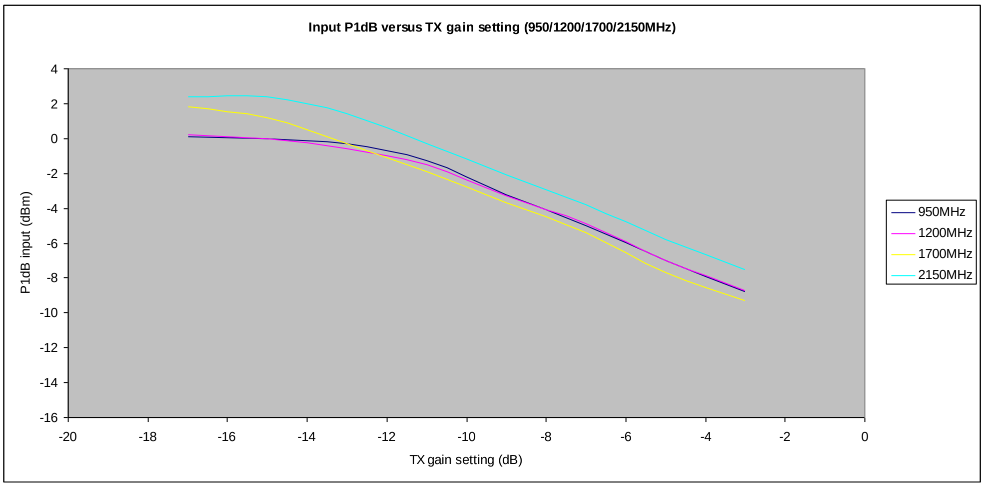
Gain plots versus RX gain (3dB steps) at TX gain -11dB



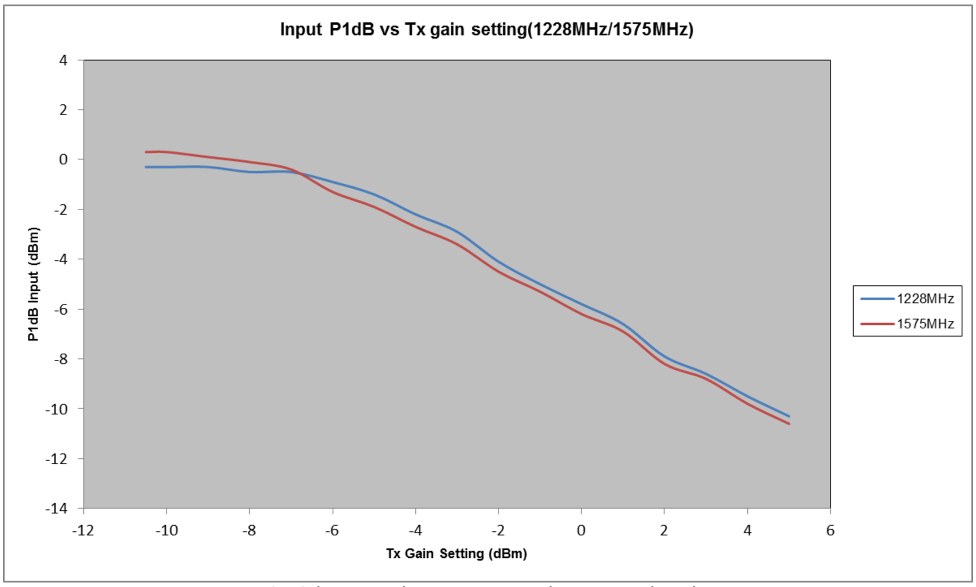
Gain plots versus RX gain (0.5dB steps) at TX gain -11dB

3.5 P1dB versus transmitter gain

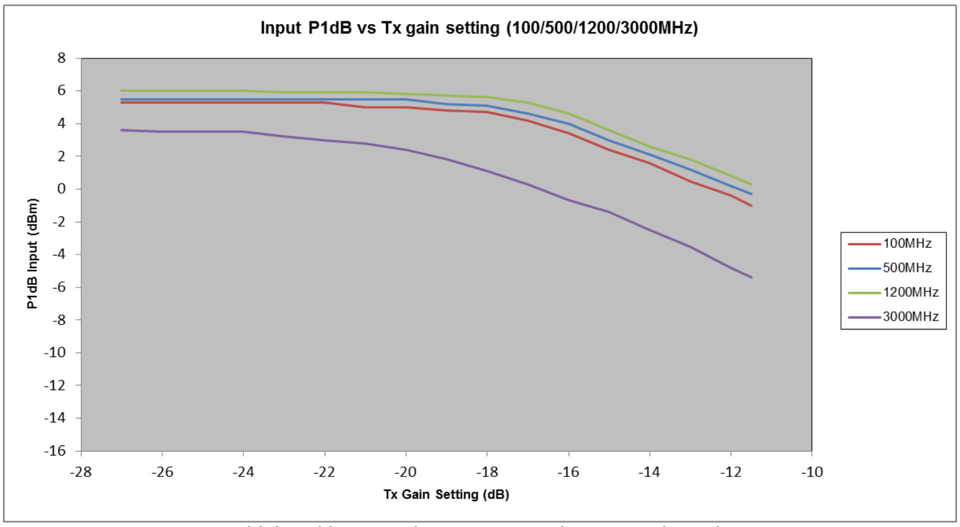
The input P1dB of the link is dependent on the transmitter gain. Increasing the transmitter gain will decrease the link input P1dB..



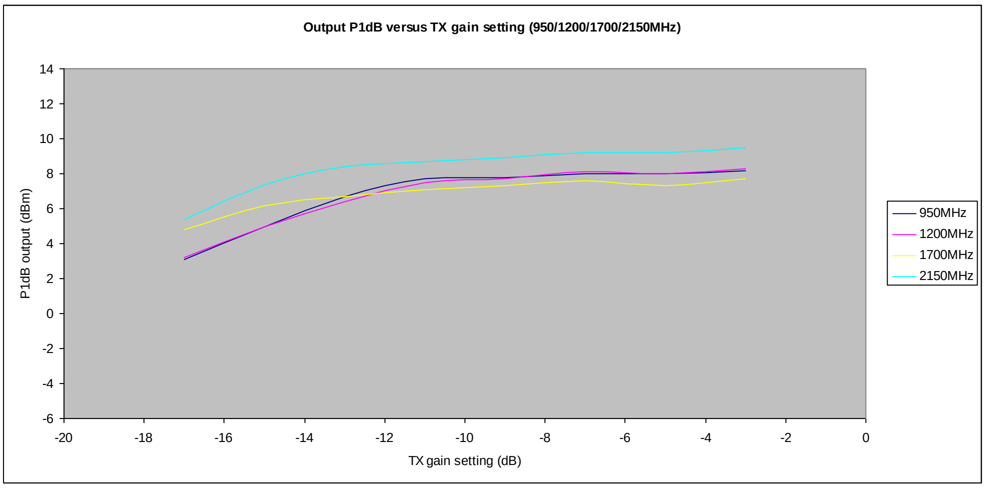
L band Input P1dB versus Tx gain at Rx gain 20dB



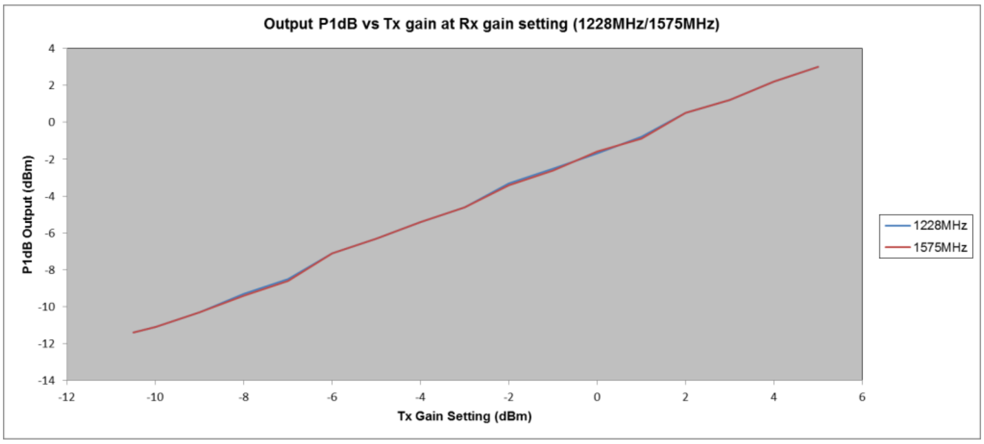
GPS input P1dB versus Tx gain at Rx gain 5dB



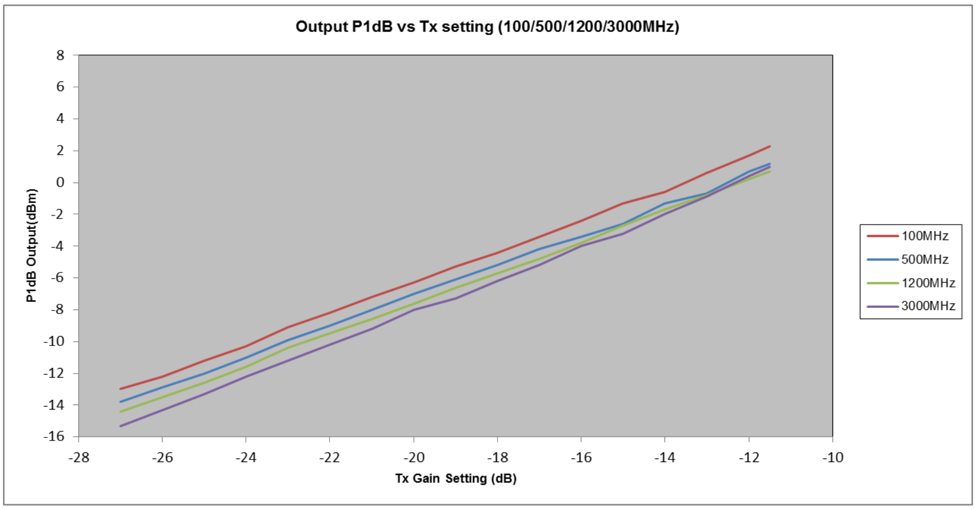
Wideband input P1dB versus Tx gain at Rx gain 15dB



L band output P1dB versus Tx gain at Rx gain 20dB



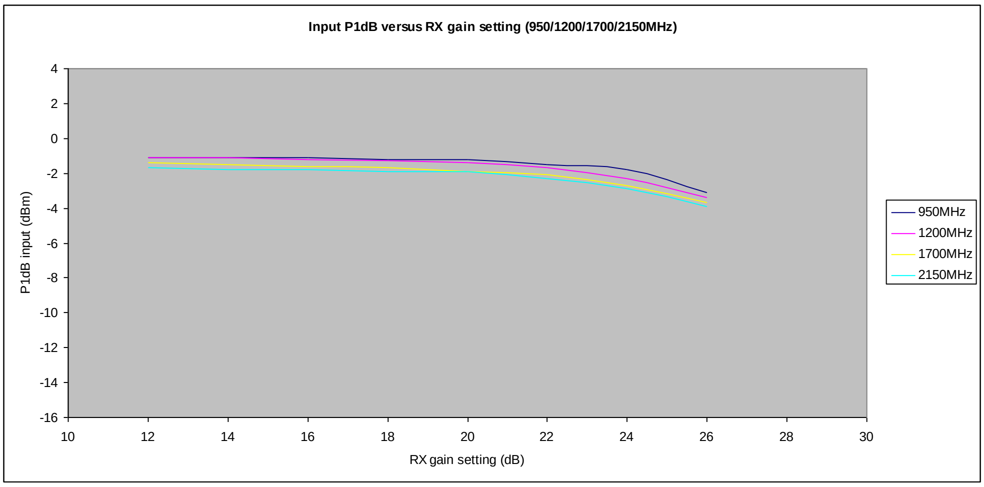
GPS output P1dB versus Tx gain at Rx gain 5dB



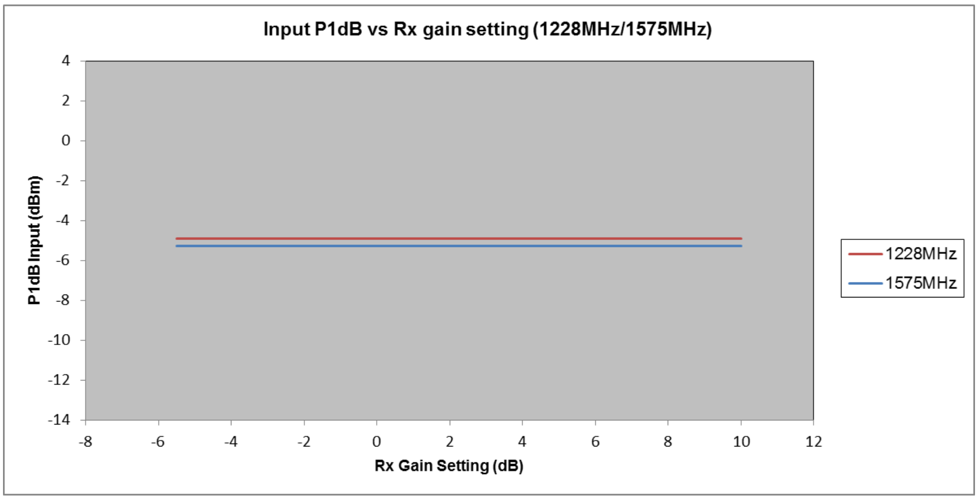
Wideband output P1dB versus Tx Gain at Rx gain 15dB

3.6 P1dB versus receiver gain

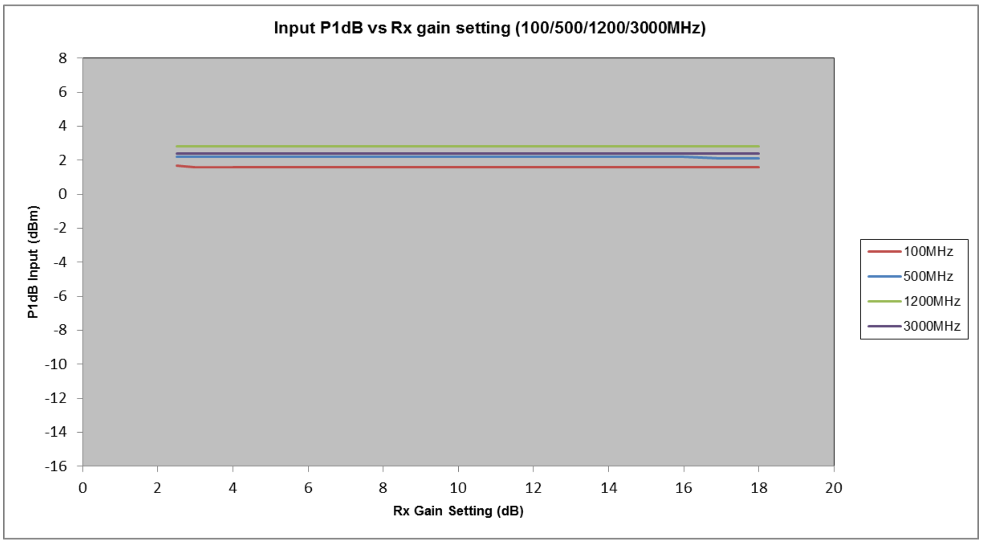
The input P1dB of the link is not significantly affected by the receiver gain. Increasing the receiver gain have little effect on the link input P1dB, unless the output of the receiver approaches saturation. Figures below are typical L-Band HTS modules responses.



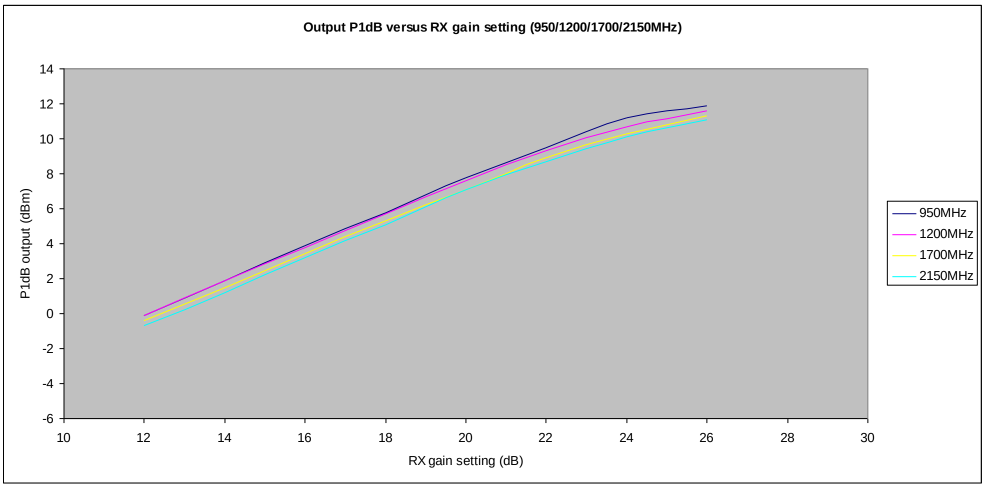
L band input P1dB versus Rx gain at Tx gain -11dB



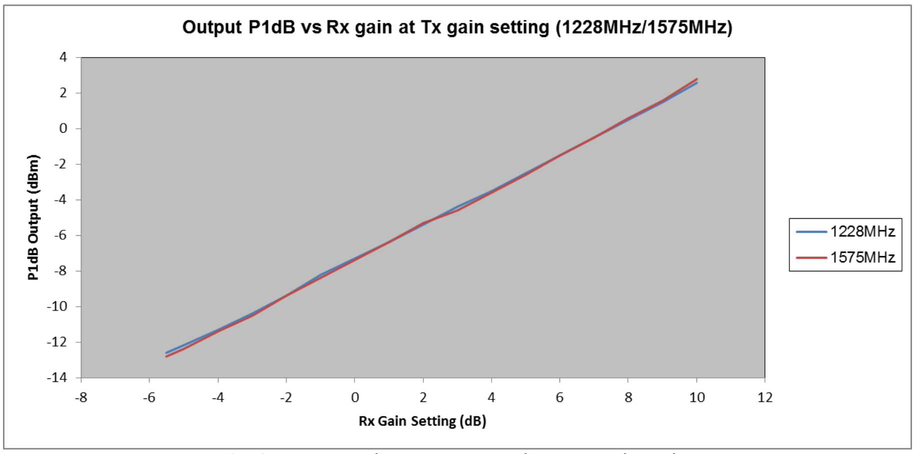
GPS input P1dB versus Rx gain at Tx gain -5dB



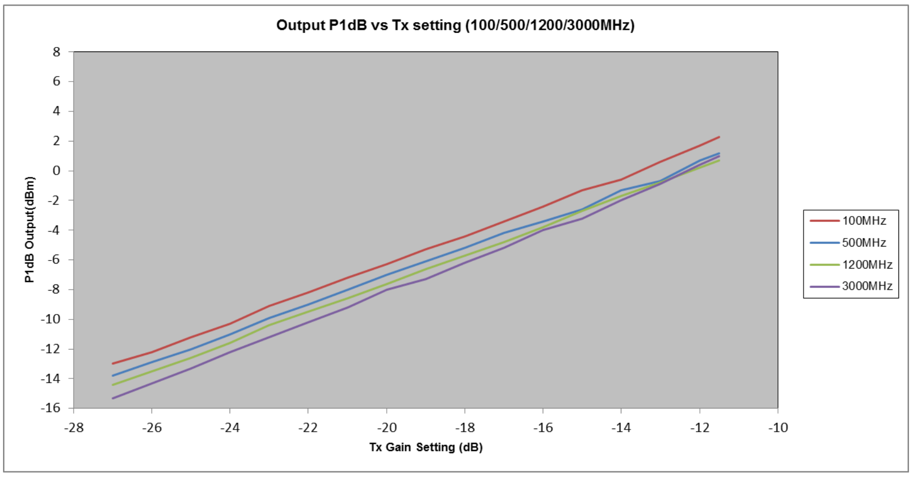
Wideband input P1dB versus Rx gain at Tx gain -15dB



L band output P1dB versus Rx gain at Tx gain -11dB



GPS output P1dB versus Rx gain at Tx gain -5dB



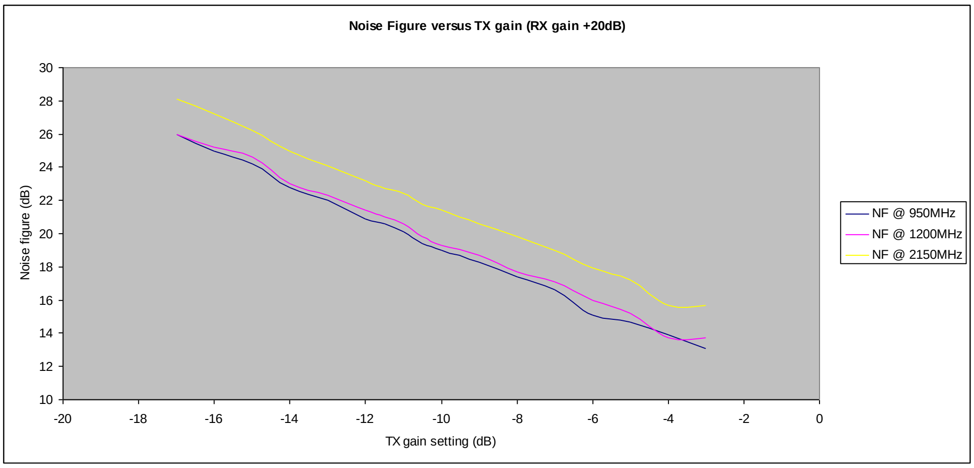
Wideband output P1dB versus Rx gain at Tx gain -15dB

3.7 P1dB, key observations

The P1dB is highly dependent on the gain setting of the transmitter, in most configurations the linearity of the link is dependent on compression of the laser and its associated amplifier, that are both situated after the gain control stage in the transmitter. At high link gains it is possible to observe some compression in the receiver, but only when this approaches its maximum gain setting.

3.8 Noise figure versus transmitter gain

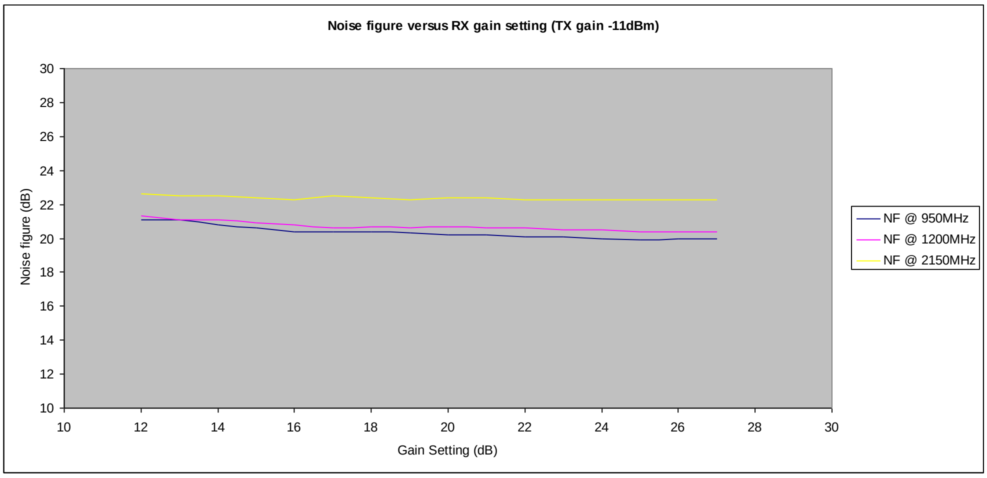
The noise figure of the link is dependent in the transmitter gain setting. Increasing the transmitter gain will reduce the noise figure. Figures shown below are typical L-Band HTS modules responses.



Noise figure versus TX gain at frequency, RX gain 20dB

3.9 Noise figure versus receiver gain

The noise figure of the link is not significantly affected by the receiver gain. Increasing the receiver gain will slightly reduce the noise figure. Figures shown below are typical L-Band HTS modules responses



Noise figure versus RX gain at frequency, TX gain -11dB

3.10 Noise figure, key observations

The noise figure of the link is approximately linearly related to the transmitter gain setting. The noise figure reduces as the transmitter gain is increased. The receiver gain only has a minor impact on the link noise figure.

3.11 Link IP3

There is a relatively simple relationship between P1dB and IP3 for ***ViaLiteHD*** links. This is dependent on the compression characteristics of the amplifiers and laser used. The IP3 of a ***ViaLiteHD*** link is generally 12 dB above the P1dB.

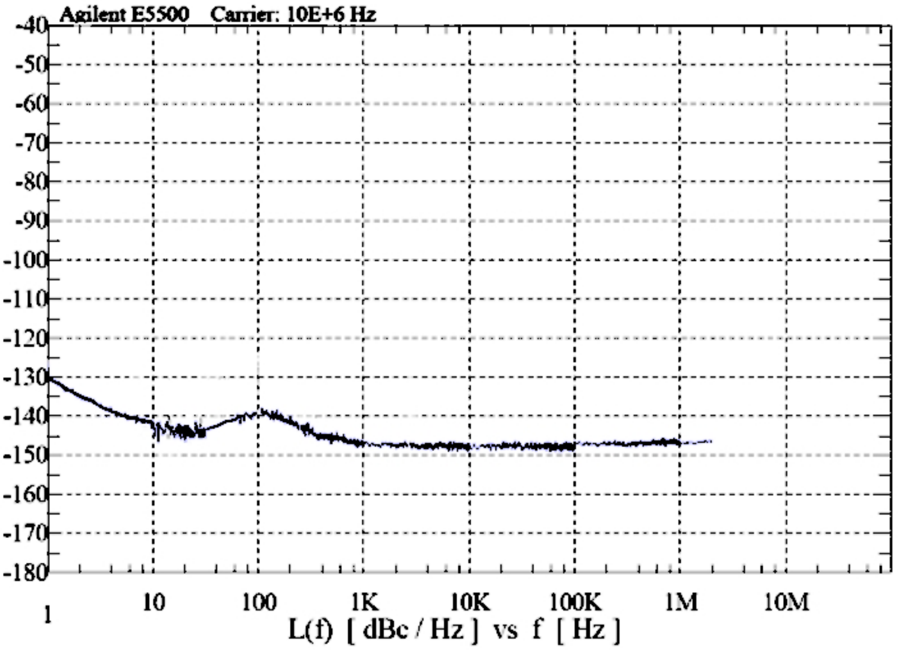
3.12 Spurious free dynamic range

The dynamic range of the system is fundamentally set by the choice of laser and the optical loss. Transmitter and receiver gain can be used to optimise this for particular applications. All standard ***ViaLiteHD*** links are equipped with high power DFB lasers to give maximum dynamic range.

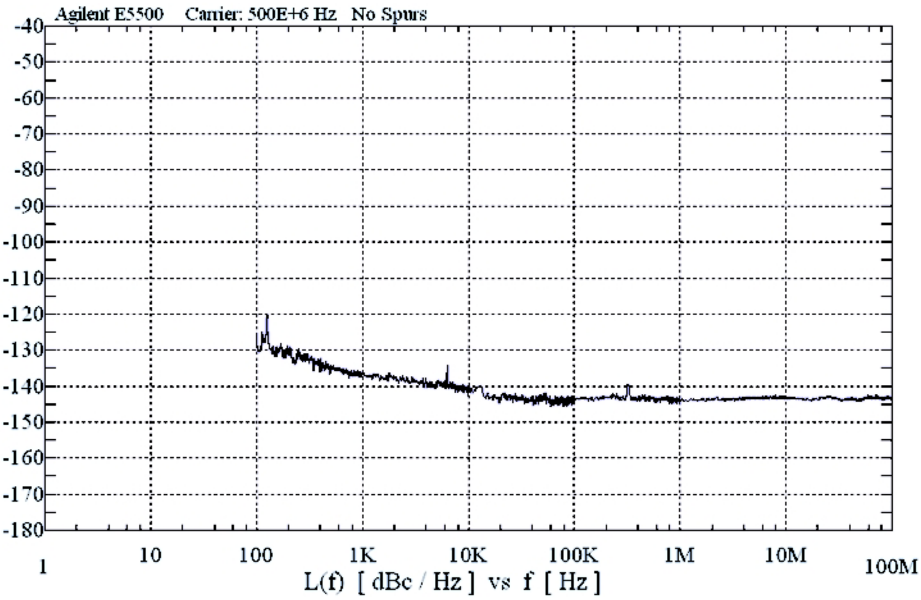
3.13 Phase noise

The ***ViaLiteHD*** link does not have any mixing or frequency conversion in the main RF path, but some residual phase noise can be measured. This phase noise is introduced by both the RF amplification elements and the laser control-loop, below are graphs that give typical performance of ***ViaLiteHD*** links. No attempt has been made to remove measure system noise; hence the results show the compound measurement system and link performance.

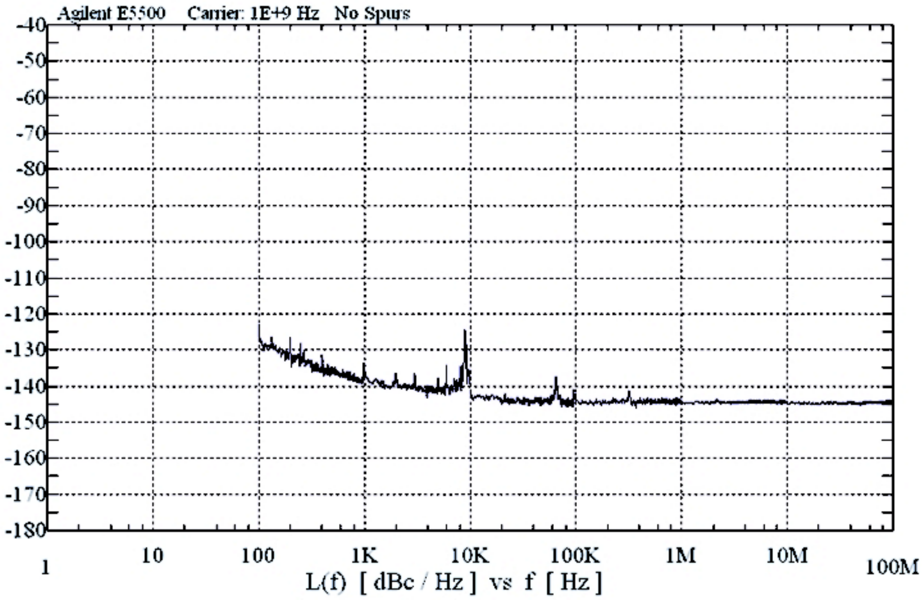
At both the lower frequency (10MHz) and the high frequency (4GHz) we believe that a significant noise contribution was made by the measurement system.



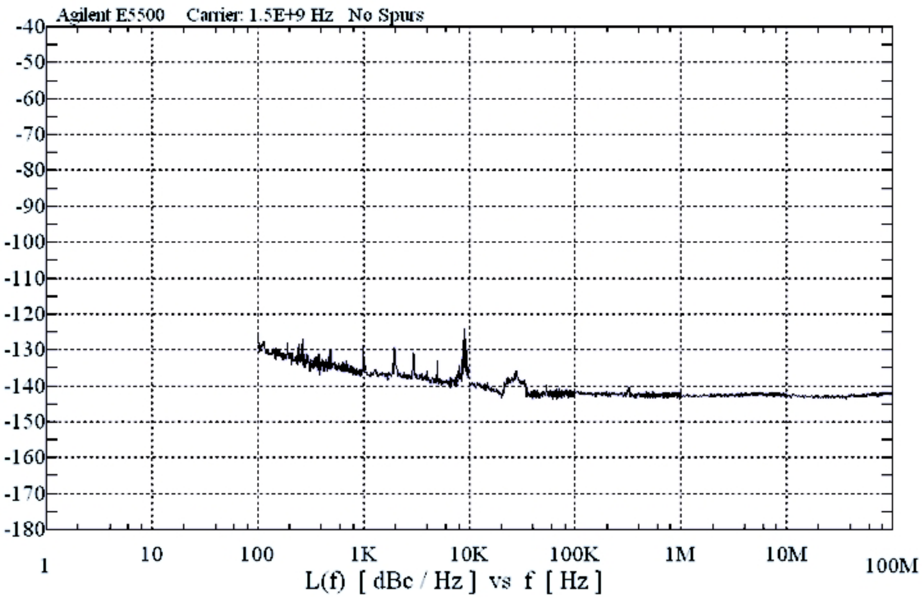
Phase Noise of a ViaLiteHD wideband link measured at 10MHz



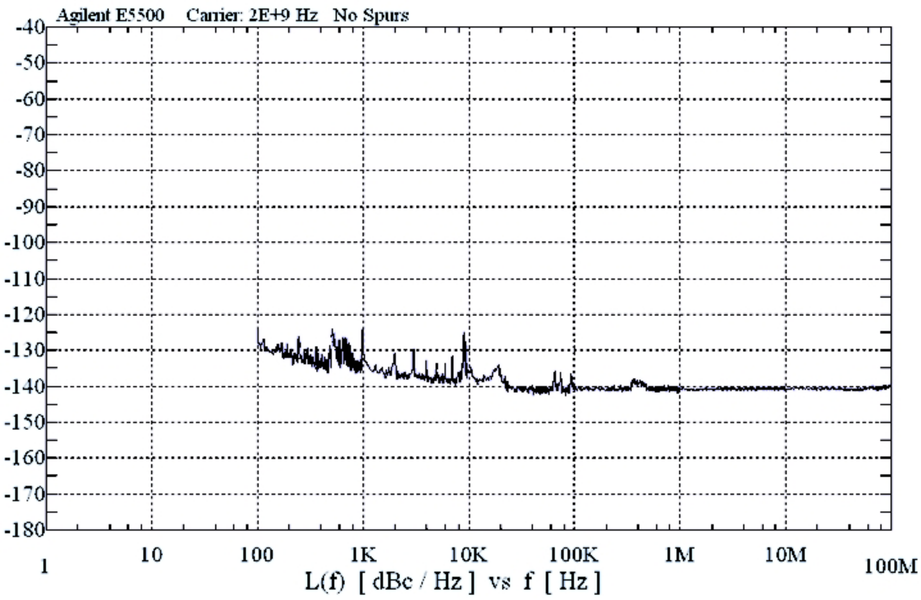
Phase Noise of a ViaLiteHD wideband link measured at 500MHz



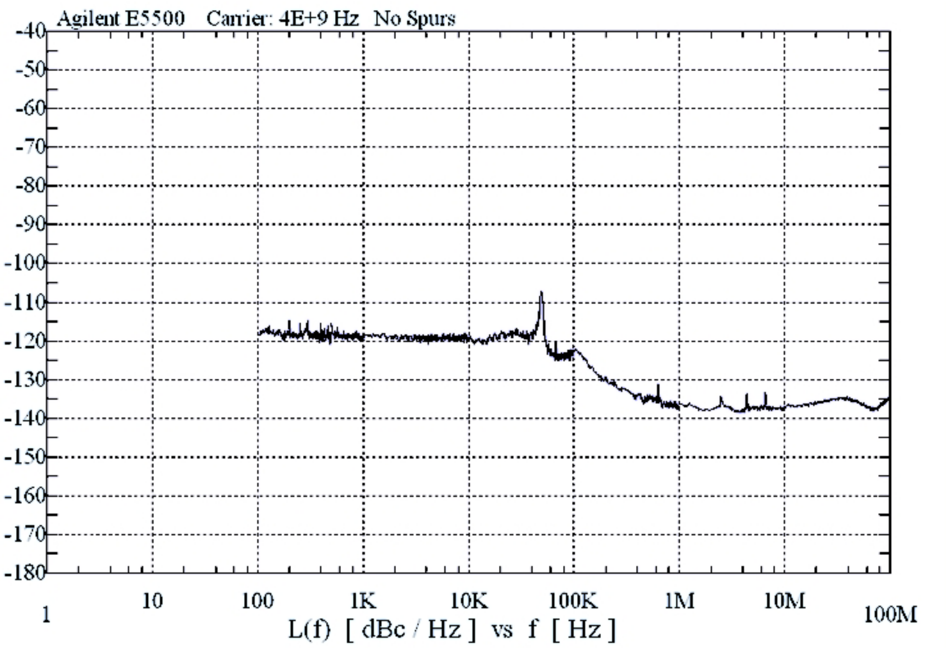
Phase Noise of a ViaLiteHD wideband link measured at 1000MHz



Phase Noise of a ViaLiteHD wideband link measured at 1500MHz



Phase Noise of a ViaLiteHD wideband link measured at 2000MHz



Phase Noise of a ViaLiteHD wideband link measured at 4000MHz

3.14 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

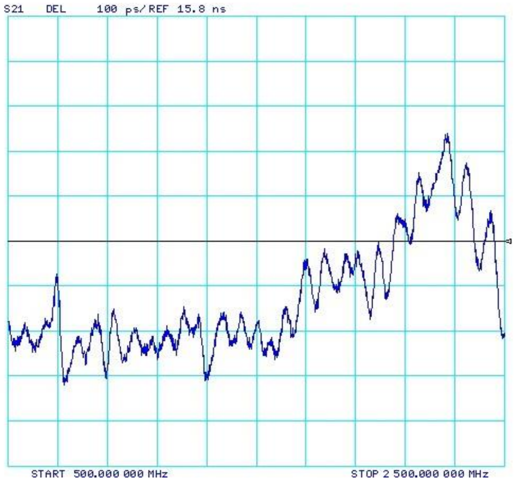
Delays quoted are typical for these cable types, construction of cables of the same type will vary between manufacturers (i.e. foam/ PTFE/ solid polyethylene dielectric). If delay is critical please check your manufacturers cable specification or electrically test the cables.

3.15 Group delay

The ***ViaLiteHD*** link has a broadband frequency response and only contributes a small amount of group delay. Plots below show typical group delay responses.

- Group delay across the full band of a FOL — 0.5ns, peak to peak, typical
- Group delay across any 36MHz band of a FOL: — 0.1ns, peak to peak, typical

All modules operating below L-Band HTS will be similar to the shown L-Band HTS



Group delay plot using a L-Band HTS Tx connected to an L-Band HTS Rx via a 0.5m fibre, 500 – 2500MHz

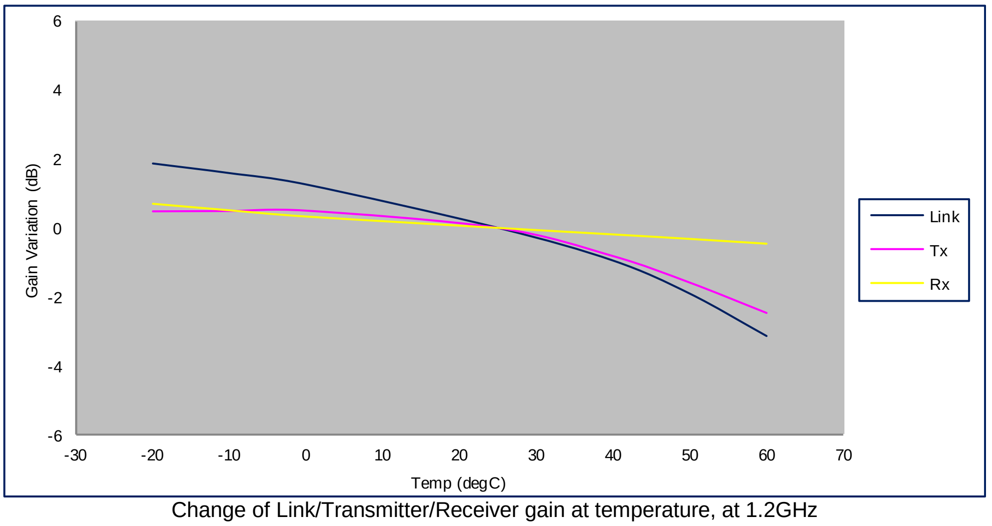
All modules operating above L-Band HTS will be similar to the Ultra Wideband.

Group delay plot using an Ultra Wideband Tx connected to an Ultra Wideband Rx via a 0.5m fibre, 10 – 4200MHz

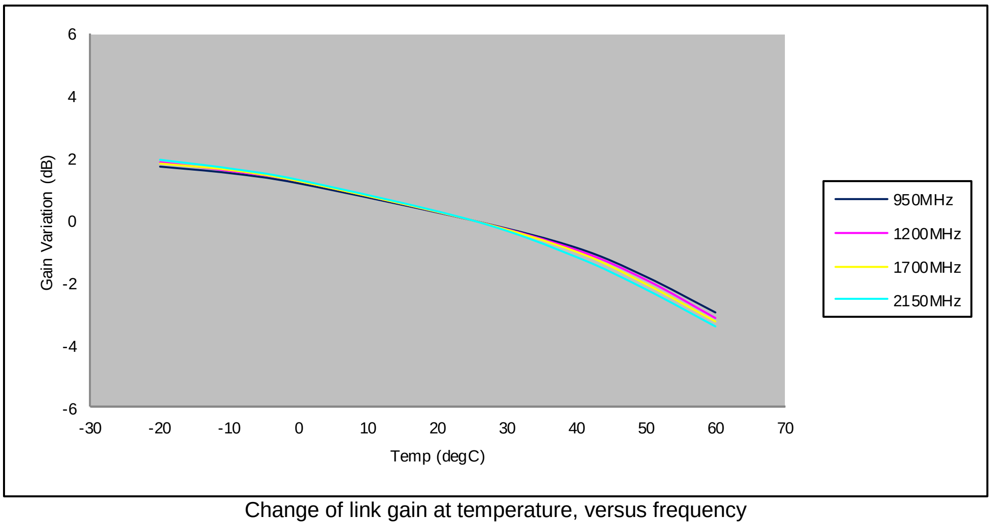
3.16 Effects of temperature

3.16.1 Effect of temperature on gain

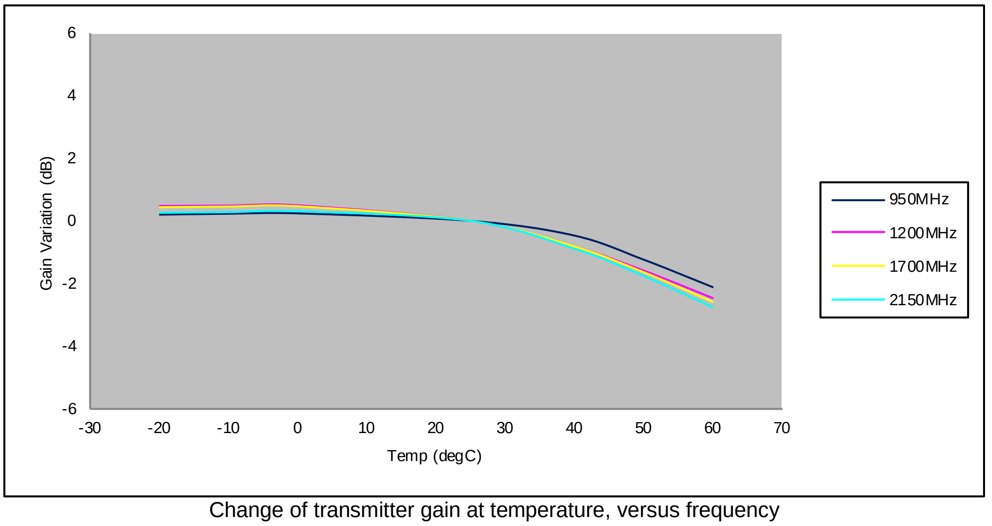
The gain of a ***ViaLiteHD*** module will reduce as temperature increases. The graph below shows change in RF gain versus the room temperature gain. The graphs show the effect of temperature both inside and outside the specified operating temperature range. The typical gain versus temperature slope is defined in the data for the module types given in section 6. The graphs below show the performance of standard transmitters. High power and DWDM transmitters have superior performance, this is detailed in section 0.



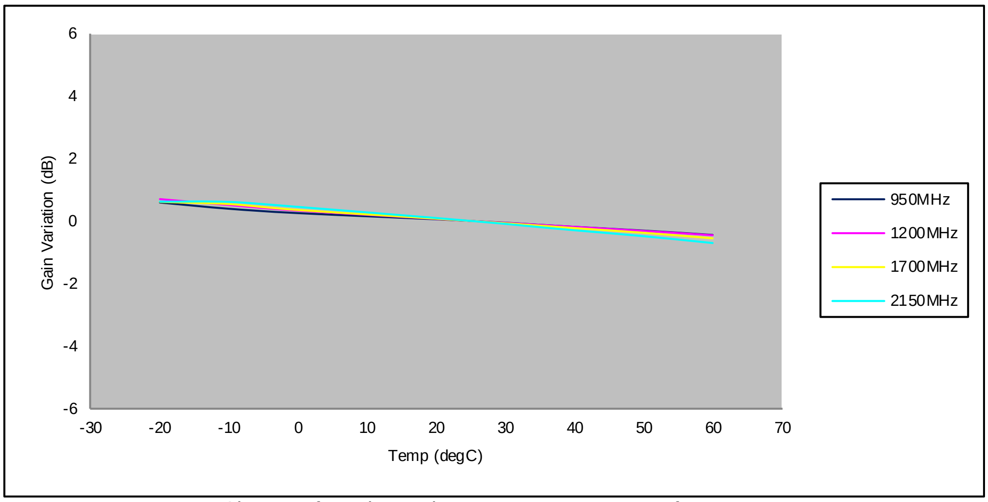
Change of Link/Transmitter/Receiver gain at temperature, at 1.2GHz



Change of link gain at temperature, versus frequency



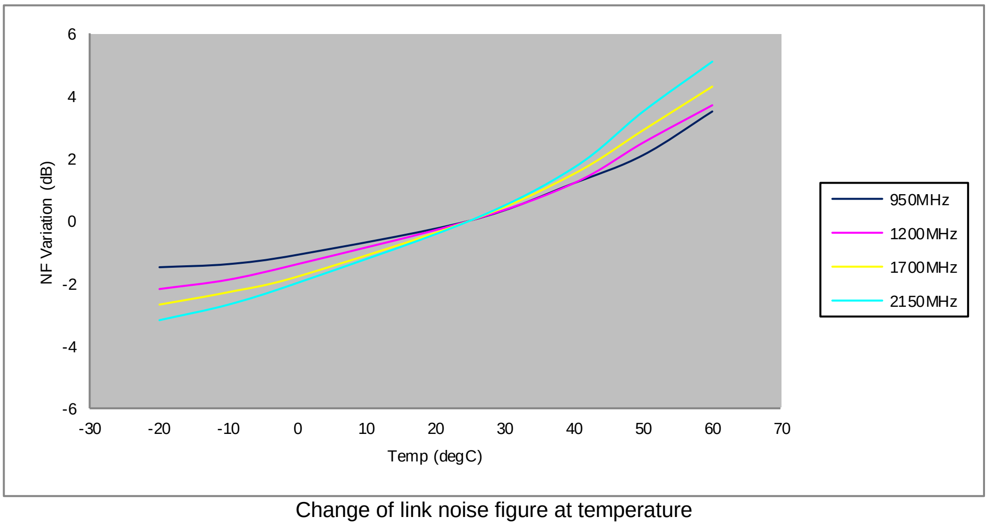
Change of transmitter gain at temperature, versus frequency



Change of receiver gain at temperature, versus frequency

3.16.2 Effect of temperature on noise figure

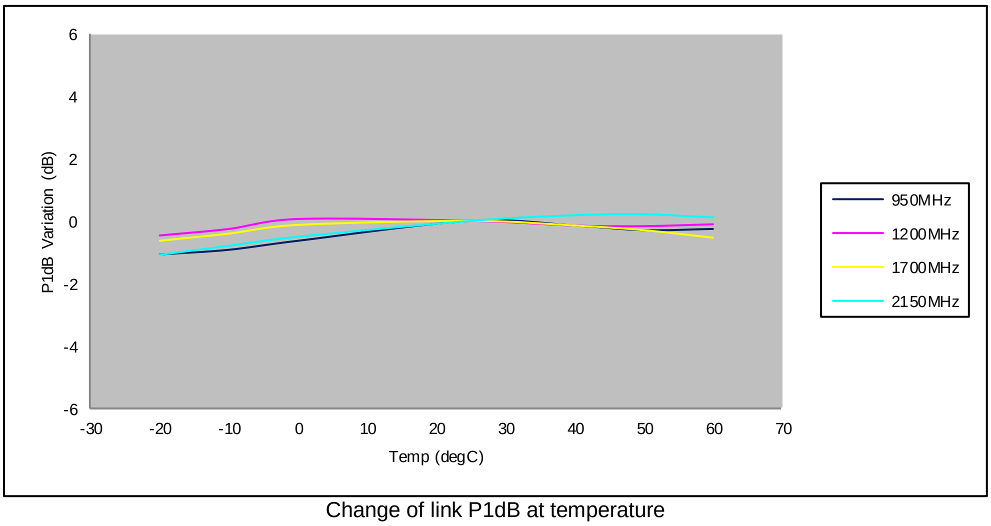
The link noise figure will be increased as temperature increases. The graph below shows change in noise figure versus the room temperature noise figure. The graph shows the effect of temperature across an extended temperature range.



Change of link noise figure at temperature

3.16.3 Effect of temperature on P1dB

The link input P1dB will be increased as temperature increases. The graph below shows change in P1dB versus the room temperature P1dB. The graph shows the effect of temperature across an extended temperature range.



Change of link P1dB at temperature

3.17 RF isolation

ViaLiteHD cards are designed to offer excellent isolation in operation, both isolation between the separate channels of dual modules and isolation from module to module in a chassis or enclosure mounted system.

The RF components for each channel of a card are fitted within a metal shield that gives a high level of isolation. Modules operating at 3GHz or more are fitted with an additional rear side shield that gives improved high frequency isolation

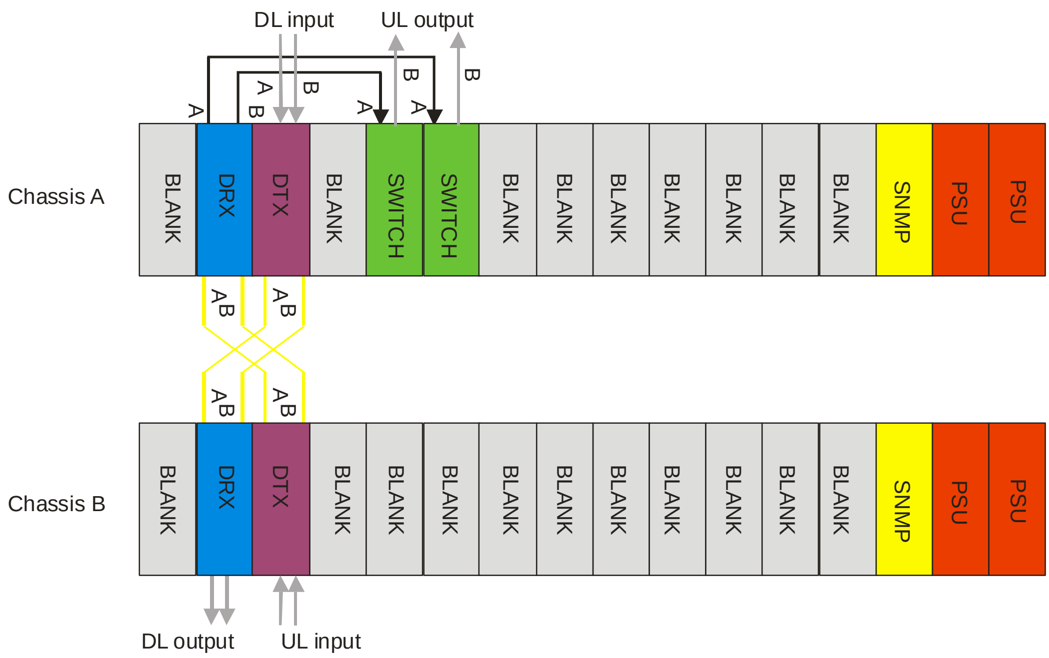
3.17.1 RF isolation, plug-in and blindmate cards

The results are shown for an L-Band HTS test system that use a range of ***ViaLiteHD*** cards, fitted in two 3U chassis. The results show the performance of the complete system.

The uplink and down link paths was composed of the following components:

- Uplink: Input > DTX (chassis B) > 2m of fibre > DRX (chassis A) > high isolation Switch(chassis A) > output
- Downlink: Input > DTX (chassis A) > 2m of fibre > DRX (chassis B) > output

In this configuration both switches are configured as through switches, with switch input A (DTX output) connected to switch output B (UL output).

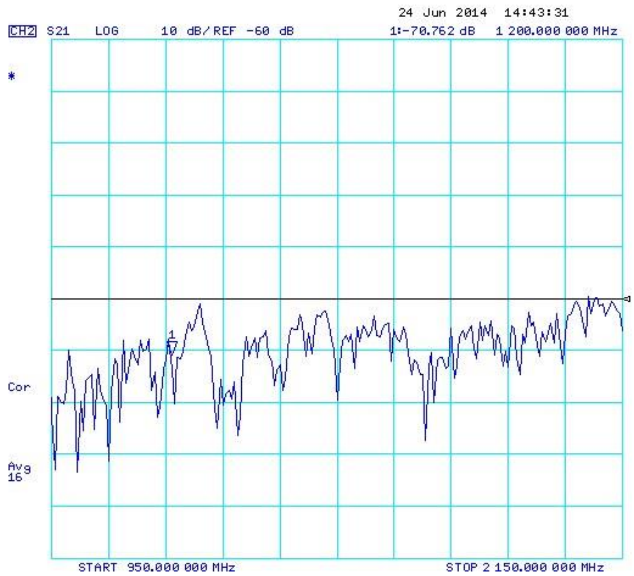


L-Band HTS isolation test system

3.17.2 RF isolation, plug-in and blindmate cards, within a module

The results below show the typical isolation between the two channels of a system using a dual card. The average isolation across the L-Band HTS frequency range is ~68dB. The dominant leakage is between channel A and channel B of both the DTX and the DRX.

Input: Port A of the DTX (chassis B)
Output: Port B of the Switch (chassis A)
Set up: Though gain is calibrated out, i.e. normal Uplink gain (~0dB for this system) is subtracted from the measured results.

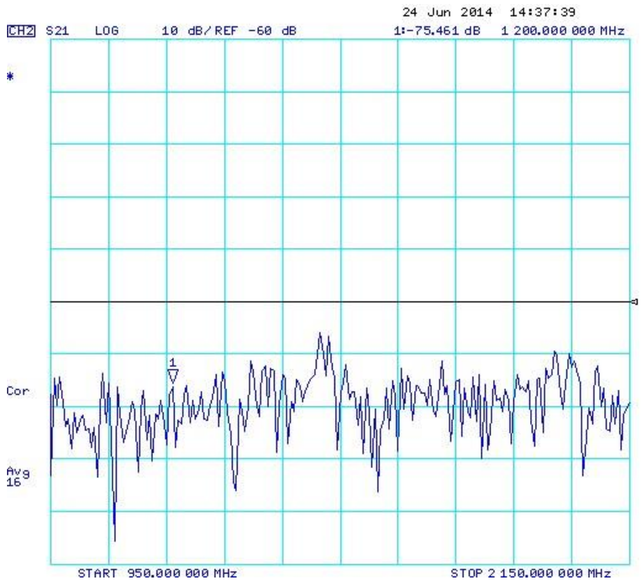


Isolation between channel A and channel B of a dual module link with high isolation switch

3.17.3 RF isolation, plug-in and blindmate cards, between modules

The results below show the typical isolation between the uplink and downlink channels of a system using a dual card. The average isolation across the L-Band HTS frequency range is ~72dB. The dominant leakage path in this case is between adjacent DTX and DRX modules.

Input: Port A of the DTX (chassis A)
Output: Port A of the DRX (chassis A)
Set up: Though gain is calibrated out, i.e. normal Uplink gain (~0dB for this system) is subtracted from the measured results.

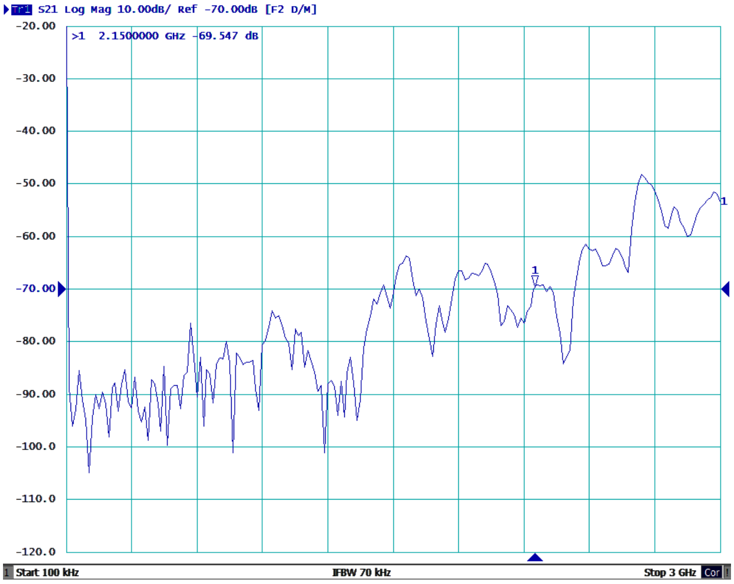


Isolation between UL and DL using dual module link

3.17.4 RF isolation, Blue link and Yellow link cards mounted in other ViaLite enclosures

Other ***ViaLiteHD*** enclosures are designed to offer similar isolation. Below is a plot taken between adjacent L-Band HTS modules in a SATCOM6 outdoor enclosure. The average isolation across the L-Band HTS frequency range is ~70dB in a SATCOM6.

Test: Isolation between L-Band HTS TX in slot 3 and L-Band HTS TX in slot 4 of SATCOM6
Set up: Though gain is calibrated out, i.e. normal Uplink gain (~0dB for this system) is subtracted from the measured results.



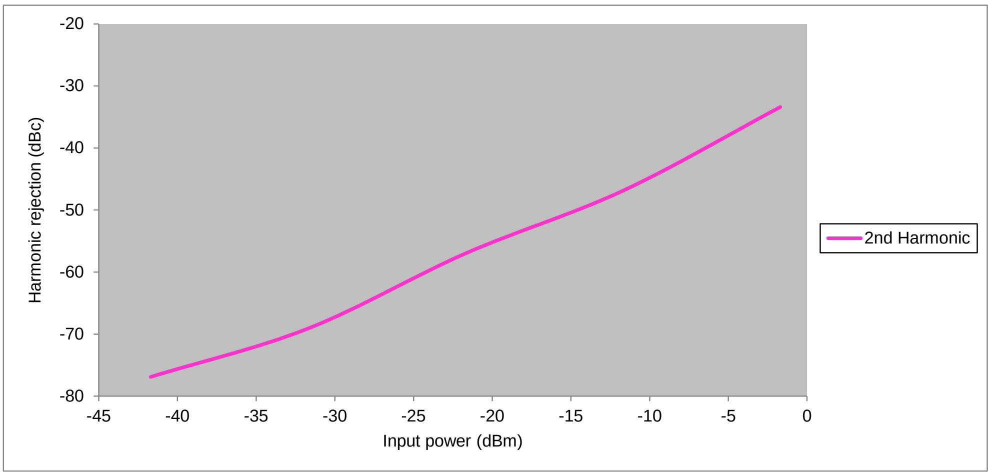
Sample isolation between adjacent modules in a SATCOM6

3.18 2nd Harmonic rejection

The second harmonic rejection is strongly dependent on how your link is configured; the chart below shows the typical performance in the following configuration.

Link Type:	L-Band HTS
Device under test:	HRT-L1-8R-33-S1310
	HRR-L1-8R-03
Link gain:	Set to default (-11/+20dB)
Input Tone:	1GHz
Optical loss:	0dB

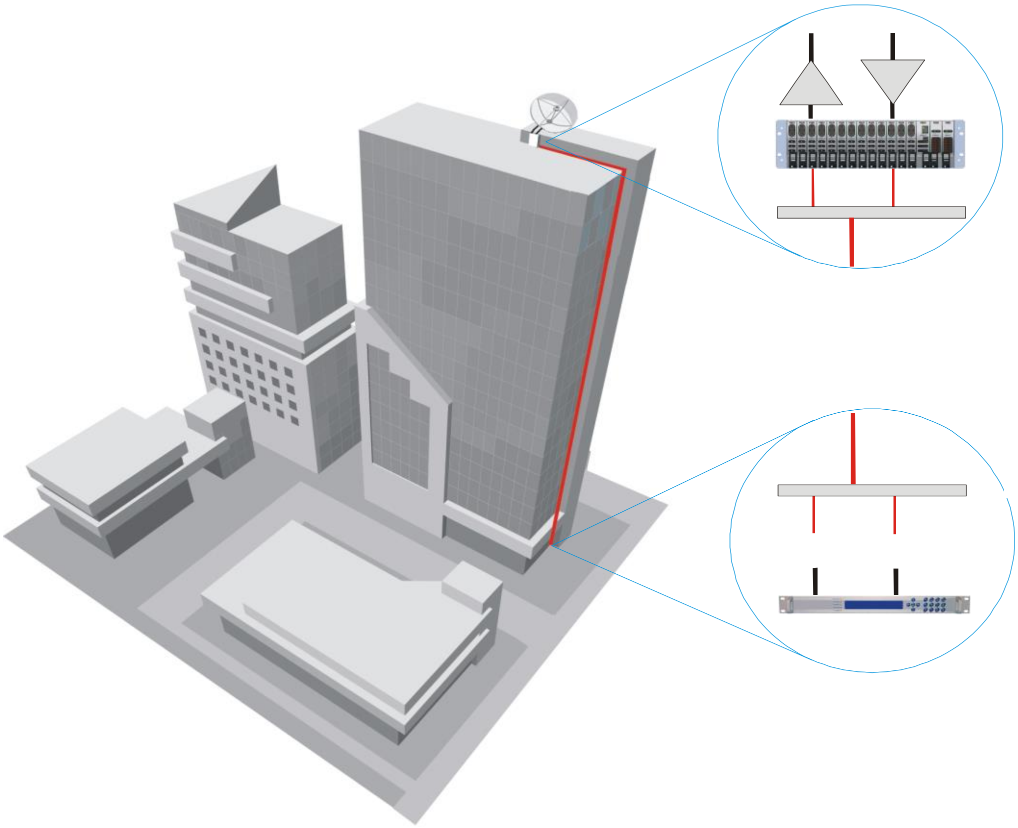
Harmonic rejection = “Output power of fundamental (1GHz)” – “Output power of harmonic (2GHz)”



2nd harmonic rejection versus input power for an L–Band link

3.19 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 loss through the optical fibre link 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 amount of laser 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.

3.20 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 an L-Band HTS interfacility link.

We will be considering the installation of the following system.

A down converter provides an output signal in the L- 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.

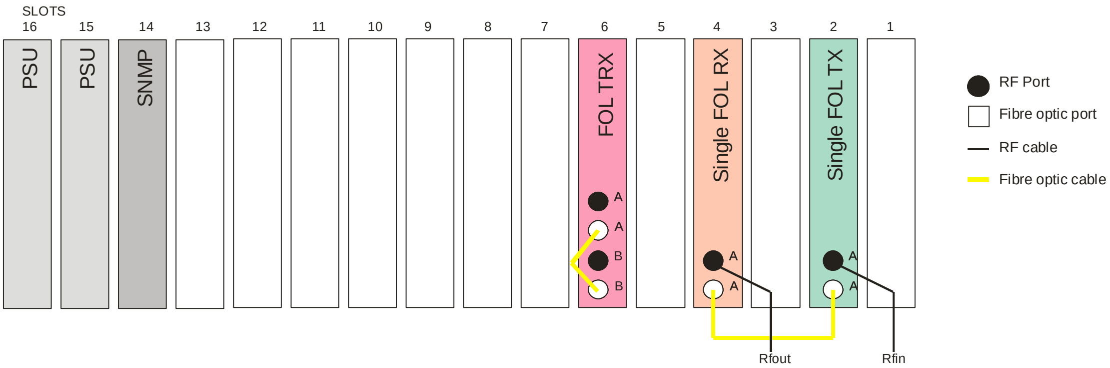
4 Mechanical details

4.1 Shock and vibration

ViaLiteHD modules have been designed and tested to operate under significant mechanical stress; the tests run far exceed normal ground fixed operational use. This has been done to assure the robustness and reliability of the designs. Below are detailed the tests undertaken.

The system under test was a set of 3U chassis mounted modules, powered by chassis mounted AC PSUs. The system is detailed below:

- HRK3S 3U chassis
- HPS-3 AC PSU
- HPS-3 AC PSU
- HRC-1-09-8R-20 SNMP controller
- HRT-N1-6R-35-S1310 1GHz TX
- HRR-N1-6R-05 1GHz RX
- HRX-N1-8D-05-C1530 1GHz TRX blindmate
- F6R1/0.5 Optical test cable
- F8R1/0.5 Optical test cable
- Laptop (running SNMP web interface), not subject to vibration or shock



Vibration and shock test configuration, rear view

Vibration applied to the system:

- Vibration (Sinusoidal)
- Planes 3 planes, X/Y/Z
- Severity 5G, 25 – 2000 Hz, 1 octaves per minute.
- Duration 1/2 hour in each axis
- Standard IEC68-2-6: 1982

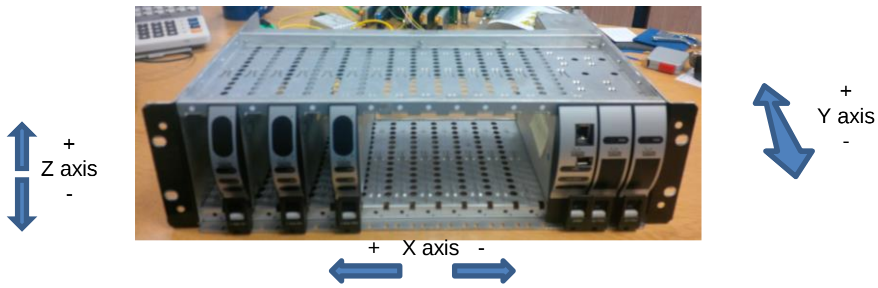
Shock applied to the system:

- Shock (half sine);
- Axis: 6 axis, X+/X-/Y+/Y-/Z+/Z-
- Severity 15g/ 11ms Shock (half sine)
- Duration 3 shocks each direction of each axes
- Standard IEC68-2-27:1987

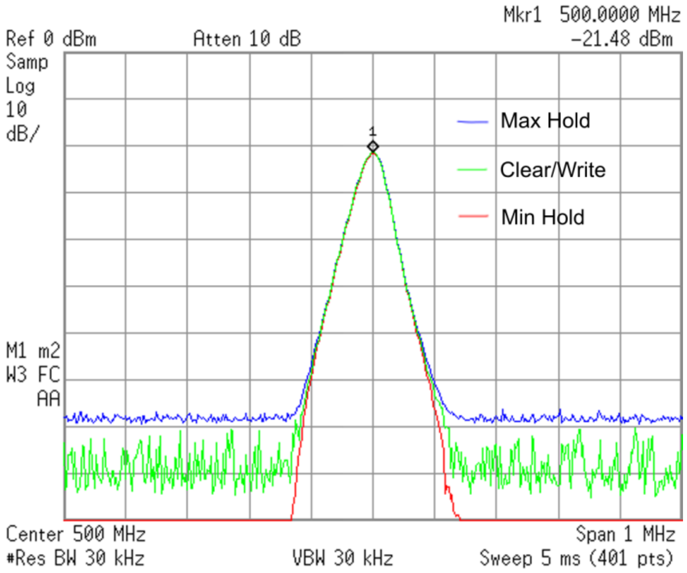
A continuous wave RF test signal was applied to the TX FOL and monitored on the RX FOL via a spectrum analyser. The spectrum analyser used both maximum and minimum hold to capture performance extremes.

The test pass requirement was as follows:

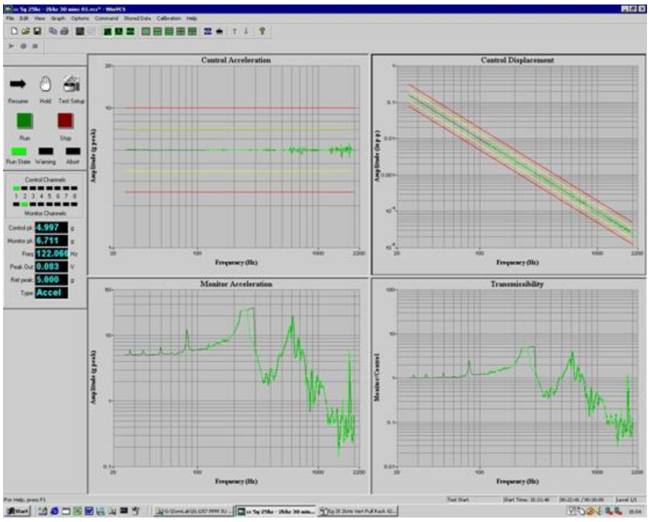
- Continuous RF operation to specification.
- No SNMP error events to be logged.
- No front panel LED errors to be shown.
- No visible mechanical damage or degradation.



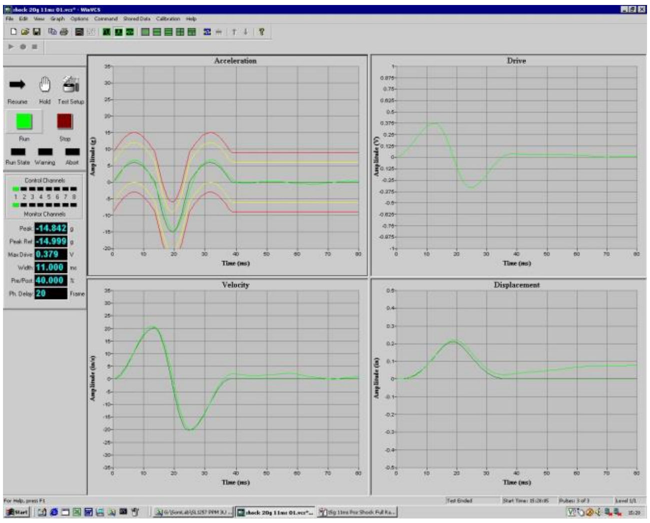
Orientation of shock and vibration



Spectrum plot of 500MHz CW tone when under vibration



Sample plot of vibration in Y axis



Sample plot of Half Sine Shock in Y+ axis

No measureable change in RF power level was detected. The system under test passed all the vibration and shock test, detailed above. A full test report is available, contact ***ViaLite Communications*** for more details.

4.2 Electrical interfaces

For typical levels and maximum ratings see details sections 2.14. In all cases GND is used as the voltage reference.

4.2.1 Signal description, alphabetic

This section gives a brief overview of the function of each signal line, more details are given in the following sections

+12Vdc	Module DC power input
ALARM	Open collector alarm for chassis modules
BUC_feed	Low frequency or DC power feed to the RF output pin of receiver modules
LD_MON	Laser diode analogue bias monitor proportional laser diode current (see section 2.3.7)
LNA_feed	Low frequency or DC power feed to the RF input pin of transmitter modules, this may also support tone signalling
MS	Serial interface module select, this enables the module to accept serial control data
RLL_MON	Received light level analogue monitor, a voltage proportional to the received optical carrier power (see section 2.3.7)
RTS_485	Request to send (RTS) signal used by RS485 modules
RX_232_OUT	Electrical output used for either TTL or RS232
RX_422_OUT-	Electrical output used for either RS422 or RS485 module, negative pin
RX_422_OUT+	Electrical output used for either RS422 or RS485 module, positive pin
RX_AGC_ON	Input to enable or disable AGC function on Blue link and Yellow link receiver module
RX_ALARM	Open collector alarm for Blue link and Yellow link modules
SCL	Serial interface clock line, uses I2C standard
SDA	Serial interface data line, uses I2C standard
TX_232_IN	Electrical input for either TTL or RS232 module
TX_422_IN-	Electrical input for either RS422 or RS485 module, negative pin
TX_422_IN+	Electrical input for either RS422 or RS485 module, positive pin
TX_AGC_ON	Input to enable or disable AGC function on Blue link and Yellow link transmitter module
TX_ALARM	Open collector alarm for Blue link and Yellow link modules

4.2.2 Plug-in module, 9 way D type module connector

The chassis D-Type 9 way connector allows access to the interfaces of the module, see 4.3.1.2 for connections

Function	Type	Typical Level	Maximum level
TX_422_IN+	Input digital	RS422 input	See 2.16.3
TX_422_IN-	Input digital	RS422 input	See 2.16.3
TX_232_IN	Input digital	RS232 input	See 2.16.2
RX_422_OUT+	Output digital	RS422 output	See 2.16.3
RX_422_OUT-	Output digital	RS422 output	See 2.16.3
RX_232_OUT	Output digital	RS232 output	See 2.16.2
RTS_485	Input digital	TTL input	See 2.16.1

4.2.3 Plug-in module, Chassis interface connectors

These signals are available from the modules via the chassis connectors. Data given in this table is ONLY appropriate to those interface lines connected to RF link modules. See the appropriate chassis handbook for pin outs.

Function	Type	Typical Level	Maximum level
ALARM	Open Drain output	GND or OPEN	See 2.16.5
LNA_feed	Power input	See 2.5	See 2.5
BUC_feed	Power input	See 2.6.1	See 2.6.1
LD_MON	Analogue output	See 2.16.7	See 2.16.7
RLL_MON	Analogue output	See 2.16.8	See 2.16.8

4.2.4 Blue link and Yellow link module, TX

These signals are available from the modules interface connector, see 4.3.2.2 and 4.3.3.2 for pin outs.

Function	Type	Typical Level	Maximum level
TX_422_IN+	Input digital	RS422 input	See 2.16.3
TX_422_IN-	Input digital	RS422 input	See 2.16.3
TX_232_IN	Input digital	RS232 input	See 2.16.2
+12Vdc	Power input	12V	See 2.16.6
LNA_feed	Power input	See 2.5	See 2.5
LD_MON	Analogue output	See 2.16.7	See 2.16.7
TX_ALARM	Open Drain output	GND or OPEN	See 2.16.5
TX_AGC_ON	Input digital	TTL input	See 2.16.1
SCL	Digital Input	I2C	See 2.16.4
SDA	Digital Input/Output	I2C	See 2.16.4

4.2.5 Blue link and Yellow link module, RX

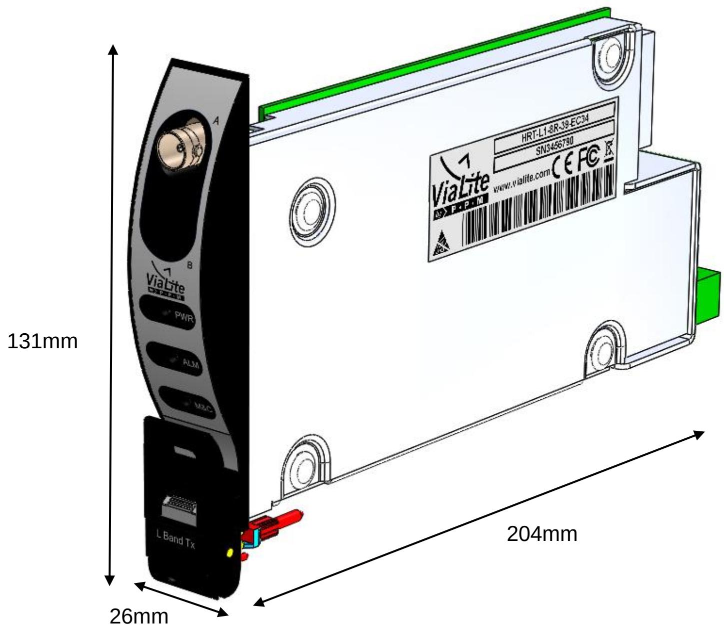
These signals are available from the modules interface connector, see 4.3.2.2 and 4.3.3.2 for pin outs.

Function	Type	Typical Level	Maximum level
BUC_feed	Power input	See 2.6.1	See 2.6.1
+12Vdc	Power input	12V	See 2.16.6
RX_422_OUT+	Digital Output	RS422 output	See 2.16.3
RX_422_OUT-	Digital Output	RS422 output	See 2.16.3
RX_232_OUT	Digital Output	RS232 output	See 2.16.2
RTS_485	Input digital	TTL input	See 2.16.1
RLL_MON	Analogue output	See 2.16.8	See 2.16.8
RX_ALARM	Open Drain output	GND or OPEN	See 2.16.5
RX_AGC_ON	Input digital	TTL input	See 2.16.1
SCL	Digital Input	I2C	See 2.16.4
SDA	Digital Input/Output	I2C	See 2.16.4

4.3 Physical interfaces

4.3.1 Plug-in and Blindmate modules

4.3.1.1 Plug-in module - dimensions



Weight: 240g typical
300g maximum

4.3.1.2 Plug-in module – connections, 9 way D type

The connections are only available from the backplane when the module is fitted into an appropriate chassis

Pin	Description	Pin	Description	Pin	Description
1	GND	4	*TX_232_IN*	7	Do not use
2	*TX_422_IN+*	5	Do not use	8	Do not use
3	*TX_422_IN-*	6	Do not use	9	Do not use

Transmitter module TX, with digital channel

Pin	Description	Pin	Description	Pin	Description
1	GND	4	Do not use	7	*RX_422_OUT-*
2	Do not use	5	Do not use	8	*RX_232_OUT*
3	Do not use	6	*RX_422_OUT+*	9	*RTS_485*

Receiver module RX, with digital channel

Pin	Description	Pin	Description	Pin	Description
1	GND	4	*TX_232_IN*	7	*RX_422_OUT-*
2	*TX_422_IN+*	5	Do not use	8	*RX_232_OUT*
3	*TX_422_IN-*	6	*RX_422_OUT+*	9	*RTS_485*

Transceiver module TRX, with digital channel

Pin	Description	Pin	Description	Pin	Description
1	GND	4	*TX1_232_IN*	7	*TX2_422_IN-*
2	*TX1_422_IN+*	5	Do not use	8	*TX_232_IN*
3	*TX1_422_IN-*	6	*TX2_422_IN+*	9	Do not use

Dual transmitter module DTX, with digital channel

Pin	Description	Pin	Description	Pin	Description
1	GND	4	*RX1_232_OUT*	7	*RX2_422_OUT-*
2	*RX1_422_OUT+*	5	*RTS1_485*	8	*RX2_232_OUT*
3	*RX1_422_OUT-*	6	*RX2_422_OUT+*	9	*RTS2_485*

Dual receiver module DRX, with digital channel

For the dual channel modules (Transceiver, Dual transmitter or Dual receiver) ; channel 1 (i.e. RX, TX1 or RX1) is transmitted through the “A” fibre and channel 2 (i.e. TX, TX2 or RX2) is transmitted through the “B” fibre.

Note: Data on the connector is only for the module fitted in that 5HP slot.
Connections in *blue* are optional and only available on some types of module.

4.3.1.3 Plug-in module – connections, backplane I2C

These connections are not externally available but maybe used to configure the module in some users equipment, they are available from the rear 30 way DIN 41612 connector. Only I2C and associated pins are shown below

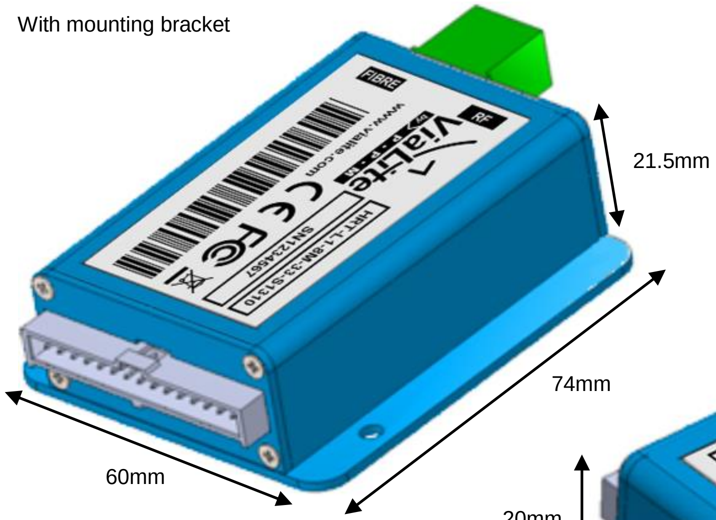
The MS is a TTL input; see section 2.16.1 for voltage levels. The modules are SELECTED by a HIGH and DESELECTED by a LOW, chassismodules have a weak internal pull up, hence they are SELECTED when open circuit.

Pin	Description
B6	MS (module select)
B7	SCL (serial clock)
B8	SDA (serial data)
A10 / B10 / C10	GND

4.3.2 Blue link module connections

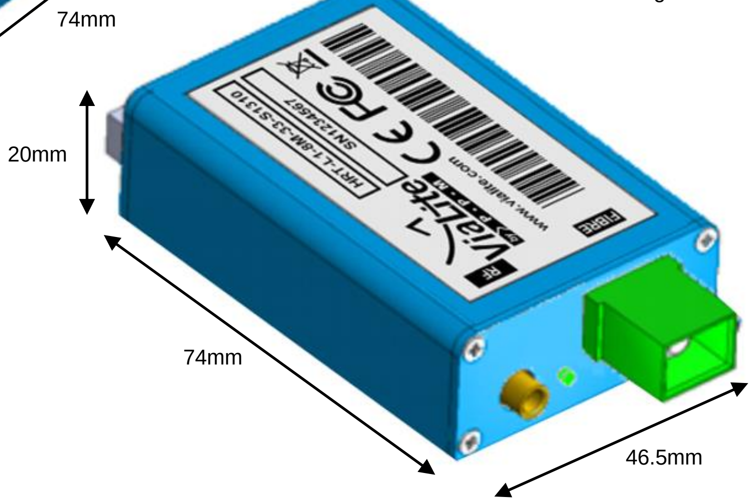
4.3.2.1 Blue link module – dimensions

With mounting bracket



Detailed mechanical drawings are available of all ***ViaLiteHD*** modules on request.

Without mounting bracket



All modules are supplied with a mounting bracket. The unit may be secured by:

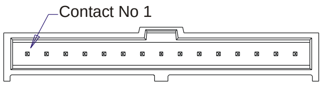
2*M2.5 tapped hole on the underside
OR
2*M3 clearance holes in the mounting bracket

Weight with mounting bracket fitted 130g typical
Weight without mounting bracket fitted 112g typical

4.3.2.2 Blue link module, connections

Pin	Blue link Transmitter	Blue link Receiver
1	*TX_422_IN+*	*BUC_feed*
2	*TX_422_IN-*	Not used
3	*TX_232_IN*	Not used
4	GND	GND
5	+12Vdc	+12Vdc
6	Not used	*RX_422_OUT+*
7	Not used	*RX_422_OUT-*
8	Not used	*RX_232_OUT*
9	*LNA_feed*	*RTS_485*
10	LD_MON	RLL_MON
11	Not used	Not used
12	TX_ALARM	RX_ALARM
13	TX_AGC_ON	RX_AGC_ON
14	SCL	SCL
15	SDA	SDA

Note: Colour indicates relevant connector drawing.
Connections in *blue* are optional and only available on some types of module.

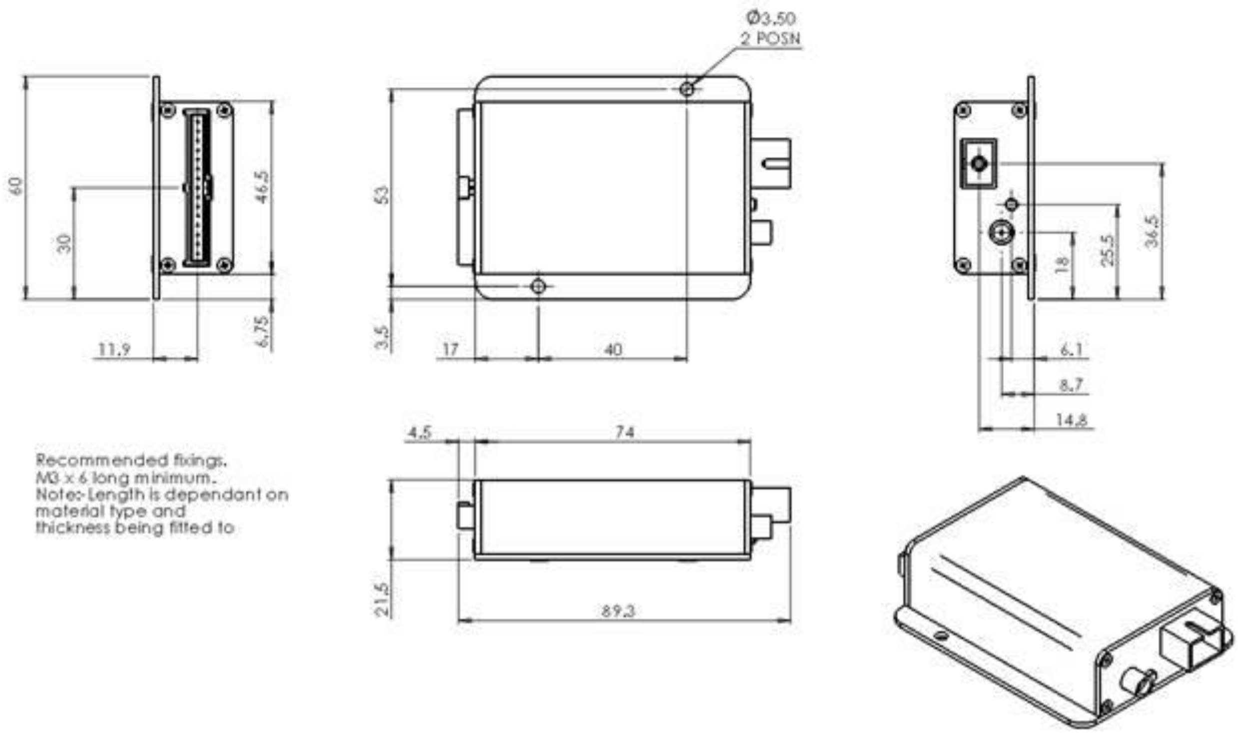


Blue link: Top view, 15 pin header (male)
Connector Type: Molex (C-Grid III), single row

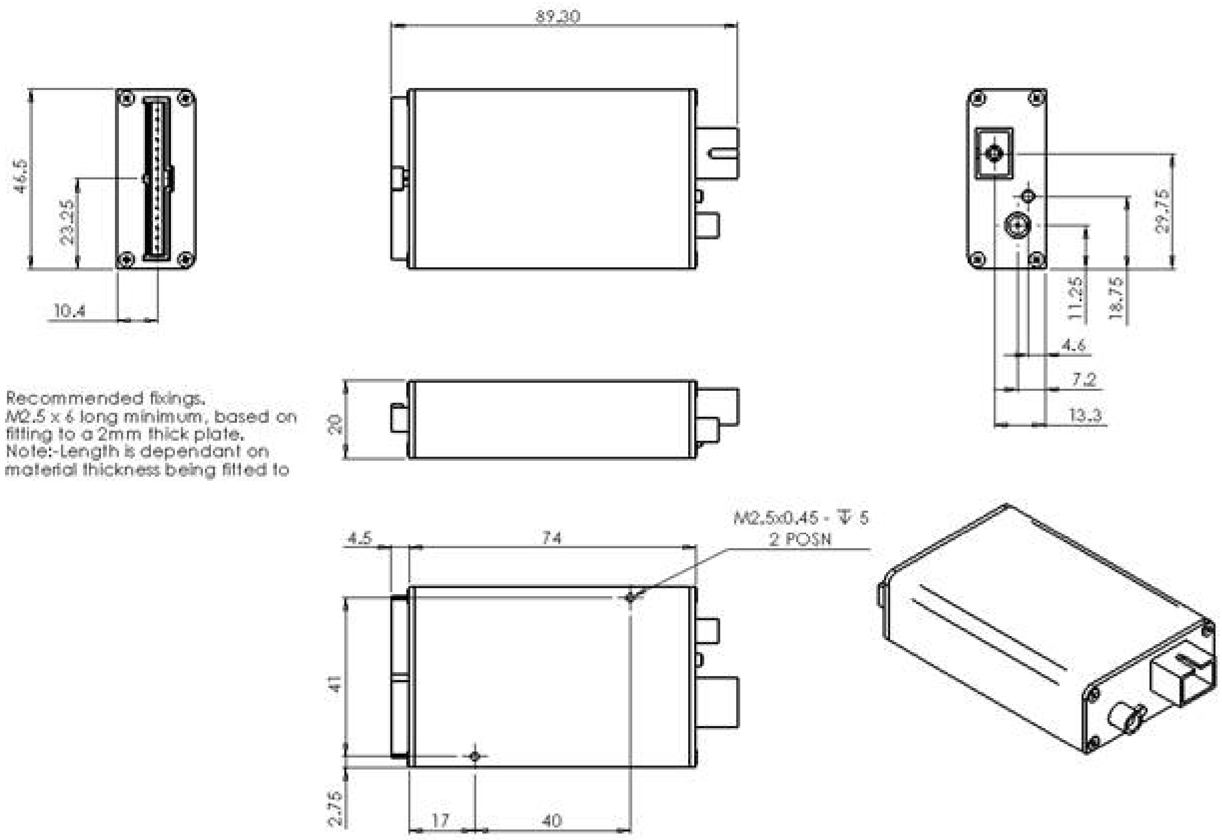
Compatible mating connectors

PPM #	Description	Supplier	Supplier part number
55708	CGRID3 15 way housing	Molex	90156-0155
54245	Crimp connector 22-24 AWG	Molex	90119-2110

4.3.2.3 Blue link – mounting dimensions, with rear plate

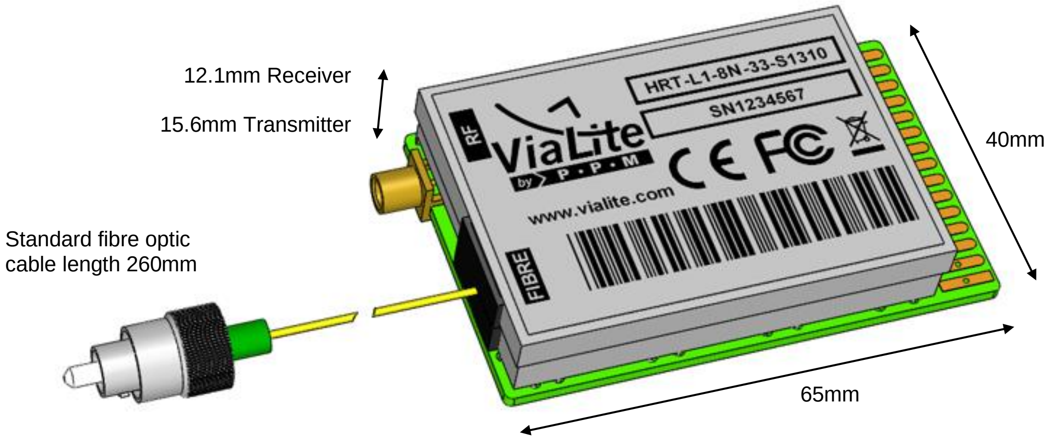


4.3.2.4 Blue link – mounting dimensions, without rear plate



4.3.3 Yellow link module connections

4.3.3.1 Yellow link module - dimensions



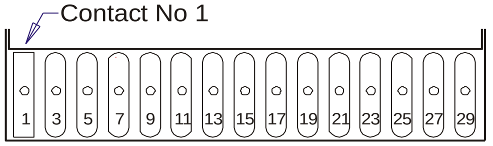
Detailed mechanical drawings are available of all ***ViaLiteHD*** modules on request.

Weight transmitter 60g typical
Weight receiver 55g typical

4.3.3.2 Yellow link - Pinout

Pin	Yellow link Transmitter	Yellow link Receiver
1, 2	*TX_422_IN+*	*BUC_feed*
3, 4	*TX_422_IN-*	Not used
5, 6	*TX_232_IN*	Not used
7, 8	GND	GND
9, 10	+12Vdc	+12Vdc
11, 12	Not used	*RX_422_OUT+*
13, 14	Not used	*RX_422_OUT-*
15,16	Not used	*RX_232_OUT*
17, 18	*LNA_feed*	*RTS_485*
19, 20	LD_MON	RLL_MON
21, 22	Not used	Not used
23, 24	TX_ALARM	RX_ALARM
25, 26	TX_AGC_ON	RX_AGC_ON
27, 28	SCL	SCL
29, 30	SDA	SDA

Note: Colour indicates relevant connector drawing.
Connections in *blue* are optional and only available on some types of module.



EDGE: Top View, 30 way double sided header
Connector Type: 2.54mm double sided edge connector

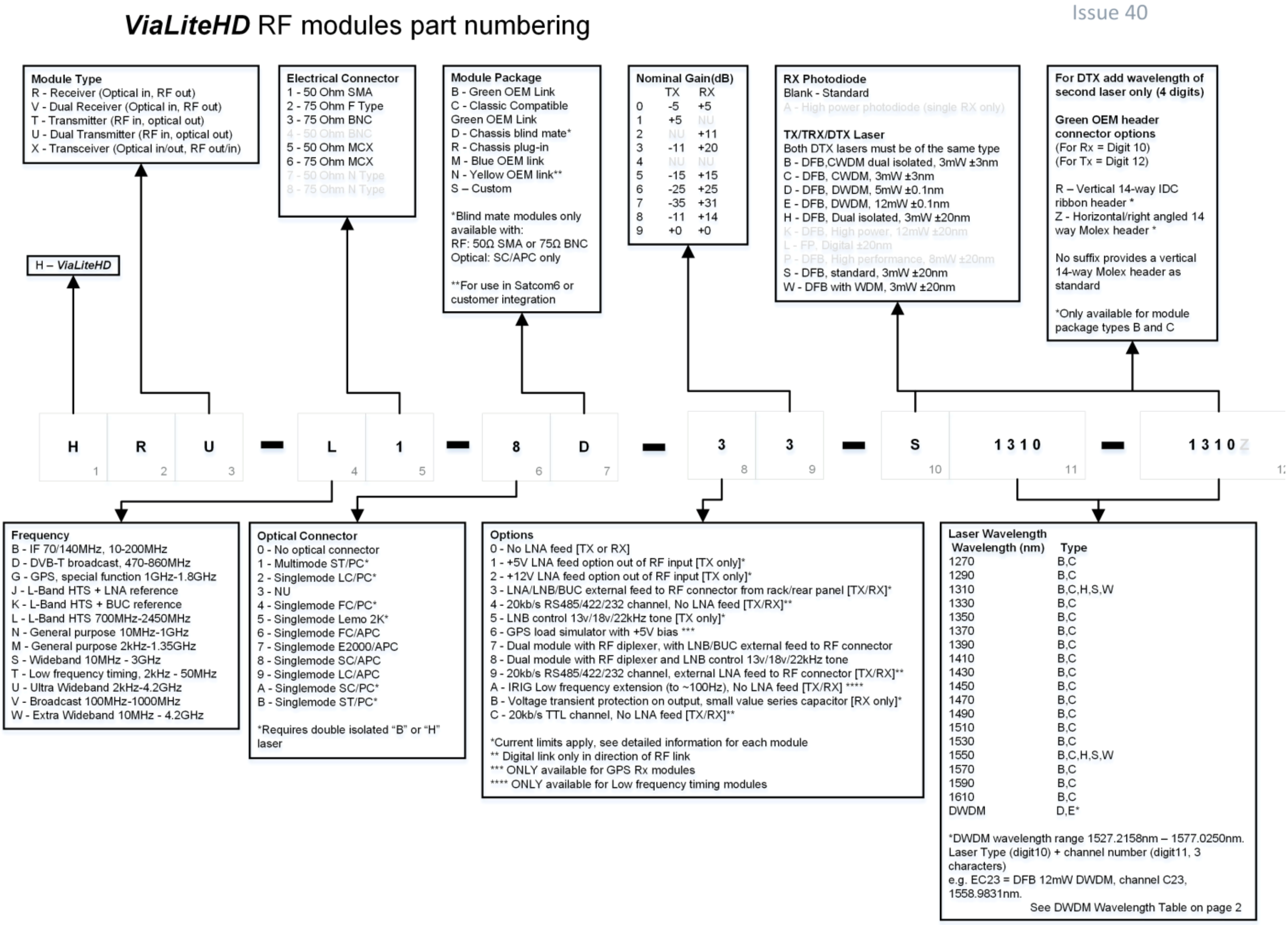
Compatible mating connectors

PPM #	Description	Supplier	Supplier part number
59897	Straight EDGE connector	Toby Electronics	802-S-30-S-R
59910	Right angle EDGE connector	Digikey	EEC15DRAN-ND

Note: Yellow link top and bottom pins are connected through vias.

5 Part numbering

5.1 Part numbering matrix



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

5.2 Part numbering, DWDM wavelengths

DWDM Wavelength Table for 5mw and 12mW Lasers

Channel	Frequency (GHz)	Wavelength (nm)	Channel	Frequency (GHz)	Wavelength (nm)	Channel	Frequency (GHz)	Wavelength (nm)	Channel	Frequency (GHz)	Wavelength (nm)
C01	190100	1577.0250	C17	191700	1563.8626	C33	193300	1550.9180	C49	194900	1538.1860
H01	190150	1576.6103	H17	191750	1563.4548	H33	193350	1550.5170	H49	194950	1537.7915
C02	190200	1576.1959	C18	191800	1563.0472	C34	193400	1550.1161	C50	195000	1537.3972
H02	190250	1575.7816	H18	191850	1562.6399	H34	193450	1549.7155	H50	195050	1537.0031
C03	190300	1575.3676	C19	191900	1562.2327	C35	193500	1549.3150	C51	195100	1536.6092
H03	190350	1574.9538	H19	191950	1561.8258	H35	193550	1548.9148	H51	195150	1536.2155
C04	190400	1574.5402	C20	192000	1561.4191	C36	193600	1548.5148	C52	195200	1535.8220
H04	190450	1574.1268	H20	192050	1561.0125	H36	193650	1548.1149	H52	195250	1535.4287
C05	190500	1573.7137	C21	192100	1560.6062	C37	193700	1547.7153	C53	195300	1535.0356
H05	190550	1573.3008	H21	192150	1560.2001	H37	193750	1547.3159	H53	195350	1534.6427
C06	190600	1572.8880	C22	192200	1559.7943	C38	193800	1546.9167	C54	195400	1534.2500
H06	190650	1572.4755	H22	192250	1559.3886	H38	193850	1546.5177	H54	195450	1533.8575
C07	190700	1572.0632	C23	192300	1558.9831	C39	193900	1546.1189	C55	195500	1533.4653
H07	190750	1571.6512	H23	192350	1558.5779	H39	193950	1545.7203	H55	195550	1533.0732
C08	190800	1571.2393	C24	192400	1558.1729	C40	194000	1545.3219	C56	195600	1532.6813
H08	190850	1570.8277	H24	192450	1557.7680	H40	194050	1544.9238	H56	195650	1532.2896
C09	190900	1570.4162	C25	192500	1557.3634	C41	194100	1544.5258	C57	195700	1531.8981
H09	190950	1570.0050	H25	192550	1556.9590	H41	194150	1544.1280	H57	195750	1531.5068
C10	191000	1569.5940	C26	192600	1556.5548	C42	194200	1543.7305	C58	195800	1531.1157
H10	191050	1569.1832	H26	192650	1556.1508	H42	194250	1543.3331	H58	195850	1530.7248
C11	191100	1568.7727	C27	192700	1555.7471	C43	194300	1542.9360	C59	195900	1530.3341
H11	191150	1568.3623	H27	192750	1555.3435	H43	194350	1542.5390	H59	195950	1529.9436
C12	191200	1567.9522	C28	192800	1554.9401	C44	194400	1542.1423	C60	196000	1529.5534
H12	191250	1567.5423	H28	192850	1554.5370	H44	194450	1541.7457	H60	196050	1529.1633
C13	191300	1567.1326	C29	192900	1554.1340	C45	194500	1541.3494	C61	196100	1528.7734
H13	191350	1566.7231	H29	192950	1553.7313	H45	194550	1540.9533	H61	196150	1528.3837
C14	191400	1566.3138	C30	193000	1553.3288	C46	194600	1540.5573	C62	196200	1527.9942
H14	191450	1565.9047	H30	193050	1552.9265	H46	194650	1540.1616	H62	196250	1527.6049
C15	191500	1565.4959	C31	193100	1552.5244	C47	194700	1539.7661	C63	196300	1527.2158
H15	191550	1565.0872	H31	193150	1552.1225	H47	194750	1539.3708			
C16	191600	1564.6788	C32	193200	1551.7208	C48	194800	1538.9757			
H16	191650	1564.2706	H32	193250	1551.3193	H48	194850	1538.5807			

Note:
Channel numbers beginning with C are on ITU 100GHz grid
Channel numbers beginning with H are on ITU 50GHz offset

6 Technical specifications

6.1 Technical specification - L-Band HTS link (700-2450MHz) external LNB feed

	Units		L-Band HTS 50 ohms	L-Band HTS 75 ohms
Transmitter			HRT-L1-8D-33-S1310	HRT-L3-8D-38-S1310
Receiver			HRR-L1-8D-03	HRR-L3-8D-08
Frequency range	MHz		700-2450	
Impedance, RF connector			50Ω SMA, blindmate	75Ω BNC, blindmate
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain), default	dB (nom)	a	+9 (-11 / +20)	+3 (-11 /+14)
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-5.5 to +10.0	-11.5 to +4.0
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5	-7.5 to +8.0
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, 700-2150MHz	dB (max)	a h	±1	±1.2
Flatness, fullband	dB (max)	a h	±1.2	±1.4
Flatness, 36MHz	dB (typ)	a	±0.2	±0.2
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-61	-50
CNR @ nominal input power, 36MHz	dB (typ)	b	57	56
$P1dB_{input}$	dBm (typ)	a k	-1	0
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	0.5	5
$IP3_{input}$, at default gain	dBm (typ)	a k	11	12
Noise figure, at default gain	dB (typ)	a k	20	21
Noise figure, at maximum TX gain	dB (typ)	a k	13	18
Noise figure, 5dB optical loss	dB (typ)	c k	26	27
SFDR	$dB/Hz^{2/3}$ (typ)	a	110	110
Test port gain, transmitter	dB (typ)	l	-20	-26
Test port gain, receiver	dB (typ)	l	-20	-14
Test port flatness	dB (typ)	l	±4	±4
Maximum input power	dBm (min)		15	15
LNB power			external 0-28V @ 350mA, from chassis power connector	
Power Tx	W (typ)		1.9	1.9
Power Rx	W (typ)		1.3	1.3

Optical connector			SC/APC, blindmate	SC/APC, blindmate
Optical wavelength	nm		1310 ± 20	1310 ± 20
Laser type			DFB - Distributed feedback laser	
Optical power output	dBm (typ)		4.5	
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay	
Operating temperature range			-10°C to +50°C	
Storage temperature range			-40°C to +70°C	
Humidity	RH		95% non-condensing humidity	

a nominal input power @ 0dB optical loss
b nominal input power @ 1dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 1.2GHz
l Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

6.2 Technical specification - L-Band HTS link (700-2450MHz) internal LNB feed

	Units		L-Band HTS 50 ohms	L-Band HTS 75 ohms
Transmitter			HRT-L1-8D-53-S1310	HRT-L3-8D-53-S1550
Receiver			HRR-L1-8D-33	HRR-L3-8D-38
Frequency range	MHz		700-2450	
Impedance, RF connector			50Ω SMA, blindmate	75Ω BNC, blindmate
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain), default	;dB (nom)	a	+9 (-11 / +20)	+3 (-11 /+14)
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-5.5 to +10.0	-11.5 to +4.0
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5	-7.5 to +8.0
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband	dB (max)	a h	±1.2	±1.4
Flatness, fullband	dB (typ)	a h	±0.5	±0.6
Flatness, 36MHz	dB (typ)	a	±0.2	±0.2
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-61	-50
CNR @ nominal input power, 36MHz	dB (typ)	b	57	56
$P1dB_{input}$	dBm (typ)	a k	-1	0
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	0.5	5
$IP3_{input}$, at default gain	dBm (typ)	a k	11	12
Noise figure, at default gain	dB (typ)	a k	20	21
Noise figure, at maximum TX gain	dB (typ)	a k	13	18
Noise figure, 5dB optical loss	dB (typ)	c k	26	27
SFDR	$dB/Hz^{2/3}$ (typ)	a	110	110
Test port gain, transmitter	dB (typ)	l	-20	-26
Test port gain, receiver	dB (typ)	l	-20	-14
Test port flatness	dB (typ)	l	±4	±4
Maximum input power	dBm (min)		15	15
LNB power			Internal 13/18/22V @ 700mA, with switchable tone	
BUC power			external ±36V @ 700mA, from chassis power connector	
Power Tx	W (typ)		1.9, excluding LNA power	1.9, excluding LNA power
Power Rx	W (typ)		1.3	1.3

Optical connector			SC/APC, blindmate	SC/APC, blindmate
Optical wavelength	nm		1310 ± 20	1550 ± 20
Laser type			DFB - Distributed feedback laser	
Optical power output	dBm (typ)		4.5	
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay	
Operating temperature range			-10°C to +50°C	
Storage temperature range			-40°C to +70°C	
Humidity	RH		95% non-condensing humidity	

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 1.2GHz
[l] Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

6.3 Technical specification - L-Band HTS link (700-2450MHz) dual isolated transmitter

	Units		L-Band HTS 50 ohms	L-Band HTS 75 ohms
Transmitter			HRT-L1-8D-33-H1310	HRT-L3-8D-33-H1310
Receiver			HRR-L1-8D-03	HRR-L3-8D-08
Frequency range	MHz		700-2450	
Impedance, RF connector			50Ω SMA, blindmate	75Ω BNC, blindmate
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain), default	dB (nom)	a	+9 (-11 / +20)	+3 (-11 /+14)
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-5.5 to +10.0	-11.5 to +4.0
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5	-7.5 to +8.0
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband	dB (max)	a h	±1.2	±1.4
Flatness, fullband	dB (typ)	a h	±0.5	±0.6
Flatness, 36MHz	dB (typ)	a	±0.2	±0.2
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-61	-50
CNR @ nominal input power, 36MHz	dB (typ)	b	57	56
$P1dB_{input}$	dBm (typ)	a k	-1	0
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	0.5	5
$IP3_{input}$, at default gain	dBm (typ)	a k	11	12
Noise figure, at default gain	dB (typ)	a k	20	21
Noise figure, at maximum TX gain	dB (typ)	a k	13	18
Noise figure, 5dB optical loss	dB (typ)	c k	26	27
SFDR	$dB/Hz^{2/3}$ (typ)	a	110	110
Test port gain, transmitter	dB (typ)	l	-20	-26
Test port gain, receiver	dB (typ)	l	-20	-14
Test port flatness	dB (typ)	l	±1	±1
Maximum input power	dBm (min)		15	15
LNB power			external 0-28V @ 350mA, from chassis power connector	
Power Tx	W (typ)		1.9	1.9
Power Rx	W (typ)		1.3	1.3

Optical connector			SC/APC, blindmate	SC/APC, blindmate
Optical wavelength	nm		1310 ± 20	1310 ± 20
Laser type			DFB - Distributed feedback laser, dual isolated	
Optical power output	dBm (typ)		4.5	
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay	
Operating temperature range			-10°C to +50°C	
Storage temperature range			-40°C to +70°C	
Humidity	RH		95% non-condensing humidity	

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 1.2GHz
[l] Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

6.4 Technical specification - UHF/VHF link (10-1000MHz) (0dB gain link)

	Units		UHF/VHF 50 ohms	UHF/VHF 75 ohms
Transmitter			HRT-N1-6R-35-S1310	HRT-N3-6R-35-S1310
Receiver			HRR-N1-6R-05	HRR-N3-6R-05
Frequency range	MHz		10-1000	
Impedance, RF connector			50Ω SMA	75Ω BNC
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain), default	dB (nom)	a	0 (-15 / +15)	0 (-15 / +15)
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-6.5 to +9.0	-8.5 to +7.0
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-7.5 to +8.0	-7.5 to +8.0
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband	dB (max)	a h	±1.0	±1.0
Flatness, fullband	dB (typ)	a h	±0.3	±0.4
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-48	
$P1dB_{input}$	dBm (typ)	a k	2	
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	3	5
$IP3_{input}$, at default gain	dBm (typ)	a k	14	
Noise figure, at default gain	dB (typ)	a k	23	
Noise figure, at maximum TX gain	dB (typ)	a k	16	18
Noise figure, 5dB optical loss	dB (typ)	c k	28	
SFDR	$dB/Hz^{2/3}$ (typ)	a	110	
Test port gain, transmitter	dB (typ)	l	-20	-26
Test port gain, receiver	dB (typ)	l	-20	-14
Test port flatness	dB (typ)	l	±1	±1
No damage input power	dBm		15	15
LNA power			external 0-28V @ 350mA, from chassis power connector	
Power Tx	W (typ)		1.9	1.9
Power Rx	W (typ)		1.3	1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 500MHz
[l] Relative to rear port @500MHz
All tests @ 25°C after 15 minutes warm up

6.5 Technical specification - UHF/VHF link (10-1000MHz) (9dB gain link)

	Units		UHF/VHF 50 ohms
Transmitter			HRT-N1-6R-33-S1310
Receiver			HRR-N1-6R-03
Frequency range	MHz		10-1000
Impedance, RF connector			50Ω SMA
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	+9 (-11 / +20)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-5.5 to +10
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, fullband	dB (max)	a h	±1.0
Flatness, fullband	dB (typ)	a h	±0.3
Gain stability over temperature, Link	dB (max)	a	±3
Gain stability	dB (typ)		0.25 @ 24 hrs
Nominal input signal / output signal	dBm		-20 / -20
IMD @ nominal output power	dB (typ)	c	-60
$P1dB_{input}$	dBm (typ)	a k	-1
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	0
$IP3_{input}$, at default gain	dBm (typ)	a k	11
Noise figure, at default gain	dB (typ)	a k	19
Noise figure, at maximum TX gain	dB (typ)	a k	12
Noise figure, 5dB optical loss	dB (typ)	c k	24
SFDR	$dB/Hz^{2/3}$ (typ)	a	110
Test port gain, transmitter	dB (typ)	l	-20
Test port gain, receiver	dB (typ)	l	-20
Test port flatness	dB (typ)	l	±1
No damage input power	dBm		15
LNA power			external 0-28V @ 350mA, from chassis power connector
Power Tx	W (typ)		1.9
Power Rx	W (typ)		1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

a nominal input power @ 0dB optical loss
b nominal input power @ 1dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 500MHz
l Relative to rear port @500MHz
All tests @ 25°C after 15 minutes warm up

6.6 Technical specification - Ultra wide band link (2kHz-4.2GHz)

	Units		Ultra wide band 2kHz-4.2GHz
Transmitter			HRT-U1-6R-05-S1310
Receiver			HRR-U1-6R-05
Frequency range	MHz		0.002-4200
Impedance, RF connector			50Ω SMA
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	0 (-15 / +15)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-12.5 to +3.0
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-12.5 to +3.0
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, 2kHz- 10MHz	dB (typ)	a h	±1.0
Flatness, 10MHz – 3GHz	dB (typ)		±0.7
Flatness, 3.0GHz - 4.2GHz	dB (typ)		±1.2
Flatness, 2kHz- 10MHz	dB (max)	a h	±2.5
Flatness, 10MHz – 3GHz	dB (max)		±1.0
Flatness, 3.0GHz - 4.2GHz	dB (max)		±1.5
Gain stability over temperature, Link	dB (max)	a	±3
Gain stability	dB (typ)		0.25 @ 24 hrs
Nominal input signal / output signal	dBm		-20 / -20
IMD @ nominal output power	dB (typ)	c	-48
$P1dB_{input}$	dBm (typ)	a k	2
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	4
$IP3_{input}$, at default gain	dBm (typ)	a k	14
Noise figure, at default gain	dB (typ)	a k	23
Noise figure, at maximum TX gain	dB (typ)	a k	22
Noise figure, 5dB optical loss	dB (typ)	c k	27
SFDR	$dB/Hz^{2/3}$ (typ)	a	110
Test port gain, transmitter	dB (typ)	l	No test port
Test port gain, receiver	dB (typ)	l	No test port
No damage input power	dBm		15
LNA power			No LNA power
Power Tx	W (typ)		1.9
Power Rx	W (typ)		1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

a nominal input power @ 0dB optical loss
b nominal input power @ 1dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 1.2GHz
l Relative to rear port @ 1.2GHz
All tests @ 25°C after 15 minutes warm up

6.7 Technical specification - Wide band RF + Digital Link (10MHz-4.2GHz)

	Units		Wide band, RF + Digital 10MHz-4.2GHz
Transmitter			HRT-W1-6R-45-S1310
Receiver			HRR-W1-6R-45
Frequency range	MHz		10-4200
Impedance, RF connector			50Ω SMA
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	0 (-15 / +15)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-12.5 to +3.0
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-12.5 to +3.0
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, 10MHz – 3GHz	dB (max)		±1.0
Flatness, 3.0GHz - 4.2GHz	dB (max)		±1.5
Gain stability over temperature, Link	dB (max)	a	±3
Gain stability	dB (typ)		0.25 @ 24 hrs
Nominal input signal / output signal	dBm		-20 / -20
IMD @ nominal output power	dB (typ)	c	-48
$P1dB_{input}$	dBm (typ)	a k	2
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	4
$IP3_{input}$, at default gain	dBm (typ)	a k	14
Noise figure, at default gain	dB (typ)	a k	23
Noise figure, at maximum TX gain	dB (typ)	a k	22
Noise figure, 5dB optical loss	dB (typ)	c k	27
SFDR	$dB/Hz^{2/3}$ (typ)	a	110
Test port gain, transmitter	dB (typ)	l	No test port
Test port gain, receiver	dB (typ)	l	No test port
No damage input power	dBm		15
LNA power			No LNA power
Power Tx	W (typ)		1.9
Power Rx	W (typ)		1.3

Data Rate	kB/s		0 - 20
Data Format			Any one of RS422/RS485/RS232 or TTL*
Bit Error Rate	BER (typ)		$<10^{-8}$
Delay	μs (typ)		2.5, □+5ns/meter of optical fibre)
Output Rise/Fall Time (10/90%)	μs (typ)		1.3
Jitter, RMS	ns (typ)		120
Optical loss budget	dBo (typ)		0 - 10
Digital data carrier level RX output	dBm (typ)	a	-46dBm @ 500kHz
Digital carrier sideband suppression	dBc (typ)		65 (relative to RF carrier)

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

* TTL available as an option

a nominal input power @ 0dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 500MHz
All tests @ 25°C after 15 minutes warm up

6.8 Technical specification - GPS Link

	Units		GPS 1000-1800MHz
Transmitter			HRT-G1-6R-10-S1310
Receiver			HRR-G1-6R-00
Frequency range	MHz		1000-1800
Impedance, RF connector			50Ω SMA
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	0 (-5 / +5)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-10.5 to +5.0
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-5.5 to +10.0
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, fullband	dB (typ)	a h	±0.3
Flatness, fullband	dB (max)		±0.75
Gain stability over temperature, Link	dB (max)	a	±3
Gain stability	dB (typ)		0.25 @ 24 hrs
$P1dB_{input}$	dBm (typ)	a k	-7
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	0
$IP3_{input}$, at default gain	dBm (typ)	a k	5
Noise figure, at default gain	dB (typ)	a k	15
Noise figure, at maximum TX gain	dB (typ)	a k	11
Noise figure, 5dB optical loss	dB (typ)	c k	20
SFDR	dB/Hz$^{2/3}$ (typ)	a	109
Test port gain, transmitter	dB (typ)	l	No test port
Test port gain, receiver	dB (typ)	l	No test port
No damage input power	dBm		13
LNA power			Internal +5V @ 80mA
Power Tx	W (typ)		1.9
Power Rx	W (typ)		1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 1.2GHz
[l] Relative to rear port @ 1.2GHz
All tests @ 25°C after 15 minutes warm up

6.9 Technical specification - Low frequency timing link (10kHz-50MHz)

	Units		Low frequency timing 10kHz-50MHz
Transmitter			HRT-T1-6R-06-S1310
Receiver			HRR-T1-6R-06
Frequency range	MHz		0.010 - 50
Impedance, RF connector			50Ω SMA
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	0 (-25 / +25)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-6.0 to +9.0
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-5.5 to +10.0
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, fullband	dB (typ)	a h	±0.2
Flatness, fullband	dB (max)		±0.5
Gain stability over temperature, Link	dB (max)	a	±3
Gain stability	dB (typ)		0.25 @ 24 hrs
$P1dB_{input}$	dBm (typ)	a k	10
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	13
$IP3_{input}$, at default gain	dBm (typ)	a k	22
Noise figure, at default gain	dB (typ)	a k	32
Noise figure, at maximum TX gain	dB (typ)	a k	30
Noise figure, 5dB optical loss	dB (typ)	c k	37
SFDR	$dB/Hz^{2/3}$ (typ)	a	109
Test port gain, transmitter	dB (typ)	l	No test port
Test port gain, receiver	dB (typ)	l	No test port
No damage input power	dBm		20
LNA power			No LNA power
Power Tx	W (typ)		1.9
Power Rx	W (typ)		1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

a nominal input power @ 0dB optical loss
b nominal input power @ 1dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 10MHz
l Relative to rear port @ 10MHz
All tests @ 25°C after 15 minutes warm up

6.10 Technical specification - DVBT link (470-860MHz) (0dB gain link)

	Units		UHF/VHF 50 ohms	UHF/VHF 75 ohms
Transmitter			HRT-D1-6R-25-S1310	HRT-D3-6R-25-S1310
Receiver			HRR-D1-6R-05	HRR-D3-6R-05
Frequency range	MHz		470-860	
Impedance, RF connector			50Ω SMA	75Ω BNC
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain) default	dB (nom)	a	0 (-15 / +15)	
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-6.5 to +9.0	-8.5 to +7.0
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-7.5 to +8.0	-7.5 to +8.0
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband	dB (max)	a h	±1.0	±1.0
Flatness, fullband	dB (typ)	a h	±0.3	±0.4
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-48	
$P1dB_{input}$	dBm (typ)	a k	2	
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	3	5
$IP3_{input}$, at default gain	dBm (typ)	a k	14	
Noise figure, at default gain	dB (typ)	a k	23	
Noise figure, at maximum TX gain	dB (typ)	a k	15.5	17.5
Noise figure, 5dB optical loss	dB (typ)	c k	28	
SFDR	dB/Hz$^{2/3}$ (typ)	a	110	
Test port gain, transmitter	dB (typ)	l	No test port	
Test port gain, receiver	dB (typ)	l	No test port	
No damage input power	dBm		15	
LNA power			Internal 12V @ 300mA	
Power Tx	W (typ)		1.9	1.9
Power Rx	W (typ)		1.3	1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 500MHz
[l] Relative to rear port @500MHz
All tests @ 25°C after 15 minutes warm up

6.11 Technical specification – 70/140MHz IF link (10-200MHz)

	Units		IF band 50 ohms	IF band 75 ohms
Transmitter			HRT-B1-6R-33-S1310	HRT-B3-6R-33-S1310
Receiver			HRR-B1-6R-03	HRR-B3-6R-08
Frequency range	MHz		10-200	
Impedance, RF connector			50Ω SMA	75Ω BNC
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain) default	dB (nom)	a	+9 (-11 / +20)	+3 (-11 / +14)
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-5.5 to +10.0	-11.5 to +4.0
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5	-7.5 to +8.0
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband	dB (max)	a h	±0.5	±0.75
Flatness, fullband	dB (typ)	a h	±0.2	±0.3
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-60	
P1dB$_{input}$	dBm (typ)	a k	-1	
P1dB$_{input}$, at minimum TX gain	dBm (typ)	a k	0	4.5
IP3$_{input}$, at default gain	dBm (typ)	a k	11	
Noise figure, at default gain	dB (typ)	a k	19	
Noise figure, at maximum TX gain	dB (typ)	a k	12	16
Noise figure, 5dB optical loss	dB (typ)	c k	24	
SFDR	dB/Hz$^{2/3}$ (typ)	a	110	
Test port gain, transmitter	dB (typ)	l	No test port	
Test port gain, receiver	dB (typ)	l	No test port	
No damage input power	dBm		15	
LNA power			external 0-28V @ 350mA, from chassis power connector	
Power Tx	W (typ)		1.9	1.9
Power Rx	W (typ)		1.3	1.3

Optical connector			FC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 100MHz
[l] Relative to rear port @100MHz
All tests @ 25°C after 15 minutes warm up

6.12 Technical specification – Receive path L-Band HTS + reference link (700-2450MHz) internal LNB feed

	Units		L-Band HTS 50 ohms	L-Band HTS 75 ohms
Transmitter			HRT-J1-8R-83-W1550	HRT-J3-8R-88-W1550
Receiver			HRR-J1-8R-73-W1310	HRR-J3-8R-78-W1310
Frequency range (L-Band HTS / REF)	MHz		700-2450 / 5-20	
Impedance, RF connector			50Ω SMA	75Ω BNC
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain), default	dB (nom)	a	+9 (-11 / +20) L-Band HTS 0 (-25 / +25) REF	+3 (-11 /+14) L-Band HTS 0 (-25 / +25) REF
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-7.0 to +8.5 L-Band HTS -11.5 to +4 REF	-10.0 to +5.5 L-Band HTS -10.5 to +4.0 REF
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5 L-Band HTS -5.5 to +10 REF	-8.0 to +7.5 L-Band HTS -9.0 to+6.5 REF
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband, L-Band HTS	dB (max)	a h	±1.5	±1.5
Flatness, fullband, L-Band HTS	dB (typ)	a h	±0.5	±0.8
Flatness, 36MHz, L-Band HTS	dB (typ)	a	±0.2	±0.2
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-61 L-Band HTS	-51 L-Band HTS
CNR @ nominal input power, 36MHz	dB (typ)	b	57 L-Band HTS	56 L-Band HTS
P1dB$_{input}$	dBm (typ)	a k	-0.5 L-Band HTS +10 REF	+0.5 L-Band HTS +6.0 REF
P1dB$_{input}$, at minimum TX gain	dBm (typ)	a k	0.5 L-Band HTS	1.0 L-Band HTS
IP3$_{input}$, at default gain	dBm (typ)	a k	11 L-Band HTS	12.5 L-Band HTS
Noise figure, at default gain	dB (typ)	a k	20.5 L-Band HTS 32 REF	21 L-Band HTS 32 REF
Noise figure, at maximum TX gain	dB (typ)	a k	14 L-Band HTS	16 L-Band HTS
Noise figure, 5dB optical loss	dB (typ)	c k	26.5 L-Band HTS	27 L-Band HTS
SFDR, at default gain	dB/Hz$^{2/3}$ (typ)	a	110 L-Band HTS	110 L-Band HTS
Test port gain, transmitter	dB (typ)	l	-20	-27
Test port gain, receiver	dB (typ)	l	-20	-13
Test port flatness	dB (typ)	l	±4	±4
No damage input power	dBm		15 L-Band HTS 20 REF	15 L-Band HTS 20 REF
LNB power			Internal 13/18/22V @ 700mA, with switchable tone	
Modem power			external ±36V @ 700mA, from chassis power connector	
Power Tx	W (typ)		3.2, excluding LNA power	3.2, excluding LNA power
Power Rx	W (typ)		3.2	3.2

Optical connector			SC/APC	SC/APC
Optical wavelength (L-Band HTS / REF)	nm		1550 ± 20 / 1310 ± 20	1550 ± 20 / 1310 ± 20
Laser type			DFB - Distributed feedback laser	
Optical power output	dBm (typ)		4.5	
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay	
Operating temperature range			-10°C to +50°C	
Storage temperature range			-40°C to +70°C	
Humidity	RH		95% non-condensing humidity	

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 1.2GHz
[l] Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

6.13 Technical specification – Transmit path L-Band HTS + reference link (700-2450MHz) external feed

	Units		L-Band HTS 50 ohms	L-Band HTS 75 ohms
Transmitter			HRT-K1-8R-73-W1310-1550	HRT-J3-8R-78- W1310-1550
Receiver			HRR-K1-8R-73-W	HRR-J3-8R-78-W
Frequency range (L-Band HTS / REF)	MHz		700-2450 / 5-20	
Impedance, RF connector			50Ω SMA	75Ω BNC
VSWR	(typ)		1:1.5	
Link gain (TX gain / RX gain), default	dB (nom)	a	+9 (-11 / +20) L-Band HTS 0 (-25 / +25) REF	+3 (-11 /+14) L-Band HTS 0 (-25 / +25) REF
TX gain adjustment range	dB (typ)		15.5	
TX gain adjustment from default gain	dB (typ)		-5.5 to +10.0 L-Band HTS -10.0 to +5.5 REF	-10.0 to +5.5 L-Band HTS -10.5 to +4.0 REF
RX gain adjustment range	dB (typ)		15.5	
RX gain adjustment from default gain	dB (typ)		-8.5 to +7.0 L-Band HTS -8.0 to +7.5 REF	-8.0 to +7.5 L-Band HTS -9.0 to+6.5 REF
Gain adjustment step size Rx and TX	dB (typ)		0.5	
Flatness, fullband, L-Band HTS	dB (max)	a h	±1.5	±1.5
Flatness, fullband, L-Band HTS	dB (typ)	a h	±0.5	±0.8
Flatness, 36MHz, L-Band HTS	dB (typ)	a	±0.2	±0.2
Gain stability over temperature, Link	dB (max)	a	±3	
Gain stability	dB (typ)		0.25 @ 24 hrs	
Nominal input signal / output signal	dBm		-20 / -20	
IMD @ nominal output power	dB (typ)	c	-63 L-Band HTS	-51 L-Band HTS
CNR @ nominal input power, 36MHz	dB (typ)	b	55 L-Band HTS	56 L-Band HTS
$P1dB_{input}$	dBm (typ)	a k	+0.5 L-Band HTS +10 REF	+0.5 L-Band HTS +6.0 REF
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	1.0 L-Band HTS	1.0 L-Band HTS
$IP3_{input}$, at default gain	dBm (typ)	a k	12.5 L-Band HTS	12.5 L-Band HTS
Noise figure, at default gain	dB (typ)	a k	22 L-Band HTS 32 REF	22 L-Band HTS 32 REF
Noise figure, at maximum TX gain	dB (typ)	a k	16 L-Band HTS	17 L-Band HTS
Noise figure, 5dB optical loss	dB (typ)	c k	28 L-Band HTS	28 L-Band HTS
SFDR, at default gain	$dB/Hz^{2/3}$ (typ)	a	110 L-Band HTS	110 L-Band HTS
Test port gain, transmitter	dB (typ)	l	-20	-27
Test port gain, receiver	dB (typ)	l	-20	-13
Test port flatness	dB (typ)	l	±4	±4
No damage input power	dBm		15 L-Band HTS 20 REF	15 L-Band HTS 20 REF
BUC power			external ±36V @ 700mA, from chassis power connector	
Modem power			external ±36V @ 700mA, from chassis power connector	
Power Tx	W (typ)		3.4, excluding LNA power	3.4, excluding LNA power
Power Rx	W (typ)		2.4	2.4

Optical connector			SC/APC	SC/APC
Optical wavelength (L-Band HTS / REF)	nm		1550 ± 20 / 1310 ± 20	1550 ± 20 / 1310 ± 20
Laser type			DFB - Distributed feedback laser	
Optical power output	dBm (typ)		4.5	
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay	
Operating temperature range			-10°C to +50°C	
Storage temperature range			-40°C to +70°C	
Humidity	RH		95% non-condensing humidity	

a nominal input power @ 0dB optical loss
b nominal input power @ 1dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 1.2GHz
l Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

6.14 Technical specification - L-Band HTS link (700-2450MHz) High power DWDM TX and RX

	Units		L-Band HTS 50 ohms
Transmitter			HRT-L1-8D-59-EC34
Receiver			HRR-L1-8D-02-A
Frequency range	MHz		700-2450
Impedance, RF connector			50Ω SMA, blindmate
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	+11 (0 / +11)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-8.0 to +7.5
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, fullband, L-Band HTS	dB (max)	a h	±1.5
Flatness, fullband, L-Band HTS	dB (typ)	a h	±0.5
Flatness, 36MHz, L-Band HTS	dB (typ)	a	±0.2
Gain stability over temperature, Link	dB (max)	a	±1
Gain stability	dB (typ)		0.25 @ 24 hrs
Nominal input signal / output signal	dBm		-20 / -20
IMD @ nominal output power	dB (typ)	c	-69
CNR @ nominal input power, 36MHz	dB (typ)	b	60
$P1dB_{input}$	dBm (typ)	a k	+1.5
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	+7.5
$IP3_{input}$, at default gain	dBm (typ)	a k	+13.5
Noise figure, at default gain	dB (typ)	a k	17
Noise figure, at maximum TX gain	dB (typ)	a k	12
Noise figure, 5dB optical loss	dB (typ)	c k	17.5
SFDR	$dB/Hz^{2/3}$ (typ)	a	114
Test port gain, transmitter	dB (typ)	l	-20
Test port gain, receiver	dB (typ)	l	-20
Test port flatness	dB (typ)	l	±4
No damage input power	dBm		15
LNB power			Internal 13/18/22V @ 700mA, with switchable tone
Power Tx	W (typ)		3.5, excluding LNA power
Power Rx	W (typ)		2.8

Optical connector			SC/APC, blindmate
Optical wavelength	nm		1550.12 ± 0.16
Laser type			DFB - Distributed feedback, thermo-electric cooled laser
Optical power output	dBm (typ)		10.8
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 1.2GHz
[l] Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

6.15 Technical specification - L-Band HTS link (700-2450MHz) High power DWDM TX and standard RX

	Units		L-Band HTS 50 ohms
Transmitter			HRT-L1-8D-59-EC34
Receiver			HRR-L1-8D-03
Frequency range	MHz		700-2450
Impedance, RF connector			50Ω SMA, blindmate
VSWR	(typ)		1:1.5
Link gain (TX /RX gain /optical loss)	dB (nom)	c	+10 (0 / +20 / -5) at 5dB optical loss
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-8.0 to +7.5
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-8.0 to +7.5
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, fullband, L-Band HTS	dB (max)	a h	±1.5
Flatness, fullband, L-Band HTS	dB (typ)	a h	±0.5
Flatness, 36MHz, L-Band HTS	dB (typ)	a	±0.2
Gain stability over temperature, Link	dB (max)	c	±1
Gain stability	dB (typ)	c	0.25 @ 24 hrs
Nominal input signal / output signal	dBm		-20 / -20
IMD @ nominal output power	dB (typ)	c	-69
CNR @ nominal input power, 36MHz	dB (typ)	c	58
$P1dB_{input}$	dBm (typ)	c k	+1.5
$P1dB_{input}$, at minimum TX gain	dBm (typ)	c k	+7.5
$IP3_{input}$, at default gain	dBm (typ)	c k	+13.5
Noise figure, at default gain	dB (typ)	c k	18, at 5dB optical loss
Noise figure, at maximum TX gain	dB (typ)	c k	13, at 5dB optical loss
SFDR	$dB/Hz^{2/3}$ (typ)	c	110, at 5dB optical loss
Test port gain, transmitter	dB (typ)	l	-20
Test port gain, receiver	dB (typ)	l	-20
Test port flatness	dB (typ)	l	±4
No damage input power	dBm		15
LNB power			Internal 13/18/22V @ 700mA, with switchable tone
Power Tx	W (typ)		3.5, excluding LNA power
Power Rx	W (typ)		1.3

Optical connector			SC/APC, blindmate
Optical wavelength	nm		1550.12 ± 0.16
Laser type			DFB - Distributed feedback, thermo-electric cooled laser
Optical power output	dBm (typ)		10.8
Minimum optical	dB		5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

[a] nominal input power @ 0dB optical loss
[b] nominal input power @ 1dB optical loss
[c] nominal output power @ 5dB optical loss
[h] default gain setting
[k] Measured @ 1.2GHz
[l] Relative to rear port @1.2GHz
All tests @ 25°C after 15 minutes warm up

Note: The minimum optical loss, if the received optical power of a standard RX module exceeds +5.8dBm this risks over driving the receiver and causing significant distortion and gross signal degradation.

6.16 Technical specification - Wide band link (10MHz-3000MHz)

	Units		**Wide band 10-3000MHz**
Transmitter			HRT-S1-8R-05-S1310
Receiver			HRR-S1-8R-05
Frequency range	MHz		10-3000
Impedance, RF connector			50Ω SMA
VSWR	(typ)		1:1.5
Link gain (TX gain / RX gain), default	dB (nom)	a	0 (-15 / +15)
TX gain adjustment range	dB (typ)		15.5
TX gain adjustment from default gain	dB (typ)		-12.0 to +3.5
RX gain adjustment range	dB (typ)		15.5
RX gain adjustment from default gain	dB (typ)		-12.5 to +3.0
Gain adjustment step size Rx and TX	dB (typ)		0.5
Flatness, 10MHz – 3GHz	dB (typ)		±0.7
Flatness, 10MHz – 3GHz	dB (max)		±1.0
Gain stability over temperature, Link	dB (max)	a	±3
Gain stability	dB (typ)		0.25 @ 24 hrs
Nominal input signal / output signal	dBm		-20 / -20
IMD @ nominal output power	dB (typ)	c	-50
$P1dB_{input}$	dBm (typ)	a k	3
$P1dB_{input}$, at minimum TX gain	dBm (typ)	a k	4
$IP3_{input}$, at default gain	dBm (typ)	a k	15
Noise figure, at default gain	dB (typ)	a k	23.5
Noise figure, at maximum TX gain	dB (typ)	a k	21.5
Noise figure, 5dB optical loss	dB (typ)	c k	27
SFDR	dB/Hz⅔ (typ)	a	110
Test port gain, transmitter	dB (typ)	l	No test port
Test port gain, receiver	dB (typ)	l	No test port
No damage input power	dBm		15
LNA power			No LNA power
Power Tx	W (typ)		1.9
Power Rx	W (typ)		1.3

Optical connector			SC/APC
Optical wavelength	nm		1310 ± 20
Laser type			DFB - Distributed feedback laser
Optical power output	dBm (typ)		4.5
Summary alarm output			Open drain alarm: OPEN: Alarm, CURRENT SINK: okay
Operating temperature range			-10°C to +50°C
Storage temperature range			-40°C to +70°C
Humidity	RH		95% non-condensing humidity

a nominal input power @ 0dB optical loss
b nominal input power @ 1dB optical loss
c nominal output power @ 5dB optical loss
h default gain setting
k Measured @ 1.2GHz
l Relative to rear port @ 1.2GHz
All tests @ 25°C after 15 minutes warm up

7 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.

8 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)

9 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.

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