ARx-R-9-xxx-xxx-AAx-AAx infonX 18 GHz Link Handbook

User Guide

ARx-R-9-xxx-xxx-AAx-AAx-HB-1

02/06/2025 CR6454

Pulse Power & Measurement Ltd, 65 Shrivenham Hundred Business Park, Watchfield, Swindon, Wiltshire SN6 8TY, UK
Tel.: +44 (0)1793 784389 Email: sales@vialite.com Web: www.vialite.com

Instrument Care and Safety Information

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

ESD Precautions

Precautions for handling electro-static sensitive devices should be observed when handling all ***ViaLiteAIR infonX*** 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 ***ViaLiteAIR infonX*** RFoF Transmitter and Transceiver modules contain laser diode sources operating at nominal wavelengths between 1270 nm and 1610 nm. These devices are rated as EN60825-1 CLASS 1M radiation emitting devices. This class is safe for exposure directly to the naked eye, but may be hazardous if exposed with the aid of optical instruments. 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 external equipment covers when operating.

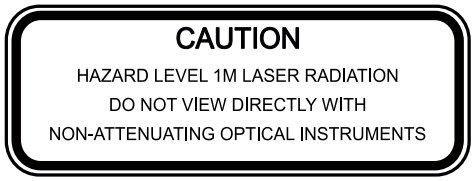
Hot Surface

The ***ViaLiteAIR infonX*** modules may have hot surfaces when operating under full load. The hot surfaces are not accessible when fitted in an approved **ViaLiteAIR infonX** chassis installation. Hot surfaces will be appropriately marked. Suitable precaution should be taken when handling devices:

- Allow to cool for 10 minutes.
- Do not touch metallic surfaces or printed circuit board when hot.
- When handling, hold front panel and handle only.

Caution

- The ***ViaLiteAIR infonX*** modules and chassis are made with folded sheet metal and machined aluminium and care should be taken when handling due to the potential for sharp edges.
- The front panel lever for retaining and removing the rack cards is a pinch hazard.
- This equipment is not suitable for use in locations where children are likely to be present.
- The equipment is to be installed below 2000m in altitude.



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Acronyms

AC	Alternating Current
APIPA	Automatic Private IP Addressing
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DWDM	Dense Wavelength Division Multiplexing
EO	Electrical to Optical conversion
ESD	Electrostatic Discharge
FC/APC	Ferrule Connector / Angled Physical Contact
GUI	Graphical User Interface
IP	Internet Protocol
IP3	Intercept Point 3
KPI	Key Performance Indicator
LC / APC	Lucent Connector / Angled Physical Contact
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNA	Low Noise Amplifier
NF	Noise Figure
OE	Optical to Electrical Conversion
P1dB	1dB Compression Point
RF	Radio Frequency
RFoF	Radio Frequency Over Fibre
RLL	Received Light Level
RTM	Rear Transition Module
SC / APC	(Subscriber or Square) Connector / Angled Physical Contact
SFDR	Spurious Free Dynamic Range
SMPM	Sub-Miniature Push-on Micro
SFP	Small Form-factor Pluggable
VSWR	Voltage Standing Wave Ratio
ZWP	Zero Water Peak

1 Initial Inspection

Unpack and inspect the equipment as soon as possible. If there is any sign of damage or any parts missing, do not install the equipment before seeking advice from ***ViaLite Communications*** or your local agent.

The equipment received should match the delivery note that is shipped with the equipment. If there are any discrepancies, contact ***ViaLite Communications*** or your local agent.

2 Introduction to the *ViaLiteAIR infonX* Range

The ***ViaLiteAIR infonX*** product range has been developed to provide a modular solution to the transmission of a wide range of analogue microwave RF signals where traditional coaxial cable or waveguide systems cannot be used, for example, in electrically noisy environments or over long distances.

The range is ideal for permanent and semi-permanent installation in satellite communications, antenna remoting and other related applications.

A variety of link modules are available that cover operation to 40 GHz in either wideband or band specific variants. All modules can be controlled and monitored by the ***ViaLiteAIR infonX*** chassis which has an integrated site controller with Ethernet network interface.

All ***ViaLiteAIR infonX*** equipment operates over high quality glass fibre optic cable, which can be supplied by ***ViaLite Communications*** in low-cost 3mm jacket, riser and outdoor specifications if needed (please contact your sales representative). The links can also be used with existing cable systems at customer premises.

A ***ViaLiteAIR infonX*** system can be added to at any time, enabling the system to evolve with the needs of the user.

ViaLiteAIR infonX is a product brand manufactured by Pulse Power and Measurement Ltd (PPM). ***ViaLite Communications*** is a division of Pulse Power and Measurement Ltd (PPM).

3 ViaLiteAIR infonX Chassis for RF over Fibre Converter modules

The ***ViaLiteAIR infonX chassis*** is a 1U chassis suitable for 19” Rack Mounting that is factory configured for AC worldwide mains power covering 100 – 240 V AC 50/60Hz.

The chassis is factory configured to accept direct connect modules in a static configuration. Up to 2 RF over fibre (RFoF) modules can be installed within the chassis and must match the chassis connectivity configuration. Each module can support dual channel operation therefore allowing up to 4 RFoF links per chassis.

The chassis is factory configured for the rear panel user optical connector type required. The default optical connection type is SC/APC, with FC/APC and LC/APC as alternative options.

The chassis has a built-in site controller and LCD display screen to manage the local system and provide Ethernet based remote management access via either electrical (RJ45) or optical (LC/APC) interfaces.

The chassis has integrated cooling fans that draw cooler air in from the left hand side (as viewed from the front) and exhausts the warmer air from the right hand side. These fans are thermally controlled by the site controller such that their operation and speed is optimised for temperature control and low acoustic noise.

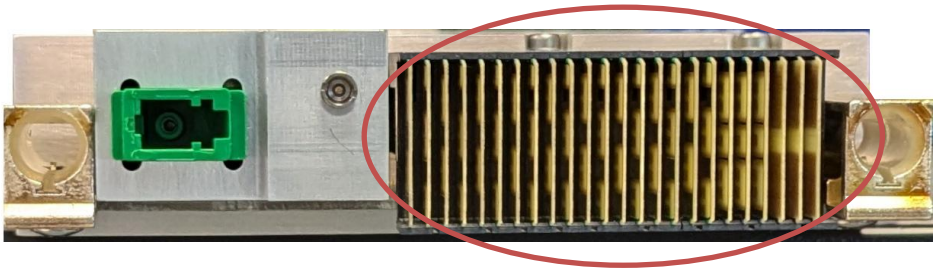
3.1 ViaLiteAIR infonX RFoF Module Slots

The ***ViaLiteAIR infonX*** chassis has two front facing slots which accept modules. Each module can support dual channel operation, allowing up to 4 RFoF links per chassis. The available configurations and resultant chassis connectivity is shown in the following table.

Configuration	RF1	RF2	FIB1	FIB2
Single E/O Transmitter	UNUSED	RF IN	UNUSED	OPTICAL OUT
Single O/E Receiver	RF OUT	UNUSED	OPTICAL IN	UNUSED
Dual E/O Transmitter	RF IN	RF IN	OPTICAL OUT	OPTICAL OUT
Dual O/E Receiver	RF OUT	RF OUT	OPTICAL IN	OPTICAL IN
Transceiver (E/O, O/E)	RF OUT	RF IN	OPTICAL IN	OPTICAL OUT

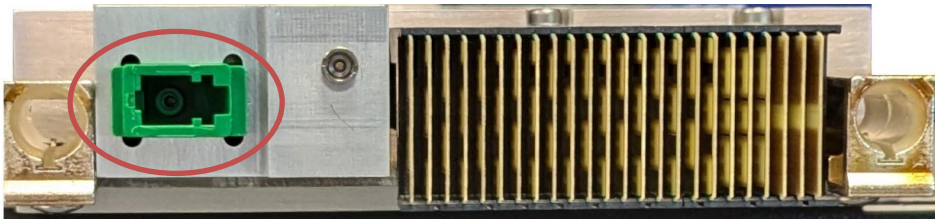
3.2 ViaLiteAIR infonX Chassis Module User Interfaces

3.2.1 RFoF Module Backplane Connector



The above image details the backplane connector (circled in red) for a single RFoF module; non-blind-mate, static chassis module type. The highlighted connector is a high reliability openVPX connector and is used for power and control purposes. This connector will mate with the internal backplane, within the chassis.

3.2.2 RFoF Module Optical Inputs / Outputs

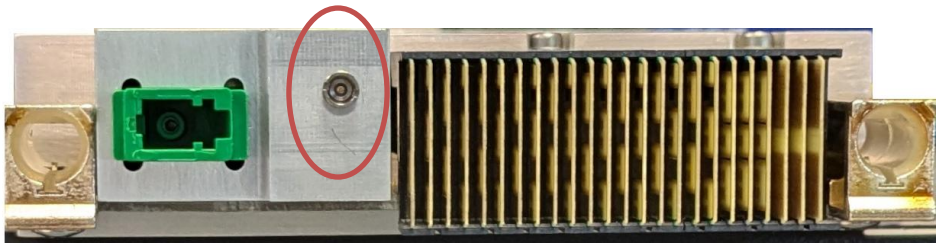


The above image details the optical connector (circled in red) for a single RFoF module; non-blind-mate, static chassis module type. The highlighted connector is an LC/APC connector which passes through the internal chassis backplane and presents in the Rear transition module (RTM) area of the chassis. An internal optical cable then connects to the LC/APC connector, and passes the optical signal through the RTM area to the chassis rear panel, should there be no optical components within the RTM area. The kind of optical components that may otherwise be present in the RTM area are Filters, Multiplexers, Circulators and Isolators.

These ports either transmit into or receive from connected optical fibres, Class 1M laser radiation in the 1310-1565 nm range which is invisible to the human eye. This class is safe for exposure directly to the naked eye, **but may be hazardous if exposed with the aid of optical instruments**.

When the optical port is an input for an OE converter be aware of the optical power damage threshold. Too much optical power can damage the sensitive photo-receiver. See the technical specification for the damage threshold.
If the optical ports are left without an optical fibre connected, it is important to refit the protective covers that were provided with the unit.

3.2.3 RFoF Module RF Inputs / Outputs



The above image details the RF connector (circled in red) for a single RFoF module; non-blind-mate, static chassis module type. The highlighted connector is an SMPM high detent connector which passes through the backplane and presents in the RTM area of the chassis. An internal RF cable then connects to the SMPM high detent connector, and passes the RF signal through the RTM area to the chassis rear panel, should there be no RF components within the RTM area. The kind of RF components that may otherwise be present in the RTM area are Bias-Ts, Filters, Attenuators, Limiters, Equalisers, Isolators and Circulators. The RF input and output ports are presented via 50 Ohm SMPM connectors which support up to 40 GHz.

The RF ports are sensitive to ESD and engineers should ensure that they use effective personal grounding (i.e. ESD wrist strap, etc.) when installing or 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.

When the RF port is an input for an EO converter be aware of the RF power damage threshold. Too much RF power can damage the laser driver circuits. See the technical specification for the damage threshold.
If the RF ports are left without a coax cable connected, it is important to refit the protective covers that were provided with the unit.

3.2.4 RFoF Module LED Indicators

During normal operation, the LED indicators will be glowing GREEN or unlit according to the product configuration. A Module LED indicator may glow ORANGE or RED if there is an alarm condition which is either a MINOR or MAJOR alarm respectively. An example alarm condition is insufficient light being received by a receiver module.

3.3 RFoF Module Integration

The ***ViaLiteAIR infonX*** RFoF modules are secured within the ***infonX*** chassis slots using a locking screw to retain any modules. The use of the locking screw prevents the removal of any installed RFoF modules and prevents any damage to the static cabling in the rear transition area of the chassis, should an attempt to remove the RFoF modules be made. The locking screw is shown circled in red in the following image.

The locking screw should not be tampered with. It prevents the static configuration of modules from being removed.

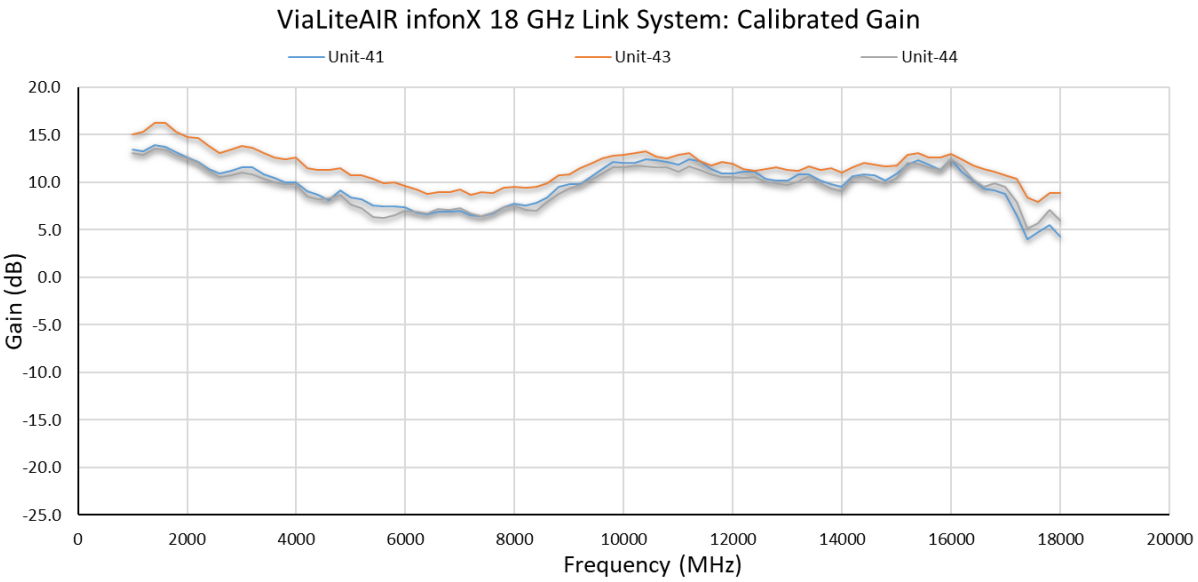
4 ViaLiteAIR infonX 18 GHz Wideband RFoF Link (AAQ-AAG)

4.1 Description

The ***ViaLiteAIR infonX*** 18 GHz AAQ-AAG configuration is a high gain link with integrated EO and OE gain control. It utilises a temperature stabilised laser for fixed wavelength applications and consistent operation over a wide temperature range. The link has full RF path temperature compensation for consistent gain, noise figure and linearity during operation.

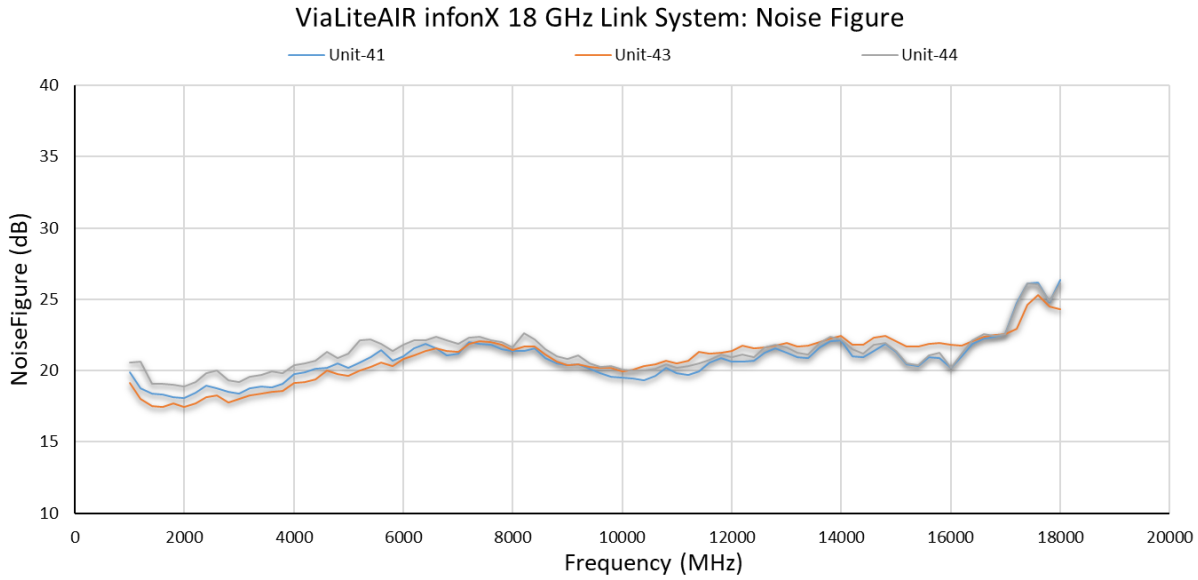
4.2 Gain

The link is nominally calibrated for a gain of +10 dB in a -10/+20 EO/OE arrangement. The integrated gain control allows this to be adjusted by the user as necessary. Adjustment of the EO gain allows the user to trade Noise Figure with Linearity to suit the application source signal. Adjustment of the OE gain allows the user to drive the optimal level into the load device. The total control range typically supports a link gain of +16 down to -16 dB. The following **ViaLite Link IFX 1-18: Calibrated Gain** graph details the typical link gain for three ViaLiteAIR infonX 18 GHz samples.



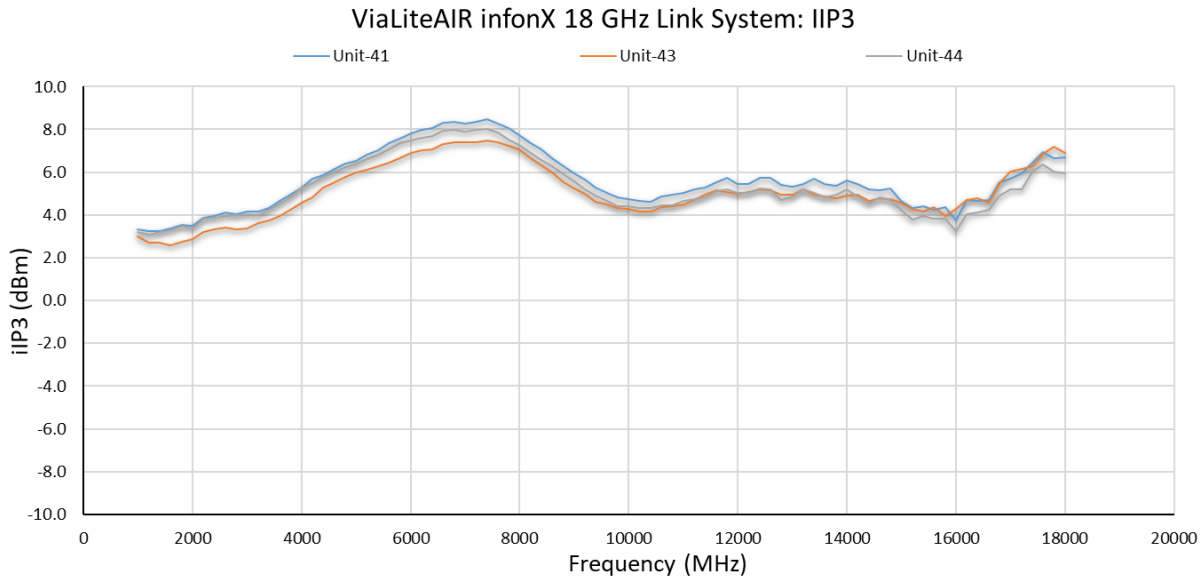
4.3 **Noise Figure**

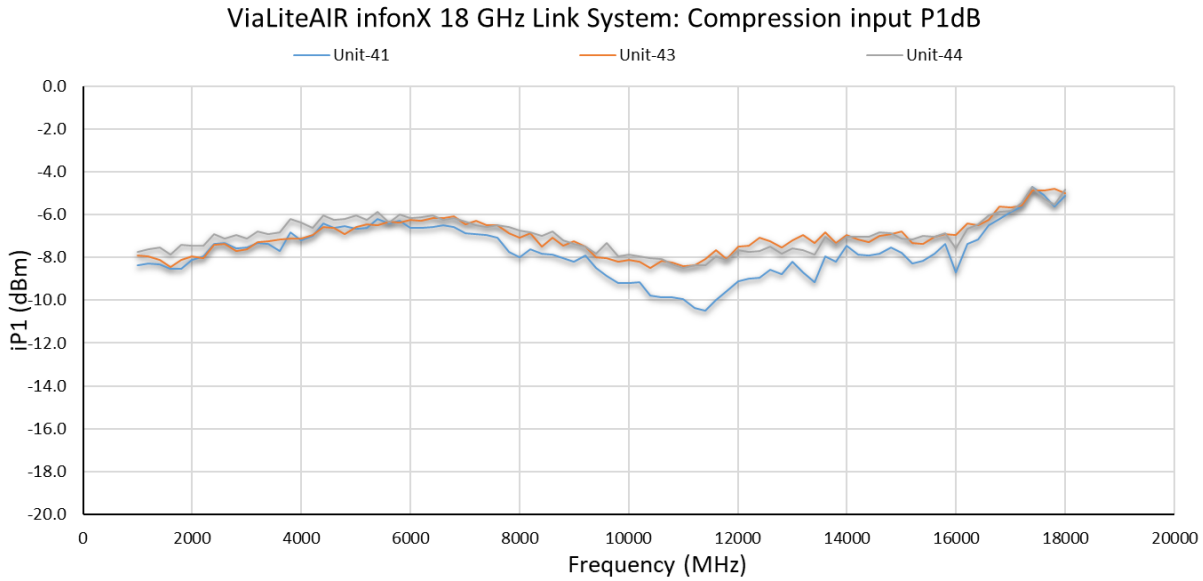
At nominal calibrated link gain of +10 dB, the noise figure for three ***ViaLiteAIR infonX*** 18 GHz samples is shown in the following **ViaLiteAIR infonX 18 GHz Link System: Noise Figure** graph. The EO gain control allows this to be traded with linearity and moved up or down with the gain setting. If more linearity is required, the EO gain can be reduced and the noise figure will increase dB for dB along with the input referred linearity. If lower noise figure is required the EO gain can be increased and the noise figure will decrease close to dB for dB along with the input referred linearity. A range of +/- 6 dB is typically accommodated by the EO.



4.4 Linearity

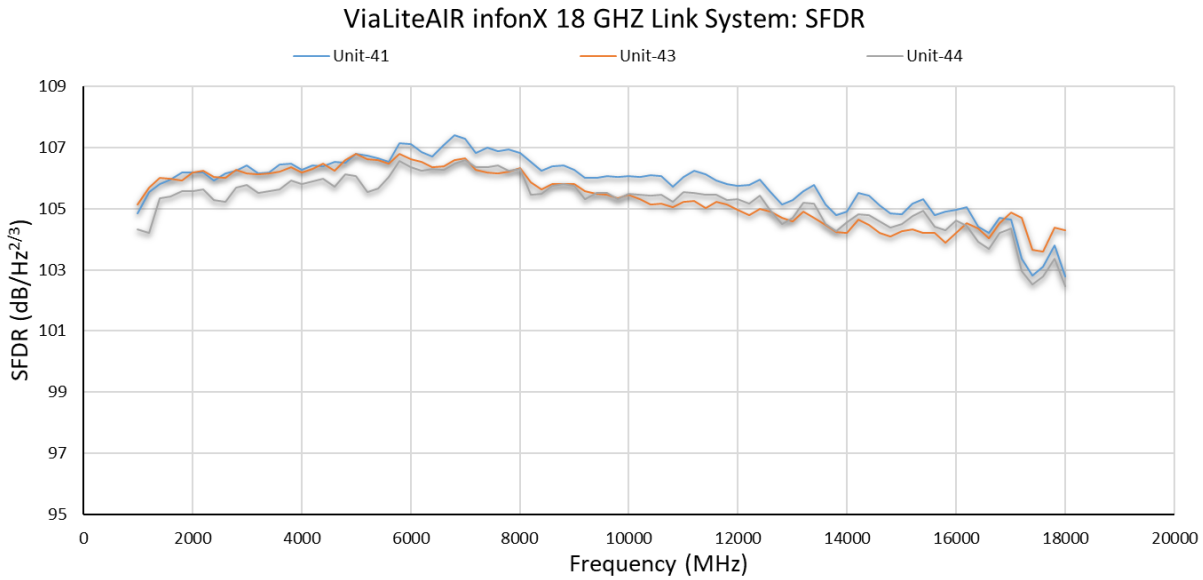
At nominal calibrated link gain of +10 dB, the linearity (IP3 & P1dB) for three ***ViaLiteAIR infonX*** 18 GHz samples is shown in the following **ViaLiteAIR infonX 18 GHz Link System: IIP3** and **ViaLiteAIR infonX 18 GHz Link System: Compression Input P1dB** graphs below. The EO gain control allows this to be traded with noise figure and moved up or down with the gain setting. If more linearity is needed, the EO gain can be reduced and the noise figure will increase dB for dB along with the input referred linearity. If lower noise figure is required the EO gain can be increased and the noise figure will decrease close to dB for dB along with the input referred linearity. A range of +/- 6 dB is typically accommodated by the EO.





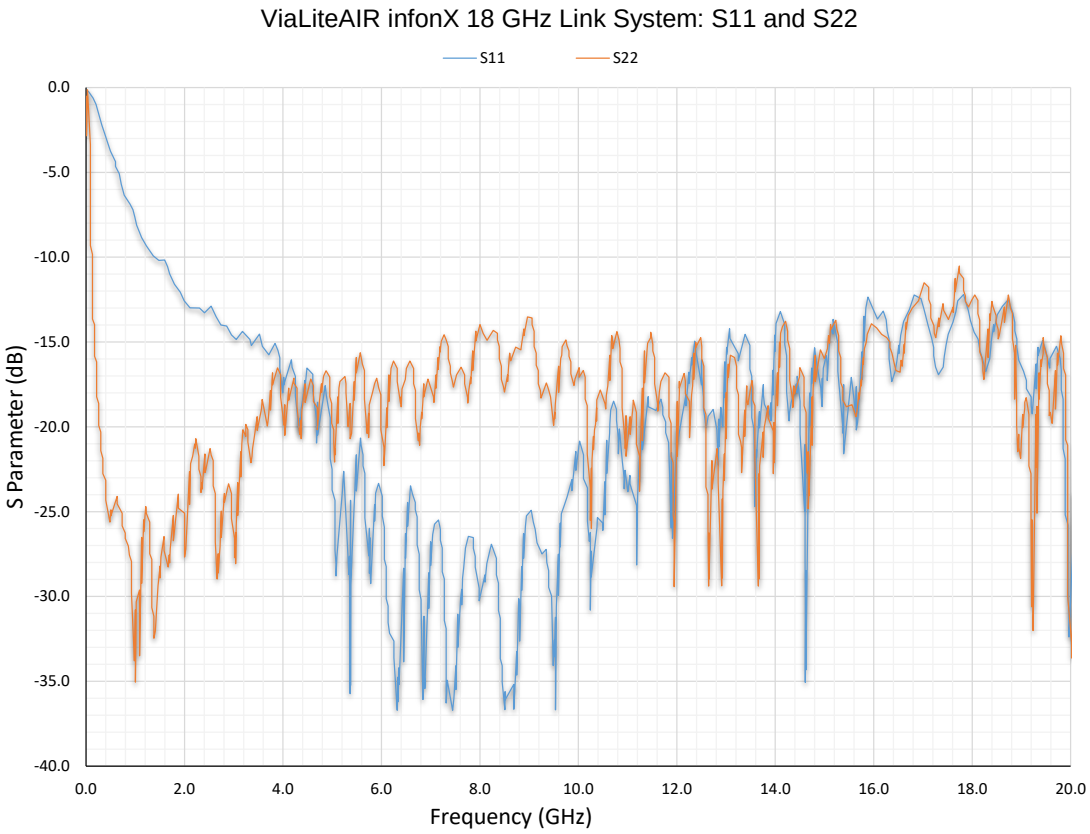
4.5 SFDR

The Spurious Free Dynamic Range (SFDR) of the link for three ***ViaLiteAIR infonX*** 18 GHz samples is shown in the following **ViaLiteAIR infonX 18 GHz Link System: SFDR** graph. SFDR is a measure of the IP3 and noise figure and is largely independent of the gain settings so is a good summary performance indicator.



4.6 Input and Output Return Loss

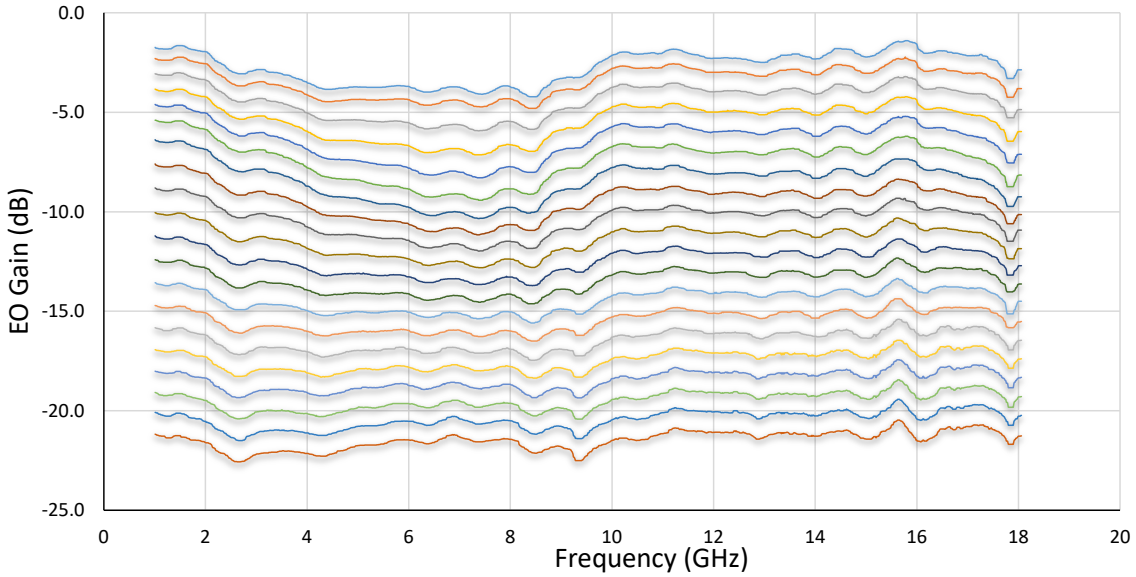
The link input and output return loss is represented in the following **ViaLiteAIR infonX 18 GHz Link System: S11 and S22** graph, which fully details the S11 and S22 measurements on a network analyser.



4.7 Gain Control

The EO (Laser transmit) end of the link has a gain control feature to allow the user to optimise the link for an application. The nominal EO gain is factory configured for -10 dB (combined with the OE gain of +20 for a +10 dB link gain), but the gain controller can move this up and down to trade NF with Linearity roughly dB for dB. The gain control does have a minor effect on the frequency response so the range and effect is shown in the following **ViaLiteAIR infonX 18 GHz Link System: EO Gain Control Range** graph for an EO gain range of 20 dB (-3 dB to -23 dB).

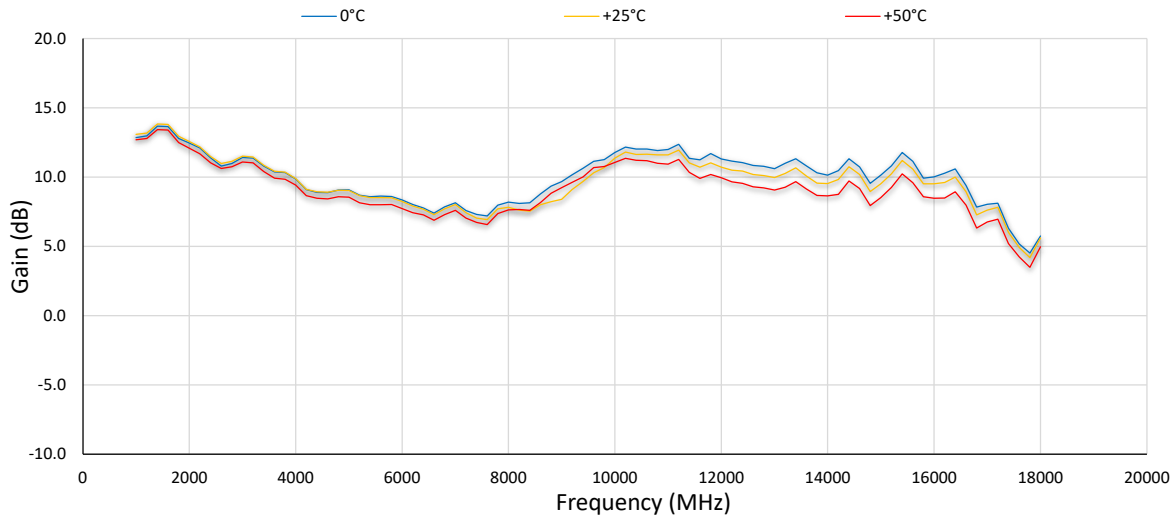
ViaLiteAIR infonX 18 GHz Link System: EO Gain Control Range



4.8 Temperature Compensation

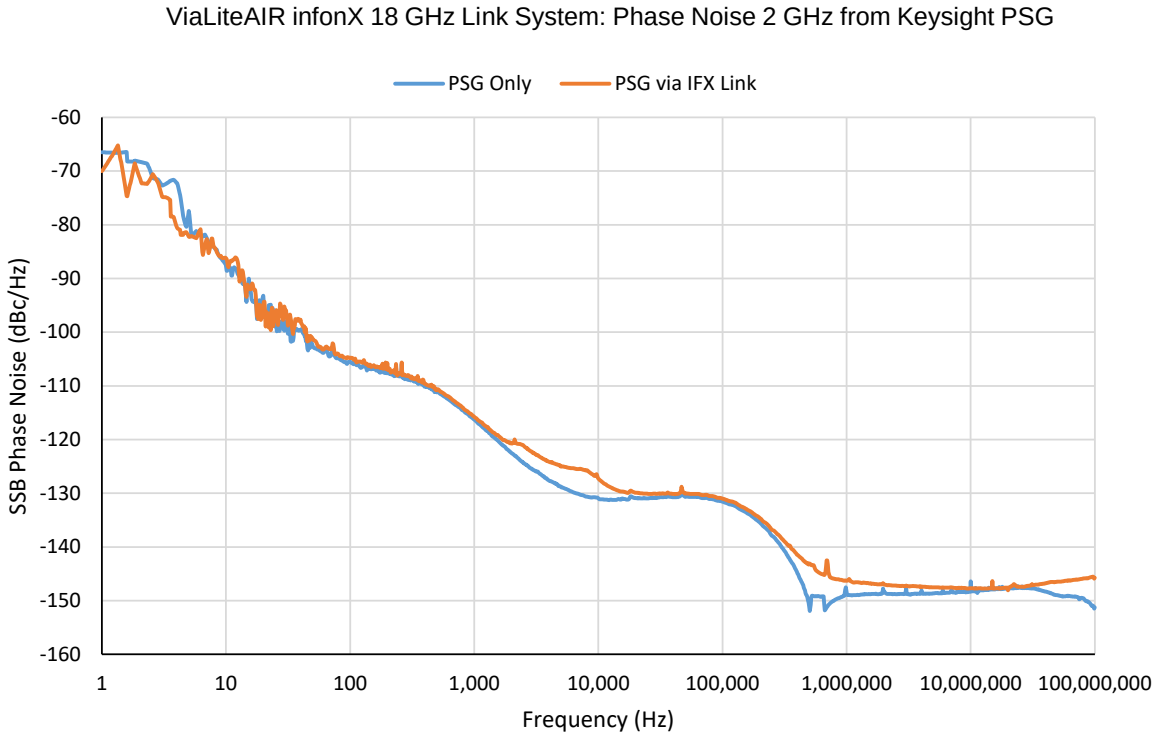
The link incorporates a temperature compensation algorithm to provide constant gain irrespective of temperature. The feature is implemented at both ends of the link (EO and OE). The gain control element providing this feature is continuously variable ensuring that the link suffers no stepped changes as temperature varies. This feature can be enable/disabled via any of the user control interfaces. The following **ViaLiteAIR infonX 18 GHz Link System: Calibrated Gain** graph indicates the small residual gain error after the use of temperature compensation in the range 0 to 50 °C.

ViaLiteAIR infonX 18 GHz Link System: Calibrated Gain



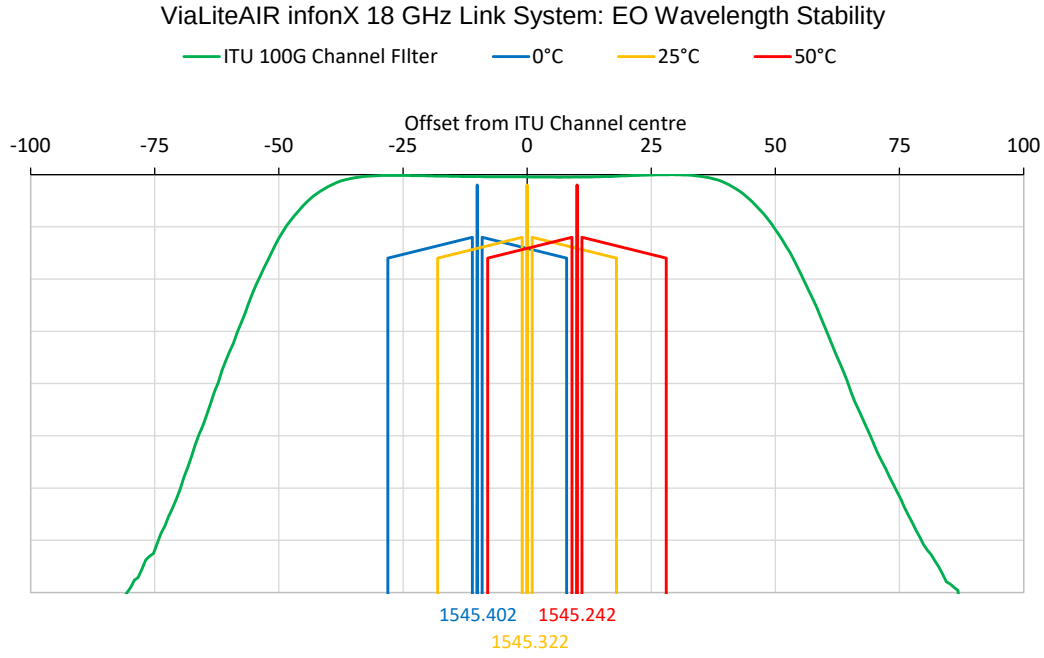
4.9 Phase Noise

The link imparts very little additive phase noise. This can be seen in the following **ViaLiteAIR infonX 18 GHz Link System: Phase Noise 2 GHz from Keysight PSG** graph which compares a 2 GHz source CW signal from a Keysight PathWave Signal Generator (PSG) before and after the link.



4.10 Wavelength Stability

The EO laser is temperature stabilised to ensure its wavelength is maintained for multiplexed applications. The following **ViaLiteAIR infonX 18 GHz Link System: EO Wavelength Stability** graph details how the wavelength and RF signal sidebands remain within a 100 GHz ITU DWDM channel over the specified operating temperature range.



4.11 **Technical Specification**

RF link parameters	**Specification**
Frequency range	1 to 18 GHz
Receiver Gain Setting, default (nominal)	+20 dB
Transmitter Gain Setting, default (nominal)	-10 dB
Link Gain (typical)	10 GHz: +12 dB
Link Gain Flatness, peak-to-peak over 1-18GHz, (typical)	6 dB
Gain stability over temperature range (maximum)	3 dB
Gain stability, constant temperature, over 24 hours (typical)	0.25 dB
Gain Adjustable Range (typical)	15.5 dB
$P1dB_{input}$ (typical)	10 GHz: -6.5 dBm
$IP3_{input}$, at default gain (typical)	10 GHz: +3.5 dBm
Noise Figure, at default gain (typical)	10 GHz: 22 dB
SFDR (Spurious Free Dynamic Range), (typical)	10 GHz: 102 dB/Hz $^{2/3}$
RF Impedance (nominal)	50 Ω
VSWR (typical)	< 2:1
Maximum RF input power without damage	+15 dBm
Optical parameters	**Specification**
CWDM Optical wavelengths	1310 ± 3 nm, 1550 ± 3 nm (Depending on Part number configuration)
Optional DWDM Optical wavelengths	DWDM ITU 50 / 100 GHz grid ± 0.1 nm
Laser type	DML (Directly Modulated Laser)
Optical power output, (typical)	10 mW
Power parameters	**Specification**
Supply Voltage, Frequency	100 to 240 VAC, 50/60 Hz
AC Power consumption, with two Power Supplies and two E/O Link cards, excluding external LNB power	20 W, 0.4PF
Rear Panel Connectors	**Specification**
Optical Link socket options	SC/APC, LC/APC, FC/APC Narrow Key
RF socket	K-type (2.92 mm)
Ethernet socket (chassis management)	RJ45
Optical socket option (chassis management)	LC/APC
AC Power socket	IEC C14
Environmental parameters	**Specification**
Operating temperature range	0 to +50 °C
Storage temperature range	-40 to +70 °C
Relative Humidity (non-condensing)	0 to 95 %
Mechanical parameters	**Specification**
Weight, with two Power Supplies and two E/O Link cards	4.2 kg
Width	19” rack mounted equipment (483 mm)
Height	44 mm (1U)
Depth	344 mm (behind rack mounting lugs)

5 System Management

The ***ViaLiteAIR infonX*** 18 GHz link system is managed remotely via Ethernet and either electrical or optical physical interfaces are supported.
When the ***ViaLiteAIR infonX*** chassis is connected to a network, the default operation is as follows:

1. The chassis will broadcast a DHCP client discovery packet
2. If a DHCP server is present on the network, the chassis will seek a network address
3. If a DHCP server is **NOT** present on the network or the request is denied, the chassis will revert to a link local address according the APIPA scheme in the range 169.254.0.1 to 169.254.255.254, with a subnet mask of 255.255.0.0. The first APIPA assigned address is 169.254.205.141.
4. If a link local address is assigned, DHCP requests will continue periodically
5. The current IP address in use, either link local or acquired from a DHCP server, will be shown on the display screen

If DHCP server based IP address allocation is unsuitable for the user network, a static IP address can be manually assigned to the chassis.

The chassis will ask the DHCP server to register its hostname with the DNS server. The hostname format is based on the chassis part number and serial number. E.g. ARK1-1234567.

5.1 Graphical User Interface

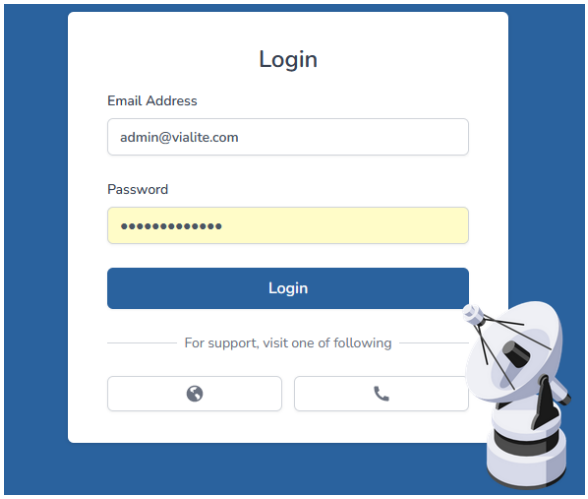
By entering the ***ViaLiteAIR infonX*** chassis IP address or hostname into a web browser on the same network, access can be obtained to the web GUI for manual system management. The first screen that the user is greeted with is the Login screen.

There are two default accounts to log into the system, each with a different level of access.
For basic RFoF control only there is:

Email: tech@vialite.co.uk
Password: technician

And for full control with access to the main site configuration including networking and NTP etc. there is:

Email: admin@vialite.co.uk
Password: vialite-admin

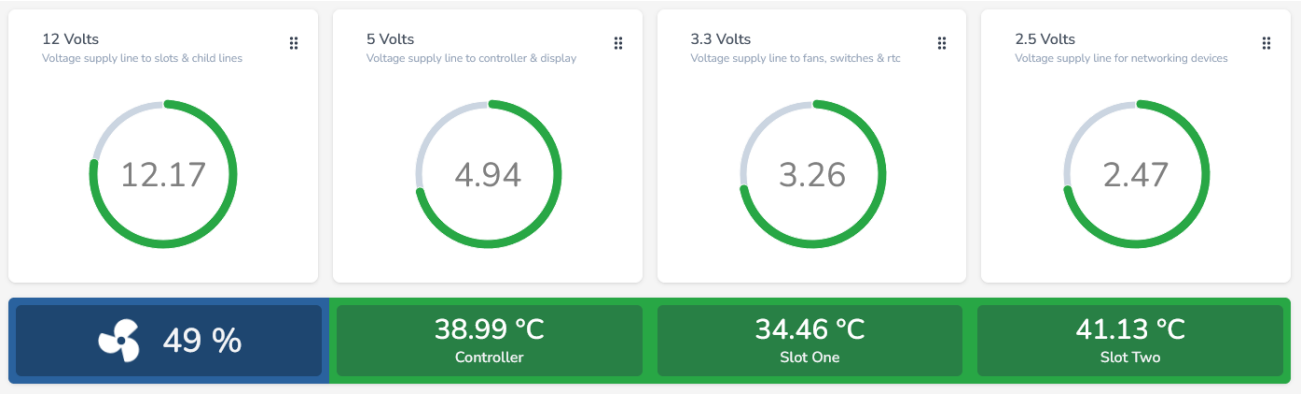


5.1.1 Rack Overview

The Rack Overview section shows the ***ViaLiteAIR infonX*** chassis part number and serial number as well as a graphical representation of the hardware and card slots. The operational firmware version is also shown.

5.1.2 Chassis Diagnostics

The Chassis Diagnostics section shows the status of the various internal power systems, component temperatures and chassis fan speed.

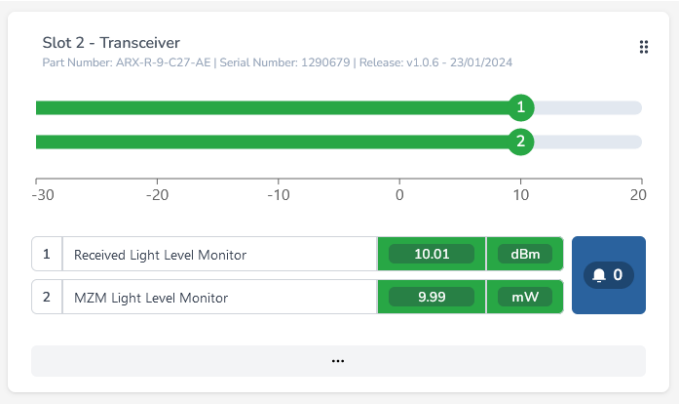


5.1.3 Slot Module Monitoring and Control

Each card slot has an observation panel with the hero values for the installed module clearly displayed.

The module part number and serial number is visible along with the operational firmware version. Also visible is the alarm count for the module.

The button at the bottom of the panel opens up the available controls for the module.



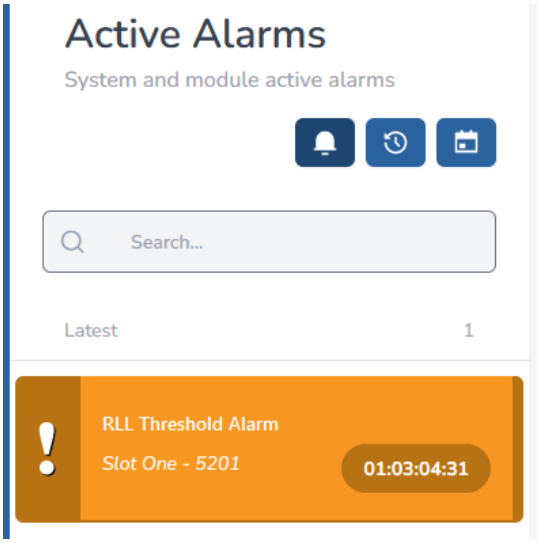
5.1.4 Active Alarms

The Active Alarm panel details all current active alarms.

For each alarm indicator, the alarm code is shown as well as the slot number of the chassis it refers to and a text description.

The counter field specifies the duration that the alarm has been active. It is formatted to express this information in Days:Hours:Minutes:Seconds.

A Received Light Level threshold MINOR alarm is shown adjacent as an example.

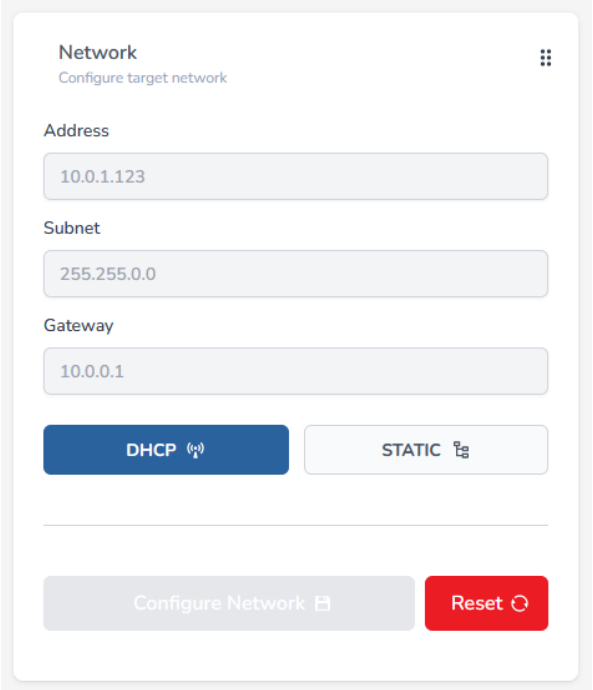


5.1.5 Network Configuration

The Network Configuration panel is used to switch operation between a static IP configuration and a dynamic one via DHCP. The initial default operation setting is DHCP.

When configuring a static IP, the desired address must be entered along with the subnet mask and Gateway. Basic syntax checks will be performed by the system to ensure valid data has been entered and a pop-up to confirm changes will appear before final application.

Changes will then apply instantly to the live system and the web GUI will only be available at the new defined static IP address. The configured static IP address will also appear on the chassis display screen.



5.1.6 EO Transmitter Control

When an EO Transmitter is installed within the ***ViaLiteAIR infonX*** chassis, it can be managed from the web GUI and its control panel is presented on the front page.

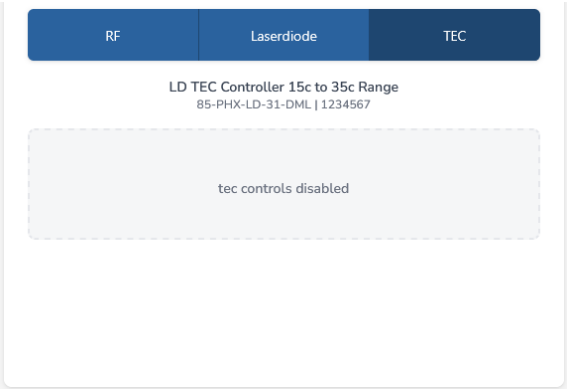
The main KPI that is presented is the “Laser Optical Power Monitor”. This should be green indicating that the laser is under closed loop control and providing stable light output. The ***ViaLiteAIR infonX*** 18 GHz AAG EO Transmitter will output 10 mW of optical power.

The drop-down control menu allows access to various parameters for the product. The main control parameters are located within the RF tab and provide gain control that is used to trade Noise figure and Linearity as discussed in section 4.

There is also the option to enable [1] / disable [0] temperature compensation which should be enabled by default.

Any changes required should be configured by the operator and then followed with the Configure button to enact it.

The Laserdiode and TEC tabs offer no user control and are for information purposes only.



5.1.7 OE Receiver Control

When an OE Receiver is installed within the ***ViaLiteAIR infonX*** chassis, it can be managed from the web GUI and its control panel is presented on the front page.

The main KPI that is presented is “Received Light Level” (RLL). This should be green indicating that sufficient light is being received from the EO Transmitter and thus the link is complete.

RLL is presented in units of dBm and for a short optical fibre link should be close to 10.0 dBm. Depending on the wavelength of the Transmitter and the length of optical fibre, the RLL could be as low as 6 dBm or even less if the application requires it.

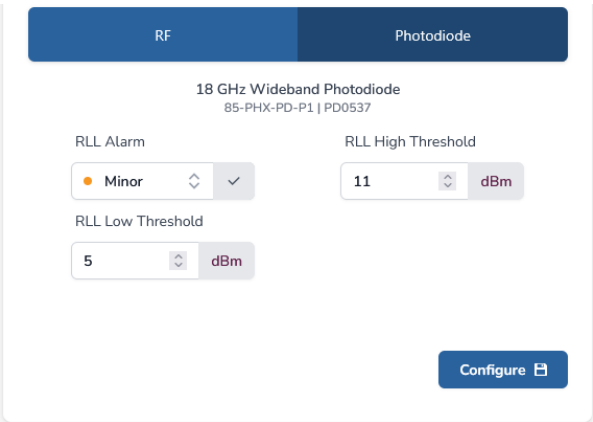
The drop down control menu allows access to various parameters for the product. The main control parameters are located within the RF tab and provide gain control that is used to provide sufficient RF drive level into the operators system.

There is also the option to enable [1] / disable [0] temperature compensation which should be enabled by default.

Any changes required should be configured by the operator and then followed with the Configure button to enact it.

The Photodiode tab provides access to RLL thresholds that can be set by the operator to bound acceptable RLL levels.

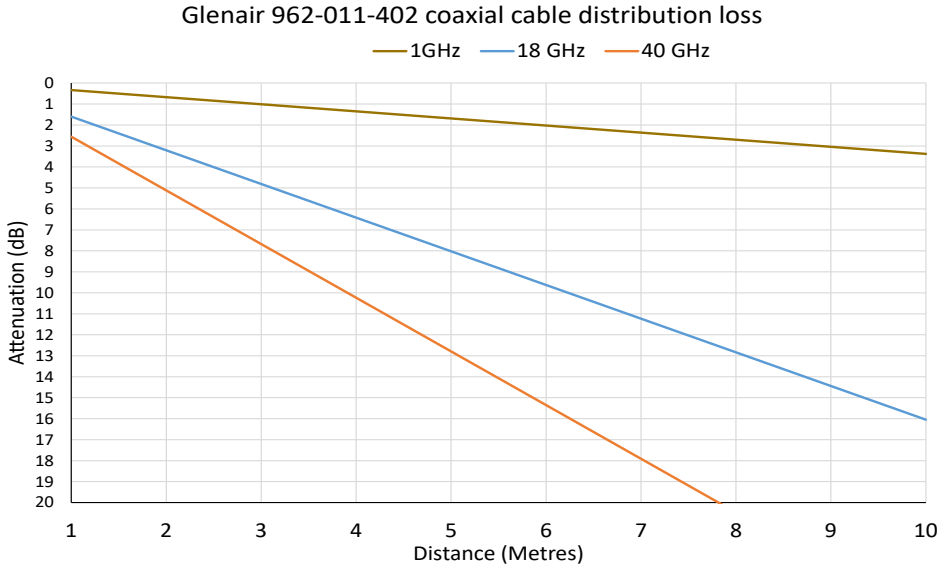
Depending on the optical losses expected, a low and high RLL alarm threshold can be set for the ***ViaLiteAIR infonX*** 18 GHz module. The severity of this alarm can also be configured. The options are [minor], [major], or [ignore].



6 Application Information

6.1 Interfacing the ViaLiteAIR infonX System with Coaxial Cables

The coaxial cable distribution of extreme RF bandwidths (up to 40 GHz) needs care to avoid high losses and the introduction of significant slope over the band. Coaxial cables between the ***ViaLiteAIR infonX*** chassis and operator equipment should be kept as short as possible and be of high quality. The following graph details signal attenuation at 1 GHz, 18 GHz and 40 GHz versus distance transported in a high quality 40 GHz capable coaxial cable.



6.2 Fibre loss

The optical loss through the fibre and any other optical distribution components has a significant effect on the performance of the link. The link end-to-end RF gain will drop 2dB for every 1dB of optical loss. It is therefore crucial to ensure optical losses are minimised.

A well mated optical connection will result in approx. 0.2dB of optical insertion loss, so minimising the number of connections is important. Wherever possible in the optical network, replace connections with splices to minimise loss. All ***ViaLiteAIR infonX*** links are calibrated inclusive of their own connection loss so these won't need to be accounted for in operator designs, only any additional connections.

Optical Characteristics		
Attenuation	Maximum	Typical
at 1310 nm	≤ 0.34 dB/km	≤ 0.33 dB/km
at 1385 nm	≤ 0.31 dB/km	≤ 0.27 dB/km
at 1490 nm	≤ 0.24 dB/km	≤ 0.21 dB/km
at 1550 nm	≤ 0.21 dB/km	≤ 0.19 dB/km
at 1625 nm	≤ 0.24 dB/km	≤ 0.20 dB/km

For long distance links, care must be taken when selecting the transmitter laser wavelength. Standard SMF28 optical fibre has a different loss profile per wavelength. The data here is an example ZWP fibre from OFS.

Significant optical losses can also be created by stretching or bending optical fibre beyond its minimum bend radius. Ensure the minimum bend radius is adhered to for the choice of single mode fibre in use.

7 Product Warranty

The guarantee / warranty period, unless otherwise agreed in writing, shall be as stated in document 'F292 - PPM Manufactured Product – Warranty', which is available at: https://ppm.co.uk/warranty-periods/. Extended warranty options are available at the time of purchase.

Prior to returning any goods for warranty or non-warranty repairs, please contact PPM / ***ViaLite Communications*** for a returns reference.

PULSE POWER & MEASUREMENT LTD, 65 SHRIVENHAM HUNDRED BUSINESS PARK, SWINDON, SN6 8TY, UK.
TEL: +44 (0)1793 784389 FAX: +44 (0)1793 784391
EMAIL: SALES@VIALITE.COM WEBSITE: WWW.VIALITE.COM