ViaLite
RF GPS
Fibre Optic Link

User Manual

LRx-G-HB-6

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Instrument Care and Safety Information

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

Electrical Safety

The ***ViaLite*** 19" Rack Case power supply units are Safety Class 1 products (having a metal case that is directly connected to earth via the power supply cable).

When operating the equipment note the following:

- Hazardous voltages exist within the equipment. There are no user serviceable parts inside, and the covers should only be removed by suitably qualified personnel.
- The equipment does not have an isolating switch on the mains inlets. Equipment must be installed within easy reach of a clearly labelled dual pole mains isolation switch.
- Make sure that only fuses of the required rated current, and of the specified type (anti-surge, quick blow, etc.) are used for replacement.

Optical Safety

The ***ViaLite*** RF GPS Transmitter modules contain laser diode sources operating at 1300nm nominal. These devices are rated at under IEC825-1 "Safety of Laser Products", Part 1, First Edition, 1993 as CLASS 1 radiation emitting devices.

When operating the equipment note the following:

- 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 accessible – always cap the connectors.
- Do not remove equipment covers when operating.
- Details of optical connections to the units, compatible fibre types and care instructions can be found in the ***ViaLite*** system handbook. Please read this section before using the link.

Adjustment, maintenance and repair of the equipment should only be carried out by suitably qualified personnel.

For more information on the *ViaLite* range of products, please refer to the *ViaLite* system handbook Lxx-HB.

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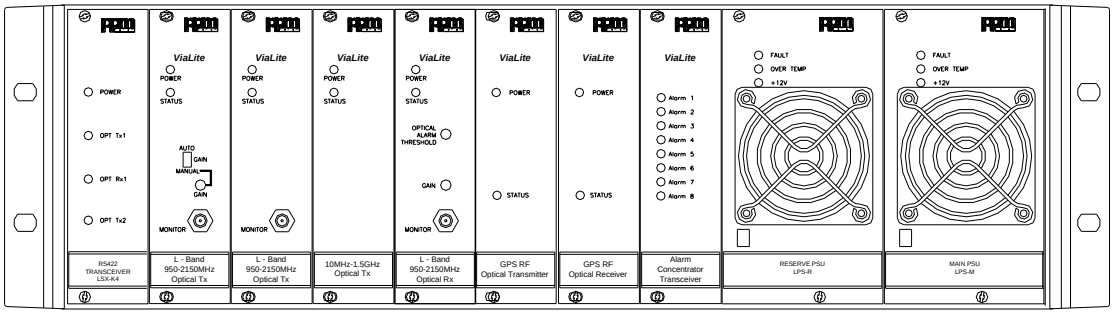
1 Introduction

1.1 ViaLite RF GPS Fibre-Optic-Link

PPM's ***ViaLite*** RF GPS Fibre-Optic-Link provides a high reliability, transparent cross-site connection between a GPS antenna and a GPS receiver.

Using optical fibre, the GPS Antenna may be positioned 10km or more away from the GPS Receiver, whilst overcoming problems due to path loss and electro-magnetic interference etc.



The wide dynamic range of the link results in negligible degradation of satellite signals due to noise or interfering signals.

The use of optical fibre has a number of inherent advantages over conventional coaxial alternatives:

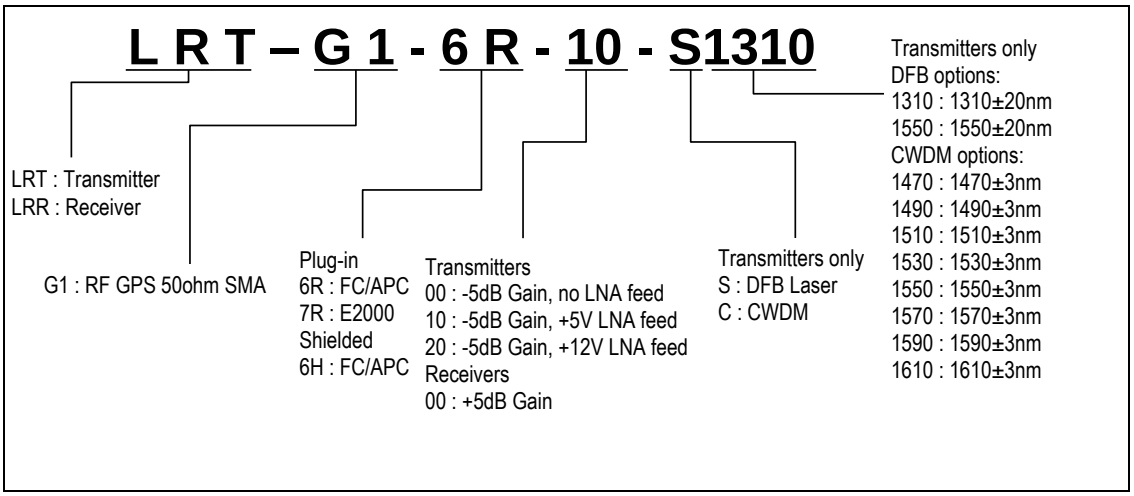
- Low loss - enabling very long path lengths with minimal degradation of carrier-to-noise.
- Lightweight, highly flexible, small diameter cable.
- Frequency response is independent of path length.
- Immunity to electrical interference - the signal is not corrupted by radiated interference.
- Non-conductive - provides electrical isolation.

PPM's ***ViaLite*** product offers particular advantages:

- L1 and L2 GPS Frequencies
- Operation from 0m to >10km
- Compact plug-in module – up to 8 in 19" chassis
- Shielded module option for use in high levels of electrical interference or over a wide operating temperature range
- Wide dynamic range for negligible signal degradation
- Front panel status LEDs and rear panel alarm outputs: laser status, received light level
- External LNA supply feed option

1.2 Part Numbers

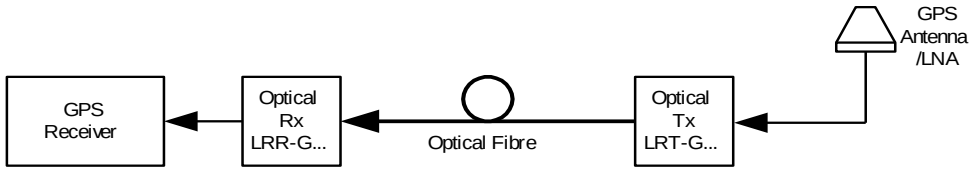
This handbook covers the following RF GPS modules:



Refer to the ***ViaLite*** System Handbook for further details on the following ***ViaLite*** items:

Part Number	Description
LRK1S	Case for Desktop or 19" rack installation. Accommodates up to 8 plug-in modules and 2 mains power supplies.
LRK2S	Subrack for 19" rack installation. Accommodates up to 8 plug-in modules and 2 mains power supplies.
LPS-M	Main Power Supply plug-in for LRK1S or LRK2S.
LPS-R	Reserve Power Supply plug-in for LRK1S or LRK2S.
75003	Converter sleeve. Converts plug-in module for standalone operation.
73502	Power Supply, 12Vdc, for plug-in Converter Sleeve
F6R1/x	FC/APC Patchlead, 2.8mm jacket. Length defined in metres by "x" (1m, 2m, 5m, 10m)

1.3 System Description



A typical system would operate as follows.

The RF GPS signal from a GPS LNA is input to the optical transmitter module, which contains RF signal conditioning and laser control circuitry. The module modulates a beam of light with the RF signal.

The light travels through optical fibre to the receiver module. The distance between transmitter and receiver can range from 0m to 10km.

The receiver module converts the modulated light back into an electrical signal, which is available at the output of the unit.

1.4 Care of fibre optic connectors

Fibre optic connectors are more sensitive to damage and contamination than electrical connectors. In order to maintain full performance from your fibre optic link system, it is necessary to take care to protect the connectors from damage and to keep them clean.

The cable connectors should always be cleaned before they are used, even if they have been protected by dust caps.

When the fibre optic cables are not connected, it is essential that the cable and module 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 and cleaning instructions.

2 Setting up and Understanding the Link

Please read fully document Lxx-HB for information on installing your ***ViaLite*** equipment before commissioning your RF link system.

2.1 Module Operation

The RF GPS fibre optic link modules are available in a range of housing options suitable for different applications.

2.1.1 Shielded Remote Module

The shielded remote modules are designed for use in electrically noisy environments and wide operating temperatures. There are three connectors on the front panel of the unit.

Power/Alarm - Lemo 1B 8-pin connector provides power to the unit.

RF - SMA connector for applying the RF GPS input (to the optical transmitter) or monitoring the RF GPS output (from the optical receiver) signal. Depending on the option selected, the transmitter module may have a 5V or 12V feed on this connector for powering a LNA.

Optical - FC/APC female receptacle for connection to the cross-site fibre optic cable.

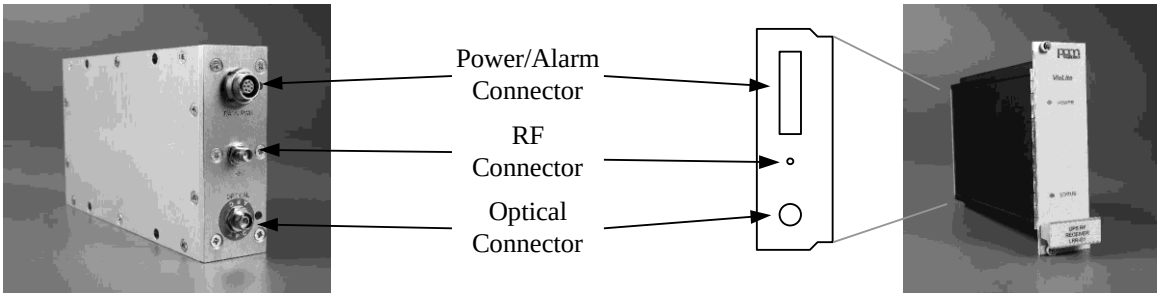
2.1.2 Plug-in Module

The plug-in modules are designed for use in PPM's ***ViaLite*** 19" Rack Case. The plug-in module may also be used in a standalone configuration with a Converter Sleeve. The module is powered from the 19" Rack Case backplane and all connections are on the rear panel of the module.

Power/Alarm - DIN 41612 backplane connector providing power and connectivity to the module alarm outputs.

RF - SMA connector for applying the RF input (to the optical transmitter) or monitoring the RF output (from the optical receiver) signal. Depending on the option selected, the transmitter module may have a 5V or 12V feed is available on this connector for powering a LNA.

Optical - FC/APC female receptacle for connection to the cross-site fibre optic cable.



2.2 Fibre Optic Cable & Connectors

2.2.1 Care of fibre optic connectors

Modern optical connectors offer very high levels of performance, reliability and repeatability. However, they are more sensitive to damage and contamination than electrical connectors. In order to maintain full performance from your fibre optic link system, it is necessary to take care to protect the connectors from damage and to keep them clean.

The light carrying core of a singlemode optical fibre is 8µm in diameter, and in a mating connector pair, the two cores must be aligned to better than 1µm in order to minimise insertion loss. The optical connectors used in PPM's systems maintain their performance even after hundreds of matings, as long as they are kept clean. Dirt or contamination may result in the core being obscured or misaligned, and this in turn results in high insertion loss and poor link performance.

The following precautions should be taken to maintain the performance of your link.

- The cable connectors should always be cleaned before they are used, even if they have been protected by dust caps.

- When the fibre optic cables are not connected, it is essential that the cable and module connectors are protected by the dust caps provided with the system.

2.2.2 Connector and Cable Types

All ***ViaLite*** RF GPS modules use singlemode (8µm/125µm) fibre terminated with FC/APC optical connectors. Cross-site cables are available in standard (3mm diameter) and heavy-duty (8mm diameter) variants.

FC/APC is an industry standard for angle-polished optical connectors and must not be confused with standard FC/PC connectors. The two connector types are not interchangeable and mating one with the other will damage both the cross-site interconnect and the module.

2.2.3 Connecting and Disconnecting

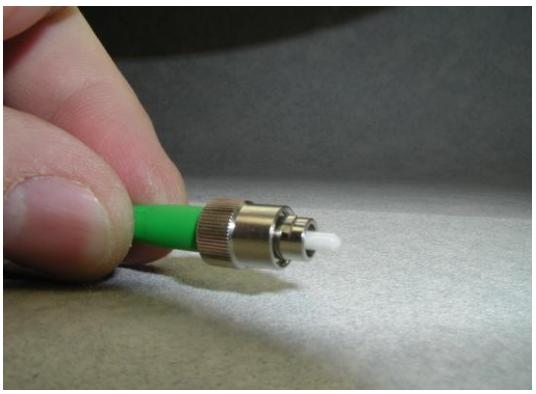
The cable connectors should be cleaned before each and every connection (see 2.2.4).

To connect FC/APC optical connectors, align the centre ferrule on the cable connector with the female receptacle in the module. There is a lug on the side of the ferrule, which must aligned to the gap in the receptacle. When they are in alignment, push the plug gently home and finger tighten the knurled collet onto the receptacle. See Figure 1 below.

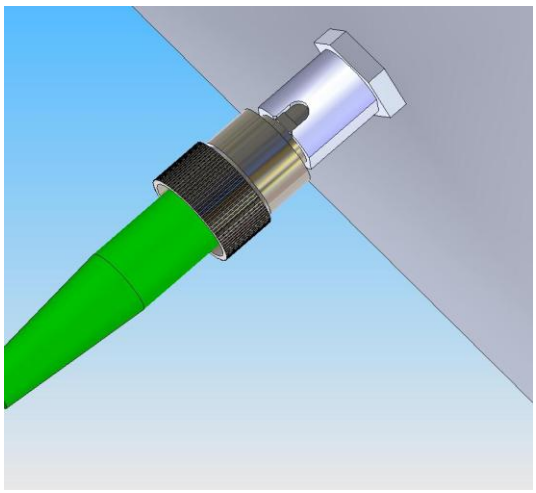
To disconnect FC/APC connectors, unscrew the knurled collet on the plug and gently withdraw the plug. Replace the dustcaps on both the receptacle and the cable connector.

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.

Figure 1
(a) showing FC/APC connector with dust cap removed, (b) showing alignment of the lug on the side of the ferrule, which must match the gap in the receptacle shroud before gently pushing the plug home and finger tighten the knurled collet nut onto the threaded receptacle.



(a)



(b)

To connect E2000/APC optical connectors, simply push the connector positively into the receptacle until a click is heard. The protective shutter will automatically lift as the connector is mating.

To disconnect E2000/APC connectors, depress the lever on the connector to disengage, then withdraw the connector from the receptacle. The shutter is spring-loaded and should spring back to protect the ferrule.

2.2.4 Care and Cleaning

The cable optical connectors should be cleaned **before each and every use**, even where they have been protected with dust caps.

It should only be necessary to clean the female receptacles on the modules if problems are being experienced.

Cleaning items required

- Lint free fibre cleaning tissues (normal cosmetic tissues produce dust and are not acceptable);
- Reagent grade Iso Propyl Alcohol;
- 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 polish the end face.
- Using the air duster, blow away all residue from the end of the connector.

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

- Twist a cleaning tissue to form a stiff probe, and moisten 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 all residue from the receptacle.

Important Notes

- IPA is flammable. Follow appropriate precautions and local guide-lines when handling and storing IPA.
- 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.**

2.2.5 Minimum Bend Radius

Because the optical fibre is made of glass, it is important not to subject it to a tight bend radius. For this reason, the fibre has a minimum bend radius (MBR) specification, beyond which the cable cannot be bent without excessive loss or damage occurring.

MBR specifications for PPM fibre are given in the ***ViaLite*** System Handbook Lxx-HB.

2.3 Using the Transmitter Module

2.3.1 Connecting the Transmitter Module

Connect the transmitter to the power supply, the fibre optic cross-site cable and the RF GPS signal as described in section 2.1. The RF input signal applied to the SMA Signal Connector should be within the maximum and minimum signal levels given in the specifications in section 5.

CAUTION!
Depending on the option selected at time of order, the transmitter may have a +5Vdc or +12Vdc external power feed connected to the RF input to provide power to the GPS LNA. Exercise caution when connecting the transmitter to other equipment including test equipment.

This output has overcurrent protection, though it is possible that in the event of a short circuit, the signal transmission will be interrupted momentarily.

2.3.2 Front Panel Indicators

The transmitter has two front panel LEDs to indicate the module status.

	Power LED		**Status LED**	
	Standard version	**Ext. Power Feed option**	**Standard version**	**Ext. Power Feed option**
OFF	Unit is Off	Unit is Off	Unit is Off	Unit is Off
GREEN	Unit is OK	Unit is OK	Laser is OK	Laser is OK
RED	Internal Fault	Internal Fault or DC Feed current limit	Laser Failure	Laser Failure

2.3.3 Alarm Output

When the plug-in transmitter module is fitted in an LRK 19" Rack Case, an open collector alarm output is available via the LRK backplane alarm concentrator connector.

There are two alarm outputs for each module position on the LRK alarm concentrator connector:
ALMnA – open collector output. Indicates laser failure OR DC Feed over-current
ALMnC – not used on the RF GPS Transmitter
(n indicates module position 1 to 8)

The open collector alarm output sinks current in the absence of an alarm condition. When an alarm occurs, the output goes into a high impedance state. Refer to section 4.3 for details of the alarm interface.

2.3.4 LNA Feed

All information in this section refers to fibre optic transmitter modules only. LNA voltages are fed **out** through the RF **input** connector on the Tx modules.

OEM Modules
Modules in this range DO NOT offer an internally generated LNA feed voltage.
Some modules do offer an ability to route a user fed LNA voltage through PIN 13 on the 14-way header, details shown below.
When using PPM Outdoor Enclosure, external LNA feed is available via the outdoor enclosure motherboard.

Plug-In Modules
Depending on bandwidth there are options for internally generated 5V or 12V LNA feed, and options to route a user fed LNA voltage through PIN 14 of the rear 15-way D-sub Connector, details shown below.

It is not possible to route a user fed LNA voltage through PIN 14 of the rear 15-way D-sub Connector on any modules that have been purchased with internally generated LNA feeds.

Module Series	**Module**		
	OEM Modules	**Plug-In Modules**	
		Standard & Standard Options	**Special Options (please contact PPM when ordering, no part code exists)**
G, GPS	External +/-36Vdc 330mA LNA feed allowed. To enable apply voltage to PIN 13 of the 14 way header connector.	LRT-G1-6R-1x-S1310 (1 in Transmitter part number signifies standard internally generated 5Vdc feed @ 80mA) LRT-G1-6R-2x-S1310 (2 in Transmitter part number signifies standard internally generated 12Vdc feed @ 80mA)	Factory option for feed +/-36Vdc at 330mA max from PIN 14 of the 15-way D-sub connector on chassis or converter sleeve

2.4 Using the Receiver Module

2.4.1 Connecting the Receiver Module

Connect the receiver to the power source, fibre optic cross-site cable and RF signal as described in section 2.1.

2.4.2 Front Panel Indicators

The transmitter has two front panel LEDs to indicate the module status.

	Power LED	Signal LED
OFF	Unit Off	Unit Off
GREEN	Unit OK	Link OK
RED	Internal Fault	Low light: Optical loss >20dB

The "Low Light" alarm is triggered when the light level at the receiver is below a preset limit. This threshold is set to be 20dB (optical) less than the nominal system gain.

2.4.3 Alarm and Monitor Output

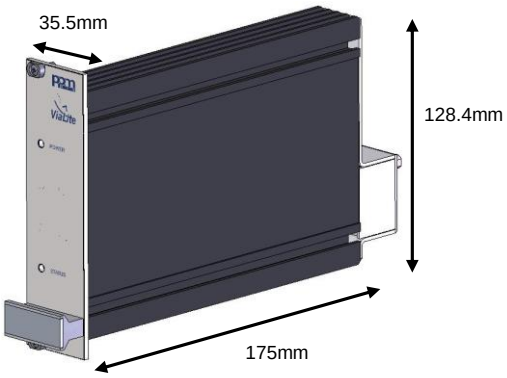
When the plug-in receiver module is fitted in an LRK 19" rack chassis, an open collector alarm output and a monitor output are available via the LRK backplane alarm concentrator connector.

There are two alarm outputs for each module position on the LRK alarm concentrator connector:
ALMnA – open collector output. Low received light level.
ALMnC – Analogue Received Light Level voltage *.

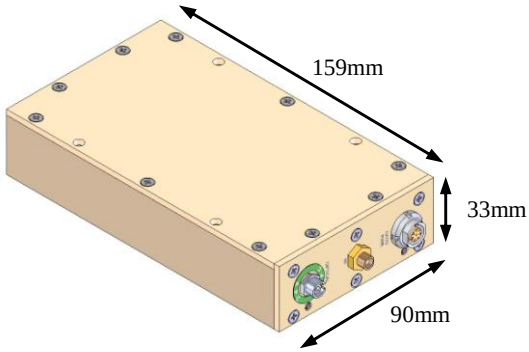
The open collector alarm output sinks current in the absence of an alarm condition. When an alarm occurs, the output goes into a high impedance state. Refer to section 4.3 for details of the alarm interface.

* RLL Output Voltage = 7.75V for a gain of 0dB and reduces by 0.125V per dB of RF link loss due to losses in the optical path.

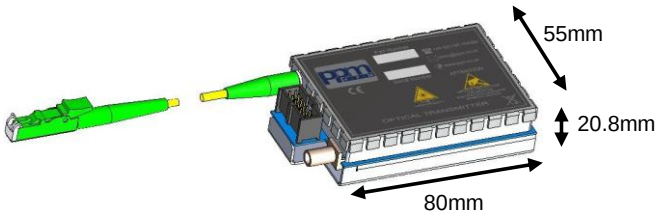
3 Module Formats



Plug in module



Shielded remote module



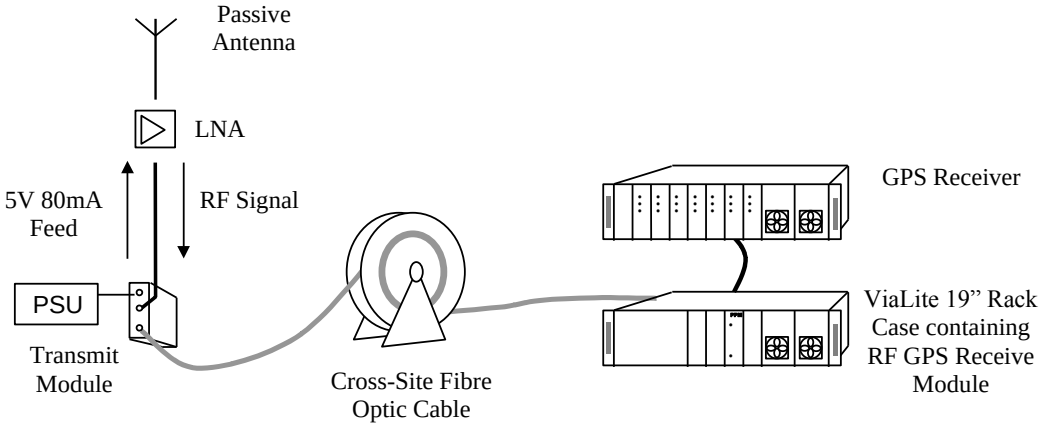
OEM module

Contact PPM for detailed dimensions

4 System Integration

4.1 Typical System Configuration

The diagram below illustrates a typical communications system configuration comprising a Shielded Satellite Transmit Module and Rack Mount Receive Module.



4.2 Link Budget Calculations

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

- Nominal Link Gain (0dB for ***ViaLite*** RF GPS)
- Optical Path Loss (due to connector insertion loss and optical fibre loss)

For clean, undamaged single-mode FC/APC connectors, the **optical** insertion loss is typically 0.4dB. The losses at the optical connections at the Transmitter and Receiver are allowed for during manufacture of the module, and may be ignored during link gain calculations.

For single mode fibre (e.g. Siecor SMF28), the **optical** loss at the 1300nm operating wavelength of the ***ViaLite*** RF Analogue links is 0.4dB/km. This is increased if the fibre is under excessive tension, compression or is bent into a small radius.

The additional **electrical** insertion loss, between the transmitter input and the receiver output, resulting from excess **optical** losses is equal to 2 times that of the **optical** loss. This is due to the physics of the opto-electrical conversion process in the receiver.

For short links (<250m) containing no additional optical connectors, and in which the fibre is not subject to any strain, then the optical path loss can be ignored.

The actual link gain can be determined as follows:

$$\text{Link Gain} = \text{Nominal Link Gain} - 2 \times (\text{optical loss}) \text{ [dB]}$$

where

$$\text{optical loss} = \text{connector insertion losses} + \text{fibre losses}$$

Example
Transmitter with 0dB gain
Receiver with 0dB gain
Optical Path Length 8km of SMF28 optical fibre with no additional optical connectors. This results in a path optical loss of 3.2dB.

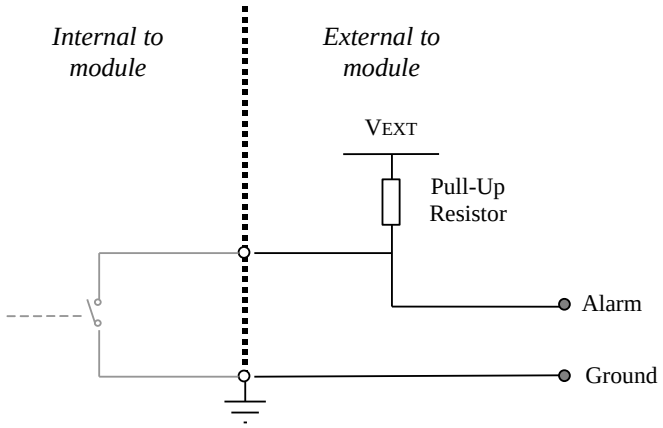
Link Gain = 0 + 0 - 2x3.2 = -6.4dB

4.3 Alarms & Monitoring

4.3.1 Module Alarm Output

The circuit below shows how the alarm output should be configured for all types of ViaLite module. The switch (to the left of the dotted line) is internal to the module. The circuitry to the right of the dotted line is provided by the system user*.

In the presence of an alarm condition, the module will act as a high impedance node and will NOT sink current. This is a fail-safe system in that an alarm condition will be raised when a module is not present. This is an important factor when commissioning link management systems, as blank module positions will register module faults.



* This circuitry is also provided by the Redundancy Switch module and the Alarm Concentrator module. When either of these modules are used, the alarm outputs can not be considered "VOLT FREE". This is because the Redundancy Switch module and the Alarm Concentrator modules use the same module alarm outputs to detect whether a unit has failed. When these modules are used, a voltage of between 5V and 12V may be present on the 'Alarm' output line when the module is in the failed mode. When the module is working correctly, the voltage on the 'Alarm' output line will be 0V (+1.0/-0). If true "VOLT FREE" contacts are required, please consult PPM.

Maximum current = 50mA
Maximum voltage = 15V

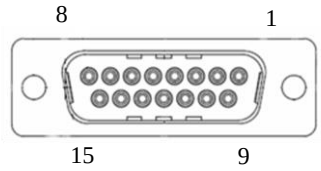
4.3.2 Module Monitor Output

All modules also provide an analogue monitor output for monitoring the condition of the Optical transmitter / receiver. Details of the monitor can be found in the technical specifications in section 5 of this document.

4.3.3 Module Alarm & Monitor Connection, Plug In Module

Connection is made to the module by the 15-way D-Sub connector on the rear of the rack backplane.

Pin	Function
1	Do Not Connect
2	Do Not Connect
3	Do Not Connect
4	Do Not Connect
5	Alarm Output
6	+12V from rack supply
7	External Feed (option)
8	Ground
9	Do Not Connect
10	Do Not Connect
11	Do Not Connect
12	Do Not Connect
13	Analogue Monitor Output
14	External LNA Feed (option)
15	Ground



View looking into connector

4.3.4 Module Alarm & Monitor Connection, Shielded Remote Module

Connection is made to the module by the Lemo 1B 8-pole free plug on the rear of the rack backplane.

Pin Number	Function
1	Alarm Output
2	Do Not Connect
3	Do Not Connect
4	Ground
5	Vsupply
6	Do Not Connect
7	Do Not Connect
8	Analogue Monitor Output

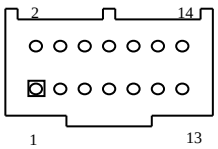
Looking into panel mount socket

Looking into Assembled plug

4.3.5 Module Alarm & Monitor Connection, OEM Module

Connection is made to the module by the 14pin boxed header Molex (C-Grid III), 0.1" dual row connector. All OEM modules are supplied with a 250mm interface cable.

Pin Number	Name	Cable Colour	Function
1	Tx_A	Pink	Do Not Connect
2	Rx_A	Pink	Do Not Connect
3	Tx_B	Pink	Do Not Connect
4	Rx_B	Pink	Do Not Connect
5	Dig_Alm	Orange	Alarm Output
6	RTS	Pink	Do Not Connect
7	+Va	Red	+12V from supply
8	0v	Black	Ground
9	Rx_232	Pink	Do Not Connect
10	Tx_232	Purple	Do Not Connect
11	0v	Black	Ground
12	Det_Opt_Tx	Pink	Do Not Connect
13	LNA_Feed	White	External LNA Feed (option)
14	An_Alm	Green	Analogue Monitor Output



Top view, 14 pin header

5 Technical Specifications

Bandwidth

Bandwidth	L1 and L2 GPS frequencies

Gain

RF Link Gain at 0dB optical loss	0dB ±3dB Subtract [2 x Optical Loss]dB for >0dB optical loss Optical Losses: Fibre = 0.4dB/km typ., Connectors = 0.5dB per connector typ.
Gain Stability over Temperature Tx Rx	< +/-3dB over operating range <0.08dB/°C below 40°C typ., <0.1dB/°C above 40°C typ. <0.05dB/°C typ.

Dynamic Range

Input Third Order Intercept	>0dBm
Input P1dB	>-10dBm
Noise Figure	<18dB, at 0dB optical loss

User Interface

Input/Output Impedance, VSWR	50Ω, ≤2:1
Power LED	Indicates DC power is applied to the module
Transmitter Status LED	Green: Transmitter laser functioning Red: Transmitter laser degraded
Receiver Status LED	Green: Received light level above threshold (threshold factory set to nominal 20dB optical / 40dB electrical loss) Red: Received light level below threshold
Transmitter Alarm Output	Current sink "Laser Degraded" Alarm
Receiver Alarm Output & Monitor	Current sink "Light Low" Alarm Analogue Received Light Level (RLL) monitor. RLL monitor voltage = 7.75V for a gain of 0dB and reduces by 0.125V per dB of RF link loss due to losses in the optical path.
RF Connector	50Ω SMA Female
External LNA Supply Voltage Option on optical transmitter	+5VDC or +12VDC @ 80mA
Dummy LNA load on optical receiver	470Ω resistor to ground, max. 0.25W. This emulates presence of an LNA to a GPS receiver.
Optical Connector	FC/APC Narrow key, >60dB return loss, Suhner FCPC-Z/M-A601
Monitor & Alarm Interface Rack plug-in module Shielded remote module Converter Sleeve	 15pin female D-type on 19" rack case backplane 8pin female Lemo 1B 15pin female D-type
Power Consumption and Operating Voltage	Transmitter <4.5W, Receiver <4W at +12VDC ± 0.5VDC

Operating Conditions

Absolute Maximum RF Input (RF in)	>+15dBm, 15VDC
Optical	>60dB return loss. Suhner FCPC-Z/M-A601 narrow keywidth connector. Use with other types may compromise system performance.
Operating Temperature Rack plug-in module Shielded remote module	 0°C to +40°C -20°C to +50°C
Storage Temperature	-40°C to +70°C

Optical Characteristics

Wavelength	1310+/-20nm
Fibre	Singlemode 9/125, Corning SMF28 or equivalent
Output Power	+4.5dBm/3mW nominal

All parameters specified after 15 minutes warm-up.

6 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 light on Shielded Remote Module.	Power source not connected.	Connect power source.
Power LED does not light on Plug-in module when plugged into Converter Sleeve.	Power source not connected. Module not plugged fully into Converter Sleeve	Connect power source. Plug module in fully
Power LED lights up RED.	External power feed is in current limit.	Check external load.
Status LED lights up RED.	Tx : Laser Failure. Rx : Low optical level. No optical signal.	Return to local PPM office. Refer to link calculations – what optical loss is in your link? Check optical link for breaks, connections, tight bend radii etc.

The ***ViaLite*** range of RF GPS Transmit and Receive Modules are precision engineered and calibrated for optimum performance and accuracy before dispatch.

However, in the event of any problems or queries arising about the equipment, please contact PPM or your local agent.

7 Product Warranty

The Company guarantees its products, and will maintain them for a period of three years from the date of shipment 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 unit to PPM.

The Company or its agents will maintain its products in full working order and make all necessary adjustments and parts replacements during the Company's normal working hours provided that the Customer will pay at the rates currently charged by the Company 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 PPM prior to returning any goods for Warranty or Non-Warranty repairs. Goods will not be accepted without a valid Goods Return Number (GRN).

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