point2point

AC ANALOGUE FIBRE OPTIC LINK

User Handbook

PAx-HB-7

PPM (Pulse Power & Measurement Ltd.) 65 Shrivenham Hundred Business Park, Watchfield, Swindon, Wiltshire SN6 8TY, England
Tel +44 (0)1793 784389 Fax +44 (0)1793 784391 Email sales@ppm.co.uk Web Site www.ppm.co.uk

Registered Office 89 Groundwell Road, Swindon Wiltshire SN1 2NA Registered at Companies House Cardiff **Registered No** 2963819

TABLE OF CONTENTS

1 INTRODUCTION 5

1.1 Transmitter Module 5

1.2 Receiver Module 5

1.3 Fibre Optic Cable 5

2 SETTING UP AND USING THE AC ANALOGUE LINK 6

2.1 Module Operation 6
2.1.1 Shielded Remote Modules 6
2.1.2 Rack Plug-In Modules 6
2.1.3 Plug-In Converter Sleeve 6

2.2 Using the Transmitter Module 6
2.2.1 Analogue Signal Input 6
2.2.2 Fibre Optic Cable Connection 6

2.3 Using the Receiver Module 7
2.3.1 Analogue Signal Output 7
2.3.2 Fibre Optic Cable Connection 7

2.4 System Integration 8

3 BATTERY PACKS 10

3.1 Battery Pack Operation 10

4 MAINTENANCE AND FAULT-FINDING GUIDE 11

5 PRODUCT WARRANTY 12

Safety Information

Please read the whole of this section
before using your ***point2point*** *product.*

Electrical Safety

The Rack Cases that are used in conjunction with the AC Link family are Safety Class 1 instruments (they have 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.
- Do not remove equipment covers when operating.
- Make sure that only fuses of the required rated current, and of the specified type (anti-surge, quick blow, etc.) are used for replacement.
- There are no user serviceable parts inside this unit.

Optical Safety

The ***point2point*** AC Analogue Transmitter modules contain laser diode sources operating at 1300nm. 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 or connector 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.

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

For more information on the Rack Case and Accessories, please refer to the generic system handbook Sxx-HB.

Important Handling Instructions

Connecting Fibre Optic Connectors

The fibre optic cable used with your ***point2point*** AC Analogue Link is terminated with angle-polished FC/APC type connectors. These should not be confused with FC/PC style connectors, **which are not compatible with this equipment.**

The protective dust caps on the equipment and cable connectors should only be removed immediately before the connectors are mated.

The optical connectors should be cleaned in accordance with the instructions in Appendix I **before each and every** connection, even if they have been protected with dust caps.

It is important to align the alignment lug on the cable plug with the matching slot in the module socket.

FC/APC connectors are high precision screw type connectors and should only be finger tightened.

Care should be taken not to drop the optical connector or to subject it to any other excessive physical shock.

Disconnecting Fibre Optic Connectors

The connectors should be removed by unscrewing and withdrawing the connector.

UNDER NO CIRCUMSTANCES SHOULD THE FIBRE BE PULLED TO REMOVE THE CONNECTOR.

Immediately after removing the connectors, all protective dust caps should be fitted.

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.

System performance may be compromised by dirt on the connector end or its alignment surfaces. Refer to Appendix I for instructions on cleaning the optical connectors.

Connector performance will be compromised if its end face is scratched or chipped.

Bend Radius

All fibre optic cable is subject to a minimum bend radius beyond which physical damage may occur to the cable. The cable supplied with this system consists of a simplex glass optical fibre with 3mm tight jacket ruggedisation. The minimum bend radius (MBR) for this type of fibre can be found in the specifications in Appendix II.

1 Introduction

The ***point2point*** AC Analogue Links are a family of non-galvanic link systems designed for the transmission of wide bandwidth analogue signals in electrically noisy environments.

This handbook covers the following ***point2point*** AC Analogue Link variants:

- PAT/R-Gx-xx 40Hz-250MHz AC Analogue Transmitter/Receiver
- PAT/R-Kx-xx 2kHz-1.35GHz AC Analogue Transmitter/Receiver
- PAT/R-Px-xx 1MHz-2GHz AC Analogue Transmitter/Receiver
- PAT/R-Sx-xx 10MHz-3GHz AC Analogue Transmitter/Receiver

1.1 Transmitter Module

The Transmitter Module contains signal conditioning/buffering/amplifier circuitry, laser bias and modulation control, power supply filtering/regulation and basic control circuitry.

The optional Battery Pack (Shielded Satellite housing option only) attaches to the side of the Transmitter Module and provides electrical power to the transmit electronics. Battery packs are quickly and easily changed. This enables the system to be operated continuously, with minimum delays whilst batteries are charged.

1.2 Receiver Module

The Receiver Module contains photodiode bias control, signal conditioning/buffering/amplifier circuitry, power supply filtering/regulation and basic control circuitry.

The optional Battery Pack (Shielded Satellite housing option only) attaches to the side of the Receiver Module and provides electrical power to the transmit electronics. Battery packs are quickly and easily changed. This enables the system to be operated continuously, with minimum delays whilst batteries are charged.

1.3 Fibre Optic Cable

The fibre optic cables used in conjunction with the ***point2point*** AC Analogue Links are terminated with a single FC/APC optical connector at each end. These are angle-polished for a return loss performance of <-60dB.

Care of fibre optic connectors

The optical connectors should be cleaned in accordance with the instructions in Appendix I **before each and every** connection, even if they have been protected with dust caps.

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.

System performance may be compromised by dirt on the connector end or in the detector.

Refer to Appendix I for instructions on cleaning the optical connectors.

Connector performance will be compromised if its end face is scratched or chipped.

2 Setting up and using the AC Analogue Link

This section describes the connections between your AC Analogue Fibre Optic Transmitter and Receiver Modules, and the operation of both units in a system.

Please read fully document Sxx-HB for information on installing your ***point2point*** equipment before attempting to make any measurements.

2.1 Module Operation

2.1.1 Shielded Remote Modules

The Module is switched on automatically by connection to a fully charged Battery Pack using the Battery Pack U-Link. Removal of the link powers down the Module.

2.1.2 Rack Plug-In Modules

The Module is powered up when the Rack Unit is switched on at the On/Standby switch, or if a System Controller is fitted, when the Controller is switch on.

2.1.3 Plug-In Converter Sleeve

The module is powered up when the Rack Mount Module is plugged into the sleeve, and the 12V converter sleeve power supply is plugged into the 2.1mm connector socket on the rear of the converter sleeve.

2.2 Using the Transmitter Module

2.2.1 Analogue Signal Input

The user's signal is applied to the SMA Signal Connector on the Transmitter Module.

The input impedance is a nominal 50Ω. The nominal maximum input signal level depends on the gain of the Transmitter.

Maximum ratings for this input are given in the technical specifications in Appendix II.

2.2.2 Fibre Optic Cable Connection

The fibre optic cable, which carries the optical signal between Transmitter and Receiver Modules, is terminated in angle polished FC/APC type optical connectors.

The FC/APC connectors are mated by aligning the lug on the connector with the notch in the receptacle shroud, gently pushing the connector into the receptacle, and finger-tightening the nut.

It is important to replace the dust caps on both the connectors and modules when not in use. Contamination may give rise to erroneous results and may damage the equipment.

2.3 Using the Receiver Module

2.3.1 Analogue Signal Output

The output signal is applied to the SMA Signal Connector on the Receiver Module.

The output impedance is a nominal 50Ω. The nominal maximum output signal level depends on the gain of the Transmitter.

2.3.2 Fibre Optic Cable Connection

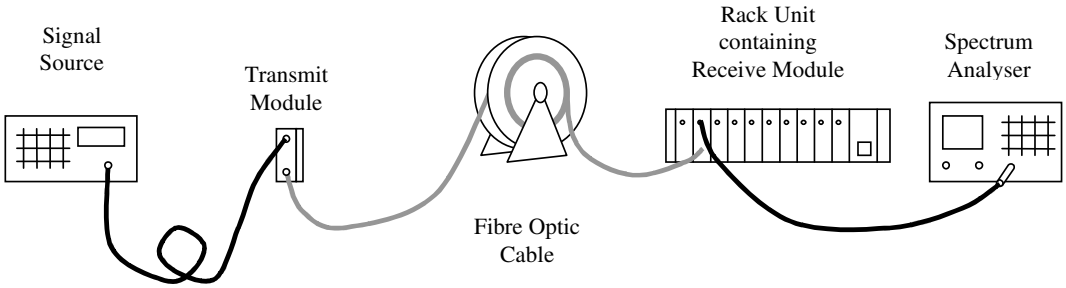
The fibre optic cable which carries the optical signal between Transmitter and Receiver Modules are terminated in super polished FC/APC type optical connectors.

The FC/APC connectors are mated by aligning the lug on the connector with the notch in the receptacle shroud, gently pushing the connector into the receptacle, and finger-tightening the nut.

It is important to replace the dust caps on both the connectors and modules when not in use. Contamination may give rise to erroneous results and may damage the equipment.

2.4 System Integration

The diagram below illustrates a typical system configuration comprising a Shielded Remote Transmitter Module and Rack Plug-In Receiver Module.



When the Transmit Module and Receive Module are connected via the Fibre Optic Cable and powered up, the Status LED on the Receiver indicates the level of signal received from the Transmitter.

The Power (P) LED has the following functions on the AC Analogue links:

Power LED	Rack Plug-In	Shielded Remote
Green	OK	Battery Voltage OK
Red	n/a	Battery Voltage is Low.
Off	Rack not switched on	Battery is discharged or not connected

The Status (S) LED has the following function on the AC Analogue links:

Status LED	All housing variants
Green	Link Gain >-3dBr
Flashing Green/Red	-10dBr < Link Gain <-3dBr
Red	Link Gain <-10dBr

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

- Transmitter Gain (options include 0dB, +20dB)
- Receiver Gain (options include 0dB, +10dB)
- Optical Path Loss (due to connector insertion loss and optical fibre loss)

For clean, undamaged super-polished 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 singlemode fibre (e.g. Siecor SMF28), the **optical** loss at the 1300nm operating wavelength of the ***point2point*** AC 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 resulting from **optical** losses is equal to 2x 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:

Link Gain = Tx Gain + Rx Gain – 2x(optical connector insertion losses + fibre losses) [dB]

Example 1
Transmitter with 0dB gain (0dBm maximum input)
Receiver with +10dB gain (+10dBm maximum output)
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 + 10 - 2x3.2 = +3.6dB

Because the optical path loss results in an electrical gain reduction of >3dB, the Receiver Status LED flashes red/green.

Example 2
Transmitter with 0dB gain (0dBm maximum input)
Receiver with 0dB gain (0dBm maximum output)
Optical Path Length 8km of SMF28 optical fibre with 6 additional optical connectors. This results in an optical loss of 8x0.4 + 6 x 0.4dB = 5.6dB.

Link Gain = 0 + 0 – 2x(5.6) = -11.2dB

Because the optical path loss is high, resulting in an electrical gain reduction of >10dB, the Receiver Status LED is a constant red.

3 Battery Packs

The Battery Packs used on ***point2point*** Shielded Satellite Modules provide a nominal output voltage of 14.4V. A fully charged Battery Pack may have an open circuit voltage of more than 17V.

3.1 Battery Pack Operation

The Modules have been designed for minimal current consumption, specified in Appendix II.
For more details of the battery operation please refer to the battery handbook

All Shielded Satellite Modules have an automatic shutdown feature to protect damage to the Battery Packs. When a fully changed Battery Pack is attached to a Module, the Module powers up. This is indicated by the Power Status LED illuminating green.

As the batteries reach the end of their discharge cycle, the Power Status LED will illuminate red to warn the user that the Module will power down shortly. The Module will continue to function in this mode without performance impairment for several minutes allowing measurements to be completed

When a Battery Pack becomes fully discharged, the module to which it is attached will shut down. At this point, it is necessary to replace the Battery Pack with one that is fully charged.

Instructions on how to change a Battery Pack are detailed in the ***point2point*** generic system handbook Sxx-HB.

Optical Transmit Modules in shut-down mode should not be left in this mode for extended periods with the Battery Pack attached, as this may over-discharge the Battery Pack, causing permanent damage.

More information on the Battery Pack including Battery Pack Care and Charging can be found in the ***point2point*** generic system handbook, Battery Handbook and charger hand books.

4 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
Illuminated Power Switch does not illuminate on the rear of the Rack Case Unit.	Power is not attached to the rack unit. Mains switch is turned off. Fuse has blown in rack unit.	Connect mains power to the rack unit, and switch on power. Switch on mains switch. Replace fuse (2A anti-surge).
Power Status LED does not light on Shielded Remote Module when Battery Pack is attached.	Battery Pack is discharged. Battery Pack U-link is not fitted at rear of module.	Recharge/replace Battery Pack. Attach Battery Pack U-link.
Power Status LED on Shielded Remote Module illuminates red.	Battery Pack power is low. External Power Supply voltage is low.	Recharge/replace Battery Pack. See Specification for allowable range of supply voltages.
Power Status LED does not light on Rack Plug-In Module.	Rack Unit is not powered. Rack Mount Module is not correctly plugged into Rack Unit.	Connect mains power to the Rack Unit, and switch on power. Power down Rack Unit, Push Module fully home, Re-apply power to Rack Unit.
Status LED is constant red or flashing red/green.	Dirt on the fibre optic connectors. Broken optical fibre.	Clean the fibre optic connector. Refer to Appendix I. Contact PPM.

The ***point2point*** range of AC Analogue Transmit and Receive Modules are calibrated for optimum performance and accuracy before dispatch. In order to guarantee the continued performance and reliability of the link, it is recommended that your fibre optic link is returned to PPM for calibration annually.

In the event of any problems or queries about the equipment, contact PPM or your local agent.

5 Product Warranty

The Company guarantees its 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 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).

Appendix I: Fibre Optic Connector Cleaning Procedure

The ***point2point*** fibre optic cable is fitted with screw type 'FC/APC' optical connectors. It is important to keep these clean to ensure accurate measurements.

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

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 any 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 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.**

Appendix II : Specifications

RF System Parameters (at 25°C unless otherwise noted)

	PAx-Gx-6x	**PAx-Kx-6x**	**PAx-Px-6x**	**PAx-Sx-6x**
Bandwidth (-3dB)	<40Hz to >250MHz	<2kHz to >1.35GHz	<1MHz to >2GHz	<10MHz to >3GHz
Risetime (10-90%)	<1.4ns	<350ps	<250ps	<200ps
Jitter (measured on a 100MHz sinewave)	<10ps rms	<10ps rms	<10ps rms	<10ps rms
Simultaneous Dynamic Range @100MHz	>150dB in a 1Hz bandwidth	>150dB in a 1Hz bandwidth	>150dB in a 1Hz bandwidth	>147dB in a 1Hz bandwidth
Electrical Link Gain, Nominal	0dB – [2 × Optical Loss] Optical Loss due to fibre is 0.4dB/km Optical Loss due to connectors is 0.5dB per connector typical			
Gain Stability	Better than ±0.25dB after 20 minutes warm up			
Receiver Gain Status LED	Green: Gain is > - 3dB Alternating Red/Green: Gain is between -3dB and -10dB Red: Gain is less than -10dB			
Passband Flatness	40Hz - 100kHz : ±1.5dB 100kHz - 250MHz : ±0.75dB	2kHz - 100kHz : ±1.5dB 100kHz - 1.35GHz : ±1dB (typ 0.5dB)	±1dB	±1dB
Phase Flatness	> 100Hz : ±20°	> 5kHz : ±20°	±20° (typical ±5° for 1MHz to 1.5GHz)	±20° (typical ±5° for 1MHz to 1.5GHz)
Noise Figure	< 22dB @ 100MHz	< 25dB @ 500MHz	< 25dB @ 500MHz < 30dB @ 2GHz	< 26dB @ 500MHz < 30dB @ 3GHz
Max. input for <2% distortion	500mVpk-pk, 250mVpeak, 180mVrms, -2dBm			
Input P1dB	> 0dBm @ 100MHz	> 0dBm @ 500MHz		
Input IP3	>10dBm @ 100MHz	>10dBm @ 500MHz		
Signal delay	5ns (+/-10%) per module + 5ns/metre delay through the cross-site optical fibre			
Signal inversion	Inverting			
Absolute maximum input	+3dBm continuous and >+15dBm, 5Vdc non-continuous			
Input/Output Impedance, VSWR	50Ω, ≤2:1			

Optical & Environmental System Parameters (at 25°C unless otherwise noted)

	PAx-Gx-6x	PAx-Kx-6x	PAx-Px-6x	PAx-Sx-6x
Operating Temperature	-10°C to +40°C			
Electrical signal connector	SMA female			
Optical signal connector	Singlemode FC/APC Narrow key, >60dB return loss, Suhner FCPC-Z/M-A601			
Optical Fibre Type	Single mode SMF-28 or equivalent			
Optical Fibre Bend Radius	30cm min.			
Supply voltage Shielded Module Plug-In Module	 13 - 15Vdc 12Vdc			
Current consumption	<250mA Tx, <150mA Rx			
Housing options	Shielded Module Plug-In Module Standalone Module (using 75002)			
Plug-In rack case suitability	SRK-1, SRK-2, SRK-3, SRK-3R			

point2point AC ANALOGUE FIBRE OPTIC LINK HANDBOOK (PAX-HB) ISSUE 7
CR2696

PPM LTD., 65 SHRIVENHAM HUNDRED BUSINESS PARK, SWINDON, SN6 8TY, UK.
TEL: +44 1793 784389 FAX: +44 1793 784391
EMAIL : INFO@PPM.CO.UK WEBSITE: HTTP://WWW.PPM.CO.UK