PPM INTELLIGENT FIBRE-OPTIC-LINK

SENTRY / SENTINEL IISC

TRx-HB-6

Contents

Calibration Information

In order to guarantee optimum gain accuracy and passband flatness performance, your Sentry / Sentinel IIsc system has been calibrated as a matched Transmitter/Receiver pair.

It is possible to use any Transmitter with any Receiver, but an additional allowance of ±0.5dB gain uncertainty and ±0.5dB passband flatness should be made. The gain error caused by using a non-matched Transmitter/Receiver pair is fixed, and can be compensated for by normal measurement calibration routines.

The following Transmitter and Receivers have been calibrated as matched pairs:

	Transmitter Serial Number	*Receiver Serial Number*
1	SN	SN
2	SN	SN
3	SN	SN
4	SN	SN
5	SN	SN
6	SN	SN
7	SN	SN
8	SN	SN

It is recommended that your Fibre Optic Link Modules be re-calibrated every 12 months to ensure conformance to the published specification.

Safety Information

Please read the whole of this section before using your new Sentry / Sentinel System.

Laser Safety

The light source within the Transmitter Module is a semiconductor laser diode of 1300nm wavelength. The light is emitted from the optical connector on the Transmitter Module front panel.

The laser radiation emitted from this product in normal use falls within the IEC825-1 CLASS 1 limit, and constitutes no hazard when used as recommended. Attention is drawn to the following statements.

CAUTION

Use of controls or adjustments, or following procedures other than those specified herein may result in hazardous radiation exposure.

CAUTION

The use of optical instruments with this product will increase the risk of eye hazard.

Electrical Safety

The PPM Test & Instrumentation System Subrack / Case that is used in conjunction with the Sentry and Sentinel IIsc FOL is a Safety Class 1 instrument (it has a metal case that is directly connected to earth via the power supply cable).

- 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.

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

Important Handling Instructions

Connecting Lemo 3K Fibre Optic Connectors

Remove the protective dust cap from the cable mounted connector by holding the dust cap in one hand, and pulling the connector out by its outer release sleeve with the other hand.

Remove the protective dust cap from the equipment by supporting the equipment with one hand, and pulling the dust cap out with the other hand.

The 3K connectors are keyed and can only be inserted in one orientation. Correct alignment is indicated by the alignment key-way and red alignment markings. The key/alignment mark should be uppermost when the connector is being inserted.

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

When the cable mounted 3K connector is inserted, it should be firmly pushed into the panel mounted connector until the lugs are felt to latch into place.

Under no circumstances should the connector be forced into position.

Care should be taken not to drop the optical connector or to subject it to any other excessive physical shock, particularly when it is not protected with the dust cap.

Disconnecting Fibre Optic Connectors

The connector is disengaged by a single straight axial pull on the outer release sleeve. This first disengages the latches and then withdraws the plug from the socket.

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 section 9 for instructions on cleaning the optical connectors.

Connector performance will be compromised if the end face is scratched.

Heavy Items

Some parts of this product can weigh in excess of 2kg. For heavy or awkward items, ensure that the correct precautions and safety equipment are implemented to avoid injury and/or damage to equipment. If in doubt, consult your Health & Safety representative.

1 Introduction to the Intelligent FOL Range

The PPM Test & Instrumentation Intelligent FOL range is designed to meet the needs of researchers and engineers whose work involves transmitting high bandwidth analogue signals in electrically noisy environments, such as those encountered in EMP and EMC testing.

The range comprises two FOL systems with similar functionality but different RF performance. These are the Sentinel IIsc and Sentry IIsc. The Sentinel IIsc has an analogue bandwidth of 2kHz to >1GHz, while the Sentry has an analogue bandwidth of 40Hz to 600MHz.

Each system consists of a battery powered transmitter unit, which converts the input electrical signal to an optical signal. This optical signal is transmitted down a fibre optic cable to a receiver unit that recovers the electrical signal and also provides control of the transmitter functions. Control signals are sent from the receiver to the transmitter via a second fibre. The signal and control fibres are contained within a single ruggedised Fibre Optic Cable. A calibrate circuit within the receiver module compensates for variations in optical loss of the optical connectors in order to maintain system gain within the specified limits.

The Sentinel / Sentry IIsc Intelligent FOLs are the logical upgrade path from the Sentinel and Sentry II, and enables the product to be compatible with the PPM Modular Test & Instrumentation System. This includes the ***point2point*** range of modules.

The Sentinel and Sentry IIsc FOLs must be used in conjunction with the System Controller, SCT-1.

The Transmitter Module

A typical transmitter configuration consists of two modules. These are :-

- Transmitter Module containing the transmit RF pre-amplifier, attenuation blocks, laser driver, laser diode module, power supply filtering/regulation and control circuitry.
- Battery Pack, used to provide electrical power to the transmit electronics.

The Transmitter Modules are designed for the maximum electrical screening possible given the size and user flexibility constraints. Battery Packs are quickly and easily changed. This enables the system to be operated continuously, with minimum delays whilst batteries are charged.

The Receiver Module

The Receiver Module receives the optical signals from the Transmitter Module and converts them back into an electrical signal. This is amplified and output on an SMA connector on the Receiver Unit front panel.

The Receiver Module must be plugged into a PPM Case or Subrack containing a System Controller before it can be operated. All receiver functions can be directly or remotely operated using the System Controller. The Controller unit provides comprehensive control features, which are easy to learn and use. A large, clear graphical LCD on the Controller and indicator LEDs on the Receiver front panel provide the user with complete system status information. During start up the system automatically detects which Receiver Units are present.

Fibre Optic Cable

A number of different types of fibre optic cable can be provided with the system. These are: -

Cross Site Fibre Optic Cables

A ruggedised Fibre Optic Cable that has a Lemo 3K optical connector mounted on both ends of a multi-core, ruggedised cable. The connector is securely bonded to the cable.

Extension Leads

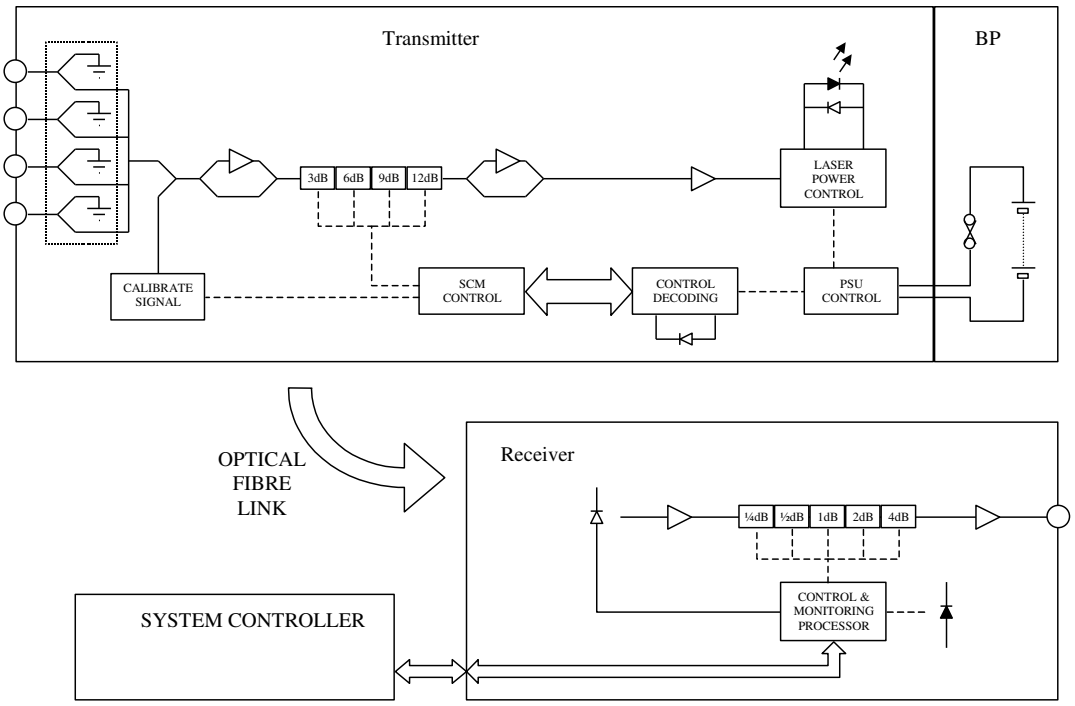
These may be used to extend the cross-site cable. For example, it may be required to have a bulkhead connector at the wall of a test chamber or control room. These extension leads may only be used as extension leads, and cannot be used in place of the cross site cable.

The Fibre Optic Cables and Extension are available in a range of lengths to suit individual requirements.

Principle of Operation

FOL System Diagram

The figure below shows a block diagram of the Sentinel / Sentry IIsc Fibre Optic Link system.



The Sentinel / Sentry IIsc Fibre Optic Link uses Intensity Modulation (IM) for the transmission of analogue data from the Transmitter to the Receiver. This scheme offers unparalleled levels of bandwidth and dynamic range when compared to alternative modulation methods.

With Intensity Modulation, the intensity of the light source varies in direct proportion to the magnitude of the modulating signal. The scheme has the following characteristics:

- The modulation bandwidth is the same as the bandwidth capability of the light source. In alternative schemes such as Analogue to Digital conversion or Frequency Modulation, the modulating bandwidth has to be significantly less than the bandwidth capabilities of the light source. IM, therefore, offers the widest bandwidth.
- Light loss along the optical path (e.g. due to optical connector insertion loss) translates to an attenuation of the transmitted signal. Therefore, if optical attenuation is not minimised or compensated, then the gain of the link will be reduced.
- Dirt contamination or damage to the optical contacts may results in optical reflections back into the transmitter laser diode that could degrade the noise performance of the system. The laser diode is designed to minimise the effects of such reflections, but care should be taken to protect and clean the optical contacts.

Transmitter Module

Input Switch
The four way input switch allows the user to select one of four inputs at a time. Unused inputs are grounded, and the circuit is designed to maximise the isolation between inputs.

High Impedance Buffer
The Sentinel IIsc FOL has been optimised for use as a wide bandwidth 50Ω system. However it is necessary to present a high impedance to certain types of sensor. To facilitate this, the user can switch a high impedance buffer into the signal path of the Transmitter Module. This circuit is positioned before the 50Ω attenuators and pre-amplifier, and its use is ***only valid when the system gain is set to 21dB*** (i.e. when all attenuators and the pre-amplifier are switched out of the signal path).

The impedance presented at the input is nominally 500kΩ. The system bandwidth with the High Impedance Buffer selected is reduced to 100MHz.

Pre-amplifier
A 12dB gain, low noise pre-amplifier may be switched into the signal path in order to improve the noise figure of the overall system, and therefore monitor ultra low level signals. This pre-amplifier, in conjunction with the attenuators is controlled by the System Controller, and allows the user to increase the gain from +21dB to +33dB in 3dB steps.

Attenuators
When the user selects the overall system gain (between -24dB to +33dB), the attenuators are automatically selected or deselected to switch in and out of the signal path to achieve the required gain. In this way, the system gain can be changed from +21dB (nominal system gain with all attenuators switched out) to -24dB (maximum attenuation, with all attenuators switched in).

Transmitter Test Signal
This circuit generates a high frequency squarewave (approx. 20MHz), which allows the user to confirm the operation of the signal path without an input signal present. This is operated by selecting "Test Signal" on the System Controller. The squarewave level is set so that the user can monitor the level of the fundamental signal when observing the Receiver Unit output in the frequency domain e.g. a spectrum analyser, or by measuring the peak-to-peak voltage level in the time domain e.g. with an oscilloscope.

Transmit Amplifier
The Transmitter input signal is amplified by a broadband, high linearity, low noise amplifier to a level suitable for modulating the laser diode.

Laser Bias and Matching
A broadband matching network maximises the coupling between the amplifier and the laser diode. The light intensity output of the laser diode varies in direct proportion to the modulating signal current generated by the transmit amplifier. A laser bias circuit biases the laser at the optimum DC bias point for AC signal linearity, noise and bandwidth.

Control Decoding
This circuit decodes control signals received from the Receiver Unit. These control signals are used to set the position of the signal switching relays, and to switch the various active circuits on and off.

Power Supply Regulation and Control
A voltage supply and monitor circuit switches the Transmitter Module off if the supply voltage falls below 12V. This prevents damage that can be caused to the Battery Pack if it is over-discharged. The supply voltage is regulated so that the system maintains full performance as the battery voltage falls from above 15V to 12V.

Battery Pack

There are two types of Battery Pack available: standard and high-capacity.

The Battery Packs can be maintained at full performance by the use of the appropriate PPM battery charger Unit.

Typical operating times for a 2.0Ah capacity battery under normal operating conditions is 10 operational or 150 hours standby time. This can be scaled depending on the actual capacity of the battery.

See battery handbook for further details.

Receiver Unit

Photodiode
The signal light from the Transmitter Module is converted back into an electrical signal by the photodiode in the Receiver Unit. The light level is measured by the Receiver and reported on the front panel.

AGC Amplifiers
The RF amplifier boosts the signal from the photodiode to generate the required system gain at the output. A variable gain stage in the design allows for fine tuning of the receiver gain to allow for variations in optical path loss.

The light level measured at the photodiode is monitored and the required adjustment to the Receiver gain is calculated. The gain is corrected accordingly. This gain adjustment takes place when the Transmitter Module is switched on, or when Receiver Calibration sequence is selected.

Control & Communications
The Receiver Unit is controlled by an on-board processor that takes control signals from the System Controller. Remote commands, ie. those which require control of the Transmitter Module, are processed by the local Receiver Module. The Receiver then communicates through the optical data link to the Transmitter Module.

Fibre Optic Cables

The optical signal path consists of singlemode fibre. This has been selected in preference to multimode fibre as it offers far superior noise performance due to the absence of modal noise. Modal noise is caused by the interference between the many modes present in multimode fibre. High performance, low insertion loss optical connectors maintain optimum link performance.

The low speed digital control signals from the Receiver Unit to the Transmitter Module are sent over a multimode fibre.

2 Installation

Safety Precautions

Refer to the Safety Information sheet at the beginning of this handbook for safety precautions prior to operating mains powered equipment.

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 PPM or your local agent.

The equipment received should correlate with the delivery documentation that is shipped with the equipment. If there are any discrepancies, contact PPM or your local agent.

Receiver Module Installation

The Sentinel / Sentry IIsc Receiver Unit is fully compatible with the PPM System Controller and Desktop Case and Subrack and can be installed in any available slot within the case.

Switch off the Controller before proceeding. Never remove or install modules with the power connected.

Take care not to touch any electrical contact inside the System Rack Chassis as many circuits within the system are sensitive to damage from Electro-Static Discharge.

To install the Sentinel / Sentry IIsc Receiver, first unscrew one blanking plate from the Case. Check that the module guides are in place and gently slide in the Receiver, ensuring that it does not foul the adjacent modules. The module should mate with the backplane connector firmly to leave the front panel level with the other front panels.

Tighten up the two front panel screws firmly. Switch on the System Controller and select the relevant module. Check that the Controller has correctly identified the module type.

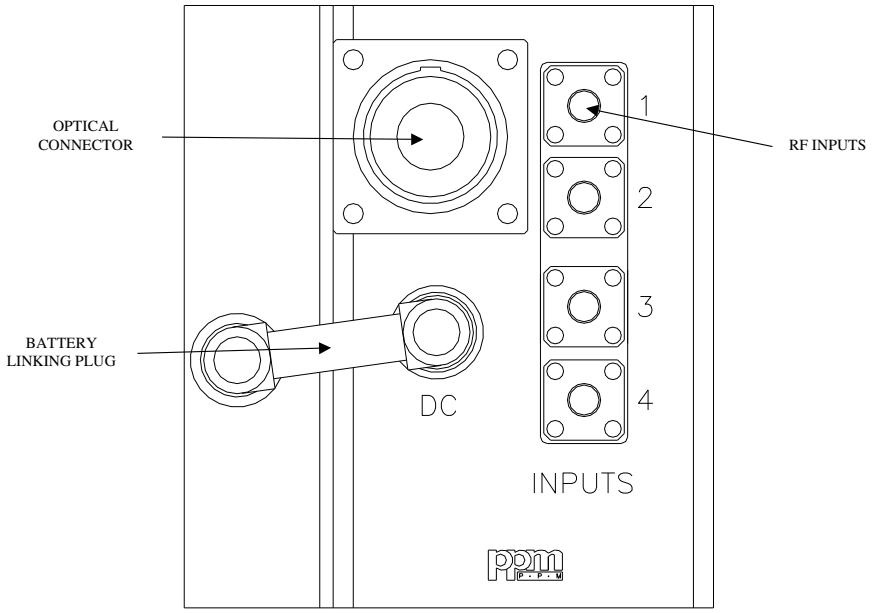
The Receiver Unit is now installed.

3 Setting up the Sentinel / Sentry IIsc FOLs

This section describes the connections between the Sentinel / Sentry IIsc FOL Transmitter and Receiver units and the System Controller. It also describes how connections are made between the Transmitter and Receiver units and external equipment.

Transmitter Connections

The figure below shows a front panel view of the transmitter module with battery pack.



Battery Pack Connection

The tab on the rear end of the Battery Pack should be located into the guide at the rear of the Transmitter Module. The two bolt heads on the Battery Pack should be then lined up with the guide holes on the Transmitter Module housing.

The Transmitter Module and the Battery Pack are linked by a shielded "U" link that pushes on to the DC Output Connector and the Transmitter Module DC input connector. Once the Battery Pack is located in position, the “U” Link can be pushed into position, and the outer shells of the "U" link screwed finger tight onto the Transmitter Module and Battery Pack DC connectors. **Failure to tighten this connector may compromise the EMC shielding performance of the Transmitter.**

RF Signal Input

The input signals are fed in to inputs 1 to 4 on the Transmitter Module. Connection should be made to the front panel with SMA male cables or adapters, and these should be tightened with an SMA torque spanner of 0.8 to 1.1Nm. Do not under tighten as this may degrade system performance. Do not overtighten as this will damage the equipment and cables.

Fibre Optic Cable Connection

Refer to page 3-3 for details of the connection of the Fibre Optic Cable connectors.

Battery Pack Removal

To remove the Battery Pack from the Transmitter Module, the "U" Link for the DC Power needs to be unscrewed and removed. The Battery Pack can then simply be lifted from the side of the Transmitter Module so that it is clear of the two locating lugs and pulled out from the locating slot at the rear of the Module.

CAUTION:

The Battery Pack is held in position by the “U” Link. Take care to support the Battery Pack when removing this link so that the Battery Pack does not fall and cause injury or damage.

Lemo 3K Fibre Optic Connector

To maximise protection in adverse environments, the Sentinel / Sentry IIsc FOL has been provided with rugged Lemo 3K type Fibre Optic Connectors.

These connectors feature a self-latching mechanism, which provides security against shock, vibration and cable tension.

CAUTION

Although the Lemo 3K connector is a very reliable connector, it is an optical component, and it relies on total cleanliness of the optical path for proper performance. Great care must be taken to keep the white ferrules within the connector shell completely clean at all times. Occasionally, it will be necessary to clean the optical contacts – refer to section 9 for details.

Connecting Lemo 3K Fibre Optic Connectors

Remove the protective dust cap from the cable mounted connector by holding the dust cap in one hand, and pulling the connector out by its outer release sleeve with the other hand.

Remove the protective dust cap from the equipment by supporting the equipment with one hand, and pulling the dust cap out with the other hand.

The 3K connectors are keyed and can only be inserted in one orientation. Correct alignment is indicated by the alignment key-way and red alignment markings. The key/alignment mark should be uppermost when the connector is being inserted.

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

When the cable mounted 3K connector is inserted, it should be firmly pushed into the panel mounted connector until the lugs are felt to latch into place.

Under no circumstances should the connector be forced into position.

Care should be taken not to drop the optical connector or to subject it to any other excessive physical shock, particularly when it is not protected with the dust cap.

Disconnecting Fibre Optic Connectors

The connector is disengaged by a single straight axial pull on the slotted outer release sleeve. This first disengages the latches and then withdraws the plug from the socket.

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

Care of fibre optic connectors

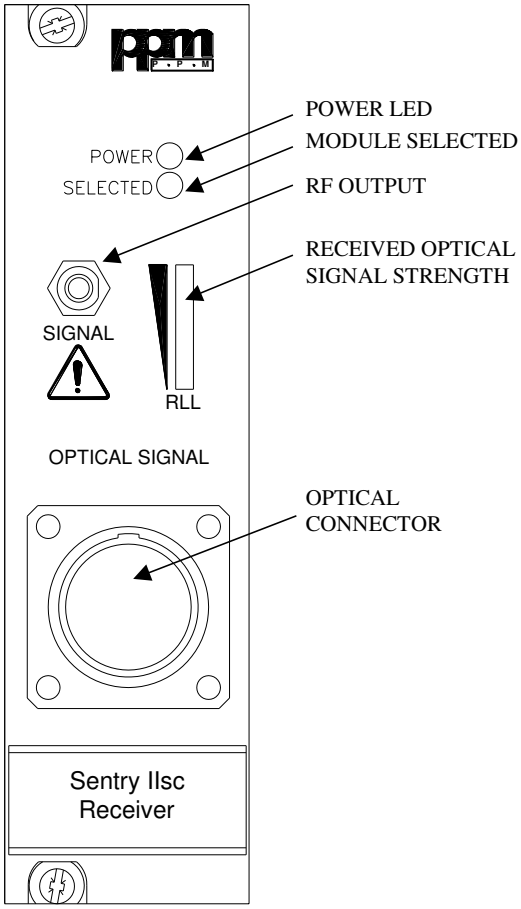
When the fibre optic cables are not connected, it is essential that the cable and equipment connectors are protected by the dust caps provided with the system. Failure to do so may result in damage to the fibre ends, which are critical to the system performance.

System performance may be compromised by dirt on the connector end or its alignment surfaces. Refer to section 9 for instructions on cleaning the optical connectors.

Connector performance will be compromised if the end face is scratched.

Receiver Connections

The figure below shows the connections on the Optical Receive Module front panel.



RF Signal Output

The output RF signal connector on the Receiver Unit is an SMA female type. Connection should be made to the front panel with SMA male cables or adapters, and these should be tightened with an SMA torque spanner of 0.8 to 1.1Nm. Do not under tighten as this may degrade system performance. Do not overtighten as this will damage the equipment and cables.

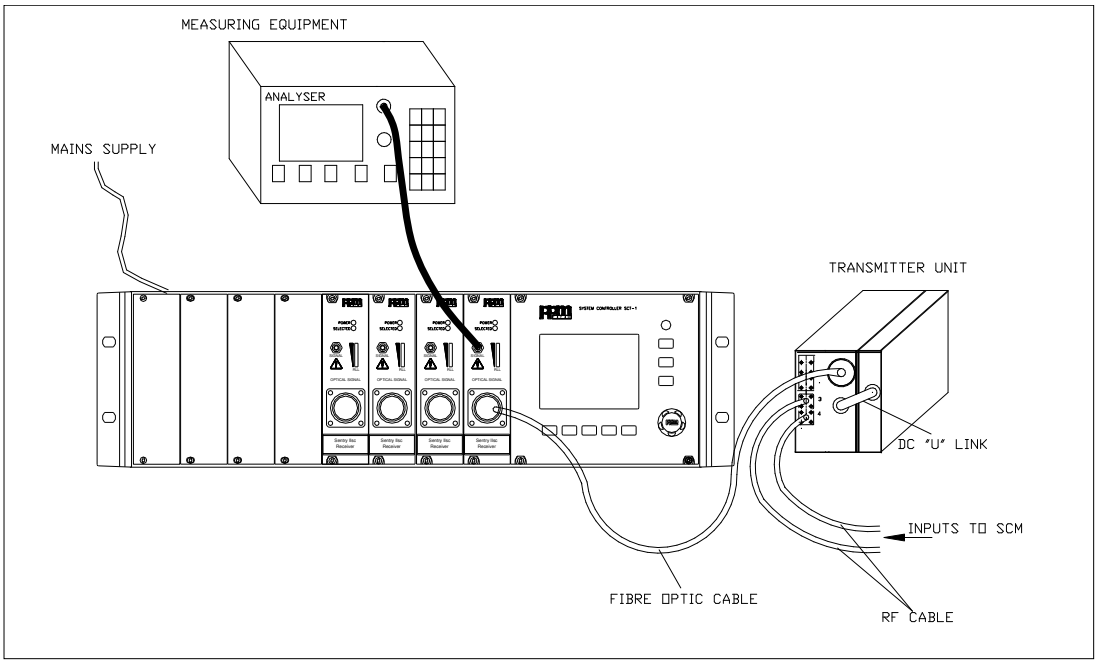
WARNING

As Sentinel & Sentry RX modules are AC coupled they will create a 1-2Vpeak DC transient at start up into a 50 ohm load (approximately 5V into a 1Mohm load). The rise time is ~150uS and the FWHM time is ~400uS. Some very sensitive spectrum analyzers (such as the R&S FSP40) have experienced front end failures, which are likely to be due to this initial transient. Please make sure that the spectrum analyzer is EITHER tolerant to these DC level OR is NOT connected to the RX output when the system controller is turned on.

Fibre Optic Cable Connection

Refer to page 3-3 for details of the connection of the Fibre Optic Cable connectors.System Interconnections

The figure below shows typical connections for a test system using the Sentinel IIsc FOL.



Once all the connections are made to the units, the System Controller can be switched on. All functions of the Transmitter and Receiver are controlled through the System Controller unit.

Information on the status of the installed links is available on the status screens on the System Controller.

All the controls available on the System Controller are also available via remote control from a computer, or equipment controller attached to the System Controller via an RS232 or GPIB link. This feature allows automated testing. More detailed information on remote control operation is available in the Remote Control section of this handbook.

4 Controlling the Sentinel / Sentry IIsc FOL

This section describes control of the Sentinel IIsc and Sentry IIsc fibre optic links through the PPM System Controller and the corresponding remote control commands. Some knowledge of the operation of the System Controller is required before this passage can be read. Consult handbook Sxx-HB.

Using the System Controller to operate the Sentinel / Sentry

On power-up, the System Controller will always scan all modules in the System Case or Subrack to determine the type of module fitted, and then select the first available controllable module.

Module settings and status indication, communication protocols, remote powering etc. are all selected from a menu driven graphical user interface on the front panel of the System Controller. The controller uses a large matrix display and softkeys to interface with the user. The functions of the softkeys change depending on the current displayed screen and a functional description appears on the LCD adjacent to each key. Where there is no legend next to a key, that key is not implemented.

The menu structure for controlling the Sentinel and Sentry IIsc modules comprises three main areas, all accessed from the horizontal buttons beneath the LCD screen. These are *Modules Settings*, *Module Status* and *Global Settings*.

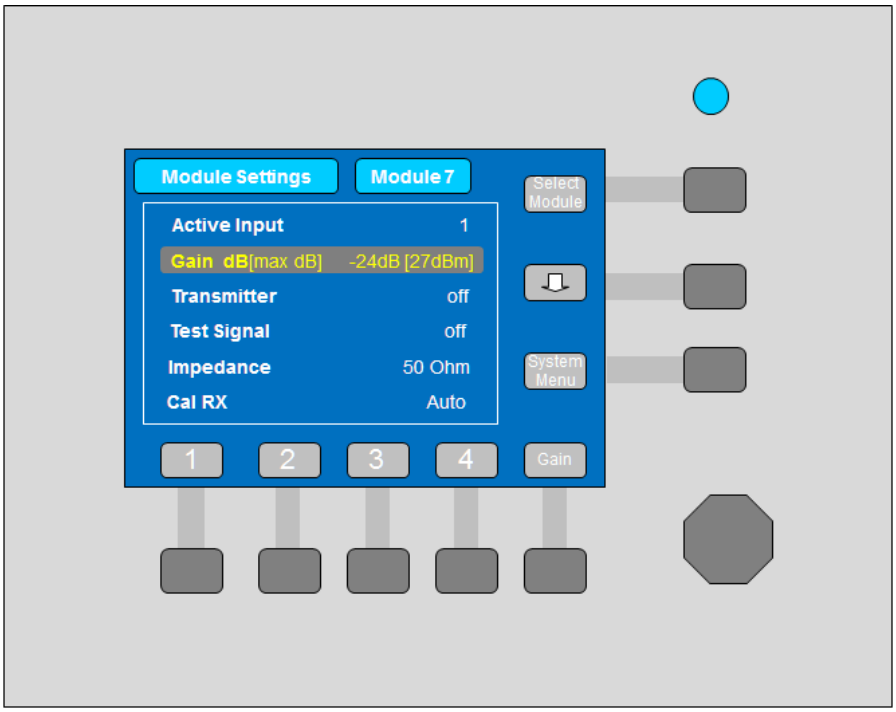
The setup of the Controller itself, which includes remote control and display settings, is accessed through the *System Settings* button to the right of the LCD display. Details of this can be found in the System handbook, Sxx-HB. This can be obtained from your local PPM representative, or downloaded from the PPM website.

Screen Title	*Description*
Module Settings	Edit all parameters for a particular FOL (Transmitter and Receiver)
Module Status	Poll a specific module pair for information
Global Settings	Control non-input-specific parameters of FOL

Switching on the Sentry / Sentinel IIsc FOL

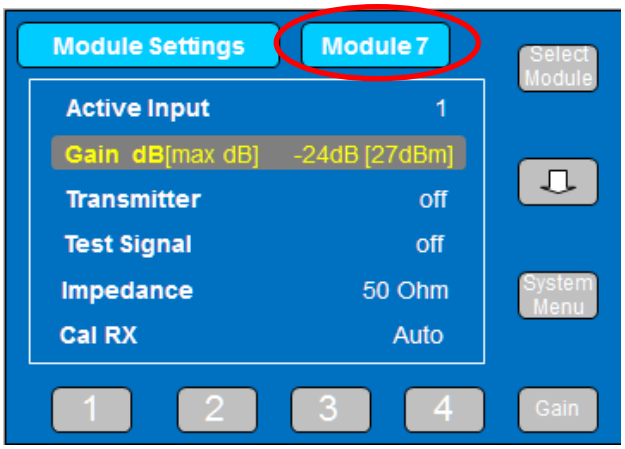
Power the case/rack using the red mains power switch on the rear panel. The System Controller's power button glows when in the standby state.

To power the controller, press the power button located to the top right of the LCD screen. The power button glows when the unit is in standby mode. After a brief start up screen you will be presented with the “Module Settings” screen. A graphical representation of the front of the SCT-1 is shown below:



Selecting a module

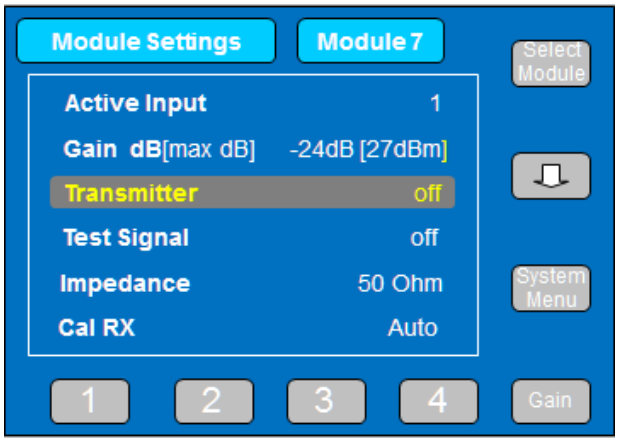
To select the module you wish to control, press the button adjacent to the “Select Module” icon. The selected module is displayed on the screen as shown below:



The selected LED on the corresponding receiver should also be green.

Transmitter on

To switch on a Transmitter Module, move the cursor down to the transmitter selection by pressing the button adjacent to the “down arrow” icon. The transmitter section of the display should now be highlighted as below:

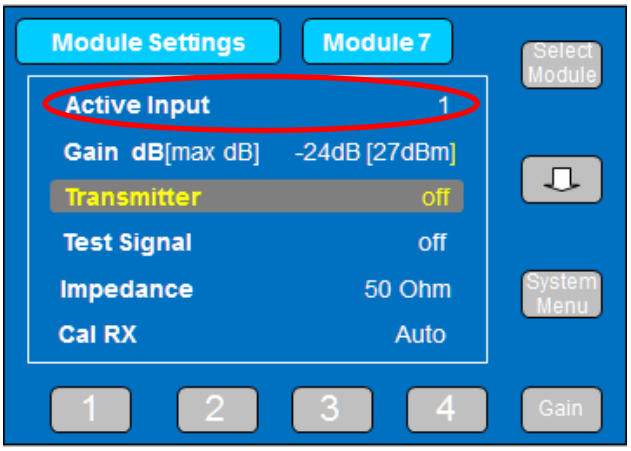


Rotate the function wheel clockwise until Transmitter status is displayed as “on”, the signal relays within the Transmitter Module will be heard to operate for a few seconds, and then the RLL bar LED array on the Receiver Unit front panel will indicate the optical level at the Receiver. If all LEDs are lit, the signal strength is within the AGC range of the receiver. For optical input powers beneath this level, each LED that is extinguished indicates another 1dB of optical insertion loss that should be calibrated out manually.

If the message “**NO CARRIER DETECTED**” is displayed on the LCD, refer to the fault finding guide in section 6.

Input Channel Select

The System Controller automatically selects Input 1 when it is switched on. The currently selected input is indicated by the “Active input” display, shown below:

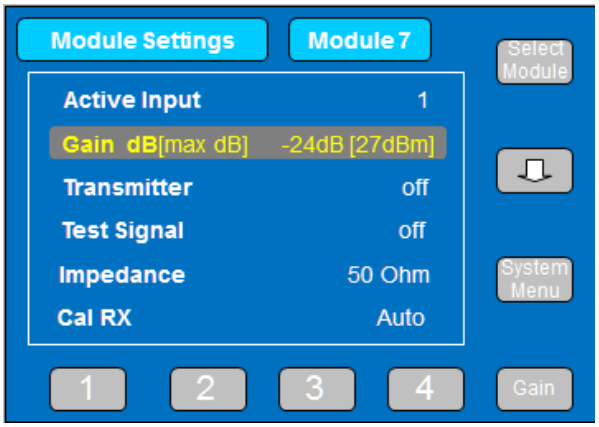


The other inputs may be selected by pressing the buttons below the icons numbered 1 to 4 on the system controller display.

Setting the Link Gain

The gain of the Sentry / Sentinel IIsc FOL is nominally -24dB. With the gain set to this level, the switchable pre-amplifier is deselected and all attenuators within the SCM are switched into the signal path. The gain may be varied by the user from -24dB to +33dB in order to match the wide dynamic range of the Sentinel / Sentry IIsc FOL to the level of the signal to be monitored.

On the "Modules Settings" screen, select the input required, and then highlight the "Gain" section of the display as shown below:



This can be achieved by, either stepping through the selections using the down arrow, or using the gain shortcut button, this is below the "Gain" icon.

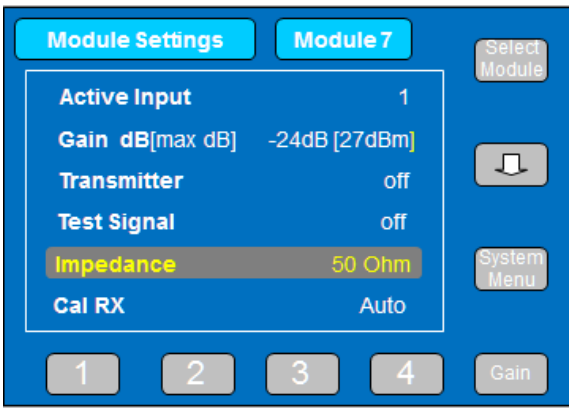
To change the gain value, use the function wheel. The gain of the transmitter will only change after the function wheel has been stationary for 2 -3 seconds.

The gain is adjustable in 3dB steps.

Changing the Input Impedance

It is possible to change the input impedance of the Sentry / Sentinel IIsc Transmitter from 50Ω to a high impedance of 500kΩ (nominal). Selection of the high impedance input limits the system bandwidth to 100MHz.

To change the impedance of an input, select the input you wish to change, highlight the Impedance section of the display by stepping through the selections using the down arrow. Screen shot shown below:

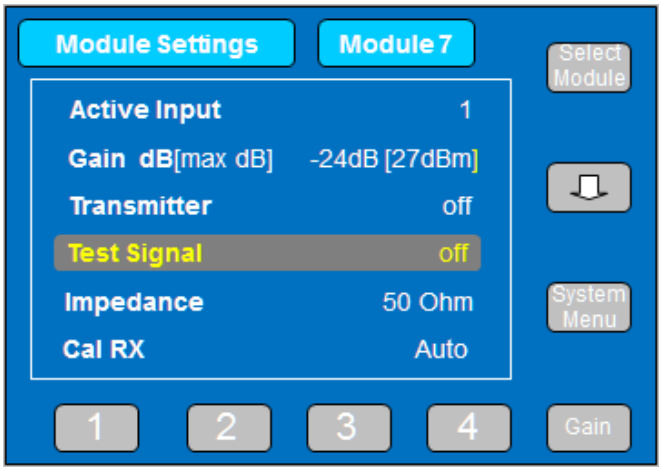


Rotate the function wheel to change the impedance. The Sentinel IIsc FOL has been optimised for ultra-wide bandwidth and wide dynamic range. As a result, the attenuators and other wideband circuits are all 50Ω, and the High Impedance buffer circuit is placed before these circuits in the Transmitter. ***The gain of the system should be set to 21dB when the High Impedance mode selected***, as operation at other system gains is likely to compromise the noise and linearity performance of the system.

Transmitter Test Signal

The 20MHz (nom.) squarewave test signal generator in the Transmitter Module can be switched in to verify the link gain. This is done by monitoring the signal at the Receiver output on a high frequency oscilloscope. The expected Receiver output level is **250mVp-p +/-25mV** when the system gain setting is set to +21dB.

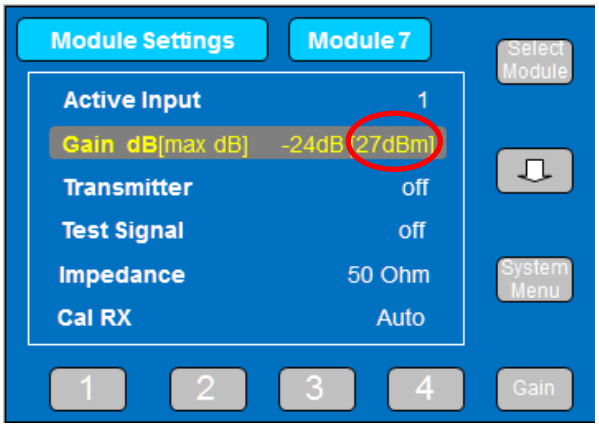
To enable the test signal, highlight the test signal section of the display by stepping through the selections by using down arrow, as shown below:



Rotate the function wheel to enable/disable the test signal.

Max Input Displayed Unit Select

The maximum allowable input is displayed on the screen, as shown below:



The maximum allowable input that may be applied can be toggled between dBm, dBμV and mV.

To change the units, select the button adjacent to the system menu icon, and then select the button adjacent to the Global Menu icon.

On the Global Settings screen, change the units using the function wheel, and then press the button adjacent to the confirm icon when you are happy with your selection. To return to the Module Settings screen, press the button adjacent to the control modules icon.

The Max Input value is automatically changed as the system gain is changed.

Operating the Sentinel IIsc Receiver Calibration Function

The Sentinel / Sentry IIsc modules automatically calibrate the link when "Transmitter On" is selected. If re-calibration is required, this function should be selected at the System Controller from Module Status menu.

The Receiver Calibration function performs the following operations :

The Receiver measures the received optical power level. This value is used to set the RF gain of the Receiver in 0.25dB steps so that the overall system gain is within 0.25dB of the indicated gain on the Controller screen.

This allows small variations in optical path loss to be accommodated, minimising the impact of variations in optical connector insertion losses. This technique maximises the dynamic range of the link, although it may result in small gain variations of no more than 0.25dB every time the Calibrate function is selected. In certain situations, this should be considered (e.g. if the link gain is accurately calibrated with a network analyser for a precise measurement). In such a situation, the Calibrate function should not be initiated between the network analyser calibration and the measurement.

If the receiver optical power is lower than can be accommodated by the AGC calibration circuit, the receiver gain is set to its maximum value to compensate in part for the loss. The actual insertion loss can be monitored either directly from the Receiver front panel LEDs, or by accessing the RLL function on the Module Status Screen of the Controller for the module in question.

To enter the module status screen from the module setting screen, first select the button adjacent to System Menu icon and then select the button adjacent to the Module Status icon. To return to the Module Settings display select the button adjacent to the Control Modules icon.

RLL BAR LED STATUS	**MEANING OF INDICATION**	**SYSTEM GAIN**
■■■■■■■■	OPTICAL PATH LOSS < 4dB	Gain accurate
■■■■■■■□	4dB < OPTICAL PATH LOSS < 5dB	!! Gain setting in error !!
■■■■■■□□	5dB < OPTICAL PATH LOSS < 6dB	!! Gain setting in error !!
■■■■■□□□	6dB < OPTICAL PATH LOSS < 7dB	!! Gain setting in error !!
■■■■□□□□	7dB < OPTICAL PATH LOSS < 8dB	!! Gain setting in error !!
■■□□□□□□	8dB < OPTICAL PATH LOSS < 9dB	!! Gain setting in error !!
■□□□□□□□	9dB < OPTICAL PATH LOSS < 10dB	!! Gain setting in error !!
□□□□□□□□	OPTICAL CARRIER LOST	-

5 Remote Commands

All the functions for the SCT-1 can be controlled remotely with a computer via an RS232 link or a GPIB link. For information about setting up a connection, or remote control of the controller's system settings, please consult the System, Sxx-HB.

Please note: *As standard, All GPIB commands written to the system controller generate a response, it is important to read these responses back from the controller even if the data is not required. Failure to do so will cause the system controller not accept another command for 2 – 3 seconds.*

To disable the "Ok" responses please see "REMOTE OFF" command.

All commands refer to the currently selected module unless otherwise specified. "Ξ" represents a SPACE character. All responses are followed by [CR] and [LF].

Command	Description	Responses	Meaning
*IDN?	System Data, Identification query	PPM,SCT-1,FOL,V1.3	Folnet successfully found at queried GPIB address.
TXΞON	Turn Transmitter ON	CARRIER DETECTED Ok	Ok
		NO CARRIER DETECTED Ok	No Optical Carrier at Receiver
TXΞOFF	Turn Transmitter OFF	Ok	Ok
INPΞ1	Select Input 1	Ok	Ok
INPΞ2	Select Input 2	Ok	Ok
INPΞ3	Select Input 3	Ok	Ok

Command	Description	Responses	Meaning
INPΞ4	Select Input 4	Ok	Ok
GAINΞ-x	Set Gain of Current Input Channel to -xdB	Ok	Ok
		NOT AVAILABLE Ok	Gain setting out of range
GAINΞ0	Set Gain of Current Input Channel to 0dB	Ok	Ok
GAINΞ+x	Set Gain of Current Input Channel to +xdB	Ok	Ok
		NOT AVAILABLE Ok	Gain setting out of range
IMPΞ50	Select 50Ω Input Impedance for Current Input Channel	Ok	Ok
IMPΞHIZ	Select High Input Impedance for Current Input Channel	Ok	Ok
CALΞON	Turn Tx Test Signal ON for Current Input Channel	Ok	Ok
CALΞOFF	Turn Tx Test Signal OFF for Current Input Channel	Ok	Ok
DBM	Puts Maximum Input Display in dBm	Ok	Ok
DBUV	Puts Maximum Input Display in dBμV	Ok	Ok
VPP	Puts Maximum Input Display in Volts Peak-to-Peak	Ok	Ok
SYS	Report Status of Current Module	See Below	Ok
REPORTΞALL	Operates the same as SYS command	See SYS Below	Ok
REPORTΞMOD	Returns only SYS Header Section	See SYS Below	Ok
REPORTΞINP1	Returns only Input 1 information	See SYS Below	Ok
REPORTΞINP2	Returns only Input 2 information	See SYS Below	Ok
REPORTΞINP3	Returns only Input 3 information	See SYS Below	Ok
REPORTΞINP4	Returns only Input 4 information	See SYS Below	Ok
ALLΞCALΞON	Turn Tx Test Signal On, All Channels	Ok	Ok
ALLΞCALΞOFF	Turn Tx Test Signal Off, All Channels	Ok	Ok
ALLΞTXΞON	Turn all Transmitters On	Ok	Ok

Command	Description	Responses	Meaning
ALLΞTXΞOFF	Turns all Transmitters Off	Ok	Ok
MODΞ1	Select Module 1	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ2	Select Module 2	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ3	Select Module 3	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ4	Select Module 4	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ5	Select Module 5	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ6	Select Module 6	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ7	Select Module 7	Ok	Ok
		MODULE DISABLED Ok	No Module Present
MODΞ8	Select Module 8	Ok	Ok
		MODULE DISABLED Ok	No Module Present
LOCAL	Puts SCT in Local mode	Ok	Ok
REMOTE	Puts SCT in Remote mode	Ok	Ok
		NOT AVAILABLE Ok	Module is already in remote mode
REMOTEΞOFF	Puts SCT in Remote mode, but also removes the “OK” response after completion of every command sent.	*NONE*	

Command	Description	Responses	Meaning
STAT	Queries the status of each module position.	0,0,0,0,0,0,7,6 Ok	Returns 8 numbers where each number represents the type of module installed in each of the 8 possible positions: 0=none 6=Sentinel 7=Sentry
REMOTEΞON	Puts SCT in Remote mode, but also adds the "OK" response on completion of every command. This command is only required if responses have been previous removed by a REMOTE OFF command.	Ok	Ok
SET?Ξx	Queries module x	1,1,Y,-24,50,2,N,-24,50,3,N,-24,50,4,N,-24,50 Ok	The output is formatted as "A,B,C,D,E,B,C,D,E,B,C,D,E,B,C,D,E" Where the character represented by "A" is the module queried. The character represented by "B" is the module input. The character represented by "C" is Y if the input is selected or N if the input is not selected. The character represented by "D" is the gain. The character represented by "E" is the input impedance, 50 for 50 ohm and HIZ for high impedance.
		MODULE DISABLED Ok	No Module Present

Command	Description	Responses	Meaning
SETΞa,b,c,d	Set a modules input, gain and impedance in one command a=module b=input c=gain d=impedance **Examples:** **SET 1,1,-3,HIZ** *Set module 1, input 1 to -3dB of gain and High impedance.* **SET 1,3,33,50** *Set module 1, input 3 to 33dB of gain and 50ohm impedance.*	Ok	Ok
		MODULE DISABLED Ok	No Module Present

Command	Description	Responses	Meaning
GPIB x	This sets the GPIB response timeout. x is between 0 and 15. 0= OFF 1= 16us 2= 32us 3= 128us 4= 256us 5= 1ms 6= 4ms 7= 16ms 8= 33ms 9= 131ms 10= 262ms 11= 1s 12= 4s 13= 17s 14= 34s 15= 134s	Ok	Ok Note: this command may cause unexpected results if the GPIB timeout is either set too low or too high and therefore should be used with care.

Other responses

SCT1 IS IN LOCAL MODE Ok	SCT is in Local Mode - send REMOTE command or press "Go Remote".
UNSUPPORTED FUNCTION Ok	Function is not supported by the type of module selected.

SYS (or REPORT ALL) Command Response

```
MODULE SELECTED: 1  SENTRY 2SC                  )
TRANSMITTER STATUS : **********                 |
BATTERY STATUS     : NOT TESTED                 |
CARRIER            : Off                        } REPORT MOD
TRANSMITTER        : Off                        |
CALIBRATE          : Off                        |
INPUT : 4                                       )

INPUT : 1 ********                              )
GAIN        : -24.0 dB                          |
MAX INPUT   : 14.1V mV p-p                      } REPORT INP1
INTEGRATOR  : OFF                               |
IMPEDANCE   : 50 Ohm                            |
FILTER      : OFF                               )
INPUT : 2 ********
GAIN        : -24.0 dB
MAX INPUT   : 14.1V mV p-p
INTEGRATOR  : OFF
IMPEDANCE   : 50 Ohm
FILTER      : OFF
INPUT : 3 ********
GAIN        : -24.0 dB
MAX INPUT   : 14.1V mV p-p
INTEGRATOR  : OFF
IMPEDANCE   : 50 Ohm
FILTER      : OFF
INPUT : 4 ********
GAIN        : 0.0 dB
MAX INPUT   : 894.0 mV p-p
INTEGRATOR  : OFF
IMPEDANCE   : 50 Ohm
FILTER      : OFF
OK
```

It should be noted that the INTEGRATOR and FILTER functions are redundant and only appear in the SYS response data to maintain compatibility with the FOLNET controller.

Please note: The following commands return multiple lines, and therefore a suitable program in LabVIEW or equivalent will have to be written to receive the data from these commands when using GPIB.

"Ξ" represents a SPACE character

Command	***Meaning***	***Number of lines returned (in REMOTE ON mode)***
SYS	Report Status of Current Module	33
REPORTΞALL	Report Status of Current Module	33
REPORTΞMOD	Returns only SYS Header Section	9
REPORTΞINP1	Returns only Input 1 information	7
REPORTΞINP2	Returns only Input 2 information	7
REPORTΞINP3	Returns only Input 3 information	7
REPORTΞINP4	Returns only Input 4 information	7

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
Module Not Recognised by System Controller	Module Not Installed Correctly or not responding to Commands from Controller.	Switch off Controller, remove Module and re-install following instructions on page 2-1
	Correct Controller Software not Installed	Update Controller Software from http://www.ppm.co.uk
System Controller indicates "Carrier Not Detected"	Discharged Battery Pack	Recharge/replace Battery Pack
	Fibre Optic Cable has not been connected correctly	Check fibre optic connectors are fitted correctly
	Dirt on the fibre optic connectors	Clean the fibre optic connector with the correct fibre optic cleaning kit. Refer to Section 9.
	Signal or Control fibre has been broken	Contact PPM
Gain or Test Signal incorrect	The gain of the system appears to be incorrect	Operate the Receiver Calibration function, which will reset the optical gain of the system.
Receiver Calibration does not resolve gain inaccuracy	Connectors are dirty or damaged	Clean the fibre optic connector with the correct fibre optic cleaning kit. Refer to section 9. If this does not remedy the problem, contact PPM.
Unit appears to respond slowly to GPIB commands	All GPIB commands written to the system controller generate a response, these must be read back from the controller even if the data is not required	Always do a GPIB read after a GPIB write to the system controller

In the event of any problems with the equipment contact PPM or your local agent.

7 System Specifications

The following specifications show the performance of Test & Measurement Fibre Optic Links.

LINK PERFORMANCE	SENTRY IISC	SENTINEL IISC
Number of Input Channels	4 switchable inputs	
Input/Output Impedance	50□ / Hi-Z Buffer*	
Frequency Response (-3dB)	<40Hz to >500MHz	<2kHz to >1GHz
Risetime	< 1.4ns	< 450ps
Output P1dB / IP3	+5dBm / +11dBm	
Dynamic Range	139dB in 1Hz bandwidth	
Noise Figure (100MHz / 21dB Gain) (100MHz / 33dB Gain)	 17dB 11.0dB	
Gain Adjustment	-24dB to +33dB in 3dB steps	
Gain Tolerance (+21dB gain)	±1dB	
Signal Inversion	Non-inverting	Inverting
Flatness (+21dB gain)	±1.2dB, 60Hz to 400MHz	±1.2dB, 3kHz to 800MHz
VSWR	< 2 : 1	
Optical Self-Calibration Range	7.5dB electrical, 0.25dB steps	
Built-In Transmitter Test Signal Frequency Amplitude	 20MHz squarewave (nominal) 250mVp-p ± 10% into 50□	

ENVIRONMENT

Operating Temperature Plug-In Receiver Shielded Transmitter	 +10°C to +40°C 0°C to +40°C
Storage Temperature	-40°C to +70°C

FIBRE OPTIC SPECIFICATION

Optical Connections	LEMO 3K dual ferrule connector
Output Power	+4.5dBm nominal (IEC825 Class 1 Laser Radiation Hazard)
Cross-Site Cable Lengths	50m, 100m, 200m

PHYSICAL FORMAT

Transmitter Module Housing Weight	 Shielded Module 1.5kg not including battery pack
Receiver Module Housing Weight	 7hp Plug-In compatible with SRK-3 Desktop Case 600g

POWER SUPPLY

Transmitter Module	Shielded Battery Pack, Standard or High capacity
Receiver Module	Power derived from subrack/case

RF CONNECTION

Transmitter Input Connectors	Gold Plated SMA (4off)
Receiver Output Connector	Gold Plated SMA (1off)

FRONT PANEL INDICATION

Receiver	Module Selected LED, Received Light Level Display
Controller SCT-1	Full System Status available via Colour LCD

Application Notes

Please contact PPM Ltd or your local agent for Application Notes describing the potential applications for the Sentinel / Sentry IIsc FOL.

8 Product Warranty

The Company guarantees its products, and will maintain them for a period of one year 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).

9 Fibre Optic Connector Cleaning Procedure

Although the Lemo 3K connector is a very rugged and reliable connector, it will occasionally become necessary to clean the optical contacts in accordance with the following procedure.

PPM provide a Lemo 3K Cleaning Kit which contains the following items:

- Extraction Tool for Fibre Optic Contact
- Cotton buds for cleaning optical contacts.

The user should source the following items locally:

- Reagent grade Iso Propyl Alcohol (IPA). NB IPA is flammable, and appropriate attention should be paid to relevant local and national safety regulations and guidelines.
- Pressurised clean air supply e.g. compressed air aerosol (“air duster”)

A Lemo 3K mating pair consists of an optical plug (usually cable mounted), and an optical socket (usually equipment panel mounted).

CAUTION

Throughout the process, great care must be taken not to use materials that may scratch the optical contacts. Even microscopic scratches may severely degrade the performance of the connector.

Cleaning the Optical Plug

Dampen the cotton bud with IPA, and gently wipe over the white ceramic optical contact visible inside the plug. Remove excess IPA from the contact with the compressed air.

It may be possible to clean the contact adequately without the use of IPA or compressed air simply by wiping the contact with a dry cotton bud.

Cleaning the Optical Socket

The optical socket is simply an optical plug with an alignment ferrule. This ferrule must be withdrawn to give access to the optical contact.

Screw the threaded end of the extraction tool into the socket until it comes to a stop. Now gently and firmly pull back on the extraction tool to remove the alignment ferrule.

Use a cotton bud and IPA as before the clean the exposed contact inside the connector.

To replace the alignment ferrule, simply push it back into place with the extraction tool, and then unscrew the extraction tool.

It may be possible to clean the contact adequately without the use of IPA or compressed air simply by wiping the contact with a dry cotton bud.

10 Spares Information

The following spares are available with the Sentinel IIsc system:

PPM Part Number	Description
73553	Lemo 3K Fibre Optic Connector Cleaning Kit

CAUTION Hazardous voltages exist within the PPM T&I System Desktop Cases and Subracks. Adjustment, maintenance and repair of the equipment should only be carried out by suitably qualified personnel.

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