## Polarization Extinction Ratio Meter

# PEM-320

**Operation Manual**

santec

## Disclaimer

Every effort has been made to ensure the information contained in this manual is accurate and easily understandable. Santec shall not, however, be liable for errors contained herein, or for incidental or consequential damages in connection with the use of this material.



ISO-9001 certificated

This product has been produced in accordance with ISO-9001 international quality system standards.

# About This Manual

This manual explains the operation and safety features of the PEM-320 Polarization Extinction Ratio Meter. To ensure the safe operation of the instrument, and to prevent the risk of personal injury and/or damage to the equipment we recommend that you read the manual fully before commencing installation and operation. In particular Chapter 6 outlines the precautions necessary to ensure safe operation. The following safety symbols are used throughout the manual and on the equipment to indicate safety related information.


This indicates a dangerous procedure that could result in serious injury or death if not performed properly.


This indicates a hazardous procedure or danger that might result in injury or that could damage the equipment if proper precautions are not taken.

This mark is used on the equipment as a warning of danger.

## Packing Materials

The original packing materials are required to ensure the safe long term storage and safe transportation of this equipment. It is recommended that all packing materials are kept for these purposes.

# Contents

## 7. Operation Procedures



## 8. Communication Interfaces



## 9. Example Programs



## 10. Care and Maintenance



## 11. Troubleshooting

## 12. Warranty

# Introduction

The PEM-320 Polarization Extinction Ratio Meter provides accurate, real-time information about the polarization state of light in an optical fiber. It can be used as a general purpose measuring instrument but has been designed, in particular, to enable the accurate and rapid alignment of polarization maintaining fibers to optical components. The rotating polarizer design, coupled with a high sensitivity detector enable the PEM-320 to measure high linear polarization extinction ratios, of up to 40dB, with a 2.5Hz refresh rate.

The PEM-320 simultaneously displays values for polarization extinction ratio (PER), optical power and polarization angle. These are the three critical parameters required for the alignment of polarization maintaining fiber to optical components. In addition, the PEM-320 has full support for GPIB and RS-232C communication interfaces together with an analogue data output. These features provide the unit with unrivalled flexibility for integration into automatic measurement and automatic fiber alignment systems.

The PEM-320 is easy to use, but to obtain the most from your unit we recommend that you read this manual fully and become familiar with its contents prior to operation. We hope that you will be satisfied with your purchase.

# Specifications

| Item | Unit | Value |
|---|---|---|
| Wavelength Range | nm | 1520 ~ 1600* (power calibrated at 1550nm) |
| PER Range | dB | 0 ~ 30 (when input power >-30dBm) |
| | | 0 ~ 40 (when input power >-20dBm) |
| PER Resolution | dB | 0.1 (when PER < 30dB) |
| | | 0.3 (when PER > 30dB) |
| Power Measurement | dBm | -40 ~ +10* |
| Power Resolution | dB | 0.1 (when Power > -30dBm) |
| | | 0.3 (when Power < -30dBm) |
| Polarization Angle Resolution | deg | 0.45 |
| Measurement Speed | s | 0.1, 0.2, 0.4 (selectable) |
| Operating Temperature | ˚C | 10 ~ 40 |
| Connector Type | - | FC, SC (SPC polish)* |
| Communication Interface | - | GPIB, RS-232C |
| Size | mm | 210 x 80 x 300 |
| Weight | kg | 3 |
| Supply Voltage | V | 100 / 110 / 230 / 240 |
| Maximum Power | W | 40 |

* The following options are available:

Wavelength Range 980nm, 1310nm, 1480nm & 1550nm bands.

Connector Polish SPC or APC

High Power Range -20dBm ~ 23dBm

The following items should be supplied with your PEM-320 unit:

1. 2 power switch keys.
2. Power supply cable.
3. Analogue interface (AIF) connection cable.
3. Operation manual.
4. Test report.

# 3 Features

## 3.1. Real Time Display

The PEM-320 displays simultaneously, and in real time, values for the three critical parameters required for the alignment and characterisation of polarization maintaining fiber and polarization fiber pigtailed components. These are the polarization extinction ratio (PER), optical power and polarization angle. In addition, the optical power can be displayed in units of mW or dBm.

## 3.2. Offset Cancel

An Offset Cancel function is provided to enable compensation for the dark current of the photodetector. This provides improved accuracy and greater dynamic range even when low optical powers are used.

## 3.3. Communication Interfaces

The PEM-320 can be used as a stand alone bench-top type measurement instrument. However, it also boasts industry standard GPIB and RS-232C interfaces through which the unit can be fully controlled and through which all parameters can be monitored. The PEM-320 is thus suitable for automated measurements in production environments and for integration into fully automatic alignment systems.

## 3.4. Analogue Data Output

In addition to the communication interfaces described above, the PEM-320 has an analogue output for monitoring of all the measured parameters. These signals are particularly useful as feedback signals for the control loops of automated alignment systems. As an option, an output monitoring the signal directly from the photodetector can also be provided.

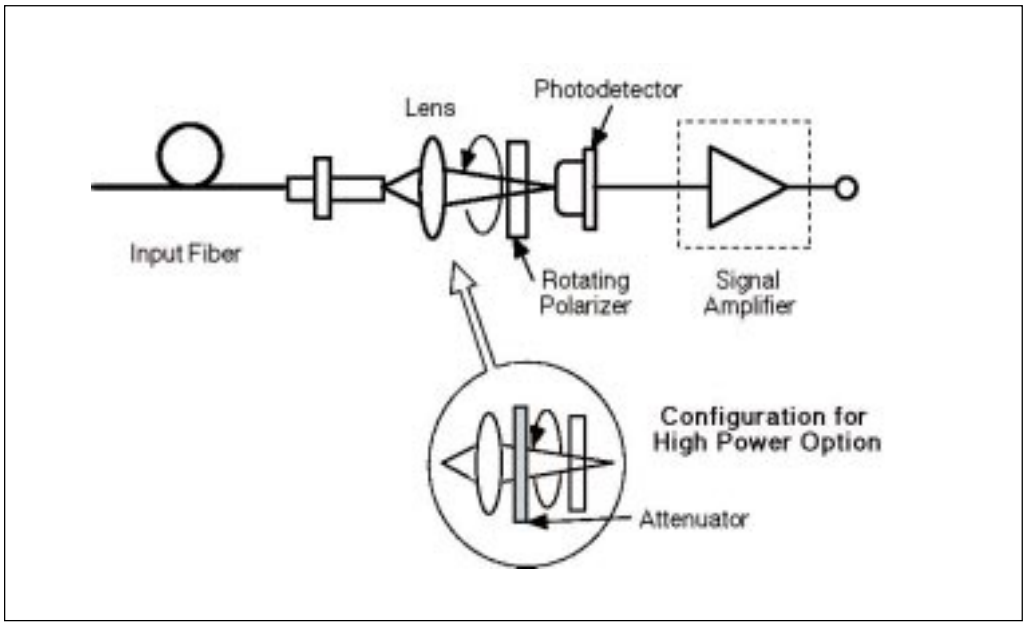
## 3.5. Stopped Polarizer Function

The PEM-320 measures PER using a rotating polarizer. In some circumstances, such as the automatic alignment of the lateral orientation of an optical fiber to a laser light source, it is useful to be able to stop the polarizer and measure the optical power with a faster response time than the 10Hz rotation will allow. The Stopped Polarizer Function provides this flexibility and enables the polarizer to be stopped at the angle of either maximum or minimum power transmission.

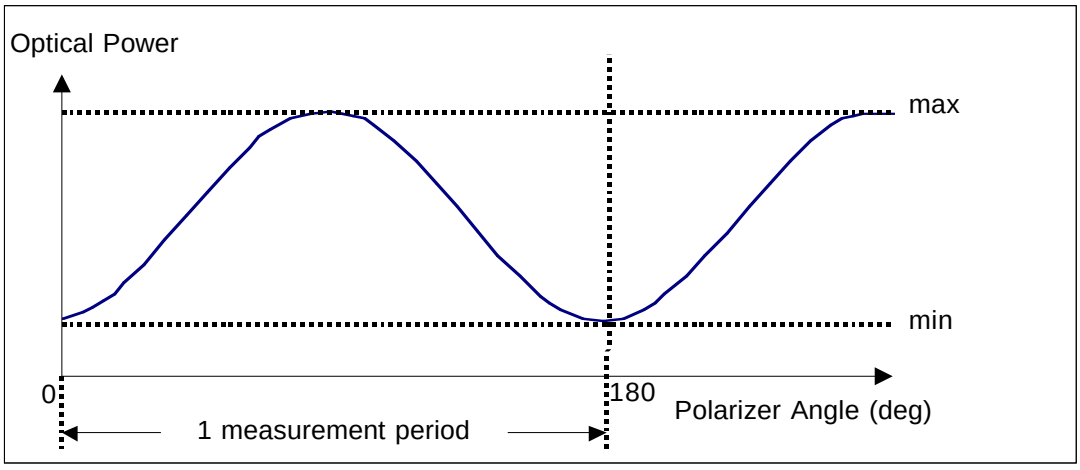
## 3.6. High Speed Measurement

To provide additional flexibility the PEM-320 can operate at one of three measurement speeds. The default 2.5Hz measurement speed is recommended as it provides the highest dynamic range for both PER and optical power. However, when required, the measurement speed can be increased through software control to either 5 or 10Hz.

# 4 Principle of Operation



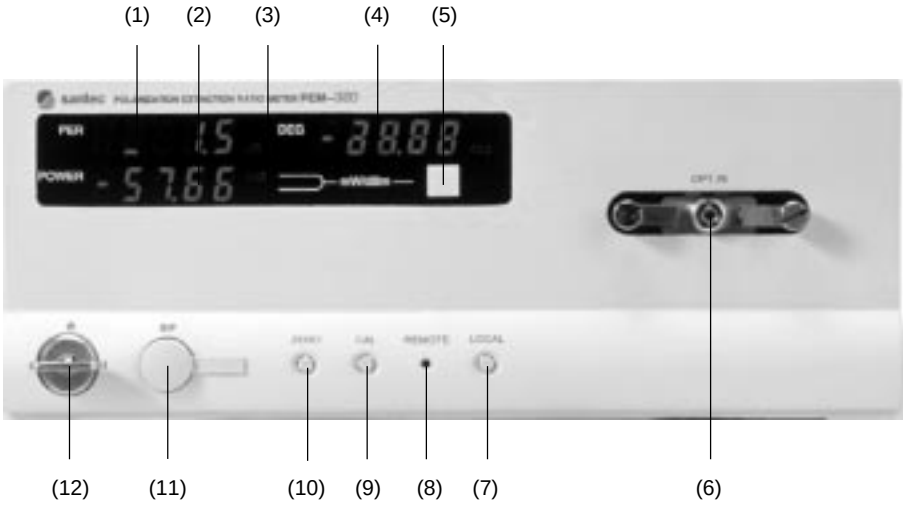

The above diagram shows the design of the PEM-320 unit. The optical fiber is connected through the input connector. The light from the fiber is then collimated by a lens, and after passing through a rotating polarizer is incident on the photodetector. In units with the high power option fitted, an optical attenuator is placed prior to the rotating polarizer. This attenuator is specially designed to be polarization independent to ensure that it does not compromise the performance of the free space optics design.



After amplification the detected signal is converted to a digital format to enable the measured parameters to be calculated by the unit's microprocessor. The diagram on the previous page shows the sine-wave signal obtained as the polarizer rotates. One measurement period corresponds to a 180˚ rotation of the polarizer. PER is calculated as the ratio of the maximum and minimum signals in any one measurement period and the polarization angle is determined by detecting the position of the polarizer at minimum transmission. The PEM-320 displays a polarization angle of zero when the polarization axis is vertical and aligned with the alignment notch of the input connector.

# 5 Panel Descriptions

## 5-1. Front Panel




**(1) PER Display Panel**

Displays the value for polarization extinction ratio (PER) in dB.

**(2) Optical Power Display Panel**

Displays the optical power. The measurement unit can be set to either mW or dBm and is toggled by pressing the Optical Power Unit Selector Key (5). The power is calibrated at the center wavelength of the operating range of the PEM-320 unit; i.e. at 980nm, 1310nm, 1480nm or 1550nm.

**(3) Optical Power Unit Indicator**

Indicates unit of optical output power (mW or dBm).

**(4) Polarization Angle Display Panel**

Indicates the polarization angle of the light from the optical input in degrees. The angle is measured with respect to the alignment notch on the optical connector; i.e. a value of zero is given when the polarization axis is vertical and aligned with the alignment notch.

**(5) Optical Power Unit Selector Key**

Toggles the optical power measurement unit between mW and dBm. This key is also used when setting the GPIB address and GPIB delimiter.

**(6) Optical Input Connector**

**(7) GPIB Local Key / GPIB Address Change Key**

**a.** Pressing this key when GPIB remote operation is active returns control to the front panel.

**b.** When this key is pressed for two seconds continuously the GPIB address and GPIB delimiter setting mode is entered. The PER Display Panel (1) shows the GPIB address which flashes to indicate that it can be changed using the Optical Power Unit Selector Key (5). Pressing the GPIB Local Key a second time causes the GPIB delimeter setting shown in the Polarization Angle Display Panel (4) to flash. Similarly, this can be changed using the Optical Power Unit Selector Key (5). Pressing the GPIB Local Key a third time saves the displayed values and returns control to normal operation.

**b.** Pressing this key when the power to the PEM-320 is first switched on sets the RS-232C delimiter to CR (carriage return).

**(8) GPIB Remote LED**

Indicates GPIB remote operation is active. When active the front panel keys become inoperative. To return control to the front panel press the GPIB Local Key (7).

**(9) Calibration Key (CAL)**

Not used (reserved for future use).

**(10) Zero Key (Offset Cancel)**

**a.** Enables compensation for the dark current of the photodetector. A cover should be placed over the Optical Input Connector to prevent any stray light entering the unit before this button is pressed.

**b.** Pressing this key when the power to the PEM-320 is first switched on sets the RS-232C delimiter to LF (line feed).

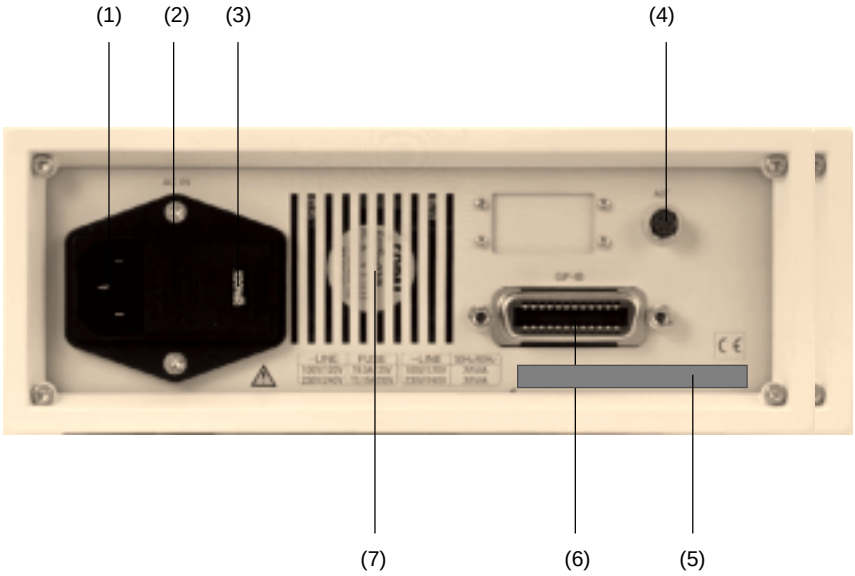
**(11) Serial Interface (SIF) Connector**

Used for RS-232C communication.

**(12) Power On / Off Key Switch**

Operated using the power switch key, this is used to switch the unit on and off.

## 5.2. Rear Panel




**(1) Mains Connector Socket**

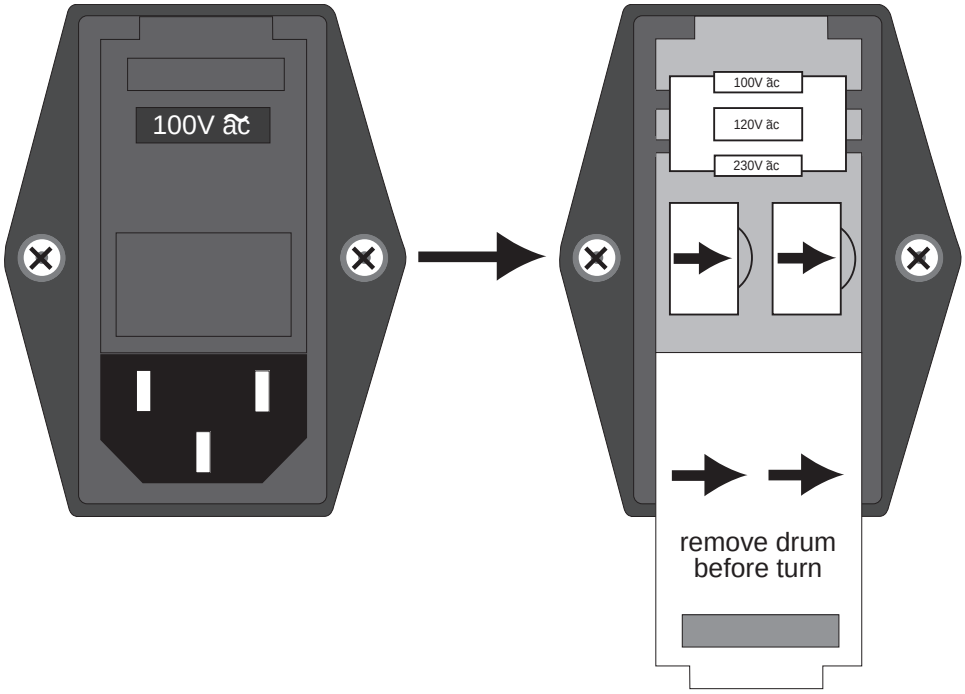
**(2) Fuse Housing**

**(3) Mains Voltage Indicator**

The supply voltage is selected by removing the fuse housing cover, and rotating the mains voltage indicator so that the correct voltage, corresponding to the mains supply voltage, is shown in the window when the fuse housing cover is replaced. Ensure that the housing cover is tightly closed before reconnecting the mains cord.

**(4) Analogue Interface (AIF) Connector**

Provides analogue output of PER, Optical Power and Polarization Angle.




**(5) Serial Number Label**

Indicates model number, serial number and options installed on each unit.

**(6) GPIB Connector**

**(7) Slit**

Slit for heat dissipation. It is important to leave at least 5 cm of space behind the PEM-320 unit to ensure proper ventilation and cooling.

# 6 Safety Information

## 6.1. Mains Voltage

Please ensure the voltage indicated on the rear panel of the instrument corresponds with the mains voltage supply. Applying an incorrect mains voltage will damage the equipment. See Section 5.2 for details of how to change the voltage setting and Section 10.3 for details of changing the fuse. Ensure that the rating of the fuse corresponds to the mains voltage selected; details are given in Section 10.3.

The unit is provided with a three pin cord. To ensure the safe operation of the instrument please make sure that this is connected to a grounded power outlet.

## 6.2. Installation

To ensure the safe operation of the instrument it should not be installed:

- In a position where the air from the cooling fan cannot flow freely. Allow at least 5cm behind the unit for this purpose.
- Where there are high levels of vibration.
- Where it would come into contact with water.
- In very humid or dusty locations.
- Where there are strong electric or magnetic fields.
- In direct sunlight.
- Where there are extremes of temperature.

## 6.3. Safe Operation

The unit should not be operated in any of the following circumstances:

- If water or other liquid is spilt on the unit.
- When the unit is cleaned or moved.
- If damage is found to the mains cord.

In the event that these occur while the unit is being used the Power On / Off Key Switch should be turned off immediately, and the mains power turned off at the outlet.

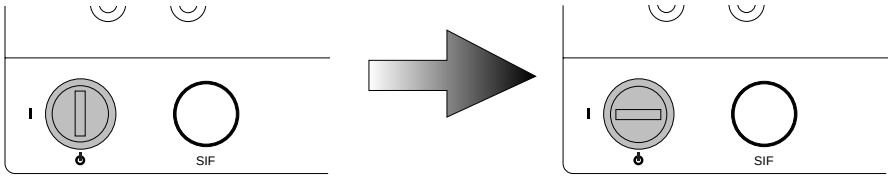
Also, please note that if the unit is moved from a cool location to a warm location there is a possibility that condensation may form on the inside of the instrument. In these circumstances allow sufficient time for the instrument to dry thoroughly before connecting the mains power.


**There is a danger of serious injury or death from electric shock if the instrument is used without the correct connection to ground.**

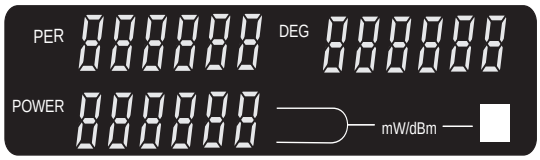
# 7 Operation Procedures

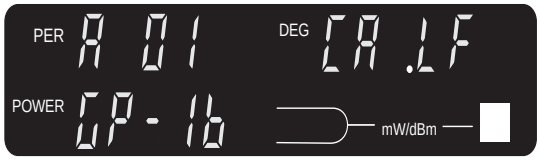
## 7.1. Power On / Off

The power cord socket is located on the unit's rear panel. Check that the voltage displayed in the window of the socket corresponds to the local mains voltage and plug the power cord into the socket. If the correct voltage is not displayed see Section 5.2 and select the appropriate voltage. Connecting an incorrect voltage will cause damage to the unit.



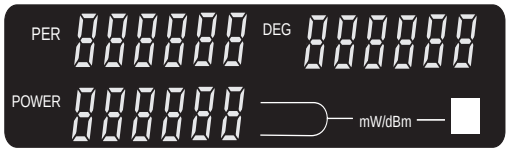

The main 'Power On' switch is a key switch located on the front panel. Insert the key and rotate clockwise 90 degrees to switch the unit on. The key can only be inserted or removed when it is in the vertical 'Off' position. The unit will perform a short initialization and check procedure lasting about one minute. The display will sequence through the following patterns.




This display indicates the currently set GPIB address and delimiter. In this example the address is 01 and the delimiter is CR+LF.


This display indicates the currently set RS-232C delimiter. In this example the delimiter is CR+LF.




It is recommended to wait at least five minutes to allow the PEM-320 unit to warm up, and to compensate for the dark current in the photodetector, before measurements are taken. The procedure to compensate for the photodetector dark current is described in Section 7.3.

The RS-232C delimiter can be changed by pressing and holding the GPIB Local or Zero keys when the power to the unit is turned on. Once set, the delimiter setting is retained even when power to the unit is turned off. The action of each key when pressed at 'Power On' is indicated below.

| | |
|---|---|
| Local Key | Sets RS-232C delimiter to CR |
| Zero Key | Sets RS-232C delimiter to LF |
| Local + Zero* Keys | Sets RS-232C delimiter to CR + LF |

*Press keys together.

The PEM-320 unit is turned off using the main 'Power On / Off' switch located on the front panel. Rotate the key anti-clockwise 90 degrees to switch the unit off. The key can only be removed when the unit is switched off and in the vertical 'Off' position.

## 7.2. Optical Fiber Connection

Remove the dust cover from the optical input connector and connect the optical fiber to the connector.

CAUTION

**Before connecting an optical fiber, always clean the end face of the connector. Dust or dirt on the connector face will result in optical loss and consequently inaccurate measurements.**

**Before connecting the input light, check that the optical power does not exceed the maximum specified level for the PEM-320. The maximum level of the standard model PEM-320 is +10dBm. If the optical input exceeds this limit, there is a risk of damage to the units's internal optical elements.**

## 7.3. Offset Cancel

The Offset Cancel function enables compensation of the dark current of the photodetector. The PEM-320 can be used directly after the power has been switched on and the initialization procedure has completed. However, to ensure high accuracy, it is recommended that the unit is allowed at least five minutes to warm up before any measurements are taken. After the unit has warmed up, ensure the cover is on the optical input connector so that no light enters the instrument and press the Zero Key to perform the Offset Cancel.

## 7.4. Changing Display Units

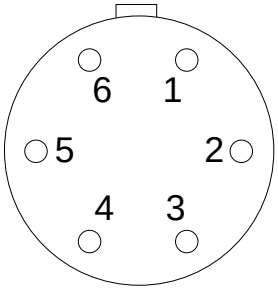
The Power Display Panel can display the optical power in either mW or dBm. The display is toggled by pressing the Optical Power Unit Selector Key.

## 7.5. PER Averaging Function

In normal operation the PEM-320 outputs a value for PER for each 360˚ rotation of the polarizer. This is the averaged value of two measurement cycles. The PER Averaging Function enables this averaging function to be turned on or off. The command is only available through the communication interfaces using the AO and AF commands (see Chapter 8 for details).

## 7.6. Analogue Output

The analogue interface (AIF) located on the rear panel of the PEM-320 enables the measured signals to be monitored as analogue voltages. The voltages mirror directly the values displayed on the front panel with the same refresh rate. The connector is a Hirose Electric HR10-7R-6S. The corresponding plug is a Hirose Electric type HR10-7P-6P. The pin assignment for the connector is detailed below.



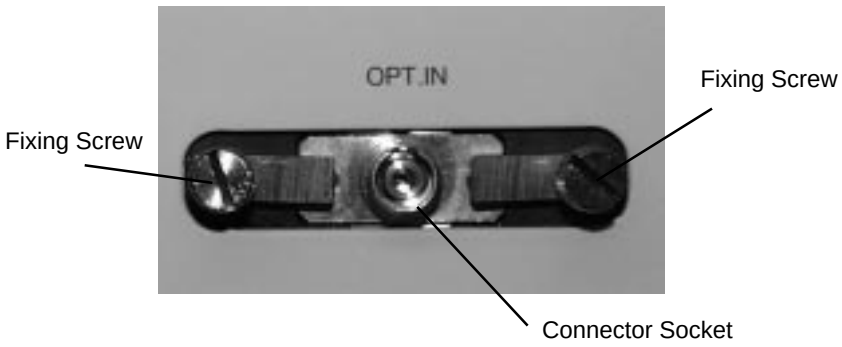

Viewed from rear of PEM-320

| Pin | Parameter | Output Signal | Measured Parameter | Example |
|---|---|---|---|---|
| 1 | Optical Power | 0 ~ 3 V | -50 dBm ~ 10 dBm | 0 dBm = 2.5 V |
| 2 | GND* | | | |
| 3 | PER | 0 ~ 2 V | 0 dB ~ 40 dB | 1 V = 20 dB |
| 4 | GND | | | |
| 5 | Polarization Angle | 0 ~ 1.8 V | 0 ~ 180 deg. | 0.9V = 90 deg |
| 6 | RRDX | | | |

* On PEM-320 units fitted with the option to enable monitoring of the signal directly from the photodetector Pin 2 of the AIF connector provides this "analogue through" output. The output ranges from 0 to 2.5 Volts, is autoranging, and supports measurement speeds up to 1kHz. The "analogue through" signal should be monitored when the polarizer is stopped.

## 7.7. Changing the Optical Connector

The PEM-320 has been to designed to enable the optical connector socket to be easily changed from FC type to SC type without affecting the optical alignment and hence the accuracy of the measurement. The procedure is described below.




1. Unscrew the two fixing screws on either side of the optical connector socket.
2. Pull the connector socket forward away from the PEM-320 unit.
3. Ensure that there is no dirt or dust on the replacement connector socket. Ensure that the alignment notch in the connector socket is facing upwards and carefully push the connector socket over the alignment ferrule.
4. Ensure the connector socket is correctly seated and flat with the face of the PEM-320 unit. Replace the two fixing screws and tighten finger tight. Do not overtighten the screws as this may cause damage to the unit.

CAUTION

**When replacing the connector socket ensure that it is correctly seated against the PEM-320 unit. If the connector socket is not flat to the face of the PEM-320 when the fixing screws are tightened the optical connector may become damaged or misaligned.**

# 8 Communication Interfaces

The PEM-320 supports both GPIB and RS-232C communication protocols. This enables remote operation of the device and integration in automated test and measurement systems. Although the two protocols are fundamentally different the core control commands are the same.

## 8-1. GPIB Control

A standard GPIB delta connector is used. Connections should be made using IEEE-488 compatible cables.

The GPIB protocol requires each device connected to the data bus to have a unique address. The PEM-320 allows addresses to be set in the range 00 to 30. The factory default setting is 01.

To enter the GPIB Address Setting Mode or to check the current GPIB address press and hold the GPIB Local Key for two seconds. The current GPIB Address is shown in the PER Display Panel and will flash to indicate that is can be changed. To exit the Address Setting Mode without changing the address or delimiter settings press the GPIB Local key twice in succession. To change the address press the Optical Power Unit Selector Key until the required address is displayed. Pressing the GPIB Local Key a second time causes the GPIB delimiter setting shown in the Polarization Angle Display Panel to flash. This can be similarly changed using the Optical Power Unit Selector Key. Pressing the GPIB Local Key a third time saves the displayed values and returns control to normal operation.

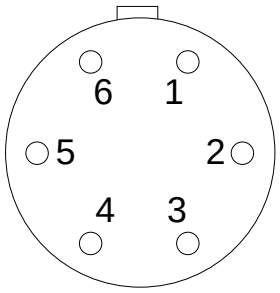
When GPIB remote control is active the 'Remote LED' on the front panel will be lit. Control is returned to the front panel by pressing the GPIB Local key on the front panel. The GPIB Local Lockout command (LLO) can be issued to prevent operation of the front panel GPIB Local key. In Visual Basic this command is issued using the 'Call SendLLO(0)' code. When the Local Lockout command has been issued control can only be returned to the front panel using the GPIB Interface Clear command (IFC). In Visual Basic this is issued as 'Call SendIFC(0)' where '0' is the GPIB interface number.


Please ensure the power to the unit is turned off before connecting or disconnecting either the GPIB or RS-232C interfaces.

## 8.2. RS-232C Control

The PEM-320 provides support for RS-232C communication through the SIF connector on the front panel. The RTDX (transmit) terminal of the PEM-320 should be connected to the receive terminal of the external device (e.g. computer). The RRDX (receive) terminal of the PEM-320 should be connected to the transmit terminal of the external device. Please ensure that the handshake line on the external device is closed. The terminals for the SIF interface (Hirose Electric HR10-7P-6S) are listed below:

| | | |
|---|---|---|
| 1 | N/C | Not used (Do not connect) |
| 2 | N/C | Not used (Do not connect) |
| 3 | GND | Ground |
| 4 | N/C | Not used (Do not connect) |
| 5 | RTDX | RS-232C Transmit |
| 6 | RRDX | RS-232C Receive |



Viewed from front of PEM-320

The following table lists the communication conditions that should be set to enable communication through the RS-232C interface of the PEM-320.

| | |
|---|---|
| Communication Method | Full Duplex |
| Baud rate | 9600 bps |
| Data Length | 8 bit |
| Stop Bit | 1 bit |
| Parity | None |
| Flow Control | None |

The delimiter for RS-232C communication is set in the factory as CR (carriage return). This can be changed when power to the PEM-320 is initially switched on. For an explanation of this procedure please see Section 7.1 Power On.

## 8.3. Control Commands

The table below lists the control commands specific to the PEM-320 which can be implemented using either the GPIB or RS-232C protocols. A command consists of two letters and may be written in either upper or lower case. As appropriate, the commands can be issued with or without a numerical suffix. A delimiter must be attached to the end of each command to ensure correct execution and termination of each command line. The delimiter required for GPIB operation is CR+LF. The delimiter required for RS-232C operation can be CR, LF or CR+LF. This delimiter is set in the factory to CR and this can be changed during the 'Power On' procedure; for details see Section 7.1 Power On.

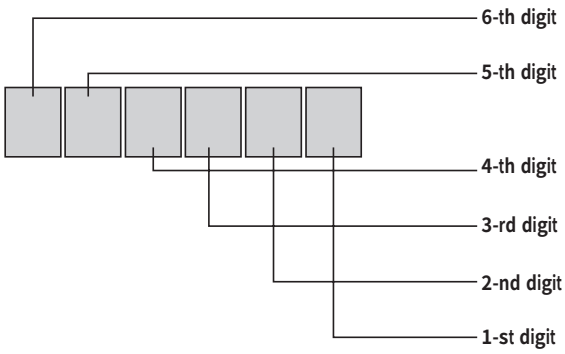
To read data from the PEM-320 it is first necessary to set the output parameter to the required data parameter. When subsequent read commands are issued the data corresponding to the set parameter is read. In RS-232C communication "echo-back" is used to verify correct communications. Once the output parameter has been set the DI command is used to request data from the unit. In both GPIB and RS-232C protocols when a command is issued that cannot be interpreted the PEM-320 outputs "NR" to the next data request. This output stops when a valid command is received.

| Command | Description | Format |
|---|---|---|
| OC | Offset cancel command. | OC |
| PE | Sets output variable to indicate PER (dB). | PE |
| DP | Sets output variable to indicate optical power (dBm). | DP |
| WP | Sets output variable to indicate optical power (mW). | WP |
| AG | Sets output variable to indicate polarization angle (deg). | AG |
| RF | Sets measurement speed to 2.5Hz. | RF0 |
| | Sets measurement speed to 5Hz. | RF1 |
| | Sets measurement speed to 10Hz. | RF2 |
| TP | Sets output variable to indicate peak measured power. | TP |
| BP | Sets output variable to indicate minimum measured power. | BP |

| | | |
|---|---|---|
| MF | Stops polarizer rotating at point of maximum measured power. | MF |
| BF | Stops polarizer rotating at point of minimum measured power. | BF |
| MO | Starts polarizer rotating. | MO |
| AF | Cancels averaging function for PER calculation. | AF |
| AO | Turns on averaging function for PER calculation. | AO |
| RE | Initiates reset of PEM-320 unit. | RE |
| SU | Sets output variable to indicate status. | SU* |
| DI | Receive data command for RS-232C communication only. The value of the output variable that has been set is received after this command is issued. | DI* |

* These commands do not support "echo-back" in RS-232C communication.

**Status Command**




The SU command is provided to enable the current status of the rotating polarizer and the measurement speed setting to be probed. The command returns a six digit number. The interpretation of the six digit number is detailed overleaf:

| | | |
|---|---|---|
| 1st digit | 0 | – Polarizer is rotating. |
| | 1 | – Polarizer has stopped rotating. |
| 2nd digit | 0 | – Measurement speed is set to 2.5Hz. |
| | 1 | – Measurement speed is set to 5Hz. |
| | 2 | – Measurement speed is set to 10Hz. |
| 3rd digit | 0 | – Normal operation. |
| 4th digit | 0 | – Normal operation. |
| 5rd digit | 0 | – Normal operation. |
| 6rd digit | 0 | – Normal operation. |

# 9 Example Programs

## 9.1. GPIB Program

The following program provides an example of the use of the Control Commands for GPIB communication. The program is written in Visual Basic and has an output function to read the Polarization Extinction Ratio and an input function to set the measurement speed to 5Hz.

```
'Read PER Routine                                   'Subroutine description
Private Sub PER_Read_dB()                           'Sets routine name to
                                                     PER_Read_dB

'Define Variables                                   'Comment
Dim Status_PER As String * 30                       'Dimensions Status_PER
                                                     array as String length 30
Dim pem320 As Integer                               'Dimensions pem320 as
                                                     integer
Dim pem320a As Integer                              'Dimensions pem320a as
                                                     integer for error checking

'Initialise Device                                  'Comment
Call SendIFC(0)                                     'Initialise GPIB interface
Call ibdev(0, 1, 0, T10s, 0, 0, pem320)             'Open and initialise device
Call ibln(pem320, 1, 0, pem320a)                    'Check for device presence
                                                     (error checking)
gpib_dl$ = Chr$(13) + Chr$(10)                      'Set Cr/Lf as delimitter

'Read PER Subroutine                                'Comment
Call ibwrt(pem320, "PE" + gpib_dl$)                 'Set output variable to
                                                     PER in dB
Call ibrd(pem320, Status_PER)                       'Read set output variable
MsgBox ("PER = " & Str(Status_PER))                 'Output read data to screen

End Sub                                             'End subroutine
```

```
‘Set Measurement Speed Routine                  ‘Subroutine description
Private Sub MeasurementSpeed_Set()              ‘Sets routine name to
                                                 MeasurementSpeed_Set


‘Define Variables                               ‘Comment
Dim pem320 As Integer                           ‘Dimensions pem320 as
                                                 integer
Dim pem320a As Integer                          ‘Dimensions pem320a as
                                                 integer for error checking


‘Initialise Device                              ‘Comment
Call SendIFC(0)                                 ‘Initialise GPIB interface
Call ibdev(0, 1, 0, T10s, 0, 0, pem320)         ‘Open and initialise device
Call ibln(pem320, 1, 0, pem320a)                ‘Check for device presence
                                                 (error checking)
gpib_dl$ = Chr$(13) + Chr$(10)                  ‘Set Cr/Lf as delimitter

‘Set Measurement Speed to 5Hz                   ‘Comment
Call ibwrt(pem320, “RF1” + gpib_dl$)            ‘Set measurement speed to
                                                 5 Hz


End Sub                                         ‘End subroutine
```

## 9.2. RS-232C Program

The following program provides an example of the use of the Control Commands for RS-232C communication. The program is written in Visual Basic and has an output function to read the polarization extinction ratio and an input function to set the measurement speed to 5Hz. The communications port in this example is Com1 and requires the ActiveX MSComm component to be included in the program.

```
'Read PER Routine                                    'Subroutine description
Private Sub PER_Read_dB()                            'Sets routine name to
                                                      PER_Read_dB

'Define Variables                                    'Comment
Dim ans As String * 30                               'Dimensions ans array as
                                                      String of length 30
'Read PER Subroutine                                 'Comment
Form1.MSComm1.PortOpen = True                        'Open communication port
                                                      MSComm1 of Form1
Form1.MSComm1.Output = "PE" + Chr$(&HD)              'Set output variable to PER
                                                      in dB (CR delimiter)
Form1.MSComm1.Output = "DI" + Chr$(&HD)              'Send receive data command
                                                      for RS-232 (echo back)
For I = 1 To 1000000                                 'Delay to wait for echo back
Next I
ans = Form1.MSComm1.Input                            'Read data from MSComm1 port
MsgBox ("PER = " & ans)                              'Output read data to screen
Form1.MSComm1.PortOpen = False                       'Close communication port

End Sub                                               'End subroutine


'Set Measurement Speed Routine                       'Subroutine description
Private Sub MeasurementSpeed_Set()                   'Sets routine name to
                                                      MeasurementSpeed_Set

Form1.MSComm1.PortOpen = True                        'Open communication port
                                                      MSComm1 in Form1 of program
Form1.MSComm1.Output = "RF1" + Chr$(&HD)             'Set measurement speed to
                                                      5Hz (CR delimiter)
Form1.MSComm1.PortOpen = False                       'Close communication port

End Sub                                              'End Subroutine
```

# 10 Care and Maintenance

## 10.1. Care

The PEM-320 is a precision optical instrument and as such requires reasonable care to be taken with its handling, operation and storage. In particular:

- Do not drop or expose the unit to shock as this may cause misalignment of the optics,
- Do not expose the unit to direct sunlight or to extremes of temperature or humidity,
- Avoid letting dust, water, oil or other dirt into the unit and do not operate the unit within such an environment,
- Do not apply a voltage exceeding that indicated in the specifications.

## 10.2. Maintenance

Occasional cleaning of the exterior surfaces of the unit may be required. Please do not use chemical cleaning agents. In particular, avoid chemicals that contain benzene, toluene, xylene, acetone or similar solvents. A dry or slightly damp cloth is recommended.

The PEM-320 is based on a free space optics design. The optical connector is thus maintenance free and does not require cleaning. The use of aerosols or similar cleaning techniques may cause misalignment and damage to the optics.

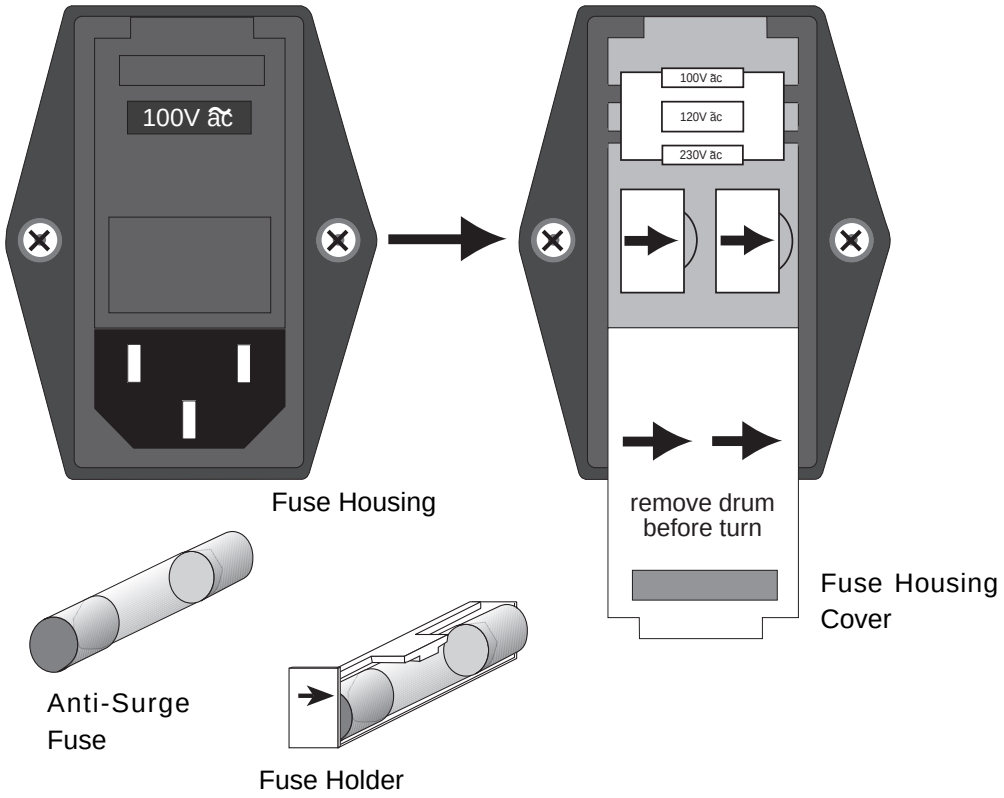
## 10.3. Changing the Fuse

If the fuse blows it is important to determine the cause and repair the fault before replacement. The fuse rating is determined by the supply voltage as indicated below. Failure to use a fuse of the correct rating may result in damage to the equipment. An anti-surge type fuse is required.

| Main Voltage | Fuse Rating |
|---|---|
| 100V-120V | 3A/125V |
| 230V-240V | 1.6A/250V |

To change the fuse first remove the mains cord from the back of the instrument and open the cover of the fuse housing using a small screwdriver. Note the direction of the arrows on the end of each fuse holder. The fuse holders can then be removed by pulling from the housing.

When replacing the fuse holders into the housing, ensure that the direction of the arrows on the end of the fuse holder corresponds with the marking on the housing cover. Also, ensure that the housing cover is firmly closed before reconnecting the mains cord.




**CAUTION**

**Before changing the fuse, always disconnect the power cord from the power outlet.**

# 11 Troubleshooting

| Problem | Possible Cause | Remedy |
|---|---|---|
| Unable to switch on. | Power cable is unplugged. | Make sure the cable is plugged in. |
| | Fuse blown. | Open the fuse holder cover on the rear panel and check the supply voltage and fuse. |
| | No fuse. | |
| | Wrong supply voltage. | |
| Unable to measure PER values above 30dB. | Measurement speed is set to 5Hz or 10Hz. | Change measurement speed to 2.5Hz. |
| | Connector polish does not match units specifications. | Check specification of unit and optical connector. |
| Unable to use front panel. | In GPIB remote mode. | If the GPIB remote LED is lit, press local key to release the GPIB remote mode. Note this function will not work if the Front Panel lockout command has been issued via GPIB. |
| GPIB Communication is not possible. | GPIB address is not set correctly. | Press Local key and hold for 2 seconds to check GPIB address and set if necessary. |
| | Delimiter setting is incorrect. | Check the delimiter setting. |
| | Cable is not connected properly. | Check the connection of the cable. |
| RS-232C Communication is not possible. | Communication protocol is incorrect. | Check the communication protocol. |
| | Delimiter setting is incorrect. | Check the delimiter setting. |
| | Cable is not connected properly. | Check the connection of the cable. |
| | Cable is not wired correctly. | Check the pin assignment of the cable. |

If after checking the above, the unit is still not operating correctly please contact Santec's technical support division.

# 12 Warranty

This product is warranted by Santec Corporation of Japan against defect in material or workmanship for a period of one year from the date of delivery. In the event that a defect occurs during the warranty period, Santec Corporation of Japan will repair this product within a reasonable period of time after notification, free of parts and labor charges, provided that (a) the defective unit is returned to Santec Corporation of Japan, if required, or a specified Santec repair facility; (b) all shipping/customs costs to Japan are paid by the owner of the defective product; (c) the defective unit has not been damaged by power failures or power surges, fire, water, pest or rodent infestation, an act of war, or any other act of nature; and (d) the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair will render this warranty VOID. Santec will not be responsible for the product when the seals have been broken or damaged.

This warranty is effective only for the original purchaser of this product and is NOT transferable.

All other expressed warranties are disclaimed and all implied warranties for this product, including the warranties of merchantability and fitness for a particular purpose, are limited in duration to a period of one year from the date of delivery. In no event shall Santec Corporation of Japan nor any subsidiary of Santec nor any distributor of Santec's products be liable to the customer for any damages, including lost profits, or other incidental or consequential damages arising out of the use or inability to use this product.

All requests for repair or service under this warranty must be made as soon as possible after the defect has been noticed and must be directed to the original seller of the product, whether a distributor of Santec's products, a subsidiary of Santec Corporation, or Santec Corporation of Japan.