

Polarization Extinction Ratio meter

User's Guide



F I B E R P R O



Polarization Extinction Ratio meter

ER2000

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[MA-PER-0305-00]

1. General Information

1.1. Warning

- Dangerous voltages, capable of causing injury or death, are present in this instrument. Use extreme caution whenever the instrument covers are removed. Do not remove the covers while the unit is plugged into a live outlet.
- To avoid electric shock, the power cord protective ground conductor must be connected to ground.
- No user serviceable part exists in this instrument. Refer all services to qualified personnel.

1.2. Caution

This instrument may be damaged if operated with the line voltage selector set for the wrong AC line voltage or if the wrong fuse is installed. Before using the instrument, be sure to read through operation manual to ensure its correct operation.

1.3. Line Voltage Selection

This instrument can operate from any single-phase AC power source that supplies 100 V / 120 V / 220 V / 240 V \pm 10 % at a frequency of 50 ~ 60 Hz. Before connecting the power cord to a power source, check if the line voltage selector located in the rear panel is set correct (for 230 V operation, use the 220 V setting). Conversion to other AC input voltage requires adjusting the line voltage selector.

Line fuse

The fuse used by this instrument is 3A/250VAC.

Line cord

This instrument has a detachable, three-wire power cord for connection to the power source and to a protective ground. The exposed metal chassis of the instrument is connected to ground via the power line cord to protect against electrical shock. Always use a socket outlet that has a properly connected protective ground.

1.4. Service

Do not attempt to service or adjust this instrument unless an authorized person is present. Do not install substitute parts or perform any unauthorized modifications to this instrument. Contact FIBERPRO or your local distributor to ask services.

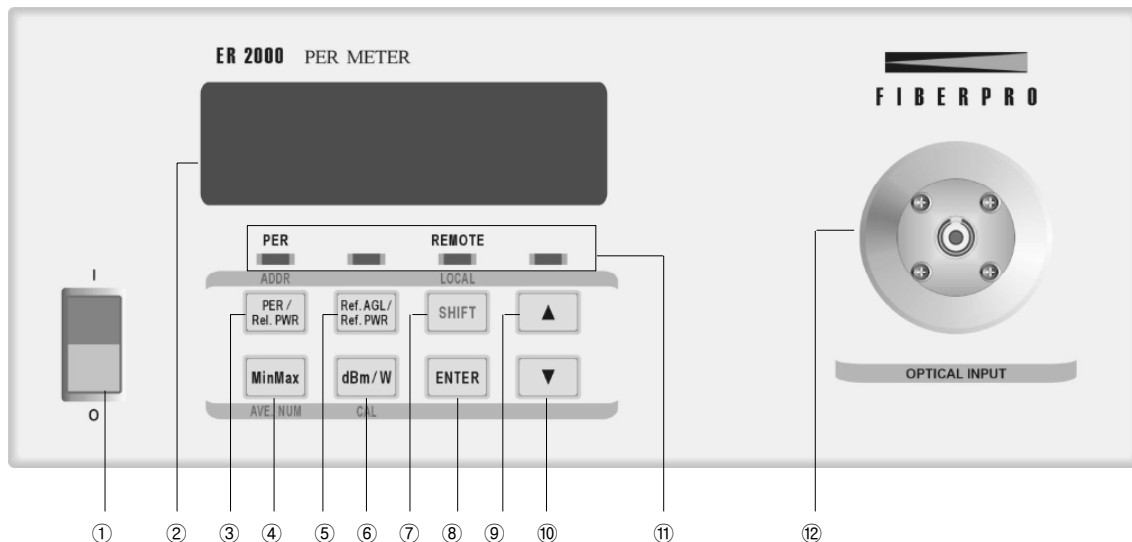
1.5. Specifications

Wavelength Range	1460 ~ 1650 nm ¹⁾
Input Power Range	-50 dBm~7 dBm ²⁾
Measurement Speed	12 Hz
Polarization Extinction Ratio Range	0 dB ~ 40 dB
Polarization Extinction Ratio Resolution	0.1 dB
Angle Resolution	0.1°
Optical Input	FC/PC ³⁾
Analog Output	3 Analog outputs : PER, Angle, Power
AC Power Input	100V ~ 125V, 210V ~ 250V, 50Hz/60Hz
Dimensions	86 (H) × 212 (W) × 420 (D) mm
Operating Temperature	10°C ~ 40°C
Storage Temperature	-10°C ~ 60°C
Interface	RS232/GPIB

- 1). Other wavelength band is available.
- 2). For higher input power, attenuator option is available.
- 3). Other optical input types are available.

2. ER2000 operation

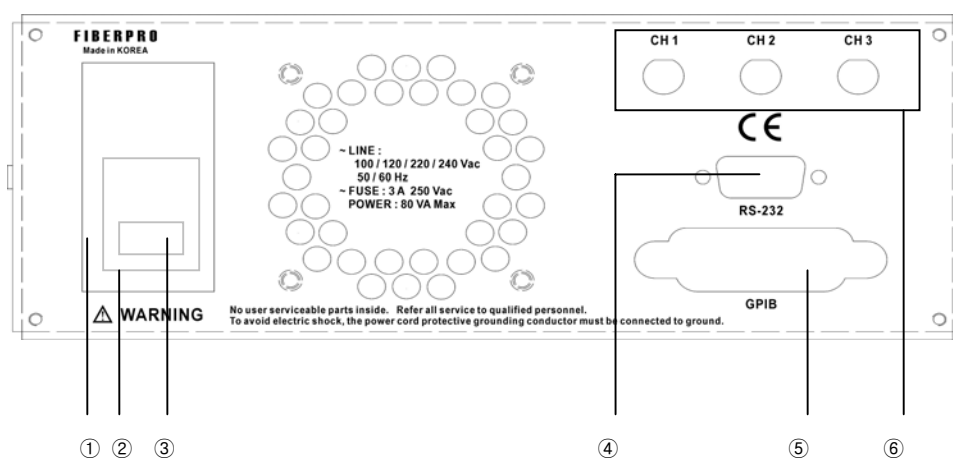
2.1. Front panel at a glance



- ① **Power Switch** – When this switch is turned on, the instrument is initialized and starts polarization extinction ratio(PER) measurement.
- ② **Front panel display** – Measurement result is displayed or appropriate information of the instrument is displayed in each setting menu.
- ③ **PER/Rel.PWR (ADDR) key** –The measurement mode toggles between PER mode and relative power mode when this key is pressed. If this key is pressed together with [SHIFT] key, the instrument enters GPIB address setting menu.
- ④ **MinMax (AVG #) key** – The stored minimum and maximum readings of PER and ANGLE are cleared and the min-max operation is restarted. If this key is pressed together with [SHIFT] key, the instrument enters average number setting menu.
- ⑤ **Ref.AGL/Ref.PWR key** – In PER measurement mode, this instrument enters reference angle setting menu, and, in relative power measurement mode, it sets current measured power to zero dB.
- ⑥ **dBm/W (CAL) key** –In PER measurement mode, the measurement display of current power toggles between dBm unit and Watt unit. If this key is pressed together with [SHIFT] key in PER measurement mode, the instrument enters offset current calibration menu.
- ⑦ **SHIFT (LOCAL) key** – When the instrument is under local control, pressing this key enables secondary function printed in blue above or below the each key. If the instrument is under remote control, the instrument is placed under local control.
- ⑧ **ENTER key** – The instrument changes the setting value and exits the setting menu or activate offset current calibration mode.
- ⑨ **[▲] key** – The setting value increases or measurement display is changed.

- ⑩ [▼] key – The setting value decreases or measurement display is changed.
- ⑪ **Indicators** – Each indicator is lit on when the instrument is under following state.
 - [PER] indicator – The instrument is in PER measurement mode.
 - [REMOTE] indicator – The instrument is controlled by the remote interface.
 The other two indicators are reserved for manufacture's necessity.
- ⑫ **Optical input**

2.2. Rear panel at a glance



- ① **Power entry module** – The power entry module for the AC line voltage input. It blocks high frequency noise entering the instrument. Before you plug the power cord into a socket outlet, check the voltage selector switch whether it is at correct position.
- ② **Voltage selector switch** – This switch is to select an input AC voltage. Setting at 115V if for operation between 100 and 125VAC. Setting at 230V is for operation between 210 and 250VAC.
- ③ **Fuse holder**
- ④ **RS-232 connector** – RS-232 interface is provided.
- ⑤ **GPIB connector** – GPIB interface is provided.
- ⑥ **BNC connectors** – The instrument outputs analog voltage that is proportional to one of the measurement results.

CAUTION

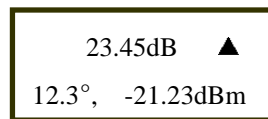
To minimize the electromagnetic interference (EMI), make sure that your cable for remote control (RS-232 or GPIB) is a shielded cable. Using not-shielded cable may increase the interference by electromagnetic radiation noise.

2.3. How to use PER meter

2.3.0. Before the start

The [SHIFT] key annunciator

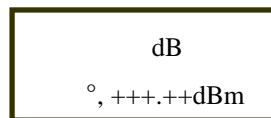
When the [SHIFT] key is pressed, its annunciator '▲' is turned on at the most upper right side of the measurement display window. If it is pressed again, its annunciator is turned off. The example is as follows.



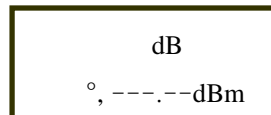
The [Shift] key has been pressed.

When input power is too high or too low

When input optical power is too high or too low to make an accurate measurement, the instrument displays not a numeric value but '++.' or '---' as a measurement result in the optical power field. The '++.' indicates that input power is too high and the '---' indicates that input power is too low. The example is as follows.



Input power is too high.



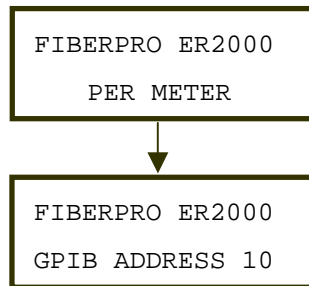
Input power is too low.

If MEAS? or READ? query command is executed in the remote operation when the input power is too high or too low, the instrument generates the device-dependent error and saves it to the error queue. Refer to 3.3. Error codes for more specific descriptions. The return messages are all zero except the optical power value. The returned optical power is 100dBm when the input power is too high and -100dBm when the input power is too low.

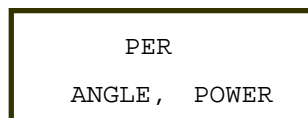
2.3.1. To power on the instrument and start PER measurement

Front panel operation

- ① Check whether the voltage selector switch is selected correctly for input AC line voltage.
- ② Connect the power cord to the power entry module at the rear of the instrument, then the other end to a suitable AC line power receptacle.
- ③ Press [POWER] switch, then power-on messages are displayed as follows.



- ④ After four indicators are turned on and off successively, the measurement display window shows the definition of each field for about 2 seconds. And then, ER2000 starts PER measurement. During PER measurement, red led indicator lights up.



2.3.2. To change measurement mode

Front panel operation

- ① Pressing the [PER/Rel.PWR] key changes measurement mode from PER mode to relative power mode and vice versa. If the instrument is in PER mode, the [PER] indicator is turned on. And, if the instrument is in relative power measurement mode, [PER] indicator is turned off.

Remote operation

- ① Execute the MODE command whose parameter is 0 or 1. 1 is for PER measurement mode and 0 is for relative power measurement mode.

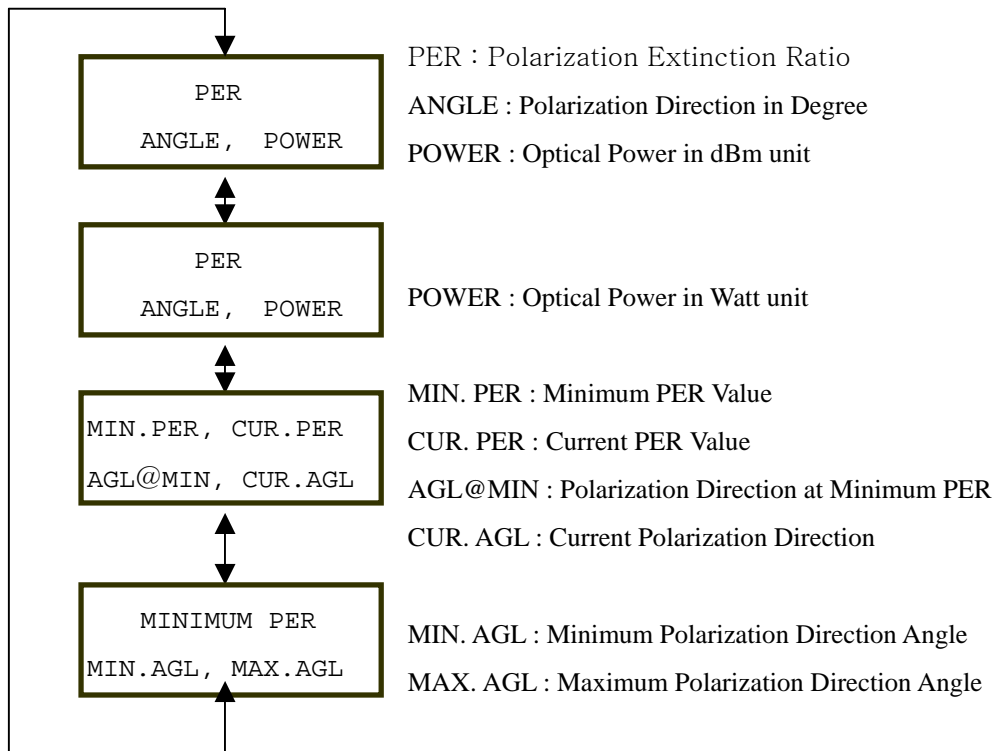
NOTE

In Relative power mode, internal polarizer is stopped and the optical power through the polarizer is measured. So, the relative power measured with ER2000 is not actual incident power. But, if the incident polarization state is stable enough, its value will be proportional to incident power.

2.3.3. To change the measurement display

Front panel operation

- ① Press the [▲] key or [▼] key until the desired measurement display is appeared. The sequence of the measurement display and definition of each parameter are as follows.



If [dBm/W] key is pressed during measurement, the display window will change to one of [PER / ANGLE / POWER] window.

2.3.4. To restart the min-max operation

Front panel operation

① Press the [MinMax] key. After following message is displayed, the stored minimum and maximum readings are cleared and the min-max operation is restarted.



② After about 0.5 seconds, the instrument returns to the measurement display window.

③ The stored minimum and maximum readings are minimum PER, polarization direction angle at minimum PER, minimum and maximum angle of polarization direction. You can see them in the following measurement display window by pressing the [▲] key or [▼] key. Refer to 2.3.3 To change the measurement display.

Remote operation

① Execute the MNMX command to restart the min-max operation.

② To get the stored minimum and maximum readings, execute the MNMX? query command.

2.3.5. To set the reference angle

Front panel operation

① During PER measurement, press the [Ref.AGL/Ref.PWR] key. Then the instrument enters the reference angle setting menu and the current angle of polarization direction is displayed as follows. Notice that the displayed angle is relative to factory-set reference angle.

```
REFERENCE SET
ANGLE: 10.9 Deg
```

② Press the [▲] key or [▼] key to increase or decrease the blinking digit. If a displayed angle is a desired value, press the [ENTER] key to save the setting value and exit this menu.

```
REFERENCE SET
wait...
```

③ If you press any other key except [ENTER] key in the menu, the instrument exits this menu without saving the setting value.

Remote operation

① Execute the SREF command whose parameter is the reference angle in degree unit. If there is not any parameter after the command header, the current input polarization angle is set as the reference angle.

2.3.6. To set reference of relative power

Front panel operation

① During relative power measurement mode, press the [Ref.AGL/Ref.PWR] key. Then current relative power displayed will be set zero dB. This function is only applicable current relative power measurement.

2.3.7. Offset Current Calibration

Front panel operation

① Block optical input adaptor with dark patch-cord. If ER2000 decide that there is light during calibration process, ER2000 stops calibration process and displays failure statement.

② Press the [SHIFT] key and the [dBm/W] key. Then the instrument displays following window.

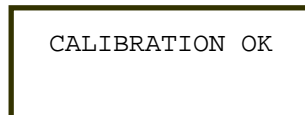
```
DC OFFSET CALIB.
PRESS ENTER
```

③ Press [ENTER] key to enter offset current calibration mode. Then the progress of calibration will be displayed.



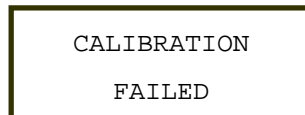
DC OFFSET CALIB.
■■■■

④ If the calibration process finished successfully, OK sign will be displayed and then return to PER measurement mode.



CALIBRATION OK

⑤ If ER2000 decide that there is light during calibration process, ER2000 stops calibration process and displays failure statement for 4 seconds.



CALIBRATION
FAILED

NOTE

Offset calibration is required to eliminate the error that comes from dark current in photo-diode. It is important to get accurate PER value, especially, when PER is high. Dark current depends on environmental variation, such as, temperature. So, FIBERPRO recommends to do offset calibration, if there is environmental variation. ER2000 do not save final calibration data performed by end-user. So, it is highly required to do offset calibration when you power on ER2000.

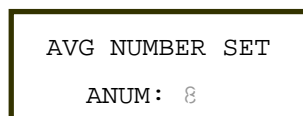
Remote operation

① Execute the `OFFS` command to do offset current calibration in PER mode.

2.3.8. To set the average number

Front panel operation

① Press the [SHIFT] key and the [MINMAX] key. Then the instrument enters the average number setting menu and the current average number is displayed as follows.



AVG NUMBER SET
ANUM: 8

② Press the [▲] key or [▼] key to increase or decrease the blinking digit. If a displayed number is a

desired value, press the [ENTER] key to save the setting value and exit this menu.

```
AVG NUMBER SET
wait...
```

③ If you press any other key except [ENTER] key in the menu, the instrument exits this menu without saving the setting value.

Remote operation

① Execute the ANUM command whose parameter is the average number. The possible parameter value is 1,2,4,8.

NOTE

Changing average number has an effect of restarting the min-max operation.

2.3.9. To set the GPIB address

Front panel operation

① Press the [SHIFT] key and the [START] key. Then the instrument enters the GPIB address setting menu and the current GPIB address is displayed as follows.

```
GPIB ADDRESS SET
ADDR: 15
```

② Press the [▲] key or [▼] key to increase or decrease the blinking digit. If displayed address is desired value, press the [ENTER] key to save the setting value and exit this menu.

```
GPIB ADDRESS SET
wait...
```

③ If you press any other key except [ENTER] key in the menu, the instrument exits this menu without saving the setting value.

2.3.10. To set the analog voltage output

Remote operation

① Execute the AOUT command whose parameter is 0, 1 or 2. The description of each parameter is as follows. The parameter 0 turns off the analog voltage output.

Parameter	Measurement value		Measurement value range	Output voltage range
0	None		None	All channels 0V
1 (Default state)	CH1	PER	0 ~ +40dB	-8V ~ +8V
	CH2	ANGLE	-45° ~ +135°	-2.5V ~ +7.5V
	CH3	POWER (Linear Scale)	Depends on gain selection	-9V ~ +9V
2	CH1	PER	0 ~ +40 dB	-8V ~ +8V
	CH2	ANGLE	-45° ~ +135°	-2.5V ~ +7.5V
	CH3	POWER (dB Scale)	-60dBm ~ 7dBm	-6V ~ +0.7V

NOTE

The default analog output mode is 1. In relative power measurement mode, channel 1 & 2 are in inactive state and there output is zero voltage.

2.3.11. To return the instrument to local control from remote control

Front panel operation

① Press the [SHIFT] key. Then the instrument becomes under local control and the [RMT] indicator is turned off.

2.4. Remote interface

2.4.1. Control via RS-232

RS-232 was originally designed for interface between DTE (Data Terminal Equipment) and DCE (Data Communications Equipment) by serial binary data interchange. Since most personal computers are now equipped with RS-232, you can easily interface the PER meter with a personal computer for remote control.

Configuration for RS-232 interface

Baud rate : 57600

Data bits : 8bit

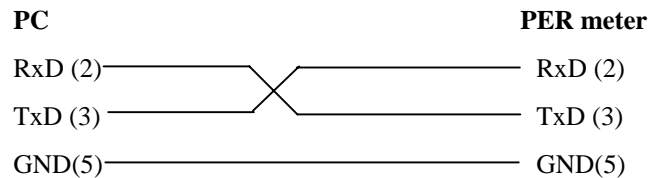
Parity : None

Stop bits : 1 bit

Message terminator ; Carriage Return (CR)

Connection to a computer

The PER meter can be programmed with a personal computer over RS-232 using a minimum three-wire interface. With a three-wire interface, the software controls the data flow between the PER meter and a personal computer. This provides a much simpler connection between devices because you can ignore hardware handshake requirements. RS-232 wiring from a personal computer's serial port into the PER meter serial interface device is follows.



RS-232 Commands

The commands set for RS-232 interface is almost the same as for GPIB interface except the RMT and LOC command. When you use RS-232 interface, it is necessary to send the RMT command at first to place the PER meter under remote control.

2.4.2. Control via GPIB

Interface capabilities

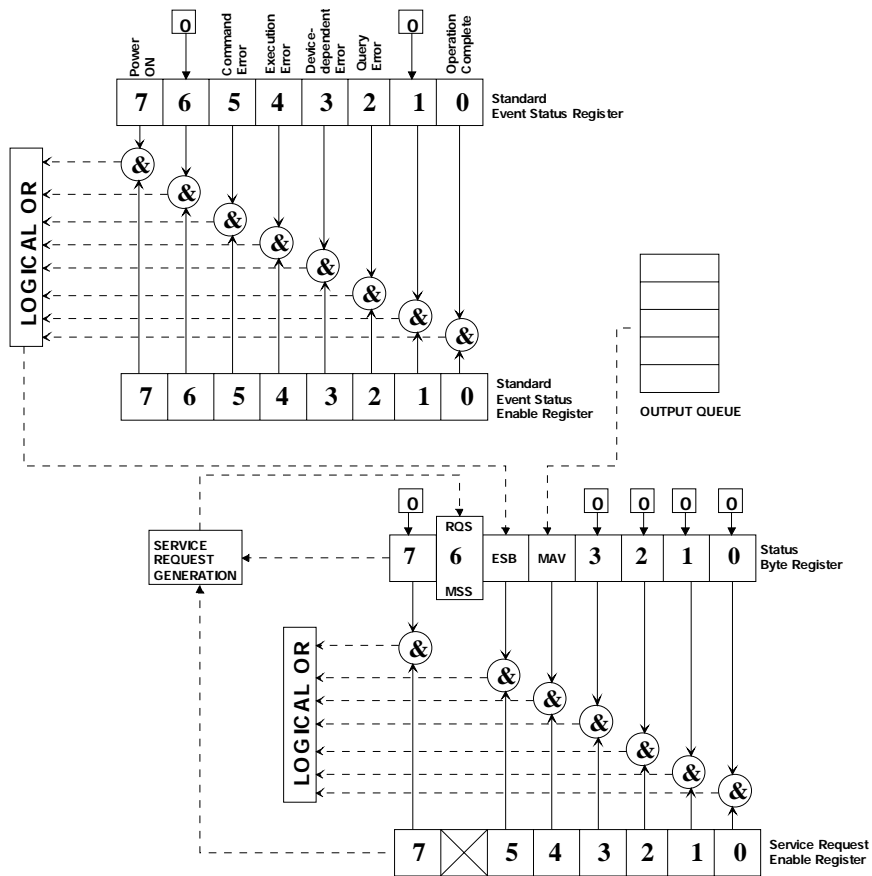
- ① The interface capabilities that the PS implements, as defined by IEEE 488.1, are SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0.
- ② The PS implements all necessary common commands and the status reporting structure defined by IEEE 488.2. A summary of the common commands is as follows.

Command	Query	Function
---------	-------	----------

*ESE	*ESE?	standard Event Status Enable command/query
	*ESR?	standard Event Status Register query
*SRE	*SRE?	Service Request Enable command/query
	*STB?	SStatus Byte register query
*CLS		CLear Status command
*RST		ReSeT command
	*IDN?	instruMent's IDEntification query
*OPC	*OPC?	OPeration Complete command/query
*WAI		WAIt Command
	*TST?	Self TeST Query

Status reporting structure

The status reporting structure of the PER meter is shown below.



Standard event status enable register & Standard event status register

The Standard Event Status Register (SESR) monitors the status events of the PER meter. When one of these events occurs, the event sets the corresponding bit in the register. You can read the contents of this register by executing the *ESR? query. The returned value is the total bit weights of all of the bits. SESR is cleared 1) at power-on, 2) by *CLS command or 3) after being read.

The Standard Event Status Enable Register (SESER) allows one or more events in the SESR to generate a summary bit. The summary bit will set the ESB bit (the bit 5) in the Status Byte Register (SBR). To generate a summary bit, you should enable the corresponding bit in the SESER by executing the *ESE command. SESER is cleared at power-on.

The status event of the PER meter, that each bit of the SESR and SESER represents, is as follows.

		Standard Event Status Enable Register	Standard Event Status Register
Bit	Weight	Enables	Condition
7	128	PON (Power ON)	Power off-on transition has occurred
6	64	URQ (User Request)	Not-Used (always 0)
5	32	CME (Command Error)	Command errors are detected.
4	16	EXE (Execution Error)	Execution errors are detected
3	8	DDE (Device Dependent Error)	Device dependent errors are detected
2	4	QYE (Query Error)	Query errors are detected
1	2	TRG (Request Control)	Not-Used (always 0)
0	1	OPC (Operation Complete)	The PS has completed all selected pending operations

Status byte register & Service request enable register

The Status Byte Register (SBR) is the summary-level register in the status reporting structure of the PER meter. The SBR contains summary bits that monitor activity in the SESER and output message queue. You can read the contents of the SBR by executing the *STB? query or serial poll. SBR is cleared 1) at power-on or 2) by *CLS command.

The Service Request Enable Register (SRER) enables one or more summary bits in the SBR to generate a service request to the controller. To generate a service request, you should enable the corresponding bit in the SRER by executing the *SRE command. The SRER is cleared at power-on.

When the enabled summary bit in the SBR is set, the MSS bit and the RQS bit in the SRER is set and service request is generated to the controller. Description of each bit in the SRER and the SBR is as follows.

		Service Request Enable Register	Status Byte Register
Bit	Weight	Enables	Condition
7	128	User Definable (Not-Used)	Not-Used (always 0)
6	64	RQS (Request Service) MSS (Master Summary Status)	The PS is requesting services
5	32	ESB (Event Status)	An enabled event in the Standard Event Status Register is set TRUE.
4	16	MAV (Message Available)	Output queue is not empty.
3	8	User Definable	Not-Used (always 0)
2	4	User Definable	Not-Used (always 0)
1	2	User Definable	Not-Used (always 0)
0	1	User Definable	Not-Used (always 0)

Service request and Serial poll

When the RQS bit in the SRER is set, the PER meter asserts the SRQ line. Then the controller polls each addressed listener to send back a status byte of the SBR that indicates whether it has asserted the SRQ line and needs servicing (Serial Poll). After the controller reads the Status Byte through serial poll, the RQS bit is cleared automatically. You should configure your controller to respond the service request to use this capability appropriately.

3. Command Set

3.1. Operation-related commands

3.1.1. Measurement-related commands

MODE

- Description ; Select measurement mode between PER mode and relative power mode.
- Syntax ; MODE {0|1}
- Parameter ; 0 for relative power measurement mode
1 for PER mode
- Example ; MODE 1

MODE?

- Description ; Query the current measurement mode. The returned message is 0 or 1 in NR1 format
- Syntax ; MODE?
- Response ; 0 or 1
- Example ; MODE? -> 1

MEAS?

- Description ; Query the measurement result. ER2000 execute new measurement and returns the results. The response message is in NR3 format and depends on operation mode of ER2000.
- Syntax ; MEAS?
- Response ; <PER in dB>, <Angle in Deg>, <Power in dBm> in PER mode
; <Relative Power in dB> in RP mode
- Example ; MEAS? -> 23.14, 12.23, -15.46 in PER mode
; MEAS? -> -15.46 in RP mode

READ?

- Description ; Query the measurement result. ER2000 returns already measured result when the command is received. The response message is in NR3 format and depends on operation mode of ER2000.
- Syntax ; READ?
- Response ; <PER in dB>, <Angle in Deg>, <Power in dBm> in PER mode
; <Relative Power in dB> in RP mode
- Example ; READ? -> 23.14, 12.23, -15.46 in PER mode
; READ? -> -15.46 in RP mode

MNMX

- Description ; Clear the stored minimum and maximum readings and restart the min-max operation.
- Syntax ; MNMX
- Parameter ; *None*
- Example ; MNMX

MNMX?

- Description ; Query the current minimum and maximum readings. The response message is in NR3 format.
- Syntax ; MNMX?
- Response ; <minimum PER in dB>, <minimum ANGLE in Deg>, <maximum ANGLE in Deg>
- Example ; MNMX?-> -12.46, -3.75, 2.37

3.1.2. Measurement configuration-related commands

SREF

- Description ; Set the reference angle.
- Syntax ; SREF [*angle*]
- Parameter ; [*angle*] the reference angle in degree unit. Notice that the angle is relative to factory-set reference angle.

If there is not any parameter after command header, the current polarization angle is set as the reference angle.

- Example ; SREF 34.5 or SREF

NOTES

The reference angle is saved in a nonvolatile memory and do not deleted when power has been off or after *RST command is executed.

SREF?

- Description ; Query the current reference angle. The returned message is in NR2 format.
- Syntax ; SREF?
- Response ; <angle in Deg>
- Example ; SREF?-> +43.45

ANUM

- Description ; Set the average number.
- Syntax ; ANUM {1|2|4|8}
- Parameter ; average number 1,2,4 or 8
- Example ; ANUM 2

ANUM?

- Description ; Query the current average number. The returned message is a decimal value in NR1 format.
- Syntax ; ANUM?
- Response ; 1,2,4 or 8
- Example ; ANUM? -> 8

OFFS

- Description ; Execute offset current calibration.
- Syntax ; OFFS
- Parameter ; *None*
- Example ; OFFS

3.1.3. Analog output – related commands

AOUT

- Description ; Set the analog voltage output mode.
- Syntax ; AOUT {0|1|2}
- Parameter ; analog voltage output mode number
- Example ; AOUT 1

Parameter	Measurement value		Measurement value range	Output voltage range
0	None		None	All channels 0V
1 (Default state)	CH1	PER	0 ~ +40dB	-8V ~ +8V
	CH2	ANGLE	-45° ~ +135°	-2.5V ~ +7.5V
	CH3	POWER (Linear Scale)	Depends on gain selection	-9V ~ +9V
2	CH1	PER	0 ~ +40 dB	-8V ~ +8V
	CH2	ANGLE	-45° ~ +135°	-2.5V ~ +7.5V
	CH3	POWER (dB Scale)	-60dBm ~ 7dBm	-6V ~ +0.7V

NOTE

In relative power measurement mode, channel 1 & 2 are in inactive state and there output is zero voltage.

AOUT?

- Description ; Query the current analog voltage output mode. The returned message is a decimal value in NR1 format.
- Syntax ; AOUT?
- Response ; 0,1 or 2
- Example ; AOUT?-> 1

3.1.4 System – related commands

ERROR?

- Description ; Query the oldest error in the error queue.
- Syntax ; ERROR?
- Response ; <Error number>,<Error description>
- Example ; ERROR?-> -103, "Undefined header"

3.2. IEEE 488.2 Command commands

***CLS**

- Description ; Clear the (1) Standard Event Status Register (SESR), (2) Status Byte Register (STB), and (3) Error Queue.
- Syntax ; *CLS
- Parameter ; *None*
- Example ; *CLS

***ESE**

- Description ; Set bits in the Standard Event Status Enable Register (SESER) that enable the corresponding bits in the Standard Event Status Register (SESR). The register is cleared (1) at power-on or (2) by sending a value of zero. The register is NOT changed by the *RST and *CLS commands.
- Syntax ; *ESE <value>
- Parameter ; The value of integer in the range of 0 through 255.

Bit	Definition	Value
7 (MSB)	Power On	128
6	Not used	0
5	Command Error	32
4	Execution Error	16
3	Device Dependent Error	8
2	Query Error	4
1	Not used	0
0	Operation Complete	1

- Example ; *ESE 17

***ESE?**

- Description ; Query the contents of the Standard Event Status Enable Register. The returned message is the total bit weights of all of the bits in NR1 format.
- Syntax ; *ESE?
- Response ; Decimal value in the range of 0 through 255.
- Example ; *ESE? → 17

***ESR?**

- Description ; Query the contents of the Standard Event Status Register (SESR). The register is cleared after being read. The returned message is the total bit weights of all of the bits in NR1 format.
- Syntax ; *ESR?
- Response; Decimal value in the range of 0 through 255.

Bit	Definition	Value
7 (MSB)	Power On	128
6	Not used	0
5	Command Error	32
4	Execution Error	16
3	Device Dependent Error	8
2	Query Error	4
1	Not used	0
0	Operation Complete	1

- Example: *ESR? → 16

***IDN?**

- Description; Query the instrument identification.
- Syntax ; *IDN?
- Response ; <Manufacturer>, <Model>, 0, <Firmware version>
- Example ; *IDN? → FIBERPRO, PM5001, 0, V1.00

***OPC**

- Description; Set the OPC bit in the Standard Event Status Register when all pending device operations have been completed.
- Syntax ; *OPC
- Parameter ; *none*
- Example ; *OPC

***OPC?**

- Description ; Place ASCII "1" in output queue when all pending device operations have been completed.
- Syntax ; *OPC?
- Response ; 1 is always returned.
- Example ; *OPC? → 1

***RST**

- Description ; Set the instrument to the reset setting stored internally.
- Syntax ; *RST
- Parameter ; *None*
- Example ; *RST

***SRE**

- Description ; Set the Service Request Enable Register bits.
- Syntax ; *SRE <value>
- Parameter ; Decimal value in the range of 0 through 255.

Bit	Definition	Value
7 (MSB)	Not used	0
6	RQS (request service)	64
5	ESB (SESR summary bit)	32
4	MAV (message in the output queue)	16

3	Not used	0
2	Not used	0
1	Not used	0
0	Not used	0

- Example ; *SRE 48

*SRE?

- Description ; Query the contents of the Service Request Enable Register. The bit 6 of the binary representation is always sent with the value zero. The returned message is the total bit weights of all of the bits in NR1 format.
- Syntax ; *SRE?
- Response ; The bit value for the register. In the range of 0 through 63 or 128 through 191.
- Example ; *SRE? → 48

*STB?

- Description; Query the contents of the Status Byte Register. The returned message is the total bit weights of all of the bits in NR1 format.
- Syntax ; *STB?
- Response ;

Bit	Definition	Value
7 (MSB)	Not used	0
6	RQS (request service)	64
5	ESB (SESR summary bit)	32
4	MAV (message in the output queue)	16
3	Not used	0
2	Not used	0
1	Not used	0
0	Not used	0

- Example ; *STB? → 80

*TST?

- Description ; Perform a self-test and place the results of the test in the output queue.
- Syntax ; *TST?
- Response ; 0 for self-test pass
1 for self-test failure
- Example ; *TST? → 0

***WAI**

- Description ; Prevent the instrument from executing any further commands until the current command has finished executing. All pending operations are completed during the wait period.
- Syntax ; *WAI
- Parameters ; *None*
- Example ; *WAI

3.3. RS-232 interface Commands

RMT

- Description ; Place the instrument in the remote operation for RS-232.
- Syntax ; RMT
- Parameter ; *None*
- Example ; RMT

LOC

- Description ; Place the instrument in the local operation.
- Syntax ; LOC
- Parameters ; *None*
- Example ; LOC

3.4. Error codes

Error Number	Description
Command errors	
-101	Invalid character
-102	Syntax error
-103	Invalid separator
-104	Data type error
-108	Parameter not allowed
-109	Missing parameter
-112	Program mnemonic too long
-113	Undefined header

Execution errors	
-222	Data out of range
-224	Illegal parameter value
-350	Too many error
Query errors	
-410	Query Interrupted
-420	Query unterminated
-430	Query deadlock state
-440	Query unterminated after indefinite response
Device dependent errors	
+201	Input power is too low
+202	Input power is too high
+521	Input buffer overflow (RS-232 only)
+522	Output buffer overflow (RS-232 only)

- ERROR? command queries the oldest error from the error queue.
- When the query result for ERROR? is 0, "no error", it means no error occurs.
- Command errors set the CME bit (the bit 5) of Standard Event Status Register (SESR)
- Execution errors set the EXE bit (the bit 4) of SESR.
- Device dependent errors set the DDE bit (the bit 3) of SESR
- Query errors set the QYE bit (the bit 2) of SESR.