Appendix A -
Remote Mode Operations

Overview

Remote Mode programming for the PR-705 / 715 is a method of commanding the instrument to perform a measurement and following the measurement, retrieve the calculated results.

The *Remote Mode* programming language consists of simple American Standard Characters for Information Interchange (ASCII) commands transmitted over the RS-232 interface. The RS-232 communications can originate from a Windows based PC, Apple Macintosh, mainframe computer, RS-232 terminal – virtually any device capable of sending and receiving ASCII characters over an RS-232 interface.

A typical *Remote Mode* command consists of two parts: An alpha command type and numeric modifier. The modifier is usually a numeric value that represents choices within the command type. In a majority of commands, the modifier is a request for a specific *Data Report Formats*. For example, the command ***M5*** tells the PR-705 to make a measurement and return the resultant spectral intensity values.

Data Report Formats are comma-delimited fields in ASCII format terminated by a carriage return / line feed character combination. Each field in each report represents a different data type. All *Data Report Formats* and associated fields are explained in detail.

See the *Data Report Formats* section for more information.

The PR-705 / 715 can be operated in *Remoter Mode* by a “dumb” RS-232 terminal, or by using RS-232 terminal emulation programs such as Terminal (Windows 3.1), or Hyper Terminal (Windows ’95, ’98 and NT).

The following is a brief summary of all the PR-705 / 715 Remote Mode commands. They are covered in full detail throughout this chapter.

B	Set display Back Light level
D	Request Data from PR-705 / 715
E	Set Full Duplex (Echo) Mode
L	Assign Alpha Numeric Measurement Title
M	Initiate a Measurement
R	Recall data from the PR-705 / 715 built-in floppy disk drive
W	Measure and Store Information to the PR-705 / 715 built-in floppy disk
Q	Quit (exit Remote Mode). Return system to Local (keyboard) mode of operation

Syntax Conventions

[…..] Required entry or data sent back from the PR-705 / 715
<…..> Optional entry or response
(…..) Comment only – not a command
CR Carriage Return
LF Line Feed

Getting Started

Prior to beginning *Remote Mode* communications with the PR-705 / 715, the instrument must be connected to a host computer using the supplied RS-232 cable or appropriate substitute. The supplied cable is a straight, pin to pin type (**not** a null modem type) cable and was designed to connect directly to a Windows or DOS based PC. If the Host you are using is not compatible with this type of computer, please consult the user manual supplied with the host computer.

Hardware Setup Procedure

1. Make sure the PR-705 / 715 and Host power are set to **OFF.**
2. Connect the PR-705 / 715 to the Host using the supplied 9 pin RS-232 (or other appropriate RS-232) cable.
3. Turn **ON** the PR-705 / 715 and Host.
4. If the PR-705 / 715 has been turned off for more that ½ hour, allow at least a 15 minute warm-up before making measurements.
5. Make sure the RS-232 communications on the HOST are set up as follows:

BAUD:	**9600**
DATA BITS:	**8**
STOP BITS:	**1**
PARITY:	**NONE**

NOTE: The PR-705 / 715 uses the Clear to Send (CTS) and Ready to Send (RTS) lines for communications handshaking. Therefore, flow control settings for terminal emulators such as Microsoft Windows HyperTerminal must be set to "Hardware".

6. If using Remote Mode commands with the PR-705, Send the command **PR705** to the PR-705 / 715 (no CR LF is required). For PR-715 systems, Send **PR715.** Note that the **PR** must be uppercase letters.
7. A screen similar to the following will appear on the PR-705 / 715 screen indicating that it is in Remote Mode.

```
PR-705 REMOTE MODE
CTRL s/w Ver 1.5.6

CMD
```

Simultaneously, the phrase **REMOTE MODE** [CR][LF] is sent to the Host.

Command Types

There are 8 commands, represented by the letters **B, D, E, L, M, R, S** and **Q** that are recognized by the PR-705 / 715. Some of these commands require additional arguments such as a Data Report Formats modifier.

All commands and their arguments will be covered below

NOTE: Alpha characters in the following commands may be sent as either upper

case or lower case. The PR-705 / 715 automatically converts to UPPER CASE.

B (Back light) Command

Use the **B** command to control the PR-705 / 715 display back light level between measurements. The PR-705 / 715 automatically shuts off the display light during a measurement.

Syntax: B<n> [CR]

where: **n** = **0** (back light off). Sending the B command without **n** turns off the back light
1 (low brightness)
2 (medium brightness)
3 full brightness)

Response from PR-705 / 715:

0000 [CR LF]	All OK
NNNN [CR LF]	Error Code – See Appendix D for error code explanations

Example

B3 [CR]

Command PR-705 / 715 back light to full brightness.

D (Data) Command

The **D** command is used to request data from the most recent measurement or the last measurement recalled from the PR-705 / 715 built-in floppy disk drive.

The **D** command, as with most PR-705 Remote Mode commands, may be accompanied by a numeric Data Report Formats. This features gives the user the ability to retrieve the calculated photometric or radiometric values available from the PR-705 / 715 without making repeated measurements.

Syntax: **D<n> [CR]**

where **n** = An integer that represents a Data Report Formats (See following section on Data Report Formats for complete details). The power-up default value for n is 1. The last value entered for n becomes the default Data Report modifier. If the D command is sent to the PR-705 / 715 without a Data Report modifier, the default value for n is used.

Example:

D5 [CR]

Request point-to-point spectral data from the last measurement or most recently recalled measurement.

Response From PR-705 / 715

Data as specified by ***n***. See the *Data Report Formats* section in this chapter for complete details.

Sample Response from PR-705 / 715 to D1 Command

0000,111,4.124e+000,0.4523,0.4150
[CR][LF]

E (Echo)

The **E** command is used to toggle the PR-705 / 715 between half duplex and full duplex communications mode.

In half duplex mode, the characters sent to the PR-705 / 715 from the Host are not returned or "echoed" from the instrument. This is the preferred method when Remote Mode commands are used within an application program, so the application program does not have to be responsible for reading “echoed” characters.

Full duplex or Echo mode is helpful when the PR-705 / 715 is being controlled from a terminal or terminal emulator. If full duplex mode is activated, a ">" symbol is displayed on the terminal at the start of each line, and the characters sent to the
PR-705 / 715 appear on the Host terminal as they are typed.

Syntax: **E[CR]**

Example:

E

Response from PR-705 / 715

> (Echo enabled) or
blank screen (Echo disabled).

L (Assign Measurement Description)

Use this feature to assign a description to a PR-705 / 715 measurement. Up to 63 alpha numeric characters (including spaces) may be used in the description.

Syntax: L<Description up to 63 alpha / numeric characters>[CR]

If the L command is sent without any characters, the current description is returned from the PR-705 / 715.

If too many characters are sent, the command is ignored and error code *1979* **is returned.**

Note: Once a description is entered using the L command, it will be used for all subsequent measurements until changed by another L command.

Example: LTest Measurement 1[CR]

Response from PR-705 / 715

None

Example: L[CR]

Response from PR-705 / 715

EEEE,<current description>

Where **EEEE** = **0000** for all OK or

1978 for empty field. **1978** is the power-on default. Upon exiting the PR-705 / 715 Remote Mode, the description field is set to empty

or

1979 Indicates too many characters sent with the **L** command.

Sample Response from PR-705 / 715

0000,Test Measurement 1 [CR] [LF]

M (Measure) Command

The **M** command is used to begin a PR-705 / 715 measurement sequence, and return user specified measured data.

The **M** command, as with most PR-705 Remote Mode commands, may be accompanied by a numeric *Data Report Formats*. This features gives the user the ability to retrieve any of the calculated photometric or radiometric values available from the PR-705 / 715 .

Syntax: **M<n> [CR]**

where **n** = An integer that represents a Data Report Formats (See following section on *Data Report Formats* for complete details). The power-up default value for **n** is ***1***. The last value entered for **n** becomes the default Data Report modifier. If the **M** command is sent to the PR-705 / 715 without a Data Report modifier, the default value for **n** is used.

Example:

M5 [CR]

Request point-to-point spectral data from the last measurement or most recently recalled measurement.

Response From PR-705 / 715

Data as specified by ***n***. See the *Data Report Formats* section in this chapter for complete details.

Sample Response from PR-705 / 715 to M2 Command

0000,111,4.495e+000,4.124e+000,1.319e+000

Aborting a Measurement

To abort a measurements, assert the Data Carrier Detect (DCD) line low. This is most easily achieved by closing the RS-232 port, then immediately re-opening the port. Since the PR-705 / 715 did not receive a **Q** command, it will still be in Remote Mode.

Q (Quit) Command

Command the PR-705 / 715 to exit *Remote Mode* and return to the Local (keyboard) mode of operation.

Syntax: Q[CR]

Response from PR-705 / 715

PR-705 / 715 returns to Local (keyboard) Mode of operation. The screen that was being displayed when *Remote Mode* was activated is again displayed.

R (Recall) Command

Recall stored measurements from the PR-705 / 715 built-in floppy disk drive.

The files to be recalled must have saved either by making and storing measurements in the Local (keyboard) operating mode (See Chapter 5) or by using the **W** command covered later in this section.

Syntax #1: R<n>,<f>[CR]

Where: **n** = Data Report Formats (integer)

f = PR-705 / 715 File Number (integer). If **f** is omitted, the file number will

automatically increment. For example, if the **R1,1** is sent, then **R1** is sent without an **f**, the data from file 0002 will be returned.

Note: To download a directory of PR-705 / 715 binary measurement files, send the **R402** command. See the *Data Report Formats* section for details on the 402 Report Format.

Response from PR-705 / 715

FFFF, Data Report Format for the requested file number.

FFFF = **PR-705 / 715 file number. For example, 0001 for File #1.**

S (Setup Command)

The **S** command is used in conjunction with one or more switches to set up the PR-705 / 715 hardware for a measurement. Parameters that can be set using the **S** command include:

- Primary and add-on optical accessories
- Measuring aperture (for multi-aperture systems)
- Photometric units (English or Metric)
- Detector exposure time
- Capture Mode (Single or continuous)
- Measurements to Average
- Calculation Mode (Power or Energy)
- Single or Continuous Measurements
- Trigger Mode (optional)
- View Shutter Position During Measurement

Syntax: **S<Primary Lens>[,]**
<Add-on Lens 1>[,]
<Add-on Lens 2>[,]
<Aperture>[,]
<Photometric Units>[,]
<Detector Exposure Time>[,]
<Capture Mode>[,]
<# Meas. To Average>[,]
<Power or Energy>[,]
<Trigger Mode>[,]
<View Shutter>[,]
<CIE Observer>[CR]

All parameters are optional. It is therefore possible to set one parameter without specifying all parameters.

Commas are used as placeholders for values that fields that precede the field of interest and separators following entered values for a given field.

Therefore, a comma that follows a value entered in a setup field does not count as a placeholder but only as a separator. The following examples will help to illustrate this concept.

Once a parameter has been changed using the **S** command, the value set for that parameter becomes the new Remote Mode default value until:

1. The value is changed again with the **S** command.
2. The PR-705 is turned off using the ON/OFF switch.

Note: The values set with the *S* command reverts to the current settings in the Local (keyboard) mode of operation when Remote Mode is exited using the *Q* command.

Setup Field Definitions

Primary Lens	Integer code value for the standard objective lens (MS55) or other lens or accessory that replaces the standard objective lens during a measurement. See the *Format 116* section for more information on accessory codes. If this value is changed, the *Add On 1* and *Add On 2* fields are set to none (null).

	The default power on code for this field is the current *Primary Lens* selected in the Local (keyboard) mode of operation, or last value set with the **S** command. See *Report Format* # **602** for information on current hardware setup parameters. Resetting this value in *Remote Mode* has no effect on the current stand alone configuration.
Add On 1	Integer code that identifies an optical accessory that can be used in conjunction with a primary accessory. Examples include calibrated neutral density filter(s) or reflectance standard(s). See the *Format 116* section for more information on accessory codes. The default power on code for this field is the current *Add On 1* selected in the Local (keyboard) mode of operation Mode, or last value set with the **S** command. . See *Report Format* # **602** for information on current hardware setup parameters. See *Data Report Formats* **112** *and* **116** for details on determining accessory codes.
Add On 2	Same as *Add On 1* for a second Add On type accessory.
Aperture	*This section applies to multiple aperture systems only.* Enter the integer code for the desired aperture. See the *Format* **112** and **117** sections for complete details on Aperture codes.

	The default when initiating *Remote Mode* is the current aperture selected in the Local (keyboard) Mode, or last value set with the **S** command. See *Report Format* # **602** for information on current hardware setup parameters. Resetting this value in Remote Mode has no effect on the Local mode aperture selection.
Photometric Units	Enter the integer code for English or metric (SI) values for photometric intensity (for example luminance and illuminance). Possible values are: **0** = English **1** = Metric (SI) The default when initiating *Remote Mode* is the current units set in the Local (keyboard) Mode, or last value set with the **S** command. . See *Report Format* # **602** for information on current hardware setup parameters. Resetting this value in Remote Mode has no effect on the current Local mode value.
Detector Exposure Time	Amount of time the detector is exposed to light expressed in milliseconds. Possible values are: **0** = Adaptive. The PR-705 / 715 automatically exposes the detector for the ideal period based on the available optical radiation. **25 60,000** = Set a fixed exposure time from 25 to 60000 milliseconds (60 seconds). Entries must be entered

	as an integer. Decimal values will be ignored. The power up default value is the current exposure time set in the Local (keyboard) Mode. If the *Expsre* field of the PR-705 / 715 *Setup Screen #3* is set to *Adptv* this value is 0. Resetting this value will not affect the value currently set in the PR-705 / 715 Local mode of operation. See *Report Format* # **602** for information on current hardware setup parameters.
Capture Mode	Select Single or Continuous measurements. Possible values are: **0** = Single (default when entering Remote Mode) **1** = Continuous measurements. To abort continuous measurements, assert the Data Carrier Detect (DCD) line low. This is most easily achieved by closing the RS-232 port, then immediately re-opening the port. Since the PR-705 / 715 did not receive a **Q** command, it will still be in Remote Mode. The default *Capture Mode* is Single (**0**).
# Meas. To Average	Enter the number of measurements to average for a measurement sequence. The range is **1** to **99** measurements. The default when initiating *Remote Mode* is the current number of measurements to average set in the Local (keyboard) Mode, or last value set with the **S** command. . See *Report Format* # **602**

	for information on current hardware setup parameters.
Power or Energy	Select the type of radiometric and ultimately photometric values to be displayed. Possible values are: **0** = **Power** The calculated radiometric and photometric values are divided by the exposure time to produce energy per second. **1** = **Energy** The calculated radiometric and photometric values are not divided by the detector exposure time yielding joules. **Note: Version 1.5.6 and above support *Power* or *Energy.* Older versions of the PR-705 / 715 Power. If in doubt, consult factory.**

Trigger Mode	Instruct the PR-705 / 715 to begin a measurement when the proper condition exists at the SYNC IN port. If you have ordered this optional feature, see Appendix E for more details on the SYNC IN and SYNC OUT ports. Possible values are: **0** = Internal trigger Measurement will begin when a valid M command is sent to the PR-705 / 715. **1** = External trigger The measurement begins when the proper signal is generated on the SYNC IN connector. The default power on code value for this field is the current *Trigger Mode* selected in the Local (keyboard) mode of operation, or last value set with the **S** command. See *Report Format* # **602** for information on accessing current hardware setup parameters.
View Shutter	Set the PR-705 / 715 Viewing Shutter to open or closed during a measurement. Possible values are: **0** = Open during the measurement. **1** = Closed during the measurement. The default power on code value for this field is the current Viewing Shutter setting selected in the Local (keyboard) mode of operation, or last value set with the **S** command. . See *Report Format* # **602** for information on current hardware setup parameters..

CIE Observer	Select 2° or 10° CIE Standard Observer Functions for calculating color following a measurement. **Note:** If photometric brightness (e.g. luminance) being evaluated, the CIE 2° Standard Observer must be used. Possible values are: **0** = CIE 1931 2° Standard Observer Functions. **1** = CIE 1960 CIE 10° Standard Observer Functions. The default power on code value for this field is the current *CIE Obs.* Selection in the Local (keyboard) mode of operation, or last value set with the **S** command. See *Report Format* # **602** for information on current hardware setup parameters.

Response from PR-705 / 715

EEEE[CR LF]

EEEE = **0000** for All OK.
Error code Usually a syntax error or invalid setup request. See Appendix D for error code definitions.

Example # 1

S2[CR]

Select *Primary Accessory #2.* Note that no trailing placeholders (commas) are required.

Example #2

S,,,2[CR]

Select Aperture #2. Note that commas have replaced the values for the Primary Lens and Add On 1 and Add On 2.

Example #3

S1,,,3[CR]

Select *Primary Lens #1*, and *Aperture #3*. Note in this example, that the comma immediately following **S1** is a separator, and the next two commas represent empty *Add On 1* and *Add On 2* fields.

W (Write) Command

Using the **W** command, measurements are made, data returned to the Host and automatically stored directly to the PR-705 / 715 built-in floppy disk drive.

Following the measurement, the data is automatically added to the directory of files on the PR-705 / 715 floppy disk. The file name for the data on the floppy disk ends with the file extension **.MEA.** The first part of the file name is the 8 digit serial number of the instrument - for example, 75980601.MEA. The file is a binary file designed specifically for the on-board software of the PR-705/715. It cannot be recognized by other software packages.

Use the **Write** command when no other method of saving data exists. Ideally, data should be

saved on the Host computers hard disk or other storage media.

The **W** command is identical to the **M** command with the addition of automatic disk storage following the measurements.

If **W** is sent without the optional *Data Report Format* <**n**>, data will be displayed using the format last specified using a **W** or **M** command.

Syntax: **W<n>[CR]**

Where: **n = Data Report Formats or**
0 = Store most recent measurement to disk with no Data Report

Response from PR-705 / 715

Requested Data Report Format for the just completed measurement. See the *Data Report Formats* section for full details on PR-705 / 715 reports.

Z (RS-232 Baud Rate) Command

The PR-705 / 715 factory default RS-232 baud rate is 9600. Use the **Z** command to change to one of the following:

4800, 9600, 19200, 38400, 57600 or 115200

Note: Sending the *Z* command without the baud rate leaves the baud rate unchanged and simultaneously sets the Echo to half-duplex.

Syntax: Z[baud] [CR]

Data Report Formats

Through *Data Report Formats,* the PR-705 / 715 supplies the results from the last measurement made, or previous measurements stored on the PR-705 / 715 floppy disk.

Each *Report Format* contains one or more comma delimited fields. In most cases, the fields are fixed size however in some cases the field size is variable. For example, a field describing the accessory or aperture used in the last measurement will vary according to the accessory description (e.g. MS-55 or RS-3) or measurement description. The longest possible field (63 bytes) is the measurement description as specified by the **L** command that is also variable depending on the length of the description.

The information in each field differs depending on the format type. Full descriptions for each format type follow in the remainder of this chapter.

Most formats have one or more fields in common. The two most common are *error code* and *units.*

Error code provides information relating to syntax or measurement errors. An *Error Code* of 0000 indicates the *Remote Mode* command was

performed successfully including the measurement. If a syntax or measurement error is encountered that causes a measurement sequence abort, the *Error Code* is the only field returned by the PR-705 / 715.

Appendix D contains details on error codes.

The *Units* field contains information describing the units type for the **Y** report parameter (photometric intensity). In general, the **Y** value represents calculated intensity. The *Units* field will have one of the following values for **Y**:

Units Code Reference Table

		CALC Mode	
		Power	*Energy*
Unit	**Given As**	**Units Code**	**Units Code**
Luminance	***** footlamberts (fl) or candelas per square meter (cd/m^2)	111	1110
Radiance	watts per steradian per square meter ($w/sr/m^2$)	11	110
Illuminance	***** footcandles (fc) or lux	112	1120
Irradiance	watts per square meter (w/m^2)	12	120
Luminous Intensity	Millicandelas (mcd)	113	1130
Radiant Intensity	watts per steradian (w/sr)	13	130
Luminous Flux	Lumens (l)	114	1140
Radiant Flux	Watts (w)	14	140

** Use report **601** or **602,** field number 5, to determine if these photometric units are given as English (fl or fc) or Metric (cd/m^2 or lux) values.*

The following table provides a quick reference of the Report number, brief description of the report, and the Remote Mode commands that honor the Report number.

Remote Mode Commands Quick Reference Guide

		Remote Mode Command Type			
Rpt #	**Description**	**Meas.**	**Write**	**Recall**	**Data**
0	Error code, write to disk		Y		
1	Error code, units, Y, x, y	Y	Y	Y	Y
2	Error code, units, X,Y,Z	Y	Y	Y	Y
3	Error code, units, Y, u', v'	Y	Y	Y	Y
4	Error code, units, Y, CCT, u, v deviation	Y	Y	Y	Y
5	Error code, units, Peak WL, total, Rad., total photon rad., WL, spectral data	Y	Y	Y	Y
6	Error code, units, Y, x, y, u', v'	Y	Y	Y	Y
7	Error code, units, Y, u, v	Y	Y	Y	Y
8	Error code, (Light + Dark) A/D value per detector	Y	Y	Y	Y

9	Error code, Dark A/D value per detector	Y	Y	Y	Y
10	Error code, (Light - Dark) A/D value per detector	Y	Y	Y	Y
11	Error code, units, V (scotopic intensity)	Y	Y	Y	Y
12	Error code, units, Y, x, y, u, v	Y	Y	Y	Y
110	Error code, PR-705 / 715 serial number				Y
111	Error code, instrument type				Y
112	Error code, # of accessories, # of apertures				Y
114	Error code, PR-705 / 715 software version				Y
116	Error code, list of calibrated accessories				Y
117	Error code, list of calibrated apertures				Y
120	Error code, detector and measured spectral configuration				Y
200	Error code, max. signal A/D, min. signal A/D, avg. signal A/D	Y	Y	Y	Y

201	Error code, max. dark A/D, min. dark A/D, avg. dark A/D	Y	Y	Y	Y
202	Error code, max. signal-dark A/D, min. signal-dark A/D, avg. signal-dark A/D	Y	Y	Y	Y
401	PR-705 floppy disk info. - file # of last meas., disk volume label, no. of meas. on disk, max. meas. allowed on disk, meas. date, meas. time, meas. descrip.			Y	
402	PR-705 floppy disk directory			Y	
601	Error code, primary lens, add-on 1, add-on 2, aperture, units, exposure mode, exposure time, capture mode, cycles, calc. mode, trigger mode, view shutter pos., CIE observer				Y
602	Same info. As 601 with some descriptive labels				Y

Report Format Descriptions

Format # 0 – Save Measurement to Disk

(Works with Write command)

Format 0 saves the most recent, unsaved measurement (e.g. the result of a Remote Mode measurement command) to the PR-705 floppy disk. Following the disk save operation, the record number the data was saved to is returned to the Host.

NOTE: A floppy disk with valid PR-705 measurement files must be present in the on-board PR-705 floppy disk drive. If no disk is present, the operation will no be successful and an error message will be displayed.

Syntax:

[W0][CR]

Response from PR-705 / 715 to Host

Record number, [CR][LF]

Example

```
>W0
 0009
```

Format # 1 – Intensity, CIE x,y

(Use with Meas., Write, Recall, and Data commands)

Syntax:

[M1][CR], or [W1][CR], or [R1][CR], or [D1][CR]

Response from PR-705 / 715 to Host:

Error code,units code,Y,x,y [CR][LF]

Where:

Y = Photometric intensity
x = CIE 1931 x chromaticity coordinate
y = CIE 1931 y chromaticity coordinate

Examples

```
>M1
 0000,111,2.919e+001,0.4476,0.4074

>W1
 0005,111,2.919e+001,0.4476,0.4074

>R1,1
 0001,111,2.919e+001,0.4476,0.4074

>D1
 0000,111,2.919e+001,0.4476,0.4074
```

Note: The first field of the W1 and R1 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 2 – CIE Tristimulus Values

(Use with Meas., Write, Recall, Data commands)

This format returns the CIE tristimulus (Red, Green, and Blue components) values of the requested measurement.

Syntax:

[M2][CR], or [W2][CR], or [R2][CR], or [D2][CR]

Response from PR-705 / 715 to Host:

Error code,units code,X,Y,Z [CR][LF]

Where:

- X = CIE X (Red) Tristimulus value
- Y = CIE Y (Green) tristimulus value and Photometric intensity (always in metric [cd/m2 or lux] values)
- Z = CIE Z (Blue) tristimulus value

Examples

>M2
0000,111,1.098e+002,1.000e+002,3.558e+001

>W2
0006,111,1.098e+002,1.000e+002,3.558e+001

>R2,6
0006,111,1.098e+002,1.000e+002,3.558e+001

>D2
0000,111,1.098e+002,1.000e+002,3.558e+001

Note: The first field of the W2 and R2 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 3 – Intensity, CIE u',v'

(Use with Meas., Write, Recall, and Data commands)

Syntax:

[M3][CR], or [W3][CR], or [R3][CR], or [D3][CR]

Response from PR-705 / 715 to Host:

Error code,units code,Y,u',v' [CR][LF]

Where:

Y = Photometric intensity
u' = CIE 1976 u' chromaticity coordinate
v' = CIE 1976 v' chromaticity coordinate

Examples

```
>M3
 0000,111,2.919e+001,0.2560,0.5243

>W3
 0007,111,2.919e+001,0.2560,0.5243

>R3,7
 0007,111,2.919e+001,0.2560,0.5243

>D3
 0000,111,2.919e+001,0.2560,0.5243
```

Note: The first field of the W3 and R3 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 4 – Intensity, CCT, uv Deviation

(Use with Meas., Write, Recall, and Data commands)

Syntax:

[M4][CR], or [W4][CR], or [R4][CR], or [D4][CR]

Response from PR-705 / 715 to Host:

Error code,units code,Y,CCT,uv deviation[CR][LF]

Where:

Y =	Photometric intensity
CCT =	Correlated color temperature in Kelvins
uv deviation =	Distance of chromaticity point from Plancks blackbody radiation locus in CIE 1960 color space units (u,v)

Example

```
>M4
 0000,111,2.919e+001,   2856,0.0000

>W4
 0008,111,2.919e+001,   2856,0.0000

>R4,8
 0008,111,2.919e+001,   2856,0.0000

>D4
 0000,111,2.919e+001,   2856,0.0000
```

Note: The first field of the W4 and R4 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 5 – Spectral Data

(Use with Meas., Write, Recall, Data commands)

Format 5 returns spectral information about the measurement including the integrated (total) spectral data, integrated photon values, wavelength of spectral data and point-to-point spectral data.

Syntax:

[M5][CR], or [W5][CR], or [R5][CR], or [D5][CR]

Response from PR-705 / 715 to Host:

Error code,units code,Peak WL, Integrated Spectral Data, Integrated Photon Data, WL, Spectral data[CR][LF]
WL,Spectral Data @ start WL[CR][LF]
*
*
*
WL,Spectral Data @ End WL[CR][LF]

Where:

Peak WL	Wavelength of highest intensity of this source
Integrated	Sum of all spectral data

Spectral Data	times the wavelength reporting increment
Integrated Photon Data	Total number of photons per second throughout the spectral band during the measurement
WL	Wavelength in nanometers
Spectral Data	Spectral intensity in terms of *units* at WL wavelength (e.g. Radiance, Irradiance, Radiant Intensity or Radiant Flux

>M5

0000,11,7.800e+002,4.743e+004,1.558e+023
380,9.800e+000
382,1.023e+001
384,1.067e+001
386,1.113e+001
388,1.160e+001
390,1.209e+001

>W5

0003,11,7.800e+002,4.743e+004,1.558e+023
380,9.800e+000
382,1.023e+001
384,1.067e+001
386,1.113e+001
388,1.160e+001
390,1.209e+001

R5,3

0003,11,7.800e+002,4.743e+004,1.558e+023
380,9.800e+000
382,1.023e+001
384,1.067e+001
386,1.113e+001
388,1.160e+001
390,1.209e+001

D5

0000,11,7.800e+002,4.743e+004,1.558e+023
380,9.800e+000
382,1.023e+001
384,1.067e+001
386,1.113e+001
388,1.160e+001
390,1.209e+001

Note: The first field of the W5 and R5 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 6 – Intensity, CIE 1931 xy, 1976 u'v'

(Works with Meas., Write, Recall, Data)

Format 6 returns photometric intensity and CIE chromaticity values including CIE 1931 (xy) and CIE 1976 chromaticity coordinates (u'v').

Syntax:

[M6][CR], or [W6][CR], or [R6][CR], or [D6][CR]

Response from PR-705 / 715 to Host:

Error code,units code,Y,x,y,u',v'[CR][LF]

Where:

Y = Photometric intensity
x = CIE 1931 x chromaticity coordinate
y = CIE 1931 y chromaticity coordinate
u' = CIE 1976 u' chromaticity coordinate
v' = CIE 1976 v' chromaticity coordinate

Examples

>M6

0000,111,2.919e+001,0.4476,0.4074,0.2560,
0.5243

>W6

0011,111,2.919e+001,0.4476,0.4074,0.2560,
0.5243

>R6,11

0011,111,2.919e+001,0.4476,0.4074,0.2560,
0.5243

>D6
0000,111,2.919e+001,0.4476,0.4074,0.2560,
0.5243

Note: The first field of the W6 and R6 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 7 – Intensity, CIE 1960 uv

(Use with Meas., Write, Recall, and Data commands)

Format 7 returns photometric intensity and CIE 1960 color space chromaticity coordinates (u,v).

Syntax:

[M7][CR], or [W7][CR], or [R7][CR], or [D7][CR]

Response from PR-705 / 715 to Host:

Error code,units code,u,v[CR][LF]

Where:

Y = Photometric intensity
u = CIE 1960 u' chromaticity coordinate
v = CIE 1960 v' chromaticity coordinate

Examples

>M7
0000,111,2.919e+001,0.2560,0.3495

```
>W7
 0012,111,2.919e+001,0.2560,0.3495

>R7,12
 0012,111,2.919e+001,0.2560,0.3495

>D7
 0000,111,2.919e+001,0.2560,0.3495
```

Note: The first field of the W7 and R7 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 8 – A/D Counts (Signal)

(Use with Meas., Write, Recall, and Data commands)

Format 8 returns the A/D counts for each of the 256 detector elements. This value is a combination of the sum of the optical signal and detector dark current accumulated during the measurement.

Syntax:

[M8][CR], or [W8][CR], or [R8][CR], or [D8][CR]

Response from PR-705 / 715 to Host:

Error code,[CR][LF]
Value at Pixel 0[CR][LF]
*
*
*
Value at Pixel 255[CR][LF]

Examples

```
>M8
 0000,
0                    (Data Point 1)
*
*
*
1884                 (Data Point 256)

>W8
0005,
0                    (Data Point 1)
*
*
*
1884                 (Data Point 256)

>R8,5
0005,
0                    (Data Point 1)
*
*
*
1884                 (Data Point 256)

>D8
0000,
0                    (Data Point 1)
*
*
*
1884                 (Data Point 256)
```

Note: The first field of the W8 and R8 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 9 – A/D Counts (Dark Current)

(Use with Meas., Write, Recall, and Data commands)

Format 9 returns the A/D counts of the dark current for each of the 256 detector elements that was accumulated during the measurement.

Syntax:

[M9][CR], or [W9][CR], or [R9][CR], or [D9][CR]

Response from PR-705 / 715 to Host:

Error code,[CR][LF]
Value at Pixel 0[CR][LF]
*
*
*
Value at Pixel 255[CR][LF]

Examples

```
>M9
0000,
0                    (Data Point 1)
*
*
*
164                  (Data Point 256)

>W9
0006,
0                    (Data Point 1)
*
*
*
164                  (Data Point 256)

>R9,6
0006,
0                    (Data Point 1)
*
*
*
164                  (Data Point 256)

>D9
0000,
0                    (Data Point 1)
*
*
*
164                  (Data Point 256)
```

Note: The first field of the W9 and R9 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 10 – A/D Counts (Signal – Dark Current)

(Use with Meas., Write, Recall, and Data commands)

Format 10 returns the A/D counts of the (Light – Dark) signal for each of the 256 detector elements that was accumulated during the measurement. Since the Light signal is actually a combination of both photons striking the detector and the detector dark current, Format 10 can be used to report the light only. This is the value used in the calculation chain of the RP-705/715 following a measurement.

Syntax:

[M10][CR], or [W10][CR], or [R10][CR], or [D10][CR]

Response from PR-705 / 715 to Host:

Error code,[CR][LF]
Value at Pixel 0[CR][LF]
*
*
*
Value at Pixel 255[CR][LF]

Examples

```
>M10
0000,
0                    (Data Point 1)
*
*
*
1720                 (Data Point 256)

>W10
0006,
0                    (Data Point 1)
*
*
*
1720                 (Data Point 256)

>R10,6
0006,
0                    (Data Point 1)
*
*
*
1720                 (Data Point 256)

>D10
0000,
0                    (Data Point 1)
*
*
*
1720                 (Data Point 256)
```

Note: The first field of the W10 and R10 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 11 – Scotopic Intensity

(Use with Meas., Write, Recall, and Data commands)

Use Format 11 to retrieve the Scotopic (CIE V) intensity as the result of a measurement.

Syntax:

[M11][CR], or [W11][CR], or [R11][CR], or [D11][CR]

Response from PR-705 / 715 to Host:

Error code,units code,V[CR][LF]

Where:

V = Scotopic photometric intensity

Examples

>M11
0000,111,1.527e+001

>W11
0006,111,1.527e+001

>R11,6
0006,111,1.527e+001

>D11
0000,111,1.527e+001

Note: The first field of the W11 and R11 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 12 – Intensity CIE x,y,u',v'

(Use with Meas., Write, Recall, and Data commands)

Format 12 returns photometric intensity and CIE chromaticity values including CIE 1931 (xy) and CIE 1960 (uv) chromaticity coordinates.

Syntax:

[M12][CR], or [W12][CR], or [R12][CR], or [D12][CR]

Response from PR-705 / 715 to Host:

Error code,units code,Y,x,y,u',v'[CR][LF]

Where:

- Y = Photometric intensity
- x = CIE 1931 x chromaticity coordinate
- y = CIE 1931 y chromaticity coordinate
- u = CIE 1960 u' chromaticity coordinate
- v = CIE 1960 v' chromaticity coordinate

Examples

>M12

0000,111,2.919e+001,0.4476,0.4074,0.2560,
0.3495

>W12

0005,111,2.919e+001,0.4476,0.4074,0.2560,
0.3495

>R12,6

0006,111,2.919e+001,0.4476,0.4074,0.2560,
0.3495

>D12

0000,111,2.919e+001,0.4476,0.4074,0.2560,
0.3495

Note: The first field of the W12 and R12 responses above contains the record number on the PR-705 floppy disk instead of the error code.

Format # 110 – Serial Number

(Use with Data command)

Returns the serial number of the PR-705.

Syntax:

[D110][CR]

Response from PR-705 / 715 to Host:

Error code,serial number[CR][LF]

Example

>D110
0000,75980601

Format # 111 – Instrument Type

(Use with Data command)

Returns the instrument type (PR-705 or PR-715).

Syntax:

[D111][CR]

Response from PR-705 / 715 to Host:

Error code,serial number[CR][LF]

Example

>D111
0000,PR-705

Format # 112 – Number of Accessories and Apertures

(Use with Data command)

Returns the number of calibrated accessories, and calibrated measuring apertures.

Syntax:

[D112][CR]

Response from PR-705 / 715 to Host:

Error code,number of accessories,number of apertures[CR][LF]

Examples

>D112
0000, 6, 5

Format # 114 – Software Version

(Use with Data command)

Returns the PR-705/715 software version (stand alone software).

Syntax:

[D114][CR]

Response from PR-705 / 715 to Host:

Error code,software version[CR][LF]

Examples

>D114
0000,1.5.6

Format # 116 (Use with Data command)

Provides a list of calibrated accessories, accessory codes and accessory type. Returns the number of calibrated accessories, and calibrated measuring apertures.

Syntax:

[D116][CR]

Response from PR-705 / 715 to Host:

Error code,accessory code,accessroy name,accessory type,photometric units, radiometric units[CR][LF]

Notes:

1. This length of this report is variable. Its length depends on the number of accessories and the accessory type. The following example is designed to illustrate possible accessory descriptions. For the last accessory, the ND-10, the photometric and radiometric units are not applicable. In this case, the accessory shares the units of the primary accessory with which it is used.

2. The *accessory code* is the value used in the *S* command to specify the desired accessory. See *Format 116* to obtain a list of accessories calibrated for your instrument

Examples

```
>D116
 0000, 0,MS-55,Primary,Luminance,Radiance
 0000, 1,CR-
55,Primary,Illuminance,Irradiance
 0000, 2,IS-700,Primary,Lum.Flux,Rad.Flux
 0000, 3,MS-77,Primary,Luminance,Radiance
 0000, 4,RS-3,AddOn,Illuminance,Irradiance
 0000, 5,ND-10,AddOn,N.A,N.A
```

Format # 117 – List of Accessories and Apertures

(Use with Data command)

Provides a list of calibrated aperture codes, aperture descriptions, and system bandwidth information.

Syntax:

[D117][CR]

Response from PR-705 / 715 to Host:

Error code,aperture code,aperture name,system bandwidth using this aperture (in nm)[CR][LF]

Note:

1. This length of this report is variable and its depends on the number of apertures, the aperture description and bandwidth description. The following example lists all standard apertures available with the PR-705/715.

2. The *aperture code* is the value used in the *S* command to specify the desired aperture. See *Format 117* to obtain a list of calibrated and associated codes for your instrument.

Example

```
>D117
 0000, 0,1 deg.,10.00
 0000, 1,1/2 deg.,5.00
 0000, 2,1/4 deg.,2.50
 0000, 3,1/8 deg.,2.50
 0000, 4,2 deg.,20.00
```

Format # 120 – Spectral and Detector Information

(Use with Data command)

Provides detector and spectral information about the PR-705 or PR-715 being used including:

- Number of data points
- Wavelength limits and
- Wavelength increment
- First and last useful detectors for this instrument

Syntax:

[D120][CR]

Response from PR-705 / 715 to Host:

Error code,number of measured points,starting wavelength (in nm),ending wvelength,wavelength increment,number of detectors,first detector used, last detector used[CR][LF]

Example

>D120
0000,201,10.00,380,780,2,256,5,251

Format # 200 – A/D Statistics (Signal)

(Use with Meas., Write, Recall, and Data commands)

Supplies statistical information about the A/D values for all detectors, including the maximum, minimum, and average values. These values represent the total (signal plus dark current) accumulated during the measurement.

Syntax:

[D200][CR]

Response from PR-705 / 715 to Host:

Error code,maximum A/D,miminum A/D,average A/D[CR][LF]

Example

>M200
0000,1996,14667,5665

>W200
0005,1996,14667,5665

>R200,5
0005,1996,14667,5665

>D200
0000,1996,14667,5665

Format # 201 A/D Statistics (Dark Current)

(Use with Meas., Write, Recall, and Data commands)

Supplies statistical information about the A/D values for all detectors, including the maximum, minimum, and average values. These values represent the dark current accumulated during the measurement.

Syntax:

[D201][CR]

Response from PR-705 / 715 to Host:

Error code,maximum A/D,miminum A/D,average A/D[CR][LF]

Example

>M201
0000,4,201,93

>W201
0005,4,201,93

>R200,5
0005,4,201,93

>D201
0000,4,201,93

Format # 202 A/D Statistics (Signal – Dark Current)

(Use with Meas., Write, Recall, and Data commands)

Supplies statistical information about the A/D values for all detectors, including the maximum, minimum, and average values. These values represent the signal (total minus dark) accumulated during the measurement.

Syntax:

[D202][CR]

Response from PR-705 / 715 to Host:

Error code,maximum A/D,miminum A/D,average A/D[CR][LF]

Example

>M202
0000,773,13439,4439

>W202
0012,773,13439,4439

>R202,12
0012,773,13439,4439

>D202
0000,773,13439,4439

Format # 401 – 705 Disk Information

(Use with Recall command)

Provides information on the last measurement stored on the PR-705 floppy disk including:

- File number of last measurement
- Disk label
- Total number of stored measurements on this disk
- Maximum number of measurements that may be stored on this disk
- Date of last measurement
- Time of last measurement
- Measurement description (if any)

Syntax:

[R401][CR]

Response from PR-705 / 715 to Host:

File number of last measurement,disk label,total number of stored measurements on this disk,maximum number of measurements that may be stored on this disk,date of last measurement,time of last measurement,measurement description (if any)[CR][LF]

Example

```
>R401
 0002,0213991256  ,2,246,Feb 13
1999,12:59:09,
```

Notes:

1. **In the preceding example, no measurement description was specified for the measurement therefore the last field, preceded by a comma is blank.**

2. **The length of this field is variable based on the length of the measurement description if supplied.**

Format # 402 – 705 Disk Directory

(Use with Recall command)

Supplies a directory of all files stored on the PR-705 installed floppy disk including:

- Measurement file number
- Measurement date
- Time of measurement
- Measurement description (if any)

Syntax:

[R402][CR]

Response from PR-705 / 715 to Host:

Error code,file number,date of last measurement,time of last measurement,measurement description (if any)[CR][LF]

Example

```
>R402
 0001,Feb 13 1999,12:58:58,
 0002,Feb 13 1999,12:59:09,
 0003,Feb 15 1999,12:39:11,
 0004,Feb 15 1999,12:50:11,
 0005,Feb 15 1999,12:50:45,Sample
description
```

Note: The length of this report is variable and is based on the number of measurements stored on the disk and the length of the measurement description (if applicable).

Format # 601 – Instrument Setup (Abbreviated)

(Use with Data command)

Reports instrument set-up for last measurement taken. Parameters returned include:

Primary lens:	Primary lens code
Add On Lens 1:	Add-on #1 code
Add On Lens 2:	Add-on #2 code
Aperture:	Aperture code
Photometric Units:	0 = English, 1 = SI
Exposure Mode:	0=Adaptive, 1=Fixed (User Defined)
Exposure Time:	In milliseconds
Capture Mode	0=Single Measurement, 1=Continuous Measurements

Measurements to Average:	1 – 99
Power Mode:	0=Power (energy / sec.), 1=Energy
Trigger Mode:	0 = Internal Trigger (standard Remote mode measurement command), 1=Trigger Signal from SYNC IN port after measurement command sent
View Shutter:	0=Closed during measurement, 1=Open during measurement
CIE Observer:	0=2° CIE 1931 Standard Observer, 1=10° 1964 Observer

Syntax:

[R601][CR]

Response from PR-705 / 715 to Host:

Error code,primary lens code,add on 1 code,add on 2 code,aperture code,photometric units,exposure mode,exposure time,capture mode,measurements to average,calculation mode,trigger mode,viewing shutter position,CIE observer[CR][LF]

Example

```
>D601
 0000,0,0,0,4,0,0,300,0,1,0,0,0,0
```

Format # 602 – Instrument Setup (Verbose)

(Use with Data command)

Supplies the same data as Format # 601, with some field codes replaced by descriptions.

Syntax:

[R602][CR]

Example

```
>D602
 0000,MS-55,,,2 deg.,0,Adptv,300,0,1,0,0,0,0
```

Note that for some fields, code integers are replaced by descriptions. Furthermore, unused accessories (in this example Add Ons 1 and 2) that in Format #1 are represented by “0”, are replaced by commas. All fields in Format 602 have the same meaning as Format 601.

Remote Mode Error Codes

Following is a list of syntax error codes that may be encountered during Remote Mode operations. With few exceptions, these errors are generated by improper Remote Mode commands.

Remote Mode Error Codes

Error Code	Description
2000	Invalid Response code
1999	Invalid ASCII command
1998	Field overflow S command
1997	Invalid Primary accessory
1996	Invalid Add On accessory 1
1995	Invalid Add On accessory 2
1994	Add On accessory 2 same as 1
1993	Invalid Aperture
1992	Invalid Units
1991	Integration time out of range
1990	Invalid Capture Mode
1989	Number of Cycles out of range
1988	Invalid Calc Mode
1987	Invalid Trigger Mode
1986	Invalid View Shutter command
1985	Invalid CIE Observer
1984	Invalid Meas Index
1983	Field overflow R cmd
1982	String overflow L cmd
1981	Disk Empty
1980	Measurement required
1979	Excessive length
1978	Empty string

Appendix B - GPIB-232 Interface

The GPIB-232 is designed to provide the user with the capability of controlling the PR-705 / 715 over an IEEE-488 interface using Remote Mode commands (see Appendix A for more information concerning Remote Mode operation).

There are two, eight position dip switches located on the side of the interface that control the IEEE-488 (SW1 or left most set of dip switches) and RS-232 (SW2 or left most set of dip switches) protocols.

The dip switches are set at the Photo Research to honor the following conditions:

IEEE-488

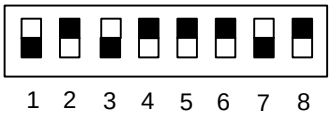
IEEE-488 Address:	5
SRQ:	Disabled
Buffer:	Large
Operating Mode:	D

RS-232

Baud:	9600
Parity:	None
Data Bits:	8
Stop Bits:	1
XON/XOFF:	Disabled

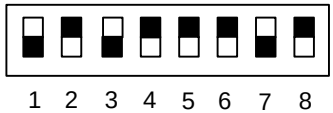
The default (factory) switch settings are illustrated below:

SW1



GPIB Address, Config, Mode

SW2



Baud Rate, Data Format, Handshake

NOTE: Consult the National Instruments (GPIB-232CV-A) Instruction Manual supplied with the interface for further details.

Operating Instructions

Step 1 - Connect the IEEE-488 cable (not supplied) from the Host computer to the appropriate connector on the GPIB-232.

Step 2 - Connect the RS-232 cable from the appropriate connector on the GPIB-232 to the RS-232 connector on the PR-705.

Step 3 - Connect the AC cable from the GPIB-232 to a proper AC supply.

CAUTION: Make sure attention is paid to the AC Voltage rating of the GPIB-232 located on the label on the bottom of the interface. Connecting to the wrong AC supply will cause irreversible damage.

Step 4 - Turn on the GPIB-232 using the 0/1 switch.

Step 5 - Turn on the PR-705 using the 0/1 switch and allow to warm up for at least 10 minutes before making measurements.

Step 6 - Align and focus the PR-705 on the sample.

Step 7 - Send Remote Mode commands (see Appendix A) from your IEEE-488 application program.

Appendix C -
IS-700 Integrating Sphere

Overview

The IS-700 is a 3 inch sphere designed to measure the total luminous flux (lumens) of LEDs or similarly sized miniature lamps. This accessory consists of a sphere with baffle and LED Mounting Tube (See Figure 1). During operation, the LED is inserted into the interior end of the Mounting Tube, the Adjustment Screw is set so that the tip of the LED protrudes precisely 0.100 inches into the sphere, and the measurement is conducted. The power cables for the LED (plus and minus current) are connected via mini banana jacks located on the anterior end of the mounting tube.

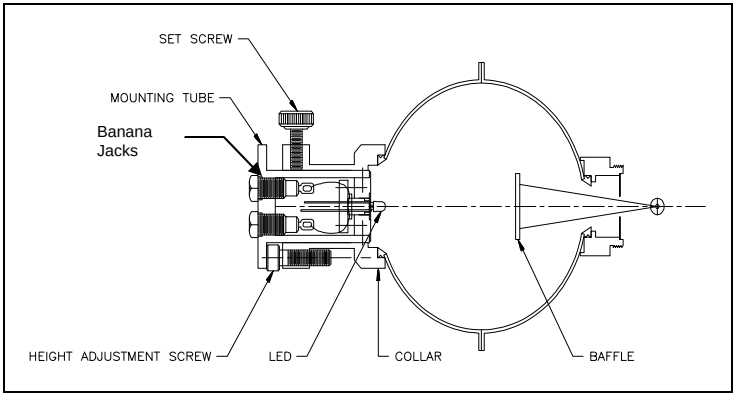


FIGURE 1 - IS-700 INTEGRATING SPHERE

Installing the IS-700

Step 1 Remove the current optical accessory (Primary Lens) from the PR-705 by turning counter-clockwise.

Step 2 Install the IS-700 by carefully threading clockwise into the mounting ring located in the front of the PR-705 / 715.

Mounting the LED

Step 1 Loosen the Set Screw (Figure 1) by turning it counter-clockwise.

Step 2 Remove the Mounting Tube from the Collar by gently pulling away from the sphere. If there is any resistance, further loosen the Set Screw.

Step 3 Insert the leads of the LED into the two miniature sockets located on the interior end of the Mounting Tube. Push the LED in as far as possible. Take care to note the polarization of the leads. For simplicity, the POSITIVE LED lead should be inserted into the socket corresponding to the RED Banana Jack located on the opposite end of the Mounting Tube.

Adjusting the Mounting Tube Height

Step 1 Referring to Figure 2, position the tip of the LED so that it is directly adjacent to the Height Adjustment Screw, and resting on the outside surface of the Collar.

Step 2 Adjust the Height Adjustment Screw so that it is just touching the end of the Mounting Tube next to the LED.

Step 3 Attach the LED current source (not supplied) to the Mounting Tube using appropriate miniature banana plugs paying attention to the polarity.

Step 4 Supply the appropriate current to the LED and allow at least 10 minutes warm-up. Make sure the LED is properly lit.

Step 5 Insert the Mounting Tube into the Collar until the Mounting Tube just touches the top of the Height Adjustment Screw.

Step 6 Tighten the Set Screw to hold the Mounting Tube in place**. DO NOT OVER TIGHTEN!**

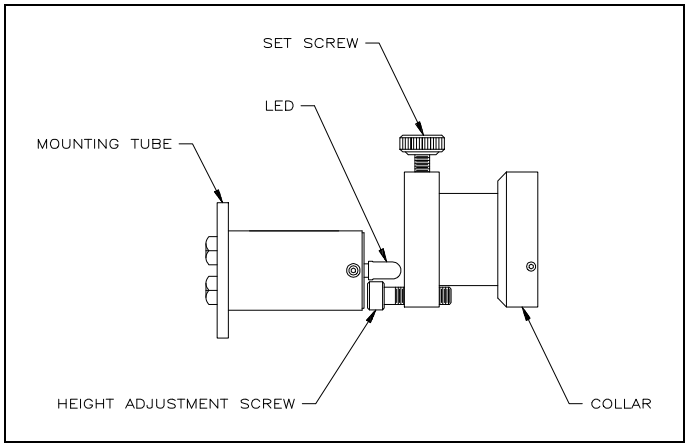


FIGURE 2 - HEIGHT ADJUSTMENT

Making a Measurement

Step 1 Turn on the PR-705 / 715 by pressing the 0/1 (ON/OFF) located on the side of the instrument. Allow at least 10 minutes for warm-up before beginning measurements.

Step 2 Press the **FRWD** key on the PR-705 / 715 local keyboard until *Setup Screen #1* displayed.

Step 3 Use the ▲ or ▼ key to place the **>** symbol next to *Lens:.*

Step 4 Press **ENTR** to cause the field next to *Lens* to begin blinking.

Step 5 Use the ▲ or ▼ key until *IS-700* is displayed.

Step 6 Press **ENTR.**

Step 7 Make sure the *Add1* and *Add2* fields are set to *None*.

Step 8 Press **MEAS**

or

Use *Remote Mode* commands to make a measurement.

Note: For some fields, code integers are replaced by descriptions. Furthermore, accessories specified as not in use, (in this example Add On 1 and 2) that in Format #1 are represented by "0", are replaced by commas. All other fields in Format 602 have the same meaning as Format 601. Use standard Remote Mode commands over IEEE-488 interface bus to make measurements and retrieve measurement results. Press the MEAS key on the PR-705 to make a measurement and display the results.

Appendix D -
Error Codes

The following tables contain the various error codes that may be encountered while using the PR-705.

Important Note

The PR-705 / 715 is highly sophisticated equipment and no attempt should be made by the user to repair the instrument. Consult Photo Research for trouble shooting and repair information. The following error codes are to be used as information that may be useful in analyzing an existing problem.

The **Code** column of each table displays the error code that is displayed either on the PR-705 / 715 LCD screen or returned during Remote Mode operations.

In the **Type** column, the error type is displayed. Following are descriptions for each error type:

E = General error,
S = System error
T = Timeout error
W = Warning error

Fatal Errors

Fatal errors indicate a gross malfunction of one of the PR-705 system components. Should you encounter one of these errors (errors beginning with the number 9), contact Photo Research and have the error code available when calling.

CODE	TYPE	DESCRIPTION
9999	E	Error opening file.
9998	E	0 length buffer encountered while writing file
9997	E	Error setting index for write operation
9996	E	Writing file not all items
9995	E	Opening file to read
9994	E	Reading size error first two bytes
9993	E	Size of file different from expected
9992	E	Error setting index for read operation
9991	E	Reading file not all items
9990	E	Unexpected end of file
9989	E	Meas[0]
9988	E	Meas[1]
9987	E	Meas[2]
9986	E	Meas[3]
9985	E	Meas[4]
9984	E	Meas[5]
9983		
9982		
9981		
9980	E	Primary accessory calibration error
9979	E	Add On #1 calibration error
9978	E	Add On #2 calibration error
9977	E	CIE calculation error
9976	E	Instrument configuration error

CODE	TYPE	DESCRIPTION
9975	E	Linearity calibration error
9974	E	Unknown control error
9973	E	Illegal measurement description
9972	E	Spectral data error
9971	E	Calculation error
9970	E	Aperture calibration error
9969	E	Instrument setup error
9968	E	Delta LAB error
9967	E	Remote buffer error
9966	E	Data conversion error
9965	E	Data conversion error
9964	E	Null file buffer encountered while reading file
9963	E	Error initializing screens
9962	E	Flag not set
9961	E	Data conversion error.
9960	E	Raw data [0] error
9959	E	Raw data[1] error
9958	E	Raw data [2] error
9957	E	Raw data [3] error

Hardware Errors

The following errors report malfunctions of the detector chamber pressure or the detector temperature.

The PR-705 / 715 detector is sealed in a chamber filled with an inert moisture free gas to prevent condensation as the detector temperature is lowered by the thermo-electric detector cooler.

Should a problem arise with either the detector chamber pressure or the temperature regulation of the detector, one of the following error messages will

be reported. In most cases, these errors require repair at Photo Research, Inc., as it means inspection and or repair of components relating to the detector and re-calibration following the repair.

CODE	TYPE	DESCRIPTION
7999	W	Detector Pressure error
7998	E	Detector Pressure sensor failure
7997	W	Detector Temperature is out of spec
7996	E	Detector Temperature device failure
7995	E	Maximum Internal Temperature Exceeded

Hardware Command Errors

These errors typically occur when the PR-705 / 715 is sent or receives an illegal command, or command that cannot be successfully carried out.

CODE	TYPE	DESCRIPTION
6355	E	Unknown micro-processor error
6350	E	Unknown micro-processor command
6155	E	Data structure mismatch
6150	S	Micro-processor abort
6145	S	User Abort
6130	E	Keyboard buffer overrun
6116	E	Detector pressure failure
6115	E	Pressure Warning
6111	E	Detector cooler failure
6110	E	Detector cooler Warning
6103	E	Shutters home
6102	E	Meas shutter home
6101	E	View shutter home

CODE	TYPE	DESCRIPTION
6100	E	Error code not specified
6091	E	Keyboard error
6090	E	Measuring shutter home
6089	E	Viewing shutter home
6088	E	Aperture home signal not found
6087	E	Aperture not homing
6086	E	Aperture parameter error
6085	E	Aperture mode
6084	E	Detector operational. timeout
6083	E	SYNC IN timeout
6069	E	No response from detector
6068	E	DSS Timeout
6067	E	DSD CRC error
6066	E	DSD Not found
6065	E	DSD Error fam3. code

Timeout Errors

Timeout errors occur when an event does not complete within a specified time.

CODE	TYPE	DESCRIPTION
5355	T	R cmd FF
5354	T	R cmd FE
5353	T	R cmd FD
5352	T	R cmd FC
5351	T	R cmd FB
5350	T	R cmd FA
5250	T	Stop Test
5240	T	Detector cooler control
5235	T	CCD Test
5232	T	CCD abort
5230	T	CCD run cont.
5225	T	Apert Test
5220	T	Apert Jog
5215	T	Apert Home

CODE	TYPE	DESCRIPTION
5210	T	LCD test
5205	T	Read LCD
5200	T	Load LCD with table
5165	T	KBD control
5160	T	KBD special ctrl
5155	T	KBD Simulate
5150	T	Scan KBD
5145	T	Apert Control
5142	T	CCD [1] control
5141	T	CCD [0] control
5140	T	CCD control
5138	T	Config has changed
5136	T	Update S.N Temperature etc
5135	T	Update HD status
5130	T	EL control
5125	T	LED control
5120	T	LCD control
5115	T	Shutter Control
5111	T	Testing Structures
5110	T	Initializing micro-controller
5100	T	R cmd 0

Measurement Errors

CODE	TYPE	DESCRIPTION
5000	E	Weak Signal
4999	E	Time Underflow Level Overflow
4996	E	A2D overflow Measuring Light
4995	E	A2D overflow Measuring Dark
4994	E	Variable Light Level
4993	E	Adaptive Time Limit

Floppy Disk Errors

These errors are generated by a malfunction of the built-in floppy disk drive. Often, floppy disk errors are caused by the media (floppy disk) and not the disk drive.

If you experience one of these errors, try reinserting or replacing the floppy disk and then retry the operation.

It may also be necessary to reset the PR-705 / 715 by turning off the instrument off the PR-705 / 715 using the system ON/OFF (*0/1)* switch.

CODE	TYPE	DESCRIPTION
2500	E	Floppy Disk General failure
2499	E	Floppy Disk Unknown unit
2498	E	Floppy Disk Unknown command
2497	E	Floppy Disk Data (CRC) error
2496	E	Floppy Disk Bad request length
2495	E	Floppy Disk Seek error
2494	E	Floppy Disk Unknown media type
2493	E	Floppy Disk Sector not found
2492	E	Floppy Disk Out of paper
2491	E	Floppy Disk Write fault
2490	E	Floppy Disk Read fault
2489	E	Floppy Disk Invalid disk change
2488	E	Floppy Disk WRITE Protected
2487	E	Floppy Disk Not AVAILABLE
2486	E	Floppy Disk COUNTER.### missing
2485	E	Floppy Disk .MEA file missing
2484	E	Floppy Disk .SUP file missing
2483	E	Floppy Disk Not Enough Space

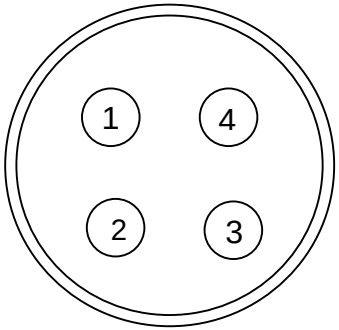
Appendix E -
External Trigger

The *Trigger* option enables PR-705 / 715 measurements to be actuated from the SYNC IN (see Chapter 2 - *Getting Started*) connector.

After the SYNC IN (pins 1 and 3) pulse has been received, the PR-705 / 715 software readies the instrument for a measurement, begins the measurement, then sends a pulse to the SYNC OUT pins (2 and 4). This pulse is to be used for sources (for example xenon strobes) that can be externally triggered. The source should trigger on the leading edge of the output pulse.

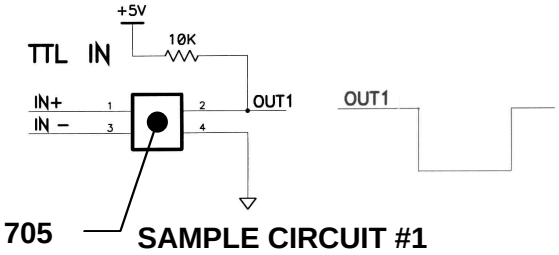
Specifications:

Min. SYNC IN pulse width:	50 μsec
SYNC OUT pulse width:	20 ms

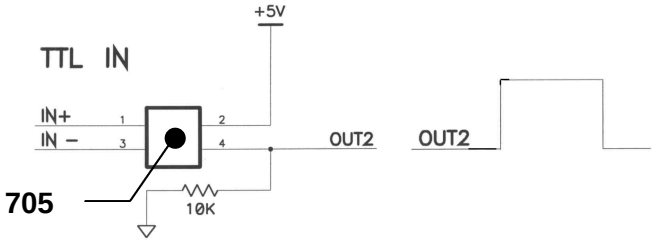


SYNC IN / SYNC OUT Connector

Pin	Color	Description
1	WHT	SYNC IN +
2	GRN	SYNC OUT +
3	ORG	SYNC IN -
4	YEL	SYNC OUT -



SAMPLE CIRCUIT #1



SAMPLE CIRCUIT #2

The preceding circuit samples can be used to drive SYNC IN to provide the illustrated outputs (OUT1 and OUT2). The PULSE IN drawing illustrates the input pulse for the resulting OUT1 and OUT2 examples.

Although the above samples show the recommended values for TTL Levels (VCC = 5V), the circuit will work with CMOS (VCC = 15V) driven pulses without changing the value of the pull up resistors (10K).

Procedure

Make sure the PR-705 / 715 is OFF.

Connect the supplied connector to the SYNC IN / SYNC OUT receptacle by turning the connector until it aligns with the receptacle. Gently push in the connector until it “clicks” into place.

Connect the terminated leads to the sync input and source to be measured.

Step 1 - Turn on the PR-705 / 715 and allow at least a 10 minute warm-up before making measurements.

Step 2 - After warm-up, use the **FRWD** key until *Setup Screen #4* is displayed.

Step 3 - Use the ▲ or ▼ key to position the **>** symbol next to the *Calc:* field.

Step 4 - Press **ENTR** to cause the field adjacent to *Calc:* to begin blinking.

Step 5 - Use the ▲ or ▼ key to select *Energy.*

Step 6 - Press **ENTR.**

Step 7 - Use the ▲ or ▼ key to position the **>** symbol next to the *Trigger:* field.

Step 8 - Press **ENTR** to cause the field adjacent to *Trigger:* to begin blinking.

Step 9 - Use the ▲ or ▼ key to select *External.*

Step 10 - Press **ENTR.**

Step 11 - Press the **MEAS** key to begin the measurement. Within 10 seconds, send the trigger pulse to the SYNC IN pins. If the *SYNC IN* pulse is not received The PR-705 / 715 will not accept the pulse if it not sent within 10 seconds of pressing the **MEAS** key.

Note: If *Manual* **is selected in this field, and the Trigger option has been enabled on this instrument, the PR-705 / 715 will issue the outgoing pulse without waiting for the** *SYNC IN* **pulse.**

or

If using Remote Mode operations:

Step 1 - Send the **S, , , , , , , ,1,1** setup command to set the *Power / Energy Mode* to *Energy* and the *Trigger* mode to *External*.

Step 2 - Send a measurement command (e.g. **M1**).

Step 3 - Within 10 seconds of sending the measurement command, send the *SYNC IN* pulse. If the *SYNC IN* pulse is not

received within 10 seconds, the measurement will abort.

Note: If the command S , , , , , , , , ,1 is sent to the PR-705 / 715, (*Manual* **trigger and** *Energy)***, and the Trigger option is enabled on this instrument, the PR-705 / 715 will issue the** *SYNC OUT* **pulse without waiting for the** *SYNC IN* **pulse.**

Appendix F -
CR-55 Cosine Receptor

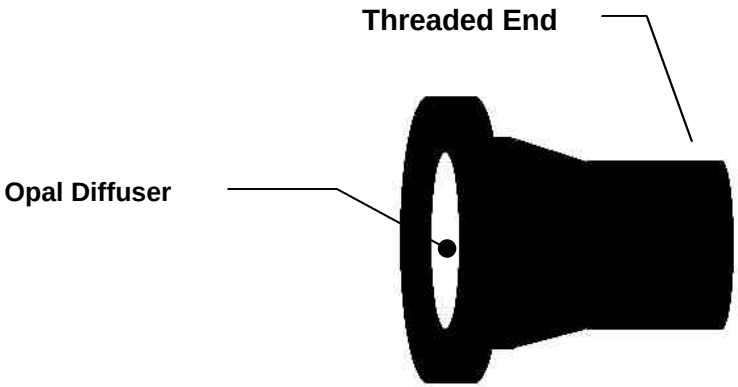
Overview

The *CR-55* Cosine receptor is designed to provide a convenient method of measuring light incident on a surface. In radiometric terms, this value is given as watts per square meter (*w/m^2).* Photometrically, making measurements with the *CR-55* will provide results in lumens per square feet or footcandles (*fc)* or lumens per square meter or lux (*lux).*

The *CR-55* accessory is equipped with a cosine corrected, translucent opal diffuser. When threaded into the lens mount of the PR-705 / 715, the *CR-55* provides results corrected for any off angle relationship of the incident light to the glass surface of the *CR-55.*

Generally speaking, the amount light incident on a surface decreases by the cosine of the angle of the rays relative to the normal (0°) orientation to the surface. Therefore, at 45°, the light falls off by 0.707, and, at 90°, the incident light is 0.000.

The *CR-55* corrects for the angle of the light incident on it's surface so that measured results follow the cosine law.



CR-55 Cosine Receptor

Installing the CR-55

Step 1 Remove the current optical accessory (Primary Lens) from the PR-705 by turning counter-clockwise.

Step 3 Install the threaded end of the *CR-55* by carefully threading clockwise into the mounting ring located in the front of the PR-705 / 715.

Aligning the Instrument

Step 1 Turn on the source (e.g. lamp or other point source), and allow sufficient temperature stabilization.

Step 2 Set the white surface of the *CR-55* at the desired distance and angle relative to the source.

Making a Measurement

Step 1 Turn on the PR-705 / 715 by pressing the 0/1 key (ON/OFF key). Allow at least 10 minutes for warm-up before beginning measurements.

Step 2 Press the **FRWD** key on the PR-705 / 715 local keyboard until *Setup Screen #1* displayed.

Step 3 Use the ▲ or ▼ key to place the **>** symbol next to *Lens:.*

Step 4 Press **ENTR** to cause the field next to *Lens* to begin blinking.

Step 5 Use the ▲ or ▼ key until *CR-55* is displayed.

Step 6 Press **ENTR.**

Step 7 Make sure the *Add1* and *Add2* fields are set to *None*.

Step 8 Press **MEAS**

or

Use *Remote Mode* commands to make a measurement.

Calculating Candelas

Sources such as lamps are often rated in candelas (lumens per steradian or luminous intensity), and sometimes referred to axial luminous intensity (luminous intensity in a given direction).

Using the following formula, illuminance (*footcandles* or *lux*) can easily be converted to *candelas*. This formula assumes the source radiates equally in all directions.

$$cd = fc \textbf{ (or lux) } * d^2$$

where:

cd = candelas
fc = footcandles
lux = lux
d = Distance of source to *CR-55* in feet for footcandles or meters for lux.

Note: By replacing *lux* with *watts,* the same formula can be used to convert irradiance (*w/m^2*) to radiance intensity (*w/sr*).

Inverse Square Law

As can be readily seen, *cd* is directly changed by the square of the distance of the source to the *CR-55.* This physical fact illustrates the *inverse square law,* which states that the amount of light incident on a plane (footcandles or lux) changes by the inverse square of the distance of the source to the plane. This is given by:

$$I = \frac{1}{d^2}$$

where:

***I* =** Intensity
***d* =** Distance

As *d* increases, I is reduced by *d* * *d.*

Appendix G - Specifications

The following tables detail performance, sensitivity and field coverage specifications for the PR-705 and PR-715 spectroradiometers.

Notes:

1. Sensitivity values are for CIE Illuminant A sources (2856 Kelvin). Low light sensitivity is specified at for 10% Relative Standard Deviation (RSD). Measurements can be made at lower levels at reduced precision.

2. Optical bandwidth (full width, half-maximum) is a function of the aperture height (See Field Coverage Chart).

3. To find the minimum to maximum photometric limits for the PR-715, divide the appropriate values in the Sensitivity Chart by 2.

4. Special horizontal slit apertures (1/2° x 1 1/2° and 1/8° x 1 1/2°) are available. Consult factory for details on special apertures.

Appendix G – Specifications

Appendix I – FP-55 Fiber Optic Probe

Performance Specifications

Wavelength	PR-705: 380 to 780 nm PR-715: 380 to 1068 nm
Spectral Accuracy	PR-705: ± 2 nm PR-715: ± 4 nm
Spectral Bandwidth	≥ 2.5 nm - Spectral bandwidth is dependent on aperture height and wavelength dispersion. See Field Coverage chart for more details
Available Apertures	2°, 1°, 1/2°, 1/4°, 1/8° Select one or all at time of purchase. Special apertures also available. Consult factory.
Minimum measuring area	0.12 mm (0.005") with standard MS-55 Lens and 1/8° aperture.
Luminance Sensitivity for CIE Illuminant A	(See Sensitivity Chart)
Luminance Accuracy	± 2% to NIST traceable luminance standard at 2856 Kelvin
Luminance Precision (Repeatability)	The standard deviation of repeat measurements over a 30 minute period is less than 0.1% when operated under normal conditions.
Colorimetric Accuracy (for CIE Illuminant A)	PR-705: CIE 1931 x ± .0015 y ± .001 PR-715: CIE 1931 x ± .0030 y± .002

Appendix G – Specifications

Performance Specifications (Continued)

Color Precision	± ,005 for CIE 1931 x,y measuring CIE Illuminant A
Polarization Error	≥ 5% when measuring 100% linearly polarized sources
Visual Field of View	8.5° with MS-55 lens at infinity
Interfaces:	RS-232, Centronics Parallel, SYNC IN / SYNC OUT, 3.5" Floppy Disk Drive
Digital Resolution	65,536:1 (16 bit)
Power Requirements	AC 100V-240V 50/60 Hz
Weight	12 lbs. 6 oz with MS-55 lens
Operating Temperature and Humidity	5° to 30° C (41° to 86°) 0 - 90% RH (non-condensing)

Appendix G – Specifications

PR-705 / 715 Sensitivity Chart

			Aperture (Degrees)				
Accessory	**Distance**	**Units**	**2°**	**1°**	**1/2°**	**1/4°**	**1/8°**
MS-55	1.75 in. to infinity (44 mm to infinity)	fl cd/m^2	0.001-500 0.003-1700	0.003-2000 0.01-6800	0.012-8000 0.04-27400	0.048-32000 0.16-109600	0.192-12820 0.66-438000
MS-1X	3.80 in. (96 mm)	fl cd/m^2	0.001-500 0.003-1700	0.003-2000 0.01-6800	0.012-8000 0.04-27400	0.048-32000 0.16-109600	0.192-128000 0.66-438000
MS-2.5X	1.76 in. (45 mm)	fl cd/m^2	0.001-500 0.003-1700	0.003-2000 0.01-6800	0.012-8000 0.04-27400	0.048-32000 0.16-109600	0.192-128000 0.66-438000
MS-5X	1.11 in. (28 mm)	fl cd/m^2	0.0015-750 0.0025-2500	0.0045-3000 0.015-10200	0.018-12000 0.06-41000	0.072-48000 0.24-164000	0.288-192000 0.96-656000
MS-77	4.25 in. (108 mm)	fl cd/m^2	0.0015-750 0.0025-2500	0.0045-3000 0.015-10200	0.018-12000 0.06-41000	0.072-48000 0.24-164000	0.288-192000 0.96-656000
CR-55	N/A	fc lux	0.004-2000 0.043-21500	0.012-8000 0.13-86000	0.048-32000 0.52-344000	0.192-128000 2.06-1375000	0.768-512000 3.072-5500000
FP-55	2 ft max	fl cd/m^2	0.0015-750 0.0025-2500	0.0045-3000 0.015-10200	0.018-12000 0.06-41000	0.072-48000 0.24-164000	0.288-192000 0.96-656000

Appendix G – Specifications

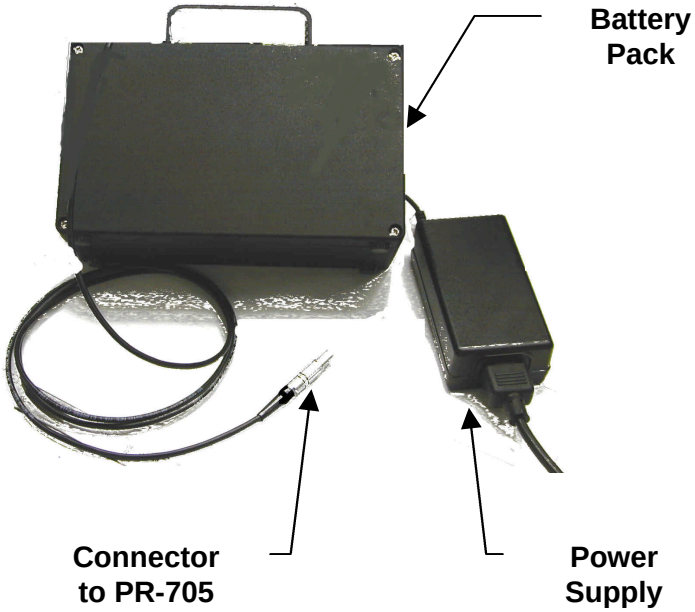
PR-705 / 715 Bandwidth and Field Coverage Chart

		Aperture (Degrees)				
Accessory	**Working Distance**	**2°**	**1°**	**1/2°**	**1/4°**	**1/8°**
PR-705 Bandwidth	N/A	20	10	5	2.5	2.5
PR-715 Bandwidth	N/A	40	20	10	5	5
MS-55	1.75 in. (44 mm) 1000 ft. (305 m)	0.076 in. (1.93 mm) 420 in. (10.66 m)	0.038 in. (0.97 mm) 210 in. (5.33 m)	0.019 in. (0.48 mm) 105 in. (2.67 m)	0.009 in. (0.24 mm) 52.5 in. (1.33 m)	0.005 in. (0.12 mm) 26.3 in. (660 mm)
MS-1X	3.80 in. (96 mm)	0.76 in. (1.93 mm)	0.038 in. (0.97 mm)	0.019 in. (0.48 mm)	0.009 in. (0.24 mm)	0.005 in. (0.12 mm)
MS-2.5X	1.76 in. (45 mm)	0.030 in. (0.76 mm)	0.015 in. (0.38 mm)	0.008 in. (0.19 mm)	0.004 in. (0.10 mm)	0.002 in. (0.05 mm)
MS-5X	1.11 in. (28 mm)	0.015 in. (0.38 mm)	0.008 in. (0.19 mm)	0.004 in. (0.10 mm)	0.002 in. (0.05 mm)	0.001 in. (0.02 mm)
MS-77	4.25 in. (108 mm)	0.026 in. (0.64 mm)	0.013 in. (0.32 mm)	0.006 in. (0.16 mm)	0.003 in. (0.08 mm)	0.002 in. (0.04 mm)

Appendix H -
PR-705 / 715 Battery Pack

NOTE: Although the Battery Pack is fully charged when it leaves the factory, for optimum performance we recommend fully charging the Battery Pack before its initial use.

The **PR-705 Battery Pack** provides portable power for remote measurements with the PR-705 (or PR-715) where an AC power source is not available.



Description

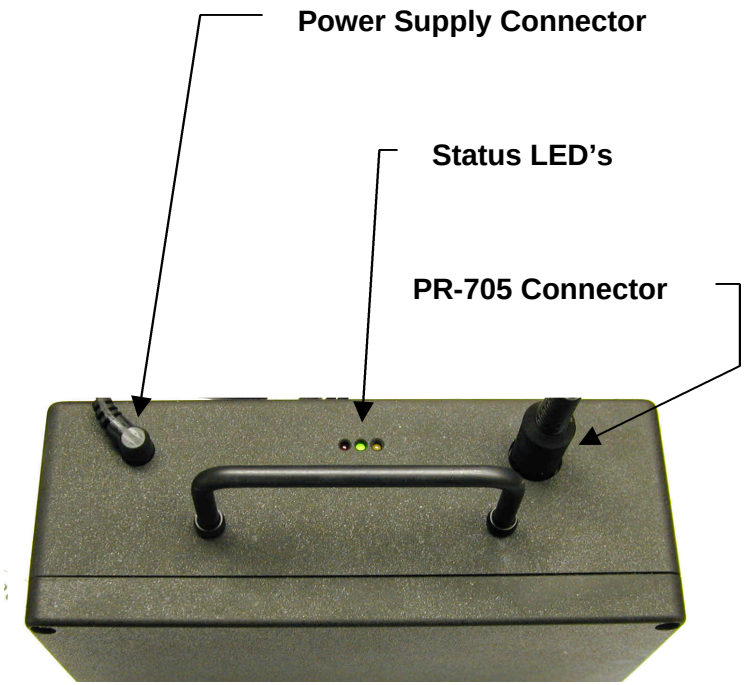
The **PR-705 Battery Pack** consists of the Battery Pack, Power Supply and Connecting Cable.

The Battery Pack contains a lead-acid battery and charging circuitry.

The Power Supply converts AC (alternating current) into 24 volt DC (direct current) required by the Battery Pack.

PR-705 / 715 Battery Pack Specifications

Description	Specification
Battery Type	Lead Acid
Battery Voltage	24 VDC
Shut Off Voltage	22 VDC
Continuous Use	1.5 Hours
Recharge from Full Discharge	5 Hours
Power Supply Input	90 – 240 VAC, 50 – 60 Hz
Shelf Life (After full charge)	1 month (Battery **MUST** be recharged if not used for 30 days or serious damage may result)
Dimensions	7.8 in. W x 4.9 in. H x 3 in. D (19.8 cm x 12.4 cm x 7.6 cm)
Battery Pack Weight	5.9 lb. (2.68 kg)
Power Supply Weight	1 lb. (0.45 kg)
Operating Temperature	34° to 95° F (1° to 35° C)



Operating Procedure

Step 1 - Insert the large end of the PR-705 Connector cable into the proper receptacle on the Battery Pack by rotating the connector until the alignment keys properly mate, then gently push in the connector***.*** ***Do not use excessive force!***

Step 2 - Make sure the power switch on the PR-705 / 715 is set to **OFF (0).**

Step 3 - Connect the other end of the cable to the appropriate receptacle on the PR-705 / 715.

Step 4 - Turn the power switch on the PR-705 / 715 to **ON.**

NOTE: During operation, none of the status LEDs are illuminated. This is a normal condition.

Step 5 - Operate the PR-705 as normal.

Step 6 - When the Battery Pack has reached 22 volts DC, it will automatically shut down indicating the need for a re-charge. This will not harm the PR-705 / 715.

Charging Procedure

Step 1 - Disconnect the Battery Pack from the PR-705 / 715. The Battery Pack cannot be recharged and run the PR-705 / 715 simultaneously.

Step 2 - Connect the cable from the AC power supply to the Battery Pack.

Step 3 - Insert the AC power cord into an appropriate receptacle.

Step 4 - The amber status LED should flash temporarily meaning that the Battery Pack is testing the condition of the battery.

Step 5 - When the amber LED stops flashing, the Battery Pack has begun charging.

Step 6 - Continue charging the battery until the green status LED illuminates.

Step 7 - The battery pack is now ready for use with the PR-705 / 715.

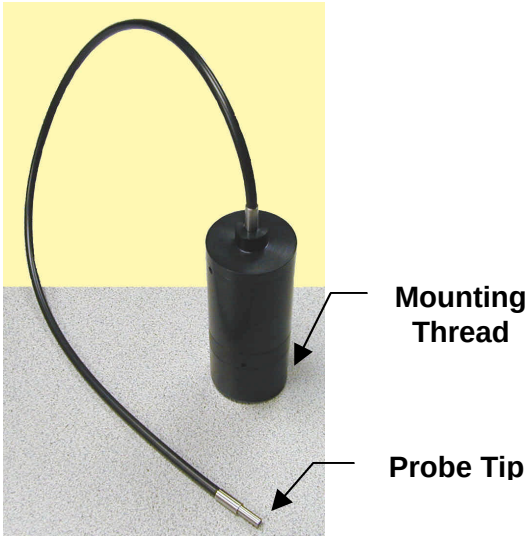
Charging Status LED's

Red	Error – Consult Factory
Green	Fully Charged
Flashing Amber	Testing Battery
Solid Amber	Charging

Appendix I -
FP-55 Fiber Probe

Description

The **FP-55 Fiber Probe** is a convenient accessory for making spectroradiometric based radiance / luminance and color measurements in cramped and



FP-55 Fiber Optic Probe

or inaccessible locations. When the probe tip is placed in contact with a self-emissive or back-lit source, the 24 inch (61 cm) long probe measures over a 0.125 inch (3.2 mm) diameter area. For the best results, the source must be or closely approximate a Lambertian (diffuse) surface.

CAUTION !!: **The glass fibers in the probe are very delicate and susceptible to breakage if bent too sharply. Fiber breakage will affect the calibration and accuracy of the FP-55. Use caution in storing and handling the probe to ensure that the probe is not bent at a sharp angle.**

Measuring Procedure

Step 1 - Remove the MS-55 or other optical accessory from the PR-705/715 lens mount by turning counter-clockwise.

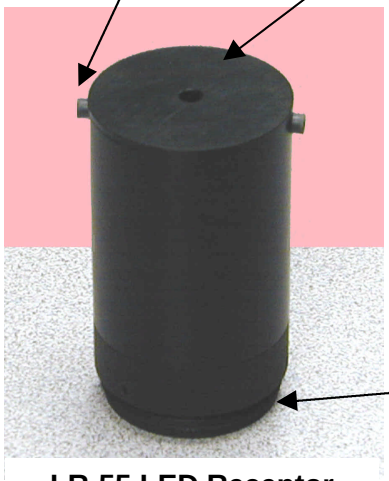
Step 2 - Install the **FP-55** by threading clockwise into the lens mount on the front of the PR-705/715.

Step 3 - Select the **FP-55** accessory in the PR-705/715 *Setup Screen #1, Lens:* field. For SpectraWin users, select the **FP-55** from the Setup / Instruments window.

Step 4 - Place the **FP-55** probe tip in contact with the source. Make sure the front of the tip is flat against the surface.

Step 5 - Perform a measurement as described in the body of this manual, or as described in the SpectraWin manual.

Appendix J -
LR-55 LED Receptor



LR-55 LED Receptor

Description

The **LR-55 LED Receptor** enables the PR-705/715 to measure the axial spectral radiant intensity (watts / steradian) and luminous intensity (candelas) and color of light emitting diodes (LED's).

The **LR-55** consists of a 2.5 inch (63.5 mm) long tube with an LED port on one end and a mounting thread

at the other end. The threaded end is installed into the lens mount of the PR-705/715.

During use, the LED's are inserted into the LED port at the open end of the accessory. Two different sized LED ports are supplied with the **LR-55**. One is designed to accept 0.118" (2.99 mm) diameter LED's, and the other accepts 0.205" (5.21 mm) diameter LED's.

Note: Special adapters can be fabricated for LED's that do not exceed 0.275" (7 mm) in diameter. Contact Photo Research for details.

Geometrical Considerations

The **LR-55** is designed to measure the emittance of LED's over an 8.3^{o} acceptance cone.

It is important to note that since the spatial distribution of LED's varies with angle, LED's measured using acceptance cones other than 8.3^{o} will produce different results. Generally, measurements through smaller cones will yield higher values, while LED's sampled over larger cones will produce measurements with lower radiant and luminous intensity values. Therefore, as part of the measurement report it is important to note the acceptance cone sampled during the test.

Procedure - LED Adapter Cap Replacement

If it becomes desirable to switch between the two LED Adapter caps supplied with the **LR-55**, proceed as follows:

Step 1 - Loosen and remove the two SAE 4-40 hex cap screws that secure the LED Adapter cap to the main tube.

Step 2 - Remove the LED Adapter cap.

Step 3 - Insert the new adapter cap making sure to align the threaded holes in the adapter with the through holes in the tube.

Step 4 - Replace and tighten the screws. ***DO NOT OVER TIGHTEN THE SCREWS!!***

Procedure - Making Measurements

Step 1 - Remove the MS-55 lens or other accessory currently installed on the PR-705/715 by turning counter clockwise.

Step 2 - Install the **LR-55** by threading it clockwise into the PR-705/715 lens mount. Do not over tighten.

Step 3 - From the PR-705/715 *Setup Screen #1*, select **LR-55** from the *Lens:* field. For SpectraWin users, select the **LR-55** from the *Primary Accessory* widow. Consult the SpectraWin manual for full instructions.

Step 4 - Insert the LED into the adapter port and allow at least a 5 minute warm-up (unless otherwise specified).

Step 5 - Making sure the LED is properly seated in the adapter, perform a measurement.