Chapter 8
Maintenance

Routine Maintenance

The PR-650 SpectraColorimeter has been designed to give long, trouble-free service requiring minimal routine maintenance. The following section gives guidelines for insuring optimum service from the PR-650.

Cleaning Lenses / Optical Accessories

Step 1   Keep the PR-650 clean and dust-free.

Store the PR-650 in a clean, dry environment, preferably in a storage case when not in use. Dust optical surfaces with a soft camel's-hair brush or blow them off with clean, dry air.

Note: Avoid touching optical surfaces.

Step 2   If the exterior optical surfaces become dirty, clean them as you would any high-quality coated lens.

Use lens cleaning fluid or anhydrous alcohol on a piece of lens cleaning tissue or cotton. Do not soak.

△ Do not use acetone or other organic solvents or excessive pressure! Do not soak or allow water to enter the instrument!

Cleaning Exterior Surfaces

If the exterior plastic surfaces, such as the display face plate or instrument case becomes dirty or full of fingerprints, use a mild dish washing liquid and a slightly damp, non abrasive cloth to gently remove fingerprints and dirt.

⚠️ Do not use acetone or other organic solvents or excessive pressure! Do not soak or allow water to enter instrument!

Recalibration

The PR-650 is designed to maintain stable calibration for long periods of time. However, changes in calibration are inevitable, due to the effects of aging, temperature and dirt accumulation. Therefore, for best results, periodic recalibration is recommended.

To maintain the instrument's accuracy, recalibration checks or recalibration is recommended at six-month intervals. Please consult factory for availability of optional user self-calibration.

Please contact the Customer Service Department for a Return Material Authorization (RMA) number, before returning the instrument.

Factory Repair

In-Warranty Repair

If the instrument malfunctions within the one-year warranty period, it will be repaired at no charge to the customer (provided the warranty has not been voided by tampering, physical damage or other abuse).

Notes: Any *unauthorized* tampering with the instrument, including opening of the case, automatically voids the warranty.

Batteries are not covered under the warranty.

Before returning the instrument to Photo Research, it is recommended that the user perform a RAM RESTORE operation since a corrupted RAM card could possibly cause the unit to malfunction. Please see the section entitled Restoring the ICM Card beginning on page 7-3 for a detailed explanation of this procedure.

After contacting the Customer Service Department for a Return Material Authorization (RMA) number, the entire instrument including all accessories, should be brought or shipped prepaid to the Photo Research Service Department in Chatsworth, CA, USA (or contact Photo Research for information concerning authorized repair facilities in your area).

Pack the PR-650 and all attachments and accessories in suitable protective packaging, along with a note describing the nature of the malfunction.

The instrument will be returned by a commercial surface transportation method of Photo Research's choice.

If Air Freight or other rapid delivery is desired, the user should include a check or money order to cover the cost of return shipping.

Out-of-Warranty Repair

If the instrument is out of warranty, contact the Customer Service Department for a Return Authorization (RMA) number. The instrument should be brought or shipped prepaid to the Photo Research Service Department (or call Photo Research for information as to authorized repair facilities in your area).

Pack the PR-650 and *all* attachments and accessories in suitable protective packaging along with a note describing the nature of the malfunction.

Photo Research will evaluate the damage and advise the user of the estimated repair and recalibration costs before proceeding.

Appendix A
Error Codes

Overview

If the PR-650 malfunctions for whatever reason, the *red* LED flashes and one of the following messages will appear on-screen to help identify the problem. Pressing the FRWD key causes the previous menu screen to appear, but the *red* LED will continue to flash and measurements cannot be made until the error is corrected.

For the following error messages, try retaking the measurement several times. If the messages continue to appear, it may indicate a problem with the hardware or software.

The following error codes are generally time-out errors, and indicate a failure of the PR-650 hardware:

- NO EOS START - No end-of-scan at start up.

- NO START - Not enough start pulses in 2X integration time.

- NO EOS TIME - No end-of-scan during timed mode.

- DMA FAILURE - Direct Memory Address failure.

- NO EOS SYNC - No end-of-scan during AutoSync measurement.

- NO EOS START/TIME/SYNC - No end of scan pulse from the detector. Indicates failure of detector or associated circuitry. Consult Photo Research Service Dept.

For the following messages, try increasing the intensity of the source being measured.

- WEAK SIGNAL - Signal-to-noise is too low to make a good measurement. Measurement is aborted.

- TOO MUCH TIME - Unit requires too much time to perform a measurement due to the low light level of the measured light source.

- LOW LIGHT LEVEL - *Not* an error, but a warning that signal-to-noise is in the marginal range. The measurement is completed and the data can be viewed by pressing the FRWD key.

For the following error messages, try re-entering the file number.

- ILLEGAL FILE NUMBER

- NO FILE FOUND

If one of the following messages appear, it's possible that an AutoSync measurement may not be completed. Sometimes holding the instrument extremely still and repeating the measurement several times will work. If one of the following messages is repeated while trying to make AutoSync measurements, change to Timed mode.

- **UNABLE TO SYNC** - Could not get a sync "lock". Can be caused by low light level, multiple pulsing sources or a non-pulsing source.

- **SYNC LOST** - Sync lock could not be maintained.

- **VARYING LIGHT** - Source is not a repetitively pulsing light source or its pulse (refresh) rate is varying too much. This prevents the sync mode from working.

The warning messages are as follows:

OVERLOAD - Turn down the intensity of the measured source or install the optional Neutral Density Filter Add-On Accessory.

RAM CARD DATA CORRUPTED - Fatal error with ICM Card and requires ICM Card to be restored from a Host PC. See Chapter 6 for instructions on how to restore the ICM Card.

ALL FILES FULL - Some files will have to be changed to unlocked files so that they can be written over to make room for new files, or a newly restored ICM Card can be installed.

PRINTER OFF LINE - Check printer power or cables.

DATA CORRUPTED - File has somehow been damaged.

DUPLICATE ACCESSORY - Select only one accessory.

BATTERY LOW - Battery should be replaced with another freshly charged battery or use the optional AC Adaptor.

OPERATOR ABORT - Indicates that the user pressed the ALT key and then the MEASure key to terminate a measurement.

RAM CARD IS MISSING OR WRITE PROTECTED - ICM Card is not properly installed. Turn power *off*. Remove ICM Card, verify that it is *not* write protected (WP) and reinsert.

SERIAL NUMBERS DON'T MATCH - An ICM Card from a different PR-650 has been installed in the unit. Turn power *OFF*, remove the card and replace it with the proper card. The serial numbers on the PR-650 unit and the ICM Card must match or the unit will not operate.

Appendix B
Remote Mode Commands

Overview

The PR-650 can be set up to operate in Remote Mode using an RS-232 line in either of two methods. These include: an RS-232 terminal (or a computer emulating one), or an applications program running in a Host computer supporting asynchronous communications over an RS-232 serial line. Both of these methods must provide the capability of sending and receiving ASCII characters.

Whichever method is selected, communications are conducted using the supplied CTRL/XFER RS-232 cable.

Communications Configuration

The following communications line configuration must be observed for successful communications with the PR-650:

Baud rate	:	9600
Parity	:	None
Data Bits	:	8
Stop Bits	:	1
Full duplex	:	The PR-650 can be commanded to echo characters it receives.

PR-650 CTRL/XFER Cable Pinouts

TD (DB25 pin 2)   Serial data to the PR-650

RD (DB25 pin 3)   Serial data from the PR-650

RTS (DB25 pin 4)   Input to the PR-650.

                         When this line is driven low, the
                         PR-650 initiates a 0.1 second RESET
                         putting it into a known state.

DTR (DB25 pin 20)   Input to the PR-650.

                         Data will be sent from the PR-650 only
                         when the DTR line is high. If not driven,
                         this signal is high.

GND (DB25 pin 7)   Signal ground.

The following section explains how to connect the hardware
and CTRL/XFER cable to allow remote operation of the
unit.

Hardware Set-Up Procedure

Step 1   Connect the 25-pin, sub D connector on the CTRL/XFER cable to the RS-232 port on the Host. (For some computers, it may be necessary to use 25 to 9 pin reduction connectors, and/or "gender changers").

Step 2   Set the CTRL/XFER switch, located on the side of the 25-pin connector to **CTRL**.

Step 3   Connect the other end of the CTRL/XFER Cable to the RS-232 connector on the PR-650 (see Figure 1-1). This is done by aligning the keyway on the connector and pressing inward until an audible "click" is heard.

Note: The RS-232 connector on the PR-650 is not fixed and does have some play in it. This is normal and not a defect.

This completes the information on setting up the hardware.

The next section describes the procedure for operating the PR-650 in Remote Mode.

Remote Mode Startup

Overview

Whenever the CTRL/XFER cable is connected to the
PR-650, the unit automatically "wakes up" after power up in
Remote Mode whether connected to a PC or not. However,
if the unit is not connected to a PC, or a command is not
sent to establish and maintain Remote operations, the
PR-650 reverts to normal operating mode.

Note: During Remote Mode, the only active key on the
         PR-650 control panel is the O/1 (on/off) key.

From an Applications Program

1 -   Turn on the PR-650

2 -   Set the RTS line high.

3 -   Set the RTS line low. This charge causes the PR-650
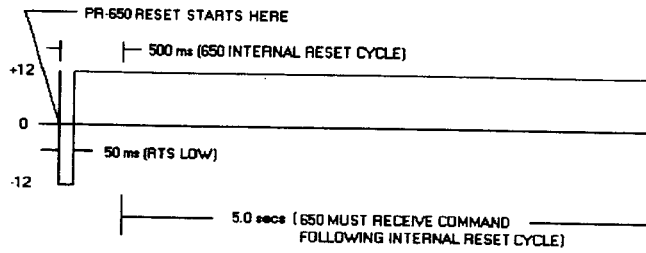   to reset.

      Leave the RTS line low for a minimum of 50 ms.

4 -   Set the RTS line high.

      Send a command within 5 seconds to start commun-
      icating with the PR-650.

For example, send the command 'S' (upper or lower case).
If a command is not received within 5 seconds, the PR-650
reverts to normal operating mode. See Figure B-1.

```
                    PR-650 RESET STARTS HERE
                         ┌─ 500 ms (650 INTERNAL RESET CYCLE)
        +12
          0
              50 ms (RTS LOW)
        -12
                    ├──────── 5.0 secs (650 MUST RECEIVE COMMAND ────────
                                      FOLLOWING INTERNAL RESET CYCLE)
```

Figure B-1: Remote Mode Timing Diagram

5 - The application program should now read the Response
     Code relevant to the command sent. Refer to Appendix
     B sections, **ASCII Commands** and **Responses Codes** for
     more detailed information.

The following sections give examples of how to start
Remote Mode operation of the PR-650 by (1) using
terminal emulation, or (2) from an application program.

In Terminal Emulation Mode

1 - Turn on the terminal, or load the asynchronous communications program (e.g., PROCOMM PLUS).

2 - Check the communications protocol (9600 baud, no parity, 8 data bits, 1 stop bit, full duplex).

3 - Turn on the PR-650.

4 - Within 5 seconds, send the letter 'E' (upper or lower case) to the PR-650. This puts the PR-650 in echo mode so that all characters sent to the PR-650 can be viewed on the screen.

5 - If the PR-650 reverts to normal mode, (command not sent within 5 seconds), turn off the PR-650 by pressing and holding the the red 0/1 button until the screen goes blank, then repeat Steps 3 and 4.

6 - To reset the PR-650, turn off the terminal, or exit the communications software.

The following sections give examples of how to start Remote Mode operation of the PR-650 by: 1) using terminal emulation, or 2) from an application program.

Starting Remote Mode Using Terminal Emulation

This example illustrates how to initiate Remote Mode from an IBM PC in terminal emulation mode. It consists of a batch file (650.BAT) and two command files (650.ASP and 650-1.ASP) written for PROCOMM PLUS. The batch file first loads PROCOMM using the 650.ASP commands which exits PROCOMM forcing RTS low. The batch file then loads PROCOMM again using the commands in 650-1.ASP which sets up the communications protocol, waits for the PR-650 internal reset cycle and sends the "E" (ECHO) command thereby forcing the 650 to remain in Remote Mode.

650.BAT Listing

```
PCPLUS /F650
PCPLUS /F650-1
```

650.ASP Listing

```
QUIT  ;Exit PROCOMM thereby setting the RTS
      ;line low and triggering remote on the 650
```

650-1.ASP Listing

```
SET PORT COM1 :Set RS-232 communications to COM1:
SET BAUDRATE 9600   ;Set BAUD rate for 9600
SET DATABITS 8      ;Set Data Bits to 8
SET PARITY NONE     ;Set Parity to NONE
SET STOPBITS 1      ;Set Stop Bits to 1
EMULATE ANSI        ;Emulate ANSI terminal
PAUSE .500          ;wait 500 ms
TRANSMIT "E ^ M"    ;Send an "E" (ECHO) and carriage
                    ;return to the 650
```

Remote Mode from An Application Program

The following program listing, written for Microsoft Quick Basic, first asks for a command to send to the PR-650, then receiving the command, initializes the Remote Mode, and sends the command. The data is then sent back from the PR-650 to be displayed on screen.

Note: It is not recommended that an "E" (ECHO) be sent to the PR-650 from an application program. This necessitates the reading back of the echoed characters each time a command is sent.

```
DECLARE SUB setup ( )
DECLARE SUB read650 (firsttime, wrt$, fileflg!, wavl( ), m5datl( ))

CLS
OPTION BASE 1

DIM temp$(48)

firsttime = 0        '        Variable to determine if this is the first
                     '          command sent.

start:
      CALL setup
      CALL read650(firsttime, wrt$)

      firsttime = 1 'Set first command variable to 1
      GOTO start

SUB read650 (firsttime, wrt$) STATIC
      temp$ = SPACE$(1)

IF firsttime = 0 THEN   'open communications with 650
```

```
OPEN "com1:,n,8,1,cd0,cs0,ds0" FOR RANDOM AS # 1:
        CLOSE  # 1
   '                 Open then close COM1: causing RTS to go low

SLEEP 1   'Wait 1 second before reopening COM1

OPEN "com1:9600,n,8,1,cd0,cs0,ds0" FOR RANDOM AS # 1
   '                 Open COM1: and set communications protocol

END IF

readstat:

        PRINT # 1, wrt$

        temp$ = " "

        WHILE not EOF(1) 'Test for EOF

        temp$ = INPUT$(1, # 1)'Read output from 650

        PRINT temp$;      'Print results

        WEND

        PRINT : PRINT "Press Any Key to Continue"

        WHILE INKEY$ = ""

        WEND

END SUB

SUB setup          '       Enter command

        SHARED wrt$

        INPUT "Enter Command  ", wrt$

END SUB
```

PR-650 Remote Mode ASCII Commands

Command messages from the Host begin with a letter
which is not case sensitive. Some commands are optionally
followed by one or more parameter fields. Fields are
separated by commas and the message is terminated by a
carriage return (< CR >) character which is used as the
End of Message (EOM) byte. Fields may be absent but
their commas must be present. For example, the command
message 'S1,,,,2' < CR > is valid. Note that this message
format is variable in length. A line feed character < LF >
may be appended to the EOM character, but is otherwise
ignored.

Some messages have Response Code parameters which
specify the format of the Response (output from PR-650
following a command). Responses sent from the PR-650 to
the Host are a FIXED length for ease of decoding within
the Host. Responses terminate with a < CR > followed by
a < LF >. Some Response Codes have multiple carriage
returns or line feeds depending on the number of lines in
the Response.

All values sent from the PR-650 are displayed without
identifying labels or measuring units. Refer to the
Response Codes section of this Appendix for format
information of Responses from the PR-650.

The word 'send' refers to data sent from the PR-650 to the
Host. The word 'set' refers to the PR-650 setting some
internal value in response to data from the Host.

'[ ]'   Indicates optional parameters. Default values
          of optional parameters are specified for each
          command message in the following descriptions.

'< >' encases single parameter names

Command Summary

Code	Command
S	Set-Up Measurement Parameters
M	Measure Light
D	Send Miscellaneous Data from PR-650
F	Measure Frequency
E	Echo Command
B	Backlight Command (Adjust LCD Backlight)

'S' Command - Set-Up Measurement Parameters

Use the S (and optional parameters) to set up measure-
ment variables such as accessory in use, sync frequency,
fixed integration time, units type (footLamberts or
$cd * m^{-2}$) etc. Note that a variable may be omitted and
replaced with a comma (,) which also serves as the field
delimiter.

Format - S   [< 1st acc number >], (integer)
               [< 2nd acc number >], (integer)
               [< 3rd acc number >], (integer)
               [< 4th acc number >], (integer)
               [< nom sync frequency >], (integer)
               [< integration time >], (integer)
               [< avg cnt >], (integer)
               [< units type >] < CR > (character)

1st acc number-Number of first (Primary) accessory
        attached to the PR-650 for this measure-
        ment. This number must represent a
        Primary Accessory (MS-75 lens, CR-650,
        LA-650 or FP-650).

        Default = 01 (Standard Objective Lens,
                    typically MS-75).
        Allowable values: 01 - 12

2nd acc number-Number of second accessory (if any)
        attached to the PR-650 for this measure-
        ment. This and all following accessories are
        Add-on Accessories or those that can be used
        in conjunction with a cPrimary Accessory.

        Default is no second accessory attached (,).
        Allowable values: 02 - 12

3rd acc number-Number of third accessory (if any) attached
        to the PR-650 for this measurement.

        Default is no third accessory attached.
        Allowable values: 02 - 12

4th acc number-Number of fourth accessory (if any)
        attached to the PR-650 for this measure-
        ment.

        Default is no fourth accessory attached.
        Allowable values: 02 - 12

nom sync frequency-
> Nominal sync frequency in Hertz (Hz) for
> synchronized measurements. If this field
> is absent ((,) default) no synchronization is
> used, i.e. DC source measurement.

> Allowable values: 1, 40 - 250 (Hz).
> 1 = Use the frequency measured by the last
>   "F" command.

integration time
> Measurement integration time in milliseconds.

> Allowable values:
> 0 - Use adaptive integration time where the
> PR-650 determines the optimal integration
> time.
> 10-6000 - Use a fixed integration time between
> 10 and 6000 milliseconds. Integration times
> are multiples of ten milliseconds in TIMED
> mode and multiples of 2Xperiod in SYNC
> mode. Specifying an integration time that is
> not a multiple of the appropriate value will
> cause the next lower multiple to be used.

> For example: mode = SYNC and freq = 50Hz.
> A fixed integration time of 50 milliseconds is
> specified causing a fixed integration time of
> 40 milliseconds to be used.
> (1/50 Hz * 2 = 0.040 seconds)

> The integration time specification set by this
> field is used only in Remote Mode. In normal
> mode, Adaptive Integration time is used.

avg cnt Number of measurements to average.
Default = 01
Allowable values: 01 - 99.

units type Specifies CIE Y values (English or SI)
Default = 0 (English)

Allowable values:
0 -(English) - footLamberts or footcandles
1 -(metric SI) - cd * m^{-2} or lux

See Response Code 201 for the formatted
output returned from the PR-650 following
this command line.

**M Command- Measure Light Under Conditions defined by
the 'S' command line.**

Format - M[<Response Code>]<CR>

Default Response Code = 01

Allowable Response Codes = 01 - 98
For this version, use Response Codes 1-6 and 19 with
the 'M' Command. If using response code 19, the
application must be ready to accept the binary structure.
See Response Code 19 for more information.

See the Response Codes section of this Appendix for full
details of formatted output of the PR-650 following the "M"
command and optional Response Code parameter.

D Command - Output Data to the Host

Use this command to retrieve data from the PR-650. This enables the programmer to see several data reports from a single measurement. If the response code specifies measurement data, that data is taken from the last measurement performed by the PR-650.

Note: The "D" command does not initiate measurements.

> Format - D < Response Code > < CR >
> Allowable Response Codes - ALL

See the Response Codes section of this Appendix for full details of formatted output of the PR-650 following the "D" command and optional Response Code parameter.

F Command - Measure Frequency of the Sync Signal

For synchronized measurements of non-DC sources, use this measurement command to measure the period and return a value in Hz. This value is used for sync measurements when "1" is specified in the "nom sync frequency" field of the 'S' command.

> Format - F < CR >
> Response Code = 101

E Command - Echo Command

All characters sent to the PR-650 are echoed back to the host computer or terminal after an "E" is sent. There is no method of returning to a non-echo (half duplex) state short of a reset. When the PR-650 is ready to receive a command the " > " character is sent as a prompt. All characters returned from the 650 are converted to uppercase when applicable.

It is recommended the user not send this command from an application program, since it then becomes necessary to receive characters echoed from the PR-650. This method is most useful in the terminal emulation mode so command characters can be viewed on the Host screen.

    Format - E < CR >
    Response Code = none

B Command - Set Backlight Level

Use the "B" command to remotely set the PR-650 display backlight level. Four levels (including off) can be set remotely.

    Format - B[M] < CR >

    M =   0 - Backlight off
            1 - Backlight on minimum brightness
            2 - Backlight on medium brightness
            3 - Backlight on maximum brightness

            Default = 0 (Backlight off)
            Response Code = 101

R Command - Retrieve Stored Measurement

When a measurement is retrieved using this command, it acts like "last measurement" data. That is, it remains the last measurement until another one is retrieved, or a new measurement in remote mode is made.

Multiple response codes may be used via the 'D' command to display contents of the measurement in various formats.

Format - Rffff,ccc < CR > <LF>

Where:

> ffff = file number of the stored measure-
>   ment to retrieve
>
> ccc = response code to display the retrieved
>   data

Default = Response Code 1

Example:

> R2,4<CR> <LF>(retrieves measurement # 2 and
>   displays luminance and CCT data)
>
> D5 (displays spectral data)

Response Codes

Following a command sent to the PR-650 (with the exception of the "E" command), formatted data is sent back from the PR-650 in one of the following Response codes.

Numerical response values that may have a wide range are expressed in scientific notation of the form: *.***Esee where:

*.***	= mantissa of value. This value represents specific data depending on the Response Code returned from the PR-650.
E	= Letter 'E' (signifies exponential notation)
s	= Sign of power of 10 (+ or -)
ee	= Exponent value

The symbol < /- > (blank space or minus sign) indicates the value may be positive or negative. If positive, a blank will be the first character of the field. If negative, a minus sign (-) will be the first character.

Response Code 0

This is a null response code indicating that the command has been received and acted upon.

    Format: 000 < CR > < LF >

Response Code 1

Luminance and 1931 CIE x and y. Returned after sending the 'M' or 'D' command and the character '1'(M1 or D1) to the PR-650.

Format: qq,U,Y.YYYEsee,.xxxx,.yyyy < CR > < LF >

qq	= Measurement quality code (00 = okay)
U	= 0 for luminance (units = footLamberts or cd * m^{-2})
	= 1 for illuminance (units = footcandles or lux)
	= 2 Uncalibrated

Y.YYYEsee	= 1931 CIE Y (units indicated by 'U')
.xxxx	= 1931 CIE x
.yyyy	= 1931 CIE y

Response Code 2

1931 CIE X,Y, and Z. Returned after sending the 'M' or 'D' command and the character '2' (M2 or D2) to the PR-650.

Format: qq,U,X.XXXEsee,Y.YYYEsee,Z.ZZZE see < CR > < LF >

qq	= Measurement quality code (00 = okay)
U	= 0 for luminance (units = footLamberts or cd * m^{-2})
	= 1 for illuminance (units = footcandles or lux)
	= 2 for uncalibrated

X.XXXEsee, Y.YYYEsee, Z.ZZZEsee = 1931 CIE X, Y and Z values respectively

Response Code 3

Luminance and 1976 CIE u' and v'. Returned after sending
the 'M' or 'D' command and the character '3' (M3 or D3)
to the PR-650.

Format: qq,U,Y.YYYEsee,.uuuu,.vvvv<CR> <LF>

qq = measurement quality code (00 = okay)

U = 0 for luminance (units = footLamberts
or cd * m^{-2})

= 1 for illuminance (footcandles or lux)

= 2 Uncalibrated

Y.YYYEsee = 1931 CIE Y in units indicated by 'U'

.uuuu = 1976 CIE u'

.vvvv = 1976 CIE v'

Response Code 4

Luminance and Correlated Color Temperature. Returned
after sending the 'M' or 'D' command and the character '4'
(M4 or D4) to the PR-650.

Format: qq,U,Y.YYYEsee,ttttt.,/- d.dddd<CR> <LF>

qq = Measurement quality code (00 = okay)

U = 0 for luminance (units = footLamberts
or cd * m^{-2})

= 1 for illuminance (footcandles or lux)

= 2 Uncalibrated

Y.YYYEsee = 1931 CIE Y in units indicated by 'U'

ttttt = Correlated color temperature in Kelvins

/-d.dddd = Deviation of color coordinates from an
ideal Planckian radiator in 1960 CIE
u-v units.

(+ indicates the coordinates lie above the
Planckian locus.)

Response Code 5

Radiometric (spectral) data. Returned after sending the 'M' or 'D' command and the character '5' (M5 or D5) to the PR-650.

Format: qq,U < CR > i.iiiEsee < CR > < LF >
wwww.,r.rrrEsee < CR > < LF >
wwww.,r.rrrEsee < CR > < LF >

qq = Measurement quality code (00 = okay)

U = 0 for spectral radiance
(units = $W * m^{-2} * sr^{-1} * nm^{-1}$)
= 1 for spectral irradiance
(units = $W * m^{-2} * nm^{-1}$)
= 2 Uncalibrated

i.iiiEsee = Integrated intensity (total area under spectral curve) in units specified by 'U'.

wwww. = Wavelength in nanometers. There will be one line with wavelength and corrected spectral intensity for each data point, delimited by a comma.

Response code 120 provides the starting and ending wavelengths and wavelength increment

r.rrrEsee = Spectral intensity in units indicated by 'U'

Response Code 6
Luminance, 1931 CIE x and y and 1976 CIE u'v'. Returned
after sending the 'M' or 'D' command and the character '6'
(M6 or D6) to the 650.

Format: qq,U,Y.YYYEsee,.xxxx,.yyyy,.uuuu,.vvvv
 $<CR> <LF>$
qq = Measurement quality code (00 = okay)
U = 0 for luminance (units = footLamberts
 or cd $* m^{-2}$)
 = 1 for illuminance (footcandles or lux)
 = 2 Uncalibrated

Y.YYYEsee = 1931 CIE Y in units indicated by 'U'
.xxxx = 1931 CIE x
.yyyy = 1931 CIE y
.uuuu = 1976 CIE u'
.vvvv = 1976 CIE v'

Response Code 19
Sends the last measured or retrieved data to the host in
binary format. File RMT_STRU.H contains a description
of the binary data as a C language structure. The data is
transmitted from the PR-650 with all 8 data bits used. The
receiving computer must be able to accept 8-bit binary data
to use this response. Can be used with 'M' command since
the RMT_STRU.H files contains the conversion function.

Note: At the bottom of the RMT_STRU.H file is a machine
 independent conversion function (CNV_FLPT.C)
 which converts the floating point binary data into the
 internal float representation of any computer with an
 ANSI compiler.

 RMT_STRU.H and CNV_FLPT.C are supplied on
 the SAVE/RESTORE disk.

Response Code 99

This response is sent whenever the first byte of a command is NOT one of the command codes recognized by the PR-650.

Format: Unknown Command < CR > < LF >

Response Code 101

Sync Frequency returned after sending the 'F' command.

Format: qq,hhh.hh < CR > < LR >

qq   = Measurement quality code (00 = okay)
hhh.hh   = Frequency of sync signal in Hz

Response Code 110

Serial Number of the PR-650. Returned after sending 'D110' to the PR-650.

Format: # # # # # # # # < CR > < LF >

= 8-character instrument serial number
                (the serial number may contain letters and
                other ASCII symbols). If the field is less
                than 8 characters trailing blanks are auto-
                matically added.

Response Code 111

Model Number of the instrument in use. Reserved for later use if other versions of the PR-600 line are introduced. Returned by the PR-650 whenever the 'D111' command is sent.

Format: mmmmmm < CR > < LF >

mmmmmm =   6-character instrument model number. If the field is less than 6 characters trailing blanks are automatically added.

Response Code 112

Number of Calibrated Accessories for this instrument. Returned if the 'D112' command is sent to the 650.

Format: nn < CR > < LF >

nn   =   Number of accessories calibrated for this instrument (Primary and Add-on). Range of values is 01 - 12.

Response Code 113

List of calibrated accessories for this instrument inculding Primary and Add-On Accessories. Returned by the PR-650 when the 'D113' command is sent. One line of the following format is sent for each accessory. Lines are separated by a < CR > < LF >.

Format: aaaaaa,T,U < CR > < LF >

    aaaaaa   = name of accessory (exactly 6 characters, including any trailing blanks)
    T   = 0 for Primary Accessory
              = 1for Add-on accessory
    U   = Accessory Calibration Units
              = 0 for Radiance (or luminance)
              = 1 for Irradiance (or illuminance)
              = 2 for Uncalibrated accessories
              = 3 for not applicable accessories

Response Code 114

The version of the PR-650 software is sent in response to a 'D114' command.

Format: vvvvv < CR > < LF >

            vvvvv = 5 character software version

Response Code 115

This response code is sent whenever the command 'D115' is received by the PR-650. It reports the Main Battery and ICM Card Low Battery status.

Format: m, i < CR > < LF >

    m   = Main Battery status
    i   = ICM Card battery status

Possible Values for m and i:

         0 = OK
         1 = Low Battery

Response Code 120

Spectral range of this instrument (for the PR-650, 380 - 780 nm). Returned when the 'D120' command is sent to the PR-650.

Format: pppp,bbb.b,ffff.,wwww.,iii. < CR > < LF >

    pppp   = Number of spectral data points
    bbb.b   = Bandwidth of the instrument in nm
    ffff.   = Wavelength of first spectral data point
                   in nanometers (380nm)
    wwww.   = Wavelength of last spectral data point
                   in nm (780nm)
    iii.   = Width of each spectral data point in nm
                   (4nm)

Response Code 130

Integration Time and Operating Temperature during the last measurement. Returned if the 'D130' command is sent to the PR-650.

Format: iiii.iii,tt.tt < CR > < LF >
   iiii.iii = The actual integration time used during the last measurement in milliseconds.

   tt.tt = Temperature of the detector array during last measurement in degrees Celsius.

Response Code 201

Returned by the PR-650 whenever the 'S' command is sent.

Format: pp < CR > < LF >
pp =   00 = All okay

    =   01 - 08 number of parameter in 'S' command that is invalid.

    =   50 either: No Primary accessory specified, or more than one Primary Accessory was specified or the first accessory is not a Primary Accessory.

Response Code 301

Sends the directory of stored measurements to the host computer.

Format: nnnn < CR > < LF >
             ffff mm/dd/yy hh:mm:ss t p < CR > < LF >

where
   nnnn =   The number of measurements currently stored in the PR-650. This is also the number of lines of output following this one for reponse code 301.

    ffff = The file number of this stored measurement. Use this number to retrieve the measurement data for this measurement.

mm/dd/yy = Date of the measurement (The year 200 is represented as 00).

hh:mm:ss = Time of the completion of the measurement (24 hour system)

     t = Measurement type

Possible values:
M - a measurement made with this PR-650
I - a pre-stored reference illuminant
U - an uploaded measurement or the result of arithmetric applied to one or more stored measurements (such as ratio).

                     Remote Mode Commands

p =   Permanent flag

Possible values:

L - measurement is locked and may not be
   overwritten.

U - measurement is unlocked.

Note: The file number is the identification of the storage
slot within the PR-650 that holds the measurement.

Because sequential measurements may not be
represented by sequential file numbers, it is advisable
to check the time/date stamp on the data in addition
to the file number to assure that the proper data is
transferred.

PR-650 ASCII Mode Measurement (qq) Quality Codes

Code	Meaning
00	Measurement okay
1	No EOS signal at start of measurement
03	No start signal
04	No EOS signal to start integration time
05	DMA failure
06	No EOS after changed to SYNC mode
07	Unable to sync to light source
08	Sync lost during measurement
10	Weak light signal
12	Unspecified hardware malfunction
13	Software error
14	No sample in L*u*v* or L*a*b* calculation
16	Adaptive integration taking too much time finding correct integration time indicating possible variable light source.
17	Main battery is low
18	Low light level
19	Light level too high (overload)
20	No sync signal
21	RAM error
29	Corrupted data
30	Noisy signal

This completes the section on Remote Mode operations.