

Spectrophotometer Communications Protocol

Americas

3735 Beam Road
Charlotte, NC 28217
Tel: (1) 704-357-0400

Asia Pacific

51 Neil Road 03-10
Singapore 0208
Tel: (65) 227-5756

Europe

Brandbachstrasse 10
CH-8305 Dietlikon/Zurich
Tel: (41) 1-835 37 11

Headquarters

Brandbachstrasse 10
CH-8305 Dietlikon/Zurich
Tel: (41) 1-835 38 00

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DATACOLOR INTERNATIONAL SPECTROPHOTOMETER COMMUNICATIONS PROTOCOL

INTRODUCTION

This document describes a protocol for communicating with Datacolor International spectrophotometers. This protocol is implemented in all new generation DCI spectrophotometers including the Spectroflash, Microflash, and Dataflash families. This document describes commands for calibrating and measuring samples, as well as for controlling the state of the instrument's specular port, aperture and UV filter mechanisms.

OVERVIEW

All commands to the spectrophotometer consist of a four character *command* string, a four character checksum string, and a three character terminator string. The checksum is generated by computing the sum of the four characters in the command string and truncating this sum to 16 bits. The checksum is expressed as a four character ASCII string representing the hexadecimal value of the checksum. For test purposes the spectrophotometer will accept four asterisks (****) as a valid checksum to any command. The terminator string consists of a colon followed by a carriage return and line feed (:^CR^LF).

All commands are acknowledged with an asterisk (ACK^{*}) to indicate that the spectrophotometer recognized and accepted the command, or by a question mark (NAK) to indicate that it was invalid. If the command was accepted, the acknowledge will be followed by a 20 character status string, any data that the spectrophotometer must return, a checksum string and a terminator string.

The status string consists of 20 characters that indicate the state of the instruments mechanisms, the calibration status, and the version number of the instrument's firmware. See the section *STATUS STRING FORMAT* for details.

The data returned by the spectrophotometer for each command is detailed in the section describing that command. The checksum returned by the spectrophotometer is generated by computing the sum of all of the characters in the status string and the data block, and truncating this sum to 16 bits. The checksum is expressed as a four character ASCII string representing the hexadecimal value of the checksum. The terminator string consist of a colon(:) followed by a carriage return and line feed (:^CR^LF).

Note that all instruments do not support all of the commands. Each command description will indicate which spectrophotometers support that command.

STARTUP

Before any command can be sent to the spectrophotometer, it must be determined that the instrument is connected to the host, and that the instrument and host are set to the same communications settings (BAUD rate, data bits, parity & stop bits). This is accomplished by sending a SYNC string, consisting of a colon, carriage return and a line feed (: ^C R ^L F) to the instrument. The instrument should respond with a question mark (?).

The status string consists of 20 characters that indicate the state of the instruments mechanisms, the calibration status and the version number of the instrument's firmware. A lower-case x in any position indicates an OK condition or a not used position.



APERTURE SIZE

Supported by: SF500 SF600

This command is used to change the lens position in the spectrophotometer thereby varying the aperture size. Most spectrophotometers will require that you manually change the aperture plate (see the instruments user's manual for details).

Command: A a - - c c c c : ^C_R ^L_F
a = N for Normal aperture
a = S for Small aperture
a = U for Ultra-small aperture
- = space character
cccc = checksum string

Example: AS - - * * * * : ^C_R ^L_F

Response: Status string, followed by checksum and terminator.

x a x x x x x x x x x x e x x x x x x c c c c : ^C_R ^L_F

where:

a = N for Normal aperture

a = S for Small aperture

a = U for Ultra-small aperture

e = x for OK

e = T if aperture movement timed-out

e = E if aperture not supported

BLACK END CALIBRATION

Supported by: SF500 SF600 SF 300 MICROFLASH DATAFLASH 300

This command causes the spectrophotometer to perform a black end calibration. It is recommended that the black end calibration be performed before the white end calibration. The **RESET** command should be executed prior to performing the black end calibration. Upon completion the 3rd character of the status string will be set to a 'B'.
NOTE: The SF600, Microflash and Datflash always perform calibration using two measurements; they will ignore the second character in the command string.

Command: **B n m - c c c c : ^CR ^LF**

where:

n = Number of reading to average for measurement.

m = R for reflection mode, T for transmission mode.

- = space character

cccc = checksum string

Example: **B2 R - * * * * : ^CR ^LF**

Response: Status string, followed by checksum and terminator.

x x B x x x x x (e) x x x x x x x x x x c c c c : ^CR ^LF

where:

e = x for OK

e = E if error during calibration

FLASH DELAY

Supported by: SF500 SF600 SF300

This command sets the delay between flashes when a command is instructed to perform multiple measurements.

Command: I n n n c c c c : C_R L_F

where:

nnn = Time to delay in 1/100 second increments.

cccc = checksum string

Example: I 0 5 0 * * * * : C_R L_F

Response: Unchanged status string, followed by checksum and terminator.

x c c c c : C_R L_F

FLASH TEST RAW

Supported by: SF500 SF600 SF300

This command sets the minimum energy level between the dark and light readings on the reference channel. If the difference is less than 10 times the value set by this command, another measurement is performed. If more than three extra measurements are required, the measure error status byte is set to F (See STATUS STRING FORMAT and MEASURE command).

Command: K n n n c c c c : ^CR ^LF
where:

nnn = minimum delta ion reference energy for good read (divided by 10).
cccc = checksum string

Example: K 4 0 0 * * * * : ^CR ^LF

Response: Unchanged status string, followed by checksum and terminator.
x c c c c : ^CR ^LF

FILTER - UV

Supported by: SF600 SF500 SF300

This command is used to select the type of UV filtering to be applied to the illumination source.

Command: **F n n n c c c c :^C_R^L_F**

where:

nnn = 000 for UV included (No filtering).

nnn = 001 for 400 nm Cutoff.

nnn = 002 for 420 nm Cutoff.

nnn = 003 for 460 nm Cutoff.

nnn = 0004 and above for UV calibrator.

cccc = checksum string

Example: **F 0 0 1 * * * * :^C_R^L_F**

Response: Status string, followed by checksum and terminator.

x x x n n n x x x x x x x x e x x x x x c c c c :^C_R^L_F

where:

nnn = Filter position as described above

e = x for OK

e = T if time-out error moving filter

e = E if filter not supported

GLOSS COMPONENT

Supported by: SF500 SF600 SF300

This command is used to open or close the instrument's SPEC port, to select either specular component included or specular component excluded.

Command: **G s - - c c c c :^C_R ^L_F**

where:

s = I to select Specular Included (spec port closed)
s = E to select Specular Excluded (spec port open).
- = space character
cccc = checksum string

Example: **G I - - * * * * :^C_R ^L_F**

Response: Status string, followed by checksum and terminator.

s x x x x x x x x x x x x x e x x x x x x c c c c :^C_R ^L_F

where:

s = I for Specular Included
s = E for Secular Excluded

e = x for OK

e = T if time-out error opening/closing spec port

e = E if selected specular condition not supported.

LIMIT FOR REF

Supported by: SF500 SF600 SF600 DATAFLASH 100

This command sets the minimum reference channel energy level for reflectance data to be considered valid. If during a measurement the reference channel energy (between 500 and 600 nm) falls below 10 times this value, the corresponding reflectance value is set to zero. For the SF500 this value represent a count. For all other instruments this represents a percentage of the white calibration level. For example a value of 120 would set reflectances to zero if their reference channel energy dropped below 12% of the energy during white tile calibration.

Command: **L n n n c c c c :^C_R ^L_F**

where:

nnn = Time to delay in 1/100 second increments.

cccc = checksum string

Example: **L 0 5 0 * * * * :^C_R ^L_F**

Response: Unchanged status string, followed by checksum and terminator.

x c c c c :^C_R ^L_F

LIMIT FOR TEST

Supported by: SPECTROFLASH

This command sets the range of variation permissible in the raw data between consecutive measurements made when a command is instructed to perform multiple measurements. If during a multiple measure command the difference between the raw energy of consecutive flashes is greater than the value set by this command, another measurement is performed. If more than three extra measurements are required the measure error status byte is set to T (See the measure command). The default value is 100.

Command: **J n n n c c c c : ^C_R ^L_F**
where:

nnn = Time to delay in 1/100 second increments.

cccc = checksum string

Example: **J 2 0 0 * * * * : ^C_R ^L_F**

Response: Unchanged status string, followed by checksum and terminator.
x c c c c : ^C_R ^L_F

MEASURE

Supported by: SPECTROFLASH MICROFLASH DATAFLASH

This command causes the spectrophotometer to perform a measurement and return the reflectance data from that measurement. The data is always returned as forty 10 nm points from 360 nm to 750 nm. The data is returned in 8 lines each containing 5 reflectance values. Each line is terminated by a ^C_R and ^L_F. All values are represented by a 6 digit fixed point number, with a decimal point between the third and fourth digits. If the instrument supports only a subset of the data, the unused points will be filled with the value of the first or last valid data point.

Command: **M** **n** **@** - **c c c c** : ^C_R ^L_F
where:

n = Number of readings to average for measurement.

- = space character

cccc = checksum string

Example: **M 2 @ - * * * * :** ^C_R ^L_F

Response: Status string, followed by reflectance data, checksum and terminator.

```
x x x x x x x x x x x x x e x x x x x x x CR LF
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF/
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF/
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF
nnn.nnn nnn.nnn nnn.nnn nnn.nnn/nnn.nnn CR LF
c c c c : CR LF
```

where:

e = x for OK

e = F if reference energy is too low,

T if data between multiple readings is out of range

E for any other measurement error

nnn.nnn = reflectance data

WHITE END CALIBRATION

Supported by: SPECTROFLASH MICROFLASH DATAFLASH

This command causes the spectrophotometer to perform a white end calibration. The **RESET** command should be executed prior to performing the black end calibration. This command will return the values for the white tile data stored in the instrument. These are the white end calibration points used for all subsequent measurements. The data is always returned as forty 10 nm points from 360 nm to 750 nm. The data is returned in 8 lines each containing 5 reflectance values. Each line is terminated by a C_R and L_F . All values are represented by a 6 digit fixed point number, with a decimal point between the third and forth digits.

If the fourth character of the command string is set to a 'B' the instrument will perform a single point calibration using only the white calibration point. This feature is currently available only on the Dataflash.

NOTE: The Microflash always performs calibration using two measurements; it will ignore the value of the second character in the command string.

Command: **W n m t c c c c : C_R L_F**

where:

n = Number of readings to average for measurement.

m = R for Reflection mode, T for Transmission mode

t = space character for normal calibration, B for white only calibration

cccc = checksum string

Example: **W 2 R - * * * * : C_R L_F**

Response: Status string, followed by white tile data, checksum and terminator.

```
x x m x x x x x e x x x x x x x x x x x x x x  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
nnn.nnn nnn.nnn nnn.nnn nnn.nnn nnn.nnn  $C_R$   $L_F$ 
c c c c :  $C_R$   $L_F$ 
```

where:

m = R for Reflectance, T for Transmission

e = x for OK

e = E if error during calibration

nnn.nnn = reflectance data