

VeriColor®

Solo Identification System



Command Users Manual

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Command Codes (Alphabetical Order)

Page	Command	Description
5	br	Baud Rate
5	cb	Calibrate Black
5	ce	Clear Errors
6	cf	Configure
6	cg	Calibrate Get
7	cs	Calibrate Set
8	cw	Calibrate White
8	ge	Get Errors
9	gr	Get Reading
10	hm	Head Mode
10	hs	Head Status
11	ma	Measure
11	mp	Make Permanent
11	oi	Optics Information
12	pc	Project Clear
12	pg	Project Get
13	ph	Poll Head
14	ps	Project Set
14	re	Reset
14	sa	Standard Active
15	sc	Standard Clear
15	sg	Standard Get
15	sn	Serial Number
16	ss	Standard Set
16	sv	Software Version
17	tl	Target Learn
17	vw	Verify White Calibration
17	zz	Pass-through

General Information

This manual describes the protocol for the remote control interface (RCI) of the X-Rite VeriColor Solo spectrophotometer. It also describes the purpose and usage of each command supported by the spectrophotometer. This manual should provide sufficient technical information regarding the remote control protocol to allow an interested user to develop the necessary hardware and command string software to interface a controlling device to the instrument. The serial input port in conjunction with the remote control commands is intended to be used for controlling or monitoring the instrument remotely through a RS-232 compatible interface cable.

The remote control interface (RCI) utilizes a serial communications protocol which is patented and proprietary to X-Rite, Incorporated. The serial command format consists of a series of numeric and alphabetic characters (referred to as the command string) sent to the instrument in ASCII format, with a carriage return (0D hex) to delimit the string. The instrument is capable of receiving up to 132 characters into its receive buffer in rapid succession. When the command is fully received and processed, the instrument responds performing the command function, transmitting pertinent data, and transmitting the "status response packet". All text responses end with a carriage return (0D hex) and line feed (0A hex). The status response packet is in the form: <00> where the number within the brackets indicates the status of the instrument and where 00 indicates a normal condition with no errors (for further information on error codes, refer to the section of this document titled "ERROR COMMANDS".)

Conventions

- Numbers ending with the letter 'h' are hexadecimal. All others are decimal.
- All commands minimally respond with a status packet. A status packet has the format: <sc> where **sc** is a code indicating any error that might have occurred while processing the command. <00> indicates there was no problem processing the command. If the instrument transmits other data in response to the command, this data will precede the status packet.
- RCI refers to "remote control interface" and is the command string protocol described throughout this document.
- { } indicates the contents within are optional.
- <sc> indicates the status string which is transmitted at the end of the response of every RCI command. It includes the open and close kerrets <> with a two digit status code between them. The normal status string is <00>
- All numeric data within an RCI command string is decimal unless noted otherwise.
- CR is an ASCII carriage return character (0D hex) and LF is an ASCII line feed character (0A hex).
- All lines of text in response to a command end with a CR/LF combination.
- Unit, head, or instrument refers to the X-Rite Vericolor Solo color measurement device (VCS50).

GLOSSARY

COMMAND STRING

Each command in the RCI protocol consists of one to ten ASCII characters which is terminated with a carriage return character (0Dh). The string is referred to as the "command string". Each command requires at least one letter and may be preceded with up to eight data characters. If the expected number of characters are not received in the command string, a "BAD PARAMETERS" (12h) error code will be generated.

ERROR CODES

A variety of error conditions may be encountered during the operation of the instrument. These conditions are given numbers for identification purposes and are transmitted from the instrument as part of the "status response packet". The error codes with their descriptions are listed in the section of this document titled: ERROR COMMANDS.

ERROR STACK

The instrument is capable of keeping track of the last sixteen errors to occur. These are placed in the "error stack" and can be accessed using a variety of error commands listed in this document under the heading: ERROR COMMANDS.

I/O

Input/output.

SOFTWARE INTERFACE

BYTE FORMAT

Every data character transmitted from, and received by the instrument is made up of ten bits. The format of these bits is as follows:

BIT NUMBER	PURPOSE
1	START BIT (LOGIC 0)
2 - 9	DATA CHARACTER
10	STOP BIT (LOGIC 1)

BIT TRANSMIT ORDER

The least significant bit of the data character is transmitted first. The complete bit order is as follows:

FIRST BIT	START BIT	LOGIC 0
	DATA BIT 0	LOGIC 0 OR 1
	DATA BIT 1	LOGIC 0 OR 1
	DATA BIT 2	LOGIC 0 OR 1
	DATA BIT 3	LOGIC 0 OR 1
	DATA BIT 4	LOGIC 0 OR 1
	DATA BIT 5	LOGIC 0 OR 1
	DATA BIT 6	LOGIC 0 OR 1
	DATA BIT 7	LOGIC 0 OR 1
LAST BIT	STOP BIT	LOGIC 1

BAUD RATE

The default baud rate is 19200. The baud rate is changed using the "SET BAUD RATE" (BR) command. Baud rates supported by the instrument are as follows:

4800 BAUD
9600 BAUD
19200 BAUD (Default)
38400 BAUD
57600 BAUD

COMMAND STRING

Command characters may be one or two alphabetic letters. Many of the commands require one or more numeric digits preceding the command to provide the parameters necessary to perform the command function. Unless specified otherwise, all numeric data in a command string is decimal. All characters may be upper or lower case.

DELIMITERS

All command strings must be terminated with a CARRIAGE RETURN (0Dh) or a LINE FEED (0Ah). The CARRIAGE RETURN or LINE FEED character is referred to as the DELIMITER character. All characters received prior to the delimiter are considered part of the command string.

COMMAND STRING TIME-OUT

Each character of the command string must be received within ten seconds of each other or the command string is considered invalid and is cleared from the command processor. If the ten second time-out is reached, it is necessary to re-transmit the entire command string from its beginning.

COMMAND DESCRIPTIONS

BAUD RATE (br)

SYNTAX: #####br

Where: ##### is the desired baud rate

Supported rates are: 4800
 9600
 19200 (default)
 38400
 57600

OPERATION: Changes the baud rate for the RS232 serial communications. The status response is transmitted before the baud rate is changed. If no baud rate is given, the present rate is returned.

RESPONSE: #####
<sc>

Where: ##### is the present baud (this line not transmitted if the baud rate is being set).

CALIBRATE BLACK

SYNTAX: aa##cb

Where: ## is the number of times each LED is read and averaged per measurement (default is 24).

aa is a HEX byte representing a mask of the LED's
ff = All LED's used

If there are no parameters sent, the command will be initiated with default values of 24 for averaging and 0xff for the mask.

OPERATION: Perform a calibration reading on the black calibration plaque.

RESPONSE: <sc>

CLEAR ERRORS

SYNTAX: ce

OPERATION: Clears all errors in the error memory. The GE command is used to get the error list.

RESPONSE: <sc>

CONFIGURE

SYNTAX: **##cf

Where: ** is the option selection.
 ## is the index to the item to be configured.

OPERATION: This command is used to configure various instrument options.

RESPONSE: If an index (##) is provided, but no option selection (**), the response will be the present setting of the item selected. If (##) isn't provided either, the list of available settings will be sent. The response is completed with a <sc> status packet.

The following are a list of the configuration items and their options (Note: An asterisk (*) indicates the default setting):

Number (##)	Description	Options (**)
01	Enable/Disable Auto Transmit Status after a trigger measurement	00 = disabled* 01 = enabled

CALIBRATE GET

SYNTAX: ##cg

Where: ## is the index to the type of information requested

OPERATION: This command is used to recall calibration information previously stored in the instrument. The format of the data returned is described in the table below.

RESPONSE: If ## is left out or set to 0's, the list of choices will be transmitted. Refer to the following table for details. The response is completed with a <cs> status packet.

Number (##)	Description	Data Type
00	Outputs this list of available settings	
01	Calibration Plaque Serial Number The data string is a 1 to 9 digit decimal number from 0 to 999,999,999. Example: 123456	
02	White Cal Plaque Values The data strings is eight, comma separated, decimal reflectance values. The decimal point is omitted and assumed to be two digits from the right (100% = 10000). Example: 9001,8975,9100,9035,8997,9003,8999,9000	
03	(NOT USED)	
04	Get Last Calibration Timestamp The data string is a one to nine digit decimal number from 0 to 999,999,999. Example: 123456	
05	Get Last Verification Timestamp The data string is a one to nine digit decimal number from 0 to 999,999,999. Example: 123456	

06 Get White Verification Tolerance
The data string is a single 1 to 5 digit decimal number (up to 65535). The decimal point is omitted and assumed to be two digits from the right (1.00 = 100).
Example: 200

CALIBRATION SET

SYNTAX: ##cs

Where: ## is the index to the type of information to set.

OPERATION: This command is used to change calibration data in the instrument. After the instrument receives the command it waits for a data string. The format of the data required is described in the table below. Be sure to send a **make permanent (mp) command** after changing the settings.

RESPONSE: If ## is left out or set to 0's, the list of choices will be transmitted. Refer to the following table for details.

Number (##)	Description
00	Outputs this list of available settings (no data string expected).
01	Set Calibration Plaque Serial Number The data string is a 1 to 9 digit decimal number from 0 to 999,999,999. Example: 123456
02	Set White Cal Plaque Values The data strings is eight, comma separated, decimal reflectance values. The decimal point is omitted and assumed to be two digits from the right (100% = 10000). Example: 9001,8975,9100,9035,8997,9003,8999,9000
03	(NOT USED)
04	Set Last Calibration Timestamp The data string is a one to nine digit decimal number from 0 to 999,999,999. Example: 123456
05	Set Last Verification Timestamp The data string is a one to nine digit decimal number from 0 to 999,999,999. Example: 123456
06	Set White Verification Tolerance The data string is a single 1 to 5 digit decimal number (up to 65535). The decimal point is omitted and assumed to be two digits from the right (1.00 = 100). Example: 200

CALIBRATE WHITE

SYNTAX: aa##cw

Where: ## is the number of times each LED is read and averaged per measurement (default is 24).

aa is a HEX byte representing a mask of the LED's
ff = All LED's used

If there are no parameters sent, the command will be initiated with default values of 24 for averaging and 0xff for the mask.

OPERATION: Perform a calibration reading on the white cal plaque.

RESPONSE: <sc>

GET ERRORS

SYNTAX: {##}ge

Where: ## is 01 to get a fatal error (status LED is red).

OPERATION: Returns a list of error codes and number of occurrences for each code. Getting this error list does not clear it out until the "ce" command is sent. If the "01ge" is sent a single error is returned. This error only exists if the status LED is shining red. This error is automatically cleared when the "01ge" command is sent.

RESPONSE: The response will be up to eight error codes with their corresponding occurrence count:

aa,bb
<cs>

Where: **aa** - individual error code, see Appendix A for a detailed listing of error codes and their meaning.

bb = number of times the error has occurred

GET READING

SYNTAX: **##gr**

Where: **##** is the type of information requested, listed below

- 00 = Returns list of parameters
- 01 = Get current dLED and sample reflectances
- 02 = Get Pass/Fail Statuses
- 03 = Get Sample Averaging Status
- 04 = Get dIntensity and dColor sample Values

OPERATION: This command returns measurement sample data.

RESPONSE: Responds with the present setting of the selected configuration option. The response varies depending on the option selected. Invalid parameters will return 0's followed by the <sc> status.

00gr – Help List. Returns a help list of parameters.

01gr – Get dLED and Reflectances. The instrument returns a string of reflectances “yyyyy,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx” where xxxxx is an ASCII word where 10000 = 100.00% reflectance. yyyyy represents the dLED number between the current standard and current sample; a value of 100 = 1.00 dLED.

02gr – Get Pass/Fail Statuses. Returns a string of pass/fail flags in the format “z,z,z,z,z,z”. z is either a 0 for a fail, or 1 for a pass. The first number in the response represents the overall Pass/Fail status for the last reading (the other six value will always be 1 for backwards compatibility).

03gr – Get Sample Averaging Status. Returns a string of a couple numbers in the format “y,z” ‘y’ is how many measurements have been taken towards the running average and z is how many measurements are needed to be made before a sample is complete. So “2.5” means the last measurement was 2 out of 5.

04gr – Get dIntensity and dColor Values. Returns an ASCII string of a couple numbers in the format “aaaaa,bbbbbb”. aaaaa represents the dIntensity number and bbbbbbb the dColor value. This command reports the differences between the sample and the current standard.

HEAD MODE

SYNTAX: **##hm**

Where: ## is one of the instrument operation mode as follows:

00 – SAMPLE MODE
01 – LEARN MODE
02 – Not used
03 – Not used
04 – TARGET MODE
05 – SYSTEM STARTUP MODE
06 – SAVE LEARNED STANDARD EXIT LEARN
99 – ERROR MODE

NOTE: Learn Mode must be exited using the “06hm” command or the learned standard will not be saved.

OPERATION: This command is used by software to get/set the current operating mode of the instrument. Not all modes are accessible by software, if the new mode is not accepted the command will return an *invalid command parameter* status <02>.

RESPONSE: If no setting is provided with this command, the response is the current mode ## followed by the status <sc>. Otherwise the response is the status <sc> only.

HEAD STATUS

SYNTAX: **hs**

OPERATION: Returns a the operating status of the head.

RESPONSE: **ss**
 <cs>

Where: **ss** - is one of the following:

00 = Normal operation
01 = Warming up
02 = Hardware failure

MEASURE

SYNTAX: **ma**

OPERATION: Causes the instrument to measure a sample.

RESPONSE: <sc>

MAKE PERMANENT

SYNTAX: **mp**

OPERATION: Saves the current DataStore to FLASH

RESPONSE: <sc>

OPTICS INFORMATION

SYNTAX: {#}oi

Where: # = 0 (or none) To get the optics serial number.
 # = 1 To get the optics type.

Get the optics serial number:

SYNTAX: oi or 0oi

EXPLANATION:
Returns the optics serial number of the instrument.

RESPONSE: **dddddd**
 <sc>

Where: **dddddd** is the present optics serial number.

Get the optics type:

SYNTAX: 1oi

EXPLANATION:
Returns the optics type of the instrument. The only type at the time of this writing is 0.

RESPONSE: **0**
 <sc>

PROJECT CLEAR

SYNTAX: **pc**

OPERATION: This command clears out the current Project data and sets all project features to inactive.

RESPONSE: <sc>

PROJECT GET

SYNTAX: **##pg**

Where: ## is used as a Data Type Setting

OPERATION: These commands are used to obtain current project data from the instrument.

RESPONSE: Responds with the present setting of the selected configuration option. The response varies depending on the option selected.

01pg – Get Project Name. This returns the current Project Name String. Up to 40 characters plus a null terminator.

04pg – Get Project Configuration. The configuration of a project consists of nine bytes of data. The purpose of each byte is as follows:

<u>BYTE</u>	<u>Description</u>
1	Unused by the instrument
2	Number of readings to be averaged (or the filter weight when digital filtering)
3	Amount of time (0.1 second resolution) between auto average readings
4	The method used to average readings (0 = Normal, 1 = Digitally Filtered)
5	Time (0.1 second resolution) between external trigger and when reading occurs
6	Mode for searching for standard (0 = dLED, 1 = dIntensity, 2 = dColor)
7	Search Enable (0 = Disabled, 1 = Enabled)
8	Output Polarity (0 = normally open, 1 = normally closed)
9	Time (seconds) output port remains active (0 = infinite)

The nine bytes are comma separated and sent as a single data packet.

POLL HEAD

SYNTAX: #ph

Where: if # is a value greater than 0 sent as a parameter will reset the poll flag. If the parameter is zero or left out, the response will indicate whether a new measurement has been made or not.

OPERATION: This command will be sent often to the instrument in order to know when it has taken a measurement triggered by any source. Once a measurement is taken, this command will respond with <00> responses until the poll flag is reset with a (1ph).

RESPONSE: <**>

Where: ** is one of the following status codes:

- 00 A new measurement was performed.
- 01 No new measurements have been made since the poll flag has been reset.
- 02 A measurement was made towards a Sample Average in Manual mode. Once the last reading is made towards an average this command will return a <00> response.
- 03 A measurement was made towards a Sample Average in Auto Mode. After the series of measurements have completed, this command will respond with a <00> response.
- 04 The instrument is in an error state, and the error must be resolved before further readings can take place.
- 05 The instrument is busy and no measurement should be taken until the instrument has completed its task.

PROJECT SET

SYNTAX: **##ps**

Where: **##** is used as a Data Type Setting

OPERATION: These commands are used to set the current project data in the instrument. The types of data and their format are described below.

RESPONSE: Responds with the present setting of the selected configuration option. The response varies depending on the option selected.

01ps – Set Project Name. Using this command, the instrument will expect a name to follow (41 characters max including null terminator).

04ps – Set Project Configuration. The configuration of a project consists of nine bytes of data. The purpose of each byte is as follows:

BYTE	Description
1	Unused by instrument (can be set to any value from 0 to 255)
2	Number of readings to be averaged (or the filter weight when digital filtering)
3	Amount of time (0.1 second resolution) between auto average readings
4	The method used to average readings (0 = Normal, 1 = Digitally Filtered)
5	Time (0.1 second resolution) between external trigger and when reading occurs
6	Mode for searching for standard (0 = dLED, 1 = dIntensity, 2 = dColor)
7	Search Enable (0 = Disabled, 1 = Enabled)
8	Output Polarity (0 = normally open, 1 = normally closed)
9	Time (seconds) output port remains active (0 = infinite)

The nine bytes are comma separated and sent as a single data packet.

RESET

SYNTAX: **re**

OPERATION: Initiates a system reset via WatchDog Timeout. Sends the response out before the reset.

RESPONSE: <sc>

STANDARD ACTIVE

SYNTAX: **##sa**

Where: **##** is the Standard number (1 to 30 ASCII)

OPERATION: The number specified becomes the current Standard. Only the current standard can have its information accessed. If no parameter is sent, the current standard number is returned before the status response.

RESPONSE: <sc>

STANDARDS CLEAR

SYNTAX: **sc**

OPERATION: Clears all standards from the instrument's database memory.

RESPONSE: <sc>

STANDARD GET

SYNTAX: **##sg**

Where: **##** is used as a Data Type Setting

If no parameter is provided this command will return the number of standards presently stored in the instrument.

OPERATION: These commands are used to obtain current Standard data from the instrument. Use the (**sa**) command to access different Standards.

RESPONSE: Responds with the present setting of the selected configuration option. The response varies depending on the option selected.

01sg – Get Standard Name. This returns the current Standard Name string. Up to 40 characters plus a null terminator.

02sg – Get Standard Tolerance and Reflectances. This returns a string of eleven numbers, 3 Tolerances and eight Reflectances in the following format “aaaaa,bbbb,ccccc,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx” where each number xxxxxx is a WORD in ASCII form (10000 = 100.00% reflectance). Command will return a Bad Command if the parameter is out of range. aaaaa represents the dLED Tolerance, bbbbb for dIntensity, and ccccc dColor Tolerances where a value of 100 = 1.00.

03sg – Get Tolerance Enable/Disable. Gets the tolerance method. The tolerance options are as follows:

<u>Value</u>	<u>Description</u>
0	No tolerance
1	dLed
2	dIntensity/dColor

SERIAL NUMBER

SYNTAX: **sn**

OPERATION: Returns the instrument serial number.

RESPONSE: **dddddd**
 <sc>

Where: **dddddd** is the present serial number.

STANDARD SET

SYNTAX: ##ss

Where: ## is used as a Data Type Setting

If no parameter is provided this command will return the number of standards presently stored in the instrument.

OPERATION: These commands are used to set current standard data from the instrument. Use the (sa) command to select different standards. NOTE: The standards must be cleared (once) using the “sc” command before new standards can be loaded. When creating a standard the procedure **must be done in order** where the Standard name is set first, then the tolerances and reflectances, and the tolerance mode is set last.

NOTE: It is possible to change existing, individual standards. However, if all the standards are being changed, it is recommended that they be cleared first using the “sc” command. This will speed up the process of loading the new standards.

RESPONSE: The response varies depending on the option selected, but ends with <sc>cr

01ss – Set Standard Name. After this command is sent to the instrument, it expects the Standard Name to be sent right after. Up to 40 characters plus a null terminator.

02ss – Set Standard Tolerance and Reflectances. This command is used to set standard tolerances (first three numbers dLED, dIntensity, and dColor) and reflectances (the following eight). The input string should be the same format that it would return with the (sg) command. “aaaaa,bbbb,cccc,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx,xxxxx” where each number is a WORD in ASCII form (10000 = 100.00% reflectance or 100.00 Tolerance). Command will return a Bad Command if the parameter is out of range.

03ss – Set Tolerance Mode. This command sets the tolerance method. The tolerance options are as follows:

Value	Description
0	No tolerance
1	dLed
2	dIntensity/dColor

SOFTWARE VERSION

SYNTAX: sv or v

OPERATION: Returns the instrument type and firmware version code.

RESPONSE: X-Rite ttt Ver.yyymmdd
<sc>

Where: ttt is the instrument type.

yy is the last two digits of the year (00 – 99).

m is the month (1 – 9 respectively, October = a, November = b, December = c).

dd is the day (01 – 31).

TARGET LEARN

SYNTAX: `tl`

OPERATION: Makes the last reading the target reference reading. This is what the target readings are compare to and from which a dLED value is calculated.

RESPONSE: `<sc>`

VERIFY WHITE CALIBRATION

SYNTAX: `{#}vw`

OPERATION: Causes the instrument to read and compare the reading to the white calibration values and transmits the results of the comparison. The pass/fail tolerance of this comparison is set using the “08pv” command. The default is 1.00.

RESPONSE: If the command is “vw” or “0vw” the response will be 0 if the reading passed or 1 if the reading failed. This will be followed by the status packet `<sc>`.

If the command is “1vw” the response will be the dLED value of the comparison between the reading and the white calibration values. This will be followed by the status packet `<sc>`.

PASS-THROUGH

SYNTAX: `zz`

OPERATION: This command does nothing. It is accepted for compatibility with the Vericolor HUB command set.

RESPONSE: `<sc>`

Appendix A

ERROR CODES

Status/Error Codes

<u>Code</u>	<u>Description</u>
00	No problem
01	Unrecognized command
02	Invalid command parameter
03	Data format error (data received not in expected format)
04	Timeout
05	Busy
06	Unable to complete command action
07	Measurement failed (this would probably generate an error as well)
08	Measurement aborted
09	Calibration required
0A	Battery low
0B	External power failure
0C	Battery disconnected
0D	Battery dead
0E	Battery low
0F	Illuminant lamp weak
10	Illuminant lamp failed
11	Temperature error
12	Data lost
13	Factory initialization missing or incomplete
14	Configuration set to default
15	Configuration lost
16	Insufficient memory
17	Random access memory error
18	Data flash memory error
19	Program code error
1A	Microcontroller error
30	Datastore load error
31	Datastore "make permanent" error
32	Datastore full
33	Datastore checksum error
34	Datastore size mismatch
40	Measure slope error
41	Measure offset error
42	Measure black error
43	Measure negative error
44	Measure mask error
45	Measure white error