Spectroradiometer CS-2000/CS-2000A
Communication Specifications

[Rev. 7.00]

KONICA MINOLTA

Notes regarding these specifications

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Revision History

Revision	Date	Modifications
Rev. 1.00	March 13, 2009	First English version
Rev. 1.01	September 12, 2013	Change of company name
Rev. 1.02	December 8, 2014	Minor text edits
Rev. 5.00	September 10, 2018	RS-232C specifications have been added. "BPSS" command has been added. "BPSR" command has been added. Minor text edits
Rev. 6.00	November 2, 2018	"1.7 Storage of settings" additional explanations have been added. "RMTS" command, command parameters, and description have been added. "INIT" command has been added. Minor text edits
Rev. 7.00	July 21, 2020	Recommended setting for "1.6 Timeout Setting" have been changed. Minor text edits

Table of Contents

1 Communication Overview

This communication protocol is for both KONICA MINOLTA Spectroradiometers CS-2000 and CS-2000A.

1.1 Communication method

Communication with the CS-2000/CS-2000A is performed via USB or RS-232C.
For information on connecting the CS-2000/CS-2000A to a computer, please refer to the "Communication" section of the Spectroradiometer CS-2000/CS-2000A Instruction Manual.

1.1.1 USB

Communication with a PC can be performed with the CS-2000/CS-2000A configured as using a virtual COM port. The settings are shown below. Note that communication can be performed regardless of the settings.
In addition, changing the baud rate setting has no effect on USB communication speeds.

Specification	USB1.1 Full-Speed	
USB device driver	Kmsecs2000.inf ● Installed into CS-S10w program folder when CS-S10w software included with the instrument as a standard accessory is installed.	
Communication settings	Baud rate	115,200 bps
	Data length	8 bits
	Parity	None
	Stop bits	1 bit
	Flow control	Hardware (RTS/CTS)

1.1.2 RS-232C

Communication with a PC can be performed with the CS-2000/CS-2000A configured to use a COM port. The baud rate of the CS-2000/CS-2000A can be changed as desired. The baud rate of the PC application must match with the baud rate of the CS-2000/CS-2000A.

Communication settings	Baud rate	600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 (Default: 115,200 bps)
	Data length	8 bits
	Parity	None
	Stop bits	1 bit
	Flow control	Hardware (RTS/CTS)

1.2 Instrument control

Control of the CS-2000/CS-2000A is performed by sending the command and any associated command parameters for the desired operation from the PC to the CS- 2000/CS-2000A. After the requested operation has been performed, the CS-2000/CS-2000A sends back the operation results as an error-check code and any associated response parameters. Command details (command parameters, error-check codes, and response parameters) are explained in the Command Details section.

1.3 CS-2000/2000A settings (Remote Mode)

When controlling the CS-2000/CS-2000A from a PC, it is necessary to set the instrument to Remote Mode.

Procedure for setting Remote Mode

Procedure	(1) Connect PC and instrument with cable. (2) Send Remote Mode setting command “RMTS,1” from PC to instrument. (3) Check that error-check code “OK00” is returned from the instrument.

1.3.1 Operation of instrument keys in Remote Mode

When the instrument is set to Remote Mode, communication commands can be used to operate the instrument, and instrument keys except for ESC are disabled. In Remote Mode, the instrument ESC key has the following functions:

- When the instrument is not taking a measurement, pressing the instrument ESC key will cancel Remote Mode.
- When the instrument is measuring, pressing the instrument ESC key will interrupt and cancel the measurement.

1.3.2 Enbling instrument measurement button

The measurement button of the instrument can be enabled so that it can be used even in Remote Mode using the command “MSWE”.

When the measurement button has been enabled in Remote Mode, measurements can be started by either sending the command “MEAS” or by pressing the instrument’s measurement button.

When the measurement button has been enabled, the timing for clearing of measurement data stored in the CS-2000/CS-2000A is different. For details, refer to the Explanation section for the command “MEDR”.

1.4 Delimiter

When sending commands from a PC to the instrument, any of the following delimiters can be used:

- [CR] : Carriage return (0x0D)
- [LF] : Line feed (0x0A)
- [CR][LF] : Carriage return + Line feed (0x0D + 0x0A)

When the instrument returns the error-check code and/or data to the PC in response to a command, the delimiter code used by the instrument will be the same one that was used with the command. If there is no delimiter code, the command will not be properly recognized. In such case, if nothing is received by the instrument within 60s after receipt of the last character, the received character string will be cleared and the command will be considered invalid.

(Note)
For CS-2000 firmware versions of 1.01.0000, if nothing is received by the instrument within 60s after receipt of the last character, the received character string will be cleared and the error-check code “ER00” will be returned.

1.5 Data string formats

When sending numerical value, the number of numerical characters in the string must not exceed the number of characters indicated for the command, but can be fewer than the indicated number.
When sending a text string, the number of characters in the string must be the same as the number of characters indicated for the command. Therefore, if the number of characters in the desired string is fewer than the indicated number, spaces should be added to the initial string to create a string of the required length.

1.6 Timeout setting

The timeout time for the PC communication port should be set as follows:

- When commands other than “STDS” are sent:
  The timeout time should be set to at least 10s.
  When communicating via RS-232C at 600bps, it should be set to at least 20s.
- When the “STDS” command is sent:
  The timeout time should be set to at least 35s.

(Note)
Setting the timeout time to the longer time of at least 35s regardless of whether or not the command being sent is “STDS” is also acceptable.

1.7 Storage of settings

The measurement conditions, compensation factors, target values, and instrument display information set using commands are stored in the internal flash memory of the CS-2000/CS-2000A. As a result, such settings are maintained even after the instrument Remote Mode has

been canceled.
However, it is important to note that the number of times data can be deleted from/written to flash memory is limited. Care must be taken to prevent revising the data any more than necessary when creating a PC application. Setting the instrument to Remote Mode and selecting “RMTS,2” will prevent high-frequency setting changes such as measurement conditions and main unit LCD details from being written to the flash memory. Use this mode whenever possible.

1.8 Hexadecimal format used in commands

The parameters of some commands are specified as being in hexadecimal format. The hexadecimal format for use with the CS-2000/CS-2000A is IEEE floating point format (4-byte big-endian hexadecimal string).

2 Commands

This communication protocol is for both the CS-2000 and CS-2000A. However, for the CS-2000, there are some differences in command input and parameter input/output for firmware versions of 1.10.0003 and later compared to versions 1.01.0000 or earlier. For details, refer to the command explanations.

Parameters shown in parentheses in the “Input/Output Format” should not be input or are not output in some cases, depending on other parameters Please see the “Command Parameters” and “Response Parameters” sections of each command for details.

2.1 Command list

The commands for the CS-2000 and CS-2000A are shown in the table below. Commands for which input/returned parameters for firmware ver. 1.10.0003 are different from those of firmware ver. 1.01.0000 are indicated by “Y” in the Changed column.

Command	Description	Changed
Instrument information/Status		
RMTS	Remote Mode Select	
IDDR	Identification Data Read	Y(*1)
Condition settings		
SCMR	Sync Mode Read	
SCMS	Sync Mode Set	
SPMR	Speed Mode Read	Y(*1)
SPMS	Speed Mode Set	Y(*1)
STSR	Aperture Stop Status Read	
Calibration settings		
UCCS	User Calibration Channel Select	
UCCR	User Calibration Channel Read	
UCPS	User Calibration Parameter Set	
UCPR	User Calibration Parameter Read	
UCCD	User Calibration Channel Delete	
Optional Close-Up Lens settings		
LNSS	Close-up Lens Status Select	
LNSR	Close-up Lens Status Read	
ALFS	Attachment Lens Compensation Factor Set	
ALFR	Attachment Lens Compensation Factor Read	
Optional ND Filter settings		
NDFS	External ND Filter Select	
NDFR	External ND Filter Read	
NFCS	ND Filter Compensation Factor Set	
NFCR	ND Filter Compensation Factor Read	

(*1) Commands for which input/returned parameters for firmware ver. 1.10.0003 are different from those of firmware ver. 1.01.0000.

Command	Description	Changed
Measurement		
MEAS	Measure	
MEDR	Measurement Data Read	Y(*1)
MSWE	Measuring Switch Enable	
Measurement values		
STDS	Store Data Set	
STDR	Stored Measurement Data Read	Y(*1)
STDD	Store Data Delete	
STAD	Store All Data Delete	
Target colors		
TGSL	Target Number Select	
TGSR	Target Number Selection Read	
TGDS	Target Data Set	
TGDR	Target Data Read	Y(*1)
TGDD	Target Data Delete	
TGAD	Target All Data Delete	
Settings		
BALS	Backlight Control Set	
BALR	Backlight Control Read	
CSMS	Color Space Mode Set	
CSMR	Color Space Mode Read	
DIMS	Display Mode Set	
DIMR	Display Mode Read	
OBSS	Observer Set	
OBSR	Observer Read	
DTCR	Date/Time of Calibration Read	
BPSS	BPS Set	Y(*2)
BPSR	BPS Read	Y(*2)
INIT	Initialize	Y(*3)

(*1) Commands for which input/returned parameters for firmware ver. 1.10.0003 are different from those of firmware ver. 1.01.0000.

(*2) Commands that can be used only if the firmware ver. is 3.00.0000 or greater.

(*3) Commands that can be used only if the firmware ver. is 3.00.9301 or greater.

3 Command details

RMTS (Remote Mode Select)

Function

Selects the remote mode setting: On or Off.

Input/Output Format

PC		CS-2000/2000A
"RMTS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Remote mode setting	Integer; 1 digit	0: Off (Key mode: commands other than RMTS are not accepted.) 1: On (Communication commands will be accepted.) 2: On (Settings are not saved in FROM.)

Response Parameters

Explanation

Sets the remote mode setting.
When remote mode is off (0), the unit is in key mode and will not accept any commands other than RMTS. (If other commands are sent, the instrument will return “ER00”. In addition, Command Parameter = “2: On (Settings are not saved in FROM.)” can be used if the firmware version is “3.00.9301” or higher.
When remote mode is on (1), the unit will accept communication commands, and most key operations are disabled, with the following exceptions:

- When the instrument ESC key is pressed while the instrument is not taking a measurement, remote mode will be canceled.
- When the instrument ESC key is pressed while the unit is taking a measurement, the measurement will be canceled.
- When the instrument measurement button has been enabled (using the command MSWE), pressing the measurement button starts measurements.

When remote mode is enabled with Command Parameter = “1: On (Communication commands will be accepted.)”, the measurement conditions, correction coefficients, reference values, main unit LCD details, and other settings configured by subsequently transmitted communication commands are saved in the internal flash memory (FROM) of the CS-2000/2000A. Once saved, such settings are maintained in the FROM even after remote mode has been canceled. In general, the time required for saving to or reading form FROM tends to increase as the number of writes accumulates. A “Memory error” error code returned from the main unit may be due to an excessive number of writes to the FROM.
When remote mode is enabled with Command Parameter = “2: On (Settings are not saved in FROM.)”, settings configured by subsequently transmitted communication commands are not saved

in the FROM, making it possible to prevent unnecessary reading from or writing to FROM from occurring as when Command Parameter = “1: On (Communication commands will be accepted.)”.

The following table shows whether saving to FROM is performed in remote mode enabled with Command Parameter = “2: On (Settings are not saved in FROM.”. Refer to this table and select the remote mode as required.

Command	Description	When using RMTS,2 Y: FROM storage enabled N: FROM storage disabled
Condition settings		
SCMS	Sync Mode Set	N
SPMS	Speed Mode Set	N
Calibration settings		
UCCS	User Calibration Channel Select	N
UCPS	User Calibration Parameter Set	Y
UCCD	User Calibration Channel Delete	Y
Optional Close-Up Lens settings		
LNSS	Close-up Lens Status Select	N
ALFS	Attachment Lens Compensation Factor Set	Y
Optional ND Filter settings		
NDFS	External ND Filter Select	N
NFCS	ND Filter Compensation Factor Set	Y
Measurement values		
STDS	Store Data Set	Y
STDD	Store Data Delete	Y
STAD	Store All Data Delete	Y
Target colors		
TGSL	Target Number Select	N
TGDS	Target Data Set	Y
TGDD	Target Data Delete	Y
TGAD	Target All Data Delete	Y
Settings		
BALS	Backlight Control Set	N
CSMS	Color Space Mode Set	N
DIMS	Display Mode Set	N
OBSS	Observer Set	N
BPSS	BPS Set	N
INIT	Initialize	Y

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range

IDDR (Identification Data Read)

Function

Reads the product identification information from the instrument.

Input/Output Format

PC		CS-2000/2000A
"IDDR"Delimiter code	→	
	←	"Error-check code,[1],[2],[3]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Product name	String; 9 char.	"CS-2000" or "CS-2000A" May be different for custom units.
[2]	Variation code	Integer; 1 digit	1: CS-2000 2: CS-2000A 0 to 9: Used to differentiate models Meaning of numbers other than "1" and "2" is undefined.
[3]	Serial number	Integer; 7 digits	

Explanation

Reads the product identification information (product name, variation, serial number) from the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion

SCMR (Sync Mode Read)

Function

Reads currently set sync (synchronization) mode of the instrument.

Input/Output Format

PC		CS-2000/2000A
"SCMR"Delimiter code	→	
	←	"Error-check code,[1](,[2])"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Sync mode	Integer; 1 digit	0: No sync 1: Internal sync 2: External sync
[2]	『When Response Parameter [1] = “0” (No sync) or “2” (External sync): Not output		
	When Response Parameter [1] = “1” (Internal sync): Synchronization frequency	Integer; 5 digits	2000 to 20000: Synchronization frequency for internal sync. 100× actual value (Actual range: 20.00 to 200.00Hz) ● If number of digits is fewer than 5, “0” will be added before value.

Explanation

Reads current instrument Sync mode. When Sync mode is set to 1 (Internal sync), a second parameter indicating the synchronization frequency will also be output.

Error-check codes

Code	Meaning
OK00	Normal completion

SCMS (Sync Mode Set)

Function

Sets sync (synchronization) mode of the instrument.

Input/Output Format

PC		CS-2000/2000A
"SCMS,[1](,[2])"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Sync mode	Integer; 1 digit	0: No sync 1: Internal sync 2: External sync
[2]	When Command Parameter [1] = “0” (No sync) or “2” (External sync): Do not input		
	When Command Parameter [1] = “1” (Internal sync): Synchronization frequency	Integer; Up to 5 digits	2000 to 20000: Synchronization frequency for internal sync. 100× actual value (Actual range: 20.00 to 200.00Hz)

Response Parameters

Explanation

Sets synchronization mode (and synchronization frequency for internal sync).

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Sync mode set to a value outside of the range: 0 to 2 (inclusive), or Synchronization frequency was set to a value outside of the setting range: 2000 to 20000 (inclusive).
ER30 ER32 ER34	Instrument internal memory error

SPMR (Speed Mode Read)

Function

Reads currently set speed mode of the instrument.

Input/Output Format

➢ For CS-2000 with instrument firmware ver. 1.10.0003 or later, or for CS-2000A

PC		CS-2000/2000A
"SPMR"Delimiter code	→	
	←	"Error-check code,[1],[2](,[3])"Delimiter code

➢ For CS-2000 with instrument firmware ver. 1.01.0000 or earlier

PC		CS-2000/2000A
"SPMR"Delimiter code	→	
	←	"Error-check code,[1](,[2],[3])"Delimiter code

Command Parameters

Response Parameters

➢ For CS-2000 with instrument firmware ver. 1.10.0003 or later, or for CS-2000A

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: Normal 1: Fast 2: Multi Integ Normal 3: Manual 4: Multi Integ Fast
[2]	When Response Parameter [1] = “0” (Normal) or “1” (Fast): Internal ND filter mode	Integer; 1 digit	0: Off 1: On 2: Auto
	When Response Parameter [1] = “2”(Multi Integ Normal) or “4”(Multi Integ Fast): Integration time	Integer; 2 digits	01 to 16: Integration time in seconds ● If number of digits is fewer than 2, “0” will be added before value.
	When Response Parameter [1] = “3” (Manual): Integration time	Integer; 9 digits	000005000 to 120000000: Integration time in μsec. ● If number of digits is fewer than 9, “0” will be added before value.

	Meaning	Type	Details/range
[3]	When Response Parameter [1] = “0” (Normal) or “1” (Fast): Not output		
	When Response Parameter [1] = “2”(Multi Integ Normal) or “4”(Multi Integ Fast): Internal ND filter mode	Integer; 1 digit	0: Off 1: On 2: Auto
	When Response Parameter [1] = “3” (Manual): Internal ND filter mode	Integer; 1 digit	0: Off 1: On

➢ For CS-2000 with instrument firmware ver. 1.01.0000 or earlier

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: Normal 1: Fast 2: Multi Integ 3: Manual
[2]	When Response Parameter [1] = “0” (Normal) or “1” (Fast): Not output		
	When Response Parameter [1] = “2” (Multi Integ): Integration time	Integer; 2 digits	01 to 16: Integration time in seconds ● If number of digits is fewer than 2, “0” will be added before value.
	When Response Parameter [1] = “3” (Manual): Integration time	Integer; 9 digits	000005000 to 120000000: Measurement time in μsec. ● If number of digits is fewer than 9, “0” will be added before value.
[3]	When Response Parameter [1] = “0” (Normal), “1” (Fast), or “2” (Multi Integ): Not output		
	When Response Parameter [1] = “3” (Manual): Internal ND filter mode	Integer; 1 digit	0: Off 1: On

Explanation

Reads Speed mode, Integration time, and Internal ND Filter Mode currently set on instrument.
For CS-2000 with instrument firmware ver. 1.01.0000 or earlier, Internal ND Filter Mode is read only when Speed Mode is set to Manual (Response Parameter [1] = “3”); for other Speed Modes, Internal ND Filter Mode is fixed at Auto.

Error-check codes

Code	Meaning
OK00	Normal completion

SPMS (Speed Mode Set)

Function

Sets speed mode of the instrument.

Input/Output Format

PC		CS-2000/2000A
"SPMS,[1](,[2],[3])"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

➢ For CS-2000 with instrument firmware ver. 1.10.0003 or later, or for CS-2000A

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: Normal 1: Fast 2: Multi Integ Normal 3: Manual 4: Multi Integ Fast
[2]	When Command Parameter [1] = “0” (Normal) or “1” (Fast): Internal ND filter mode	Integer; 1 digit	0: Off 1: On 2: Auto ● If not set, will automatically be set to “2” (Auto)
	When Command Parameter [1] = “2”(Multi Integ Normal) or “4”(Multi Integ Fast): Integration time	Integer; 2 digits	1 to 16: Integration time in seconds
	When Command Parameter [1] = “3” (Manual): Integration time	Integer; 9 digits	5000 to 120000000: Measurement time in μsec.
[3]	When Command Parameter [1] = “0” (Normal) or “1” (Fast): Do not input.		● If a value is input, “ER00” (Invalid command string or number of parameters) will be returned.
	When Command Parameter [1] = “2”(Multi Integ Normal) or “4”(Multi Integ Fast): Internal ND filter mode	Integer; 1 digit	0: Off 1: On 2: Auto ● If not set, will automatically be set to “2” (Auto)
	When Command Parameter [1] = “3” (Manual): Internal ND filter mode	Integer; 1 digit	0: Off 1: On

➢ For CS-2000 with instrument firmware ver. 1.01.0000 or earlier

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: Normal 1: Fast 2: Multi Integ 3: Manual
[2]	When Command Parameter [1] = "0" (Normal) or "1" (Fast): Not output		● If a value is input, "ER00" (Invalid command string or number of parameters) will be returned.
	When Command Parameter [1] = "2" (Multi Integ): Integration time	Integer; 2 digits	1 to 16: Integration time in seconds
	When Command Parameter [1] = "3" (Manual): Integration time	Integer; 9 digits	5000 to 120000000: Measurement time in μsec.
[3]	When Command Parameter [1] = "0" (Normal), "1" (Fast), or "2" (Multi Integ): Not output		● If a value is input, "ER00" (Invalid command string or number of parameters) will be returned.
	When Command Parameter [1] = "3" (Manual): Internal ND filter mode	Integer; 1 digit	0: Off 1: On

Response Parameters

Explanation

Sets Speed mode, Integration time, and Internal ND Filter Mode of instrument.
For CS-2000 with instrument firmware ver. 1.01.0000 or earlier, Internal ND Filter Mode can be set only when Speed Mode is set to Manual (Command Parameter [1] = "3"); for other Speed Modes, Internal ND Filter Mode is fixed at Auto.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter was set to a value outside the specified setting range
ER30 ER32 ER34	Instrument internal memory error

STSR (Aperture Stop Status Read)

Function

Reads the status of the instrument's aperture stop (measurement angle).

Input/Output Format

PC		CS-2000/2000A
"STSR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Measurement angle (aperture stop position)	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°

Explanation

Reads the status of the instrument's aperture stop, which determines the measurement angle.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER83	Measurement angle abnormality

UCCS (User Calibration Channel Select)

Function

Selects the user calibration channel to use.

Input/Output Format

PC		CS-2000/2000A
"UCCS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	User calibration channel	Integer; 2 digits	00: Konica Minolta calibration standard (no compensation) 1 to 10: User calibration channel to use

Response Parameters

Explanation

Sets the user calibration channel to use when determining measurement data.
If set to a channel other than 00, user calibration data must already be stored in the instrument's internal memory for that channel.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER05	No compensation values (user calibration values).
ER17	Parameter error Input user calibration channel is outside the setting range of 00 to 10.
ER30 ER32 ER34	Instrument internal memory error

UCCR (User Calibration Channel Read)

Function

Reads the number of the currently selected user calibration channel.

Input/Output Format

PC		CS-2000/2000A
"UCCR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	User calibration channel	Integer; 2 digits	00: Konica Minolta calibration standard (no compensation) 01 to 10: Currently selected user calibration channel ● For single-digit channels, “0” will be added before the digit.

Explanation

Reads the currently selected user calibration channel.

Error-check codes

Code	Meaning
OK00	Normal completion

UCPS (User Calibration Parameter Set)

Function

Sets user calibration parameters.

Input/Output Format

Setting user calibration parameters is a three-step process:

Step 1: Send user calibration coefficients. (Repeat for each wavelength.)

PC		CS-2000/2000A
"UCPS,[1],[2],[3],[4]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Step 2: Send user calibration ID name.

PC		CS-2000/2000A
"UCPS,2,[2],[5]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Step 3: Finalize data and write to instrument internal memory.

PC		CS-2000/2000A
"UCPS,3"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	User calibration type	Integer; 1 digit	0: Wavelength correction 1: Level compensation
[2]	User calibration channel	Integer; 2 digits	1 to 10: User calibration channel to set data for.
[3]	Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which calibration data will be written “000” = 380nm, “001” = 381nm, ⋯ “400” = 780nm.
[4]	When Command Parameter [1] = “0” (Wavelength correction): Wavelength correction factor	Hex format	The corrected wavelength should be input. For example, to set 401nm as the corrected wavelength for 400nm, input “401” in hexadecimal format. Range: Nominal wavelength ±2nm
	When Command Parameter [1] = “1” (Level compensation): Level compensation factor	Hex format	For level compensation, the compensation factor should be input as absolute value, not percentage. (For example, 10% should be written as 0.1) Range: 0.001 to 1000
[5]	Calibration channel ID name	String; 10 char.	Alphanumeric string Length: 10 characters (if name is less than 10 characters, add spaces to achieve 10 characters) Refer to section 7: Characters.

Response Parameters

Explanation

Sets user calibration data and calibration channel ID.
The procedure is a 3-step procedure; Data are not finalized and written to the instrument internal memory until step 3 is completed.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range
ER30 ER32 ER34	Instrument internal memory error

UCPR (User Calibration Parameter Read)

Function

Reads user calibration parameters for the specified user calibration channel.

Input/Output Format

PC		CS-2000/2000A
"UCPR,[1],[2](,[3])"Delimiter code	→	
	←	"Error-check code,[4]"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	User calibration data requested	Integer; 1 digit	0: Wavelength correction 1: Level compensation 2: Calibration channel ID name
[2]	User calibration channel	Integer; 2 digits	01 to 10: User calibration channel to read data from
[3]	When Command Parameter [1] = "0" (Wavelength correction) or "1" (Level compensation): Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which calibration data will be read. "000" = 380nm, "001" = 381nm, … "400" = 780nm.
	When Command Parameter [1] = "2" (Calibration channel ID name): Do not input		

Response Parameters

	Meaning	Type	Details/range
[4]	When Command Parameter [1] = "0" (Wavelength correction): Wavelength correction factor	Hex format	The corrected wavelength is output.
	When Command Parameter [1] = "1" (Level compensation): Level compensation factor	Hex format	The compensation factor is output as absolute value, not percentage. (For example, 10% is output as 0.1) Range: 0.001 to 1000
	When Command Parameter [1] = "2" (Calibration channel ID name): Calibration channel ID name	String; 10 char.	Alphanumeric string ● If name is less than 10 characters, additional spaces will be used to achieve 10 characters

Explanation

Reads user calibration data or ID name.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER05	No compensation values (user calibration values)
ER17	Parameter error Parameter set to value outside setting range
ER30 ER32 ER34	Instrument internal memory error

UCCD (User Calibration Channel Delete)

Function

Deletes data stored in the specified user calibration channel.

Input/Output Format

PC		CS-2000/2000A
"UCCD,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	User calibration channel	Integer; 2 digits	1 to 10: User calibration channel to delete data from

Response Parameters

Explanation

Deletes data from the specified user calibration channel.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Memory number set to a value outside the range of 1 to 10.
ER30 ER32 ER34	Instrument internal memory error

LNSS (Close-up Lens Status Select)

Function

Selects the status of whether or not the optional close-up lens is attached.

Input/Output Format

PC		CS-2000/2000A
"LNSS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Close-up lens status	Integer; 1 digit	0: None 1: Attached

Response Parameters

Explanation

Sets whether or not the optional close-up lens is attached to the instrument.
The CS-2000/CS-2000A does not automatically recognize whether or not a close-up lens is attached to the instrument. It is therefore necessary to use this command to tell the instrument whether or not a close-up lens is attached.
When a close-up lens is attached, the lens compensation factors must be set in the instrument's memory in advance.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER05	No compensation values (lens compensation factors)
ER17	Parameter error Memory number set to value other than 0 or 1.
ER30 ER32 ER34	Instrument internal memory error
ER83	Measurement angle abnormality

LNSR (Close-up Lens Status Read)

Function

Reads the status of whether or not the optional close-up lens is attached.

Input/Output Format

PC		CS-2000/2000A
"LNSR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Close-up lens status	Integer; 1 digit	0: None 1: Attached

Explanation

Reads whether or not the optional close-up lens is attached to the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

ALFS (Attachment Lens Compensation Factor Set)

Function

Sets compensation factors for optional attachment lens (closeup lens).

Input/Output Format

Setting lens compensation factors is a two-step process:

Step 1: Send lens compensation factors. (Repeat for each wavelength.)

PC		CS-2000/2000A
"ALFS,[1],[2],[3]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Step 2: Finalize data and write to instrument internal memory.

PC		CS-2000/2000A
"ALFS,3"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[2]	Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which compensation factor will be written. “000” = 380nm, “001” = 381nm, … “400” = 780nm.
[3]	Compensation factor	Hex format	The compensation factor should be input as absolute value, not percentage. (For example, 10% should be written as 0.1) Range: 0 to 1

Response Parameters

Explanation

Sets compensation factor when using optional close-up attachment lens. The factors which should be used are included with the optional close-up lens at the time of purchase.

Data are not finalized and written to the instrument internal memory until "ALFS,3" is sent.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range
ER30 ER32 ER34	Instrument internal memory error

ALFR (Attachment Lens Compensation Factor Read)

Function

Reads compensation factors for optional attachment lens (closeup lens).

Input/Output Format

PC		CS-2000/2000A
"ALFR,[1],[2]"Delimiter code	→	
	←	"Error-check code,[3]"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[2]	Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which compensation factor will be read. “000” = 380nm, “001” = 381nm, … “400” = 780nm.

Response Parameters

	Meaning	Type	Details/range
[3]	Compensation factor	Hex format	Compensation factor stored in the instrument for the specified measurement angle and wavelength

Explanation

Reads compensation factors stored in instrument for when an optional close-up attachment lens is used.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER05	No compensation values (lens compensation factors)
ER17	Parameter error Parameter set to value outside setting range

NDFS (External ND Filter Select)

Function

Selects which optional external ND filter (if any) is attached.

Input/Output Format

PC		CS-2000/2000A
"NDFS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	External ND filter	Integer; 1 digit	0: None 1: ND Filter 1/10 attached 2: ND Filter 1/100 attached

Response Parameters

Explanation

Sets which (if any) optional external ND filter is attached to the instrument.
The CS-2000/CS-2000A does not automatically recognize whether or not an optional external ND filter is attached to the instrument. It is therefore necessary to use this command to tell the instrument whether or not an ND filter is attached, and, if attached, which one is attached.
Two optional ND filters are available: ND Filter 1/10 and ND Filter 1/100. The proper setting must be made with this command. If the setting does not correspond to the attached ND filter, accurate measurements cannot be performed.
When a close-up lens is attached, the lens compensation factors must be set in the instrument's memory in advance.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER05	No compensation values (lens compensation factors)
ER17	Parameter error Memory number set to value other than 0, 1, or 2.
ER83	Measurement angle abnormality

NDFR (External ND Filter Read)

Function

Reads which optional external ND filter (if any) is attached.

Input/Output Format

PC		CS-2000/2000A
"NDFR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	External ND filter	Integer; 1 digit	0: None 1: ND Filter 1/10 attached 2: ND Filter 1/100 attached

Explanation

Reads which (if any) optional external ND filter is attached to the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

NFCS (ND Filter Compensation Factor Set)

Function

Sets compensation factors for an optional external ND filter attached to instrument.

Input/Output Format

Setting compensation factors is a two-step process:

Step 1: Send compensation factors. (Repeat for each wavelength.)

PC		CS-2000/2000A
"NFCS,[1],[2],[3],[4]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Step 2: Finalize data and write to instrument internal memory.

PC		CS-2000/2000A
"NFCS,3"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[2]	External ND filter	Integer; 1 digit	1: ND Filter 1/10 2: ND Filter 1/100
[3]	Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which compensation factor will be written. “000” = 380nm, “001” = 381nm, ··· “400” = 780nm.
[4]	Compensation factor	Hex format	The compensation factor should be input as absolute value, not percentage. (For example, 10% should be written as 0.1) Range: 0 to 1

Response Parameters

Explanation

Sets compensation factor when using optional external ND filter lens. The factors which should be used are included with the optional ND filter at the time of purchase.

Data are not finalized and written to the instrument internal memory until "NFCS,3" is sent.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range
ER30 ER32 ER34	Instrument internal memory error
ER83	Measurement angle abnormality

NFCR (ND Filter Compensation Factor Read)

Function

Reads compensation factors for external ND filter attached to instrument.

Input/Output Format

PC		CS-2000/2000A
"NFCR,[1],[2],[3]"Delimiter code	→	
	←	"Error-check code,[4]"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[2]	External ND filter number	Integer; 1 digit	1: ND Filter 1/10 2: ND Filter 1/100
[3]	Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which compensation factor will be written.

Response Parameters

	Meaning	Type	Details/range
[4]	Compensation factor	Hex format	Compensation factor stored in the instrument for the specified measurement angle and wavelength

Explanation

Reads compensation factors stored in instrument for when external ND filter is attached.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER05	No compensation values (ND filter compensation factors)
ER17	Parameter error Parameter set to value outside setting range

MEAS (Measure)

Function

Performs measurement or cancels measurement in progress.

Input/Output Format

➢ To perform measurement

PC		CS-2000/2000A
"MEAS,[1]"Delimiter code	→	(Instrument performs pre-measurement. Time required: About 1 to 10s)
	←	"Error-check code,[2]"Delimiter code (Instrument starts actual measurement for time indicated by Response Parameter [2].)
	←	"Error-check code"Delimiter code (Measurement completed.)

➢ To cancel measurement in progress

PC		CS-2000/2000A
"MEAS,[1]"Delimiter code	→	(Measurement is canceled.)
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Command parameter	Integer; 1 digit	0: Cancel measurement 1: Start measurement

Response Parameters

	Meaning	Type	Details/range
[2]	Measurement time	Integer; 3 digits	002 to 242: 3-character string indicating measurement time in seconds (as determined by pre-measurement) from time of response.

Explanation

To perform measurement:
Measurement process starts when “MEAS,1” is input. A pre-measurement is taken to determine the required measurement time (and notification of this time is sent from the CS-2000/CS-2000A to the PC) and then the actual measurement begins automatically. When measurement has been completed, the instrument returns an error-check code (“OK00” if measurement was completed successfully).

To cancel a measurement in progress, “MEAS,0” can be input after the pre-measurement has been completed.
No commands will be accepted during pre-measurement.
During actual measurement, commands other than “MEAS,0” will result in a response of “ER00”.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER10	Over measurement range
ER17	Parameter error: “MEAS,0” sent when measurement is not in progress. “MEAS,1” sent while measurement is already in progress.
ER51 ER52	Temperature abnormality
ER71	Outside synchronization signal range
ER83	Measurement area abnormality

MEDR(Measurement Data Read)

Function

Reads measurement data from instrument.

Input/Output Format

PC		CS-2000/2000A
"MEDR,[1],[2],[3]"Delimiter code	→	
	←	"Error-check code,[1](,[2]・・・)"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Data mode	Integer; 1 digit	0: Measurement conditions 1: Spectral data 2: Colorimetric data
[2]	Data format	Integer; 1 digit	0: Alphanumeric 1: Hexadecimal
[3]	Data block number to read	Integer; Up to 3 digits	When Command Parameter [1] = “0” (Measurement conditions): 1 (fixed)
			When Command Parameter [1] = “1” (Spectral data): Wavelength group to read: 1: 100 pieces of data from 380 to 479nm 2: 100 pieces of data from 480 to 579nm 3: 100 pieces of data from 580 to 679nm 4: 101 pieces of data from 680 to 780nm
			When Command Parameter [1] = “2” (Colorimetric data): 00: All colorimetric data 01: X,Y,Z 02: x, y, Lv 03: u′, v′, Lv 04: T, ⊿uv, Lv 05: λd, Pe, Lv 11: X_{10}, Y_{10}, Z_{10} 12: x_{10}, y_{10}, Lv 13: u_{10}′, v_{10}′, Lv 14: T_{10}, Δuv_{10}, Lv 15: λd_{10}, Pe_{10}, Lv 100: Le 101: Lv

Response Parameters

➢ When Command Parameter [1] =0 (Measurement conditions):

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: Normal 1: Fast 2: Multi Integ Normal 3: Manual 4: Multi Integ Fast ● For CS-2000 with firmware ver. 1.01.0000 or earlier, “2” means “Multi Integ” and “4” will not be output.
[2]	Sync mode	Integer; 1 digit	0: No sync 1: Internal sync 2: External sync
[3]	Integration time	Integer; 9 digits	Integration time in μsec ● If number of digits is fewer than 9, “0” will be added before value.
[4]	Internal ND filter	Integer; 1 digit	0: Off 1: On
[5]	Optional close-up lens	Integer; 1 digit	0: None 1: Attached ● Setting stored on instrument. Not automatically detected.
[6]	Optional external ND filter	Integer; 1 digit	0: None 1: ND Filter 1/10 2: ND Filter 1/100 ● Setting stored on instrument. Not automatically detected.
[7]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[8]	Calibration channel	Integer; 2 digits	00: Konica Minolta calibration standard (no compensation) 01 to 10: User calibration channel

➢ When Command Parameter [1] =1 (Spectral data):

	Meaning	Type	Details/range
[1]	Block of spectral irradiance data		For type and format, please refer to Section 5: Numerical output formats

➢ When Command Parameter [1] =2 (Colorimetric data):

	Meaning	Type	Details/range
[1]	Selected block of colorimetric data		For type and format, please refer to Section 5: Numerical output formats

Explanation

The most recent measured data are read from the instrument memory.

The timing for clearing measurement data from the instrument memory differs depending on whether or not the measurement button is enabled.

- When measurement button is not enabled:
  Measurement data are cleared when the next measurement is started.
- When measurement button is disabled:
  Measurement data are cleared when reading of all 4 blocks of spectral data has been completed or when reading of any 1 set of colorimetric data has been completed.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER02	Measurement in process
ER10	Over measurement range
ER17	Parameter error Parameter set to value outside setting range
ER20	No measurement data
ER51 ER52	Temperature abnormality
ER71	Outside synchronization signal range
ER83	Measurement area abnormality

MSWE (Measuring Switch Enable)

Function

Enables/disables the measuring button in remote mode.

Input/Output Format

PC		CS-2000/2000A
"MSWE,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Measuring button status	Integer; 1 digit	0: Disabled 1: Enabled

Response Parameters

Explanation

Enables/disables the measuring button.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range

STDS (Store Data Set)

Function

Stores current measurement data to memory number.

Input/Output Format

PC		CS-2000/2000A
"STDS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Memory number to store data in	Integer; 2 digits	0 to 99

Response Parameters

Explanation

Copies the most recent measured data to the specified memory number.
If data already exists in that memory number, the existing data will be overwritten.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Memory number set to a value outside the range of 00 to 99.
ER20	No data No measurement data available for copying to memory number.
ER30 ER32 ER34	Instrument internal memory error

STDR (Stored Measurement Data Read)

Function

Reads stored measurement data from instrument.

Input/Output Format

PC		CS-2000/2000A
"STDR,[1],[2],[3],[4]"Delimiter code	→	
	←	"Error-check code,[1](,[2]・・・)"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Memory number to read data from	Integer; 2 digits	00 to 99 ● For single-digit numbers, add a “0” before the digit.
[2]	Data mode	Integer; 1 digit	0: Measurement conditions 1: Spectral data 2: Colorimetric data
[3]	Data format	Integer; 1 digit	0: Alphanumeric 1: Hexadecimal (IEEE floating point format: 4-byte big-endian hexadecimal string)
[4]	Data block number to read	Integer; Up to 3 digits	When Command Parameter [1] = “0” (Measurement conditions): Must be “1”.
			When Command Parameter [1] = “1” (Spectral data): Wavelength group to read: 1: 100 pieces of data from 380 to 479nm 2: 100 pieces of data from 480 to 579nm 3: 100 pieces of data from 580 to 679nm 4: 101 pieces of data from 680 to 780nm
			When Command Parameter [1] = “2” (Colorimetric data): 00: All colorimetric data 01: X, Y, Z 02: x, y, Lv 03: u’, v’, Lv 04: T, ⊿uv, Lv 05: λd, Pe, Lv 11: X_{10}, Y_{10}, Z_{10} 12: x_{10}, y_{10}, Lv 13: u_{10}', v_{10}', Lv 14: T_{10}, Δuv_{10}, Lv 15: λd_{10}, Pe_{10}, Lv 100: Le 101: Lv

Response Parameters

➢ When Command Parameter [1] = 0 (Measurement conditions):

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: Normal 1: Fast 2: Multi Integ Normal 3: Manual 4: Multi Integ Fast ● For CS-2000 with firmware ver. 1.01.0000 or earlier, “2” means “Multi Integ” and “4” will not be output.
[2]	Sync mode	Integer; 1 digit	0: No sync 1: Internal sync 2: External sync
[3]	Integration time	Integer; 9 digits	Integration time in μsec ● If number of digits is fewer than 9, “0” will be added before value.
[4]	Internal ND filter	Integer; 1 digit	0: Off 1: On
[5]	Optional close-up lens	Integer; 1 digit	0: None 1: Attached ● Setting stored on instrument. Not automatically detected.
[6]	Optional external ND filter	Integer; 1 digit	0: None 1: ND Filter 1/10 2: ND Filter 1/100 ● Setting stored on instrument. Not automatically detected.
[7]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[8]	Calibration channel	Integer; 2 digits	00: Konica Minolta calibration standard (no compensation) 01 to 10: User calibration channel to use

➢ When Command Parameter [1] =1 (Spectral data):

	Meaning	Type	Details/range
[1]	Block of spectral irradiance data		For type and format, please refer to Section 5: Numerical output formats

➢ When Command Parameter [1] =2 (Colorimetric data):

	Meaning	Type	Details/range
[1]	Selected block of colorimetric data		For type and format, please refer to Section 5: Numerical output formats

Explanation

Reads data stored in the specified memory channel from the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Input parameter is outside setting range.
ER20	No data No data are stored in the specified target channel.

STDD (Store Data Delete)

Function

Deletes data stored in the specified memory number.

Input/Output Format

PC		CS-2000/2000A
"STDD,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Memory number to delete data from	Integer; 2 digits	00 to 99

Response Parameters

Explanation

Deletes data from the specified memory number.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Memory number set to a value outside the range of 00 to 99.

STAD (Store All Data Delete)

Function

Deletes data stored in all memory numbers.

Input/Output Format

PC		CS-2000/2000A
"STAD"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

Response Parameters

Explanation

Deletes data from all memory numbers.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

TGSL (Target Number Select)

Function

Selects the target number.

Input/Output Format

PC		CS-2000/2000A
"TGSL,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Target number	Integer; 2 digits	01 to 20: Target number

Response Parameters

Explanation

Selects the target number to use for displaying color difference.
target color data must already be stored in that the memory channel for that number.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range

TGSR (Target Number Selection Read)

Function

Reads the currently selected target number.

Input/Output Format

PC		CS-2000/2000A
"TGSR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Target number	Integer; 2 digits	01 to 20: Target number ● If the target number is a single digit, a “0” will be added in front of the number.

Explanation

Reads the currently selected target number to use for displaying color difference.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

TGDS (Target Data Set)

Function

Sets target data in the specified target number channel of the instrument.

Input/Output Format

➢ For writing target data

PC		CS-2000/2000A
"TGDS,[1],[2],[3],[4],[5]"Delimiter code	→	
	←	"Error-check code"Delimiter code

➢ For writing target ID name (Data format=0, Data mode=2)

PC		CS-2000/2000A
"TGDS,0,2,[3],[6]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Data format	Integer; 1 digit	0: Alphanumeric 1: Hexadecimal
[2]	Data mode	Integer; 1 digit	0: Spectral data 1: Colorimetric data 2: Target ID name
[3]	Target number	Integer; 2 digits	1 to 20
[4]	When Command Parameter [2] = "0" (Spectral data): Wavelength number	Integer; 3 digits	000 to 400 (380nm to 780nm) Wavelength for which calibration data will be read. "000" = 380nm, "001" = 381nm, … "400" = 780nm.
	When Command Parameter [2] = "1" (Colorimetric data): Colorimetric data number	Integer; 3 digits	00: All colorimetric data 01: X, Y, Z 02: x, y, Lv 03: u', v', Lv 04: T, ⊿uv, Lv 05: λd, Pe, Lv 11: X_{10}, Y_{10}, Z_{10} 12: x_{10}, y_{10}, Lv 13: u_{10}', v_{10}', Lv 14: T_{10}, Δuv_{10}, Lv 15: λd_{10}, Pe_{10}, Lv 100: Le 101: Lv

	Meaning	Type	Details/range
[5]	When Command Parameter [2] = "0" (Spectral data): Spectral irradiance		For type and format, please refer to Section 6: Numerical input formats
	When Command Parameter [2] = "1" (Colorimetric data): Colorimetric data number		For type and format, please refer to Section 6: Numerical input formats
[6]	Target ID name	String; 10 char.	Alphanumeric string ● If name is less than 10 characters, additional spaces will be used to achieve 10 characters ● Refer to Section 7: Acceptable characters

Response Parameters

Explanation

Sets target spectral irradiance, target colorimetric data, or target ID name in the selected target number channel of the instrument.

For target spectral irradiance, data for all wavelengths must be written. If only part of the spectral irradiance data are input, the data are not stored in instrument internal memory.

When spectral irradiance data are set, the colorimetric data are calculated and stored.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error This error is also output if an error occurs during calculation of colorimetric values.
ER30 ER32 ER34	Instrument internal memory error

TGDR (Target Data Read)

Function

Reads target data stored in the specified target number channel of the instrument.

Input/Output Format

- For reading target data

PC		CS-2000/2000A
"TGDR,[1],[2],[3],[4]"Delimiter code	→	
	←	"Error-check code,[1](,[2],・・・・)"Delimiter code

- For reading target ID name (Data mode=3)

PC		CS-2000/2000A
"TGDR,[1],3"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Target number	Integer; 2 digits	1 to 20
[2]	Data mode	Integer; 1 digit	0: Measurement conditions 1: Spectral data 2: Colorimetric data 3: Target ID name
[3]	Data format	Integer; 1 digit	0: Alphanumeric 1: Hexadecimal

	Meaning	Type	Details/range
[4]	Data block number to read	Integer; 3 digits	When Command Parameter [2] = “0” (Measurement conditions): 1 (fixed)
			When Command Parameter [2] = “1” (Spectral data): Wavelength group to read: 1: 100 pieces of data from 380 to 479nm 2: 100 pieces of data from 480 to 579nm 3: 100 pieces of data from 580 to 679nm 4: 101 pieces of data from 680 to 780nm
			When Command Parameter [2] = “2” (Colorimetric data): Colorimetric data number 00: All colorimetric data 01: X, Y, Z 02: x, y, Lv 03: u′, v′, Lv 04: T, ⊿uv, Lv 05: λd, Pe, Lv 11: X_{10}, Y_{10}, Z_{10} 12: x_{10}, y_{10}, Lv 13: u_{10}', v_{10}', Lv 14: T_{10}, Δuv_{10}, Lv 15: λd_{10}, Pe_{10}, Lv 100: Le 101: Lv

Response Parameters

➢ When Command Parameter [2] =0 (Measurement conditions):

	Meaning	Type	Details/range
[1]	Speed mode	Integer; 1 digit	0: NORMAL 1: FAST 2: MULTIINTEG-NORMAL 3: MANUAL 4: MULTIINTEG-FAST ● For CS-2000 with firmware ver. 1.01.0000 or earlier, “2” means “Multi Integ” and “4” will not be output.
[2]	Sync mode	Integer; 1 digit	0: No sync 1: Internal sync 2: External sync
[3]	Integration time	Integer; 9 digits	Integration time in μsec ● If number of digits is fewer than 9, “0” will be added before value.
[4]	Internal ND filter	Integer; 1 digit	0: Off 1: On
[5]	Optional close-up lens	Integer; 1 digit	0: None 1: Attached ● Setting stored on instrument. Not automatically detected.
[6]	Optional external ND filter	Integer; 1 digit	0: None 1: ND Filter 1/10 2: ND Filter 1/100 ● Setting stored on instrument. Not automatically detected.
[7]	Measurement angle	Integer; 1 digit	0: 1° 1: 0.2° 2: 0.1°
[8]	Calibration channel	Integer; 2 digits	00: Konica Minolta calibration standard (no compensation) 1 to 10: User calibration channel

➢ When Command Parameter [2] =1 (Spectral data):

	Meaning	Type	Details/range
[1]	Block of spectral irradiance data		For type and format, please refer to Section 5: Numerical output formats

➢ When Command Parameter [2] =2 (Colorimetric data):

	Meaning	Type	Details/range
[1]	Selected block of colorimetric data		For type and format, please refer to Section 5: Numerical output formats

➢ When Command Parameter [2] =3 (Target ID name):

	Meaning	Type	Details/range
[1]	Target ID name	String; 10 char.	Alphanumeric string ● If name is less than 10 characters, additional spaces will be used to achieve 10 characters

Explanation

Reads target data stored in the specified target number channel of the instrument.

Data must be already stored in the specified target channel

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range
ER20	No data are stored in the specified memory channel.

TGDD (Target Data Delete)

Function

Deletes data for the specified target number channel.

Input/Output Format

PC		CS-2000/2000A
"TGDD,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Target number to delete	Integer; 2 digits	1 to 20

Response Parameters

Explanation

Deletes target data and target ID name from the specified target number.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Memory number set to a value outside the range of 01 to 20.
ER30 ER32 ER34	Instrument internal memory error

TGAD (Target All Data Delete)

Function

Deletes data stored in all target number channels.

Input/Output Format

PC		CS-2000/2000A
"TGAD"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

Response Parameters

Explanation

Deletes target data and target ID name from all target numbers.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

BALS (Backlight Control Set)

Function

Sets control of external display backlight during measurement.

Input/Output Format

PC		CS-2000/2000A
"BALS,[1],[2]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	External display backlight normally on/off	Integer; 1 digit	0: Off 1: On
[2]	External display backlight on/off during measurement	Integer; 1 digit	0: Off 1: On

Response Parameters

Explanation

Controls whether the backlight for the external display (LCD) on the rear of the instrument is on or off normally and during measurement. The results of the combined settings are shown below:

		Command Parameter [2]	
		0: Off	1: On
Command Parameter [1]	0: Off	Measurement values shown: Off During measurement: Off	Measurement values shown: Off During measurement: On
	1: On	Measurement values shown: On During measurement: Off	Measurement values shown: On During measurement: On

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to a value outside the setting range of 0 or 1.

BALR (Backlight Control Read)

Function

Reads the setting for control of external display backlight during measurement.

Input/Output Format

PC		CS-2000/2000A
"BALR"Delimiter code	→	
	←	"Error-check code,[1],[2]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	External display backlight normally on/off	Integer; 1 digit	0: Off 1: On
[2]	External display backlight on/off during measurement	Integer; 1 digit	0: Off 1: On

Explanation

Reads the setting for control of whether the backlight for the external display (LCD) on the rear of the instrument is on or off normally and during measurement.

For further information, please see the BALS command.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

CSMS (Color Space Mode Set)

Function

Sets the color space to be displayed on the instrument's LCD.

Input/Output Format

PC		CS-2000/2000A
"CSMS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Color space mode	Integer; 1 digit	0: Lv, x, y 1: Lv, u', v' 2: Lv, T, ⊿uv 3: X, Y, Z 4: λd, Pe 5: Spectral graph

Response Parameters

Explanation

Sets the color space to be displayed on the LCD at the rear of the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Color space mode set to a value outside of the range 0 to 5 (inclusive)

CSMR (Color Space Mode Read)

Function

Reads the color space to be displayed on the instrument's LCD.

Input/Output Format

PC		CS-2000/2000A
"CSMR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Color space mode	Integer; 1 digit	0: Lv, x, y 1: Lv, u', v' 2: Lv, T, ⊿uv 3: X, Y, Z 4: λd, Pe 5: Spectral graph

Explanation

Reads the color space to be displayed on the LCD at the rear of the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

DIMS (Display Mode Set)

Function

Sets the display mode (absolute or difference) for the instrument's LCD.

Input/Output Format

PC		CS-2000/2000A
"DIMS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Display mode	Integer; 1 digit	0: Absolute data display 1: Difference data display

Response Parameters

Explanation

Sets the display mode to show absolute colorimetric values (ABS) or colorimetric difference values (DIFF) in the LCD at the rear of the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Display mode set to a value other than 0 or 1.

DIMR (Display Mode Read)

Function

Reads the display mode (absolute or difference) for the instrument's LCD.

Input/Output Format

PC		CS-2000/2000A
"DIMR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Display mode	Integer; 1 digit	0: Absolute data display 1: Difference data display

Explanation

Reads the display mode indicating whether absolute colorimetric values (ABS) or colorimetric difference values (DIFF) are shown in the LCD at the rear of the instrument.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

OBSS (Observer Set)

Function

Sets the observer mode.

Input/Output Format

PC		CS-2000/2000A
"OBSS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Observer	Integer; 1 digit	0: 2° Standard Observer (2° OBS) 1: 10° Standard Observer (10° OBS)

Response Parameters

Explanation

Sets the CIE observer mode to 2° Standard Observer (2° OBS) or 10° Standard Observer (10° OBS) for colorimetric calculations.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Observer mode set to a value other than 0 or 1.

OBSR (Observer Read)

Function

Reads the observer mode.

Input/Output Format

PC		CS-2000/2000A
"OBSR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Observer	Integer; 1 digit	0: 2° Standard Observer (2° OBS) 1: 10° Standard Observer (10° OBS)

Explanation

Reads the CIE observer mode for colorimetric calculations: 2° Standard Observer (2° OBS) or 10° Standard Observer (10° OBS).

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

DTCR (Date/Time of Calibration Read)

Function

Reads the date and time of factory calibration.

Input/Output Format

PC		CS-2000/2000A
"DTCR"Delimiter code	→	
	←	"Error-check code,[1],[2]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Date of factory calibration	Integer; 8 digits	8 characters indicating year (4 characters), month (2 characters), and day (2 characters) For example, "20070201" means February 1, 2007.
[2]	Time of factory calibration	Integer; 6 digits	6 characters indicating hour (2 characters; 24-hour clock), minute (2 characters), and second (2 characters). For example, "235607" indicates 23:56:07 (11:56:07 PM)

Explanation

Reads the date and time of factory calibration.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters

BPSS (BPS set)

Function

Sets the baud rate for RS-232C communication.

This command can be used only if the firmware ver. is 3.00.0000 or greater.

Input/Output Format

PC		CS-2000/2000A
"BPSS,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Baud rate	Integer; Up to 6 digits	600: 600 bps 1200: 1200 bps 2400: 2400 bps 4800: 4800 bps 9600: 9600 bps 19200: 19200 bps 38400: 38400 bps 57600: 57600 bps 115200: 115200 bps

Response Parameters

Explanation

This command sets the baud rate for RS-232C communication.

When using this command via RS-232C, please carry it out according to the following procedure.

(1) Send this command and receive the response using current baud rate setting.
- There is a slight delay between when the BPSS command is sent and when the new baud rate becomes effective on the instrument. Therefore, the response from the instrument should be received at the current (before sending BPSS) baud rate.

(2) After the response is received, wait at least 50 msec and then change the baud rate before starting the next communications after changing the baud rate of the host.

(3) Communicate using the new baud rate setting.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range
ER30 ER32 ER34	Instrument internal memory error

BPSR (BPS read)

Function

Reads the baud rate for RS-232C communication.

This command can be used only if the firmware ver. is 3.00.0000 or greater.

Input/Output Format

PC		CS-2000/2000A
"BPSR"Delimiter code	→	
	←	"Error-check code,[1]"Delimiter code

Command Parameters

Response Parameters

	Meaning	Type	Details/range
[1]	Baud rate	Integer; Up to 6 digits	600: 600 bps 1200: 1200 bps 2400: 2400 bps 4800: 4800 bps 9600: 9600 bps 19200: 19200 bps 38400: 38400 bps 57600: 57600 bps 115200: 115200 bps ● If number of digits is fewer than 6, a space will be added before value.

Explanation

Reads the baud rate for RS-232C communication.

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER30 ER32 ER34	Instrument internal memory error

INIT (Initialize)

Function

Resets the data and settings to factory default.

Input/Output Format

PC		CS-2000/2000A
"INIT,[1]"Delimiter code	→	
	←	"Error-check code"Delimiter code

Command Parameters

	Meaning	Type	Details/range
[1]	Initialization target	Integer; 1 digit	0: Data and settings 1: Data only 2: Settings only

Response Parameters

Explanation

This function resets the data and settings saved in the internal flash memory of the CS-2000/2000A to factory default.

The initialization targets specified with Command Parameter [0] are as follows.

- 0: Data and settings
  Both data and settings are reset to factory default. Refer to the following table for more on the various content.
- 1: Data only

Initialization target	Factory default settings
User calibration coefficients	None
Compensation factors for optional close-up lens	None
compensation factors for an optional external ND filter	None
Current measurement data	None
Stored measurement data	None
Target data	None

- 2: Settings only

  When using this command via RS-232C, please carry it out according to the following procedure.

  (1) Send this command and receive the response using current baud rate setting.
  - There is a slight delay between when the BPSS command is sent and when the new baud rate becomes effective on the instrument. Therefore, the response from the instrument should be received at the current (before sending BPSS) baud rate.

  (2) After the response is received, wait at least 50 msec and then change the baud rate before starting the next communications after changing the baud rate of the host.

  (3) Communicate using the new baud rate setting.

Initialization target	Factory default settings
Sync mode	No sync
Synchronization frequency	60.00Hz (Enabled when the synchronization mode is set to Internal sync)
Speed mode	Multi Integ Normal: 1sec Internal ND filter mode: Auto
Integration time	33333 μsec (Enabled when the speed mode is set to Manual)
User calibration channel	00: Konica Minolta calibration standard
Optional close-up lens	None
Optional external ND filter	None
Measuring button in remote mode	Disabled
Target number	01
Backlight normally	On
Bacllight during measurement	On
Color space mode	Lv, x, y
Display mode (absolute or difference)	Absolute data display
Observer	2° Standard Observer
RS-232C communication baud rate	115200 bps
Display format	****.**** [F]

Error-check codes

Code	Meaning
OK00	Normal completion
ER00	Invalid command string/number of parameters
ER17	Parameter error Parameter set to value outside setting range
ER30 ER32 ER34	Instrument internal memory error

4 Error-check codes

Code	Meaning
OK00	Normal completion ● Received command was processed normally
ER00	Received command string was not a valid command. ● Number of parameters received were incorrect for the command.
ER02	Measurement in process ● Received command cannot be processed because instrument is currently taking a measurement.
ER05	No compensation values ● There are no user calibration values in the specified calibration channel. ● There are no attachment lens compensation values in memory for the specified measurement angle. ● There are no ND filter compensation values in memory for the specified ND filter.
ER10	Over measurement range ● The luminance of the measurement subject exceeds the instrument's luminance measuring range. ● The flicker of the measurement subject is too large.
ER17	Parameter error ● The input parameter is outside the specified input range for the parameter (numerical value range or number of characters).
ER20	No data ● There are no measurement data in the instrument's memory buffer. ● There are no measurement data in the instrument's specified memory channel. ● There are no target data in the instruments specified target number channel.
ER30 ER32 ER34	Instrument internal memory error ● An error occurred while reading from or writing to the instrument's internal memory.
ER51 ER52	Temperature abnormality ● Ambient temperature during measurement is too high, causing the internal temperature of the instrument's sensor to become abnormal.
ER71	Outside synchronization signal range ● When instrument is set for external sync, vertical synchronization signal could not be detected. ● When instrument is set for external sync, vertical synchronization signal was below 20Hz or over 200Hz.
ER81	Shutter operation abnormality ● An abnormality occurred in the operation of the instrument's internal shutter mechanism.
ER82	Internal ND filter operation malfunction ● An abnormality occurred in the operation of the instrument's internal ND filter mechanism.
ER83	Measurement angle abnormality ● Measurement was performed with the measuring angle selector not set to a normal position. ● Measuring angle selector was moved during measurement.

Code	Meaning
ER84	Cooling fan abnormality ● Cooling fan is stopped. ● An abnormality occurred in the cooling mechanism.
ER99	Program abnormality ● An abnormality other than those covered by other error-check codes has occurred.

5 Numerical output formats

5.1 Spectral irradiance values

When the CS-2000/CS-2000A outputs spectral irradiance (spectral data), the data output consists of comma-delimited spectral irradiance data at 1nm intervals for the data block number specified by the "Data block number" parameter sent with the command.
The wavelength range and number of data for each data block number are as follows:

Data block number	Wavelength range	Number of data
1	380 to 479nm	100
2	480 to 579nm	100
3	580 to 679nm	100
4	680 to 780nm	101

Each spectral irradiance data is output in either alphanumeric or hexadecimal format, according to the setting of the "Data format" parameter sent with the command.

5.1.1 Alphanumeric data

Alphanumeric data are output in the following format:

- When an error occurs during internal calculations by the instrument, the calculation error number will be output.

Status	Format	Comment
Normal	Exponential format: #.####.e±## Decimal places: 4 digits Exponent: 1 digit	
Calculation error	"-9.9999e9"	(*1)

(*1) For CS-2000 firmware ver. 1.01.0000 or earlier, "0" will be output.

5.1.2 Hexadecimal data

Hexadecimal data are output in the following format:

- When an error occurs during internal calculations by the instrument, the calculation error number will be output.

Status	Format	Comment
Normal	Hexadecimal format: ######## IEEE floating point format: 4-byte big- endian hexadecimal string (8 characters)	
Calculation error	Hexadecimal format: D1BA43B6 -9.999999e10 in hexadecimal format	(*1)

(*1) For CS-2000 firmware ver. 1.01.0000 or earlier, "0" will be output.

5.2 Colorimetric values

When the CS-2000/CS-2000A outputs colorimetric data, the data output consists of comma-delimited colorimetric data values for the data block number specified by the "Data block number" parameter sent with the command.

Data block number	Colorimetric values	Data output
0	All colorimetric data	"Le, Lv, X, Y, Z, x, y, u', v', T, ⊿uv, λd, Pe, X_{10}, Y_{10}, Z_{10}, x_{10}, y_{10}, u_{10}', v_{10}', T_{10}, $⊿uv_{10}$, $λd_{10}$, Pe_{10}"
1	X, Y, Z	"X, Y, Z"
2	x, y, Lv	"x, y, Lv"
3	u', v', Lv	"u', v', Lv"
4	T, ⊿uv, Lv	"T, ⊿uv, Lv"
5	λd, Pe, Lv	"λd, Pe, Lv"
11	X_{10}, Y_{10}, Z_{10}	"X_{10}, Y_{10}, Z_{10}"
12	x_{10}, y_{10}, Lv	"x_{10}, y_{10}, Lv"
13	u_{10}', v_{10}', Lv	"u_{10}', v_{10}', Lv"
14	T_{10}, $⊿uv_{10}$, Lv	"T_{10}, $⊿uv_{10}$, Lv"
15	$λd_{10}$, Pe_{10}, Lv	"$λd_{10}$, Pe_{10}, Lv"
100	Le	"Le"
101	Lv	"Lv"

Each colorimetric value is output in either alphanumeric or hexadecimal format, according to the setting of the "Data format" parameter sent with the command.

5.2.1 Alphanumeric data

Alphanumeric data are output in the following format:

- When an error occurs during internal calculations by the instrument, the calculation error number will be output.

Value	Status	Format	Comment
Le	Normal	Exponential format: "#.####.e±#" Decimal places: 4 digits Exponent: 1 digit	
	Le<0.00005e-9	"0.0000e-9"	
	Calculation error	"-9.9999e9"	(*1)

(*1) For CS-2000 firmware ver. 1.01.0000 or earlier, "0" will be output.

	Status	Format	Comment
Lv	0.00005<Lv<999,999.5	Fixed character count of 6 characters; Floating-point decimal: “######” or “####.#” or …. or “#.####”	
	Lv>999,999.5	Unsigned exponential format: “#.##e+#” Decimal places: 2 digits Exponent: 1 digit	(*2)
	Lv<0.00005	“0.0000”	
	Calculation error	“-9.9e9”	(*1)
X Y Z X_{10} Y_{10} Z_{10}	Normal	Exponential format: “#.####.e±#” Decimal places: 4 digits Exponent: 1 digit	
	Value<0.00005e-9	“0.0000e-9”	
	Calculation error	“-9.9999e9”	(*1)
X y x_{10} y_{10} u’ v’ u_{10}’ v_{10}’	Normal	Unsigned fixed-point decimal Decimal places: 4 digits “0.####”	
	Calculation error	“-9.999”	(*1)
T T_{10}	Normal	Unsigned integer; 5 digits maximum “#####”	
	Calculation error	“-9999”	(*1)
⊿uv $⊿uv_{10}$	Normal	Signed fixed-point decimal Decimal places: 4 digits “±0.####”	
	Calculation error	“-9.9999”	(*1)
λd Pe $λd_{10}$ Pe_{10}	Normal	Fixed character count of 6 characters; Floating-point decimal: “######” or “####.#” or …. or “#.####”	
	Calculation error	“-9.9e9”	(*1)

(*1) For CS-2000 firmware ver. 1.01.0000 or earlier, “0” will be output.

(*2) For CS-2000 firmware ver. 1.01.0000 or earlier, there is no output in unsigned exponential format.

5.2.2 Hexadecimal data

Hexadecimal data are output in the following format:

- When an error occurs during internal calculations by the instrument, the calculation error number will be output.

Status	Format	Comment
Normal	Hexadecimal format: ######## IEEE floating point format: 4-byte big- endian hexadecimal string (8 characters)	
Calculation error	Hexadecimal format: D1BA43B6 -9.999999e10 in hexadecimal format	(*1)

(*1) For CS-2000 firmware ver. 1.01.0000 or earlier, “0” will be output.

6 Numerical input formats

6.1 Spectral irradiance values

The command “TGDS” can be used to input target spectral irradiance values to the instrument in either alphanumeric or hexadecimal format, according to the setting of the “Data format” parameter sent with the command.

Data format	Format
Alphanumeric	The format for inputting alphanumeric data for target values is not specified. ● The total length of the characters sent to the instrument (including command, commas, and delimiter) must not exceed 800 bytes.
Hexadecimal	Hexadecimal format: ######## ● IEEE floating point format: 4-byte big-endian hexadecimal string (8 characters)

- All 401 spectral irradiance values (for wavelengths from 380 to 780nm) must be input for the instrument to store the target in memory. If fewer than 401 values are input, the target data will not be stored.
- When spectral irradiance values are input, the colorimetric values that will be the target color are calculated by the instrument internally.

6.2 Colorimetric values

The command “TGDS” can be used to input target comma-delimited colorimetric values for the data block number specified by the “Data block number” parameter sent with the command.
The colorimetric values and number and order of required input data for each data block number are as follows:

Data block number	Colorimetric values	Data to be input
0	All colorimetric data	"Le, Lv, X, Y, Z, x, y, u′, v′, T, ⊿uv, λd, Pe, X_{10}, Y_{10}, Z_{10}, x_{10}, y_{10}, u_{10}', v_{10}', T_{10}, $⊿uv_{10}$, $λd_{10}$, Pe_{10}"
1	X, Y, Z	"X, Y, Z"
2	x, y, Lv	"x, y, Lv"
3	u′, v′, Lv	"u′, v′, Lv"
4	T, ⊿uv, Lv	"T, ⊿uv, Lv"
5	λd, Pe, Lv	"λd, Pe, Lv"
11	X_{10}, Y_{10}, Z_{10}	"X_{10}, Y_{10}, Z_{10}"
12	x_{10}, y_{10}, Lv	"x_{10}, y_{10}, Lv"
13	u_{10}', v_{10}', Lv	"u_{10}', v_{10}', Lv"
14	T_{10}, $⊿uv_{10}$, Lv	"T_{10}, $⊿uv_{10}$, Lv"
15	$λd_{10}$, Pe_{10}, Lv	"$λd_{10}$, Pe_{10}, Lv"
100	Le	"Le"
101	Lv	"Lv"

- When either [X, Y, Z], [x, y, Lv], or [u′, v′, Lv] are input, of the colorimetric values that will be the target color, [X, Y, Z], [x, y], [u′, v′], [T, ⊿uv] and [λd, Pe] will be recalculated by the instrument internally.
- When either [X_{10}, Y_{10}, Z_{10}], [x_{10}, y_{10}, Lv], or [u_{10}', v_{10}', Lv] are input, of the colorimetric values that will be the target color, [X_{10}, Y_{10}, Z_{10}], [x_{10}, y_{10}], [u_{10}', v_{10}'], [T_{10}, $⊿uv_{10}$] and [$λd_{10}$, Pe_{10}] will be recalculated by the instrument internally.

Each colorimetric value is output in either alphanumeric or hexadecimal format, according to the setting of the “Data format” parameter sent with the command.

Data format	Format
Alphanumeric	The format for inputting alphanumeric data for target values is not specified. ● The total length of the characters sent to the instrument (including command, commas, and delimiter) must not exceed 800 bytes.
Hexadecimal	Hexadecimal format: ######## ● IEEE floating point format: 4-byte big-endian hexadecimal string (8 characters)

7 Characters for data communication

The following characters can be used for data communication with the CS-2000/CS-2000A:

- Numbers “0” to “9”
- Upper-case alphabetic letters “A” to “Z”
- Lower-case alphabetic letters “a” to “z”
- Space character

8 Measurement flow

8.1 Communication flow for measurement controlled from PC

With the CS-2000/CS-2000A set to Remote Mode, the flow of communication commands and data for taking a measurement and reading the measured spectral irradiance, chromaticity, and measurement conditions is as shown in Figure 1 below.

- The instrument should already be set to Remote Mode by sending the command “RMTS,1”.
- The measuring button on the instrument should be disabled by sending the command “MSWE,0”.

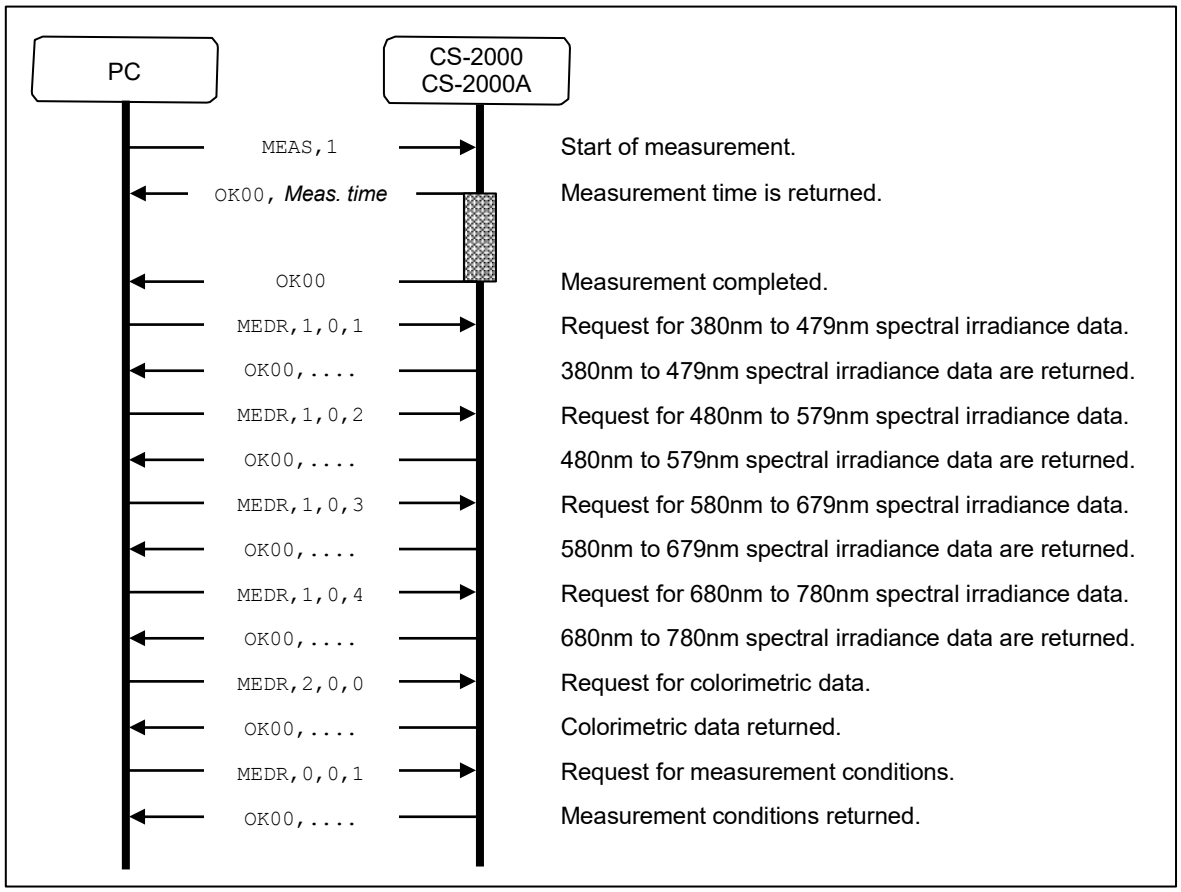

Figure 1: Communication flow from measurement to output of data and conditions

8.2 Communication flow for measurement using instrument measuring key

With the CS-2000/CS-2000A set to Remote Mode and the instrument measuring button enabled, the flow of operations and communication commands/data for taking a measurement and reading the measured spectral irradiance is as shown in Figure 2 below.

- The instrument should already be set to Remote Mode by sending the command "RMTS,1".
- The measuring button on the instrument should be enabled by sending the command "MSWE,1".
- When the instrument's measuring button is enabled, the data stored in the instrument buffer is cleared when either of the following actions is performed:
  - Reading of the spectral irradiance data for all wavelengths is completed.
  - Reading of any set of colorimetric data is completed.

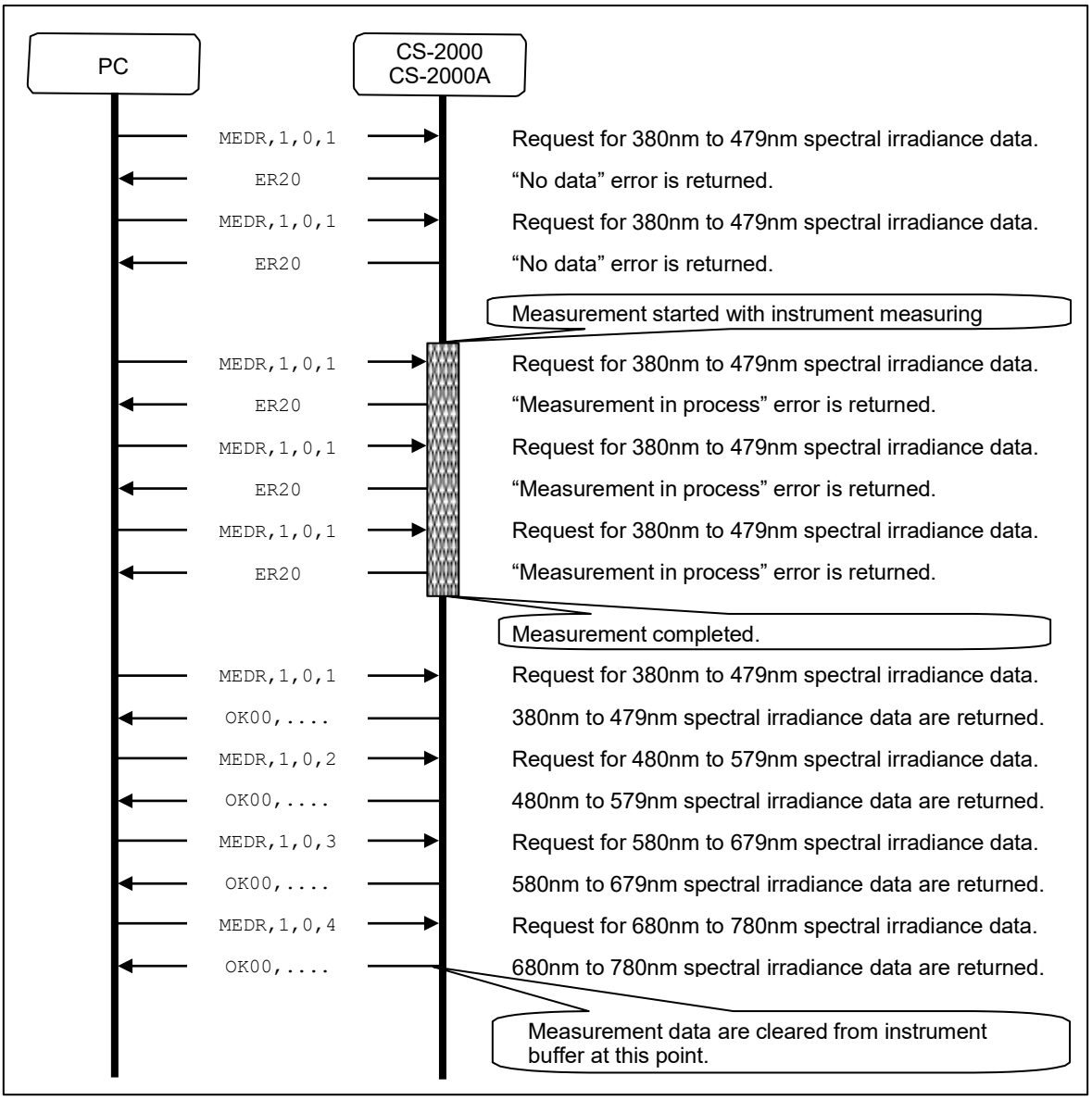

Figure 2: Communication flow for measurement using instrument measuring button

9 Modification of programs written for CS-2000 units with previous firmware versions

Modifications to programs written for CS-2000 units with firmware ver. 1.01.0000 or earlier in order to use the program with CS-2000 units with firmware ver. 1.10.0003 or later, or with CS-2000A units are described in the following sections.

9.1 Function changes in updated firmware

There are some function additions and changes in CS-2000/CS-2000A firmware ver. 1.10.0003 or later compared to ver. 1.01.0000 or earlier.

Function changed/added	Explanation
Speed Mode Read/Set (“SPMR”/”SPMS”): ● Mode name change ● Additional mode	● Name of previous “Multi Integ” mode changed to “Multi Integ Normal” ● “Multi Integ Fast:” mode added
Speed Mode Read/Set (“SPMR”/”SPMS”): ● Function added to allow selection of “Internal ND Filter Mode” of “Off”, “On”, or “Auto” for “Speed Mode” of other than “Manual”.	When “Speed Mode” is set to “Normal”, “Fast”, “Multi Integ Normal” or “Multi Integ Fast”, “Internal ND Filter Mode” can be set to “Off”, “On”, or “Auto”.
● Change of output for calculation error when reading measurement data, stored data, or target data.	When using communication commands to read out measurement data, the output data for a calculation error is the calculation error number as described in the Numerical Output Formats section. (For firmware ver. 1.10.0003 or earlier, “0” was output.)
Change in Identification Data Read (“IDDR”)	Addition of a value for “Variation code” to indicate CS-2000A.

9.2 Command changes to correspond to updated firmware

Some communication commands and/or their parameters have been changed or added to correspond to the changes in function in the CS-2000/CS-2000A firmware ver. 1.10.0003 or later compared to ver. 1.01.0000 or earlier.

9.2.1 Command changes to correspond to change of output for calculation error number

Function	Command	Details of change
Measurement mode setting	SPMS	When Command Parameter [1] = “0” (Normal) or “1” (Fast): Command Parameter [2] (Internal ND filter mode) must be added. ● If not set, will automatically be set to “2” (Auto) When Command Parameter [1] = “2”(Multi Integ Normal) or “4”(Multi Integ Fast): Command Parameter [3] (Internal ND filter mode) must be added. ● If not set, will automatically be set to “2” (Auto)
	SPMR	When Response Parameter [1] = “0” (Normal) or “1” (Fast): Output of Response Parameter [2] (Internal ND filter mode) has been added. Processing to handle the output of this added parameter should be added if necessary. When Response Parameter [1] = “2”(Multi Integ Normal) or “4”(Multi Integ Fast): Output of Response Parameter [3] (Internal ND filter mode) has been added. Processing to handle the output of this added parameter should be added if necessary.
	MEDR STDR TGDR	Upper limit of Response Parameter [1] is changed to “4” (Multi Integ Fast). If a check for the upper limit of Response Parameter [1] is currently implemented in the program, the upper limit should be changed accordingly.

9.2.2 Command changes to correspond to calculation error number changes

Function	Command	Details of change
Measurement Data Read Stored Data Read Target Data Read	MEDR STDR TGDR	If a calculation error occurs, the calculation error number will be output. Processing to handle the output of this calculation error number should be added. ● For further information, refer to the Numerical Output Formats section.

9.2.3 Command changes to correspond to Identification Data changes

Function	Command	Details of change
Instrument ID data Read	IDDR	A value of “2” (CS-2000A) may be output for Response Parameter [2]. Processing to handle the output of this value should be added if necessary.