LUMINANCE METER

LS-100/LS-110

- Communication Manual -

MINOLTA

Safety Symbols

The following symbols are used in this manual to prevent accidents which may occur as result of incorrect use of the instrument.

⚠ This indicates a sentence regarding safety warning or note.
Read the sentence carefully to ensure safe and correct use.

❗ This indicates an instruction for an operation.
Always rollow the instruction.

⚠ SAFETY PRECAUTIONS

- Always observe the following precautions and operate the unit correctly. After you have read this manual, keep it in a safe place where it can be referred to anytime a question arises.

⚠ **CAUTIOIN**	(Failure to observe the precautions and operations as described in this manual may result in personal injury or damage to the unit.)
❗	Before using this system, read this manual thoroughly as well as the instruction manuals of the Luminance Meter and personal computer.

Foreword

This manual contains the description of RS-232C two-way communication function of Luminance meter LS-100 series.

Contents

Connection to Personal Computers (PC) 1

< Notes for the connection > 1

< Data output > 1

< Connection for two-way communication by RS-232C > 3

< Communication parameters > 3

Communication settings 4

< Setting procedure > 4

List of commands 4

Delimiter code 5

Error check codes 5

Each command 6

Data output format 11

Relationship between data output and BUSY 12

RS-232C data output 14

Data communication example 14

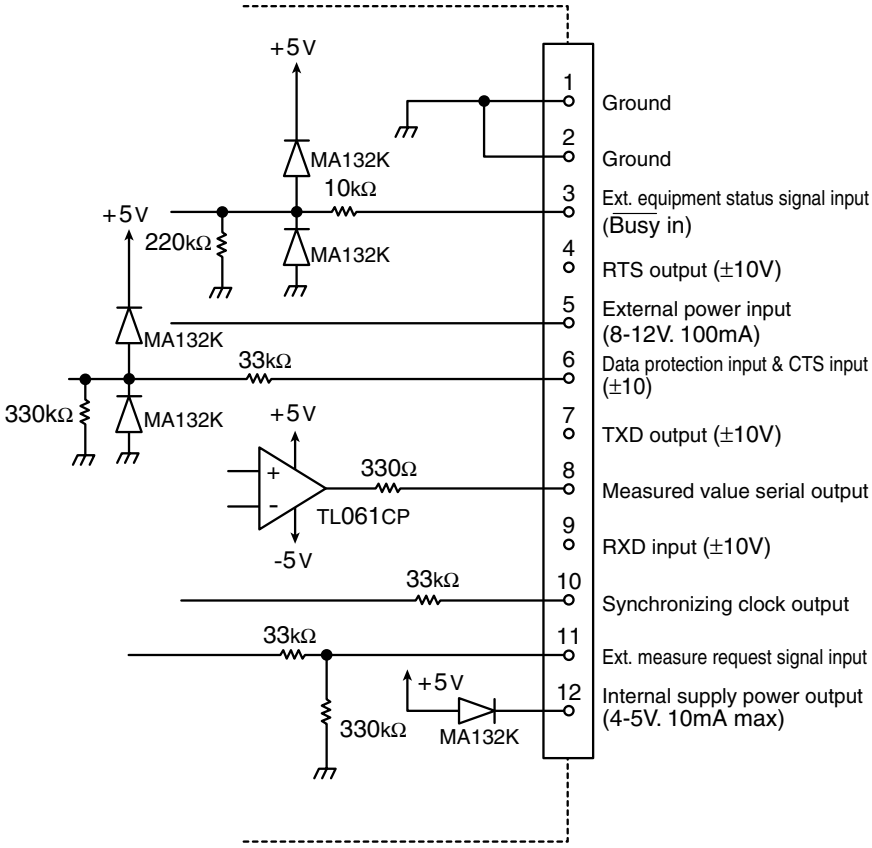
Connection to Personal Computers (PC)

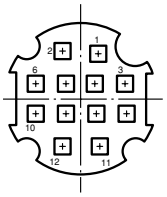
Use the RS-232C connection cables (LS-A12) to make the connection to PC

< Notes for the connection >

- Connect the connector precisely in the correct direction.
- Be sure to turn OFF the power of luminance meter and PC before making the connection.
- Be sure to hold the plug or connector when disconnecting the cord. Also, do not pull or bend the cord by force.
- Do not touch or stain the connector terminals nor apply excessive force to them.
- Make the wiring, providing the cord with an adequate allowance in length. It may otherwise cause defective contact or cable disconnection.
- When using a connection cord other than the optional LS-A12, make sure that the connections are as shown in the following diagram. If not, it may cause trouble or affect the input/output of correct data.

< Data output >



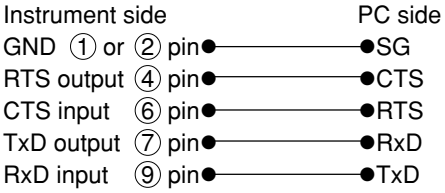


The output connector of this instrument is Hirose RP17-13RA-12SD. It is recommended to use Hirose RP17-13P-12PC connector.

Digital output terminal pins

Pin 1: Ground (GND)
Pin 2: Ground (GND)
Pin 3: External equipment status signal input ($\overline{\text{Busy}}$ in)
When Pin 3 is in a state of non-connection, the $\overline{\text{Busy}}$ signal is set to "L" and no data will be outputted. Set the $\overline{\text{Busy}}$ signal to "H" when desired to output the data.
Pin 4: RTS output
This is to be directly connected to CTS terminal of PC in dual communication by RS-232C. The output voltage level is approximately ±10V.
Pin 5: External power input
The positive ⊕ electrode of external power supply. Ground (GND) is Pin 1 or Pin 2. Use a power supply of DC 8-12V, 100mA at least.
Pin 6: Data protection input & CTS input terminal
Data protection input.
When the external measure request signal is "L" and the measuring button is OFF, the data output signal level is unstable, and it may cause malfunction of the equipment on the signal receiving side. In that case, the data output signal can be fixed at -5V by connecting Pin 6 to Pin 12 to prevent such malfunction trouble. (Connecting Pin 6 to Pin 12 increases the current consumed with the measuring button OFF to about 10mA. So, it is desirable to disconnect the pins when the data output is not used.)
CTS input
This is to be directly connected to RTS terminal of PC in two-way communication by RS-232C.
Pin 7: TxD output
This is to be directly connected to RxD terminal of PC in two-way communication by RS-232C. The output voltage level is about ±10V.
Pin 8: Measured value serial output
When the external measure request signal is "H" or it is changed from "H" to "L" or the measuring button is turned OFF, the data is outputted from this pin when the $\overline{\text{Busy}}$ signal is "H."
Pin 9: RxD input
This is to be directly connected to TxD terminal of PC in two-way communication by Rs-232C.
Pin 10: Synchronizing clock output
Synchronizing clock is outputted only while data is outputted. The frequency is 4.8 kHz.
Pin 11: External measure request signal input
When the external measure request signal is set to "H," the measurement is started. While the signal is "H," the measurement is continued and the data is outputted. (With it connected to Pin 12, the level of Pin 11 is "H.") Also, when the external measure request signal is changed from "H" to "L," the measured value being held can be outputted.
Pin 12: Internal supply power output.
With the power ON, DC4-5V, 10mA max. will be outputted between the pin 12 and Pin 1 or Pin 2.

< Connection for two-way communication by RS-232C >



< Communication parameters >

Set the parameters of the host computer according to the RS-232C communication parameters of this instrument.

- Baud rate : 4800
- Parity : EVEN
- Data length : 7 bits
- Stop bit : 2 bits

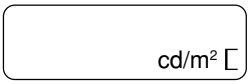
Communication settings

Make the following setting for communication by connecting this instrument and PC.

< Setting procedure >

1. Make sure the power is OFF.
2. Turn ON the power switch while pressing F key of this instrument.
3. The letter " ⌊ " will appear at the bottom right of the external display.

- Then it has been set to RS-232C two-way communication mode.



List of commands

MES : Measurement once and measured value (display VALUE) return
DSR : Hold data (display value) return
MDS : Various modes setting
CLE : Clear memory
CMR : 100% reference value data read
CMS : 100% reference value data setting (F + "ABS →%")
CMW : 100% reference value data write
LMR : Reference of user calibration data read
LMW : Reference of user calibration data write
CCR : Color correction factor read
CCW : Color correction factor write

Delimiter code

- When the command (+data) + delimiter is inputted from the control side, this instrument operates according to the command, and subsequently puts out error check code (+data) + delimiter.
- CR + LF can be used for delimiter. And the data can be punctuated by comma.
- The input and output are given in the fixed length of format decided for each command.

Error check codes

- There are 8 types of error check codes as follows:

OK00 : Normal operation
ER00 : Command error
(Input of command other than the list of page 4, outside the parameter setting range)
ER01 : Setting error (same as E)
ER11 : Memory value error (same as E1)
ER10 : Measuring range over (same as E0)
ER19 : Display range over (same as E9)
ER20 : EEPROM error (same as E2)
(Protect zone value of EEPROM has been broken, no access to EEPROM, etc.)
The meter is malfunctioning and needs to be repaired.
ER30 : Battery exhausted.
(Supply voltage is lower than BC voltage.)

Each command

(1) MES : Measurement once in the present measuring mode, and measured value (display value) return

Control side → Instrument side
"MES" + Delimiter →
← Error check code + Measured value + Delimiter

Instrument side format
(Normal operation mode)
OK00, □□□H□□□□□□CRLF
The data format conforms to the output format to the printer.

(Example)
In case the measurement is normal and the measured value is 125.35 fL in CONT, PRESET mode:
OK00, CfPH125.35CRLF

(In case of error)
ER□□CRLF

(2) DSR : Hold data (display value) return

Control side → Instrument side
"DSR" + Delimiter →
← Error check code + Measured value + Delimiter

Instrument side format
(Normal operation mode)
OK00, □□□H□□□□□□CRLF
The data format conforms to the output format to the printer.

(Example)
In case the hold data is 83.02% in PEAK mode:
OK00, P%△H△83.02CRLF
(△ : space)
(In case of error)
ER□□CRLF

(3) MDS : Setting the various measurements and display modes

Control side		nstrument side
"MDS" + Mode No. + Delimiter	→	
	←	Error check code + Measured value + Delimiter

Control side format
MDS, □□CRLF
*1
00 : Setting to "PRESET" mode
01 : Setting to "VARI • C.C.F" mode
02 : Setting to "VARI • LUMI" mode
03 : Setting to "VARI • C.C.F/LUMI" mode
04 : Setting to "ABS" mode
05 : Setting to "%" mode
06 : Setting to "FAST" mode
07 : Setting to "SLOW" mode
08 : Setting to "PEAK" mode
09 : Setting to "CONT" mode

(4) CLE: Clear memory

Control side		nstrument side
"CLE" + Delimiter	→	
	←	Error check code + Delimiter

(5) CMR : 100% reference value data read

Control side　　Instrument side

"CMR" + Delimiter　→

←　Error check code + Measured value + Delimiter

Instrument side format
(Normal operation mode)
OK00, □, □□□□□□CRLF

(Example)
In case the 100% reference value data is 21.83fL:
OK00, f, △21.83 CRLF
In case the 100% reference value data is 748000 cd/m^2:
OK00, c, 748000 CRLF
(△ : space)
(In case of error)
ER□□CRLF

(6) CMS : 100% reference value data storage (Same as F + "ABS → %")

Control side　　Instrument side

"CMS" + Delimiterr　→

←　Error check code + Delimiter

(7) CMW: 100% reference value data write and storage

Control side		Instrument side
"CMW" + 100% reference value data + Delimiter	→	
	←	Error check code + Delimiter

Control side format
CMW, □□□□□□□CRLF

(Example)
When inputting 123.4 as the value of 100% reference value data:
CMW, △123.4 CRLF
When inputting 123.4 as the value of 100% reference value data:
CMW, 123456 CRLF

Since 4 digits are valid on the instrument side, the value is recognized by rounding off the 5th digit number. The unit is to be the unit set on the instrument side.

(8) LMR: Reference of user calibration data read

Control side		Instrument side
"LMR" + Delimiter	→	
	←	Error check code + Unit + Reference of user calibration data + Delimiter

Instrument side format
(Normal operation mode)
OK00, □, □□□□□□□CRLF

(Example)
Same as CMR command.

(In case of error)
ER□□CRLF

(9) LMW: Reference of user calibration data write and storage

Control side		Instrument side
"LMW" + Reference of user calibration data + Delimiter	→	
	←	Error check code + Delimiter

Control side format
LMW, □□□□□□CRLF

(Example)
Same as CMW command.

(10) CCR: Color correction factor read

Control side		Instrument side
"CCR" + Delimiterr	→	
	←	Error check code + Color correction factor + Delimiter

Instrument side format
(Normal operation mode)
OK00, □, □□□CRLF

(Example)
In the case color correction factor is 0.990:
OK00, 0.990 CRLF

(In case of error)
ER□□CRLF

(11) CCW : Color correction factor write

Control side		Instrument side
"CCW" + Color correction factor + Delimiter	→	
	←	Error check code + Delimiter

Control side format
LMW, □. □□□CRLF

(Example)
In the case color correction factor is 1.050:
LMW, 1.050CRLF

Data output format

Output digit			1	2	3	4	5-10	11
PEAK /CONT	CONT		C	–	–	–	DATA	CRLF
	PEAK		P	–	–	–		
Unit	cd/m²		–	c	–	–		
	fL		–	f	–	–		
ABS/%	%		–	%	Space	–		
PRESET /VARI (ABS)	VARI	PRESET	–	–	P	–		
		LUMI	–	–	L	–		
		C.C.F.	–	–	K	–		
		LUMI/C.C.F.	–	–	T	–		
Continuous output /Hold	Continuous output value		–	–	–	M		
	Hold value		–	–	–	H		

Relationship between Data Output and BUSY

● Serial data (printer) output mode
When external measure request signal = Hi, and measuring button = ON, switch operation is accepted but button operation is not accepted.
During data transmission, measuring button cannot interrupt it.

1. Continuous output value

① External measure request signal = Hi
BUSY signal is checked after the end of measurement, and the data is outputted when the signal is Hi. (Measurement and output are continued.)
② External measure request signal = Hi, measuring button = OFF → ON.
Even during measurement, the measurement is started from the beginning, and BUSY signal is checked after the end of measurement, and the data is outputted when the signal is Hi. (Measurement and output are continued.)
③ External measure request signal = Low → Hi , measuring button = ON.
Even during measurement, the measurement is started from the beginning, and BUSY signal is checked after the end of measurement, and the data is outputted when the signal is Hi. (Measurement and output are continued.)

Note: Even when BUSY signal becomes Low during data output, data output is continued until completion. In case of peak value measurement, peak value will be outputted. There is no data output in cases other than above.

2. Hold value

① External measure request signal = Low, measuring button = ON → OFF.
After measuring button = ON → OFF , BUSY signal is checked (within 400ms at SLOW, within 200ms at FAST), and the data is outputted when the signal is Hi. When the signal is Low, BUSY signal is checked again for 300ms consecutively, during which time if the signal becomes Hi, the data output will be started within 7ms. If the signal remains at Low during that period of time, there will be no data output.
② External measure request signal = Hi → Low, measuring button = OFF.
After external measure request signal = Hi → Low, BUSY signal is checked (within 400ms at SLOW, within 200ms at FAST), and the data is outputted when the signal is Hi. When the signal is Low, BUSY signal is checked again for 300ms consecutively, during which time if the signal becomes Hi, the data output will be started within 7ms. If the signal remains at Low during that period of time, there will be no data output.
③ External measure request signal = Hi, measuring button = ON → OFF.
Hold data is outputted according to the next data output timing.

Note: Even when BUSY signal becomes Low during data output, data output is continued until completion.

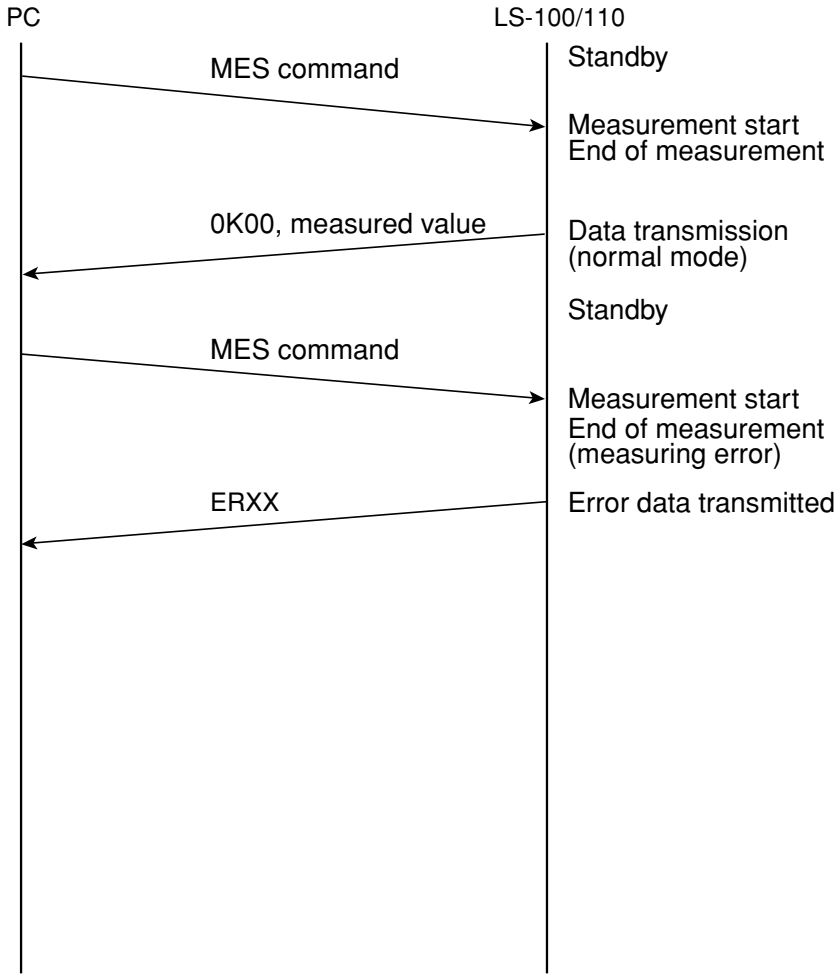
RS-232C data output

Band rate : two-way communication at 4800 bps.
Parity : EVEN
Data length : 7 bits
Stop bit : 2 bits

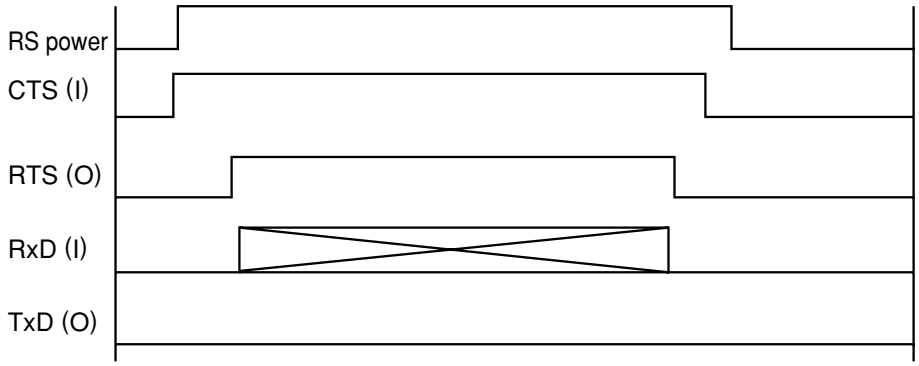
- In RS-232C communication mode, all switches except the power switch are not accepted.
- There is no printer output.
- It is operated in the order of command input --> measure --> data output.
- Output timing is the same as serial data output.
- Communication request according to timing that affects the time control (during measurement) is not accepted.
- If the next character or delimiter does not come after lapse of over 5 sec. with a command received, an error (EROO) signal will be returned, and the operation will be discontinued.
- With the command (+data) + delimiter inputted from the control side, the operation is performed in accordance with the command on the instrument side, followed by the output of error check code (+data) + delimiter.
- The delimiter is CR + LF, and the data is punctuated by comma.
- Input/output signal is emitted per command by the predetermined length of format.
- In case the personal computer is not ready for signal reception at start of data output, it will result in time-out 5 sec. later.
- In RS-232C communication mode, C is displayed at the rightmost 7 segments of external LCD.

Data communication example

Operation in receiving MES (Once measurement command) signal

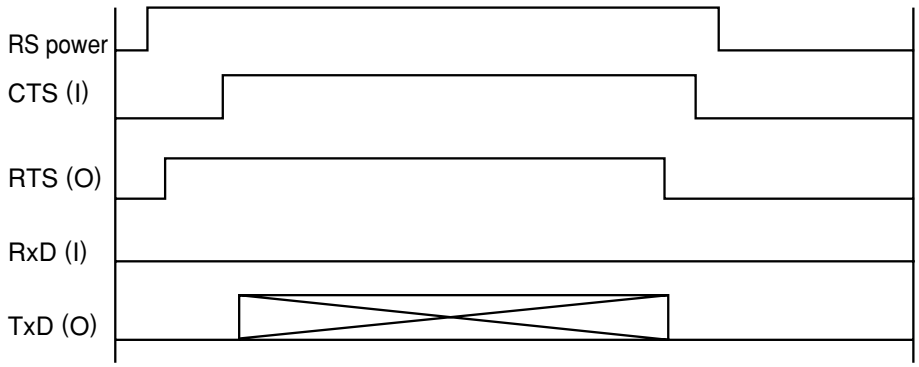


PC → LS100/110



On LS-100 side, when CTS is H, RTS is shifted to H to receive the signal if it is possible. With one packet received, RTS is shifted to L.
When an edge of CTS enters during command signal processing, LS-100 side will start signal reception in case there still exists interruption during execution or after completion of processing.

LS-100/110 → PC



On LS-100 side, when transmitting the signal as intended, RTS is shifted to H, and the data will be outputted when CTS becomes H. With one packet transmitted, RTS is shifted to L.

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