HIOKI

Communication Instruction Manual

TM6102
RGB LASER METER

TM6103
RGB LASER LUMINANCE METER

TM6104
OPTICAL POWER METER

- ✓ This manual explains the communication commands for Models TM6102 RGB Laser Meter, TM6103 RGB Laser Luminance Meter, and TM6104 Optical Power Meter.
- ✓ Please refer to the instruction manual for Model TM6102/TM6103/TM6104 for details regarding communication settings.
- ✓ Although all reasonable care has been taken in the production of this manual, should you find any points which are unclear or in error, please contact your local distributor or your authorized Hioki istributor or reseller when ordering.
- ✓ In the interest of product development, the contents of this manual may be subject to revision without notice.
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Contents

1 Introduction

In this publication, items relevant only to the TM6102, TM6103, and TM6104 are indicated as "the instrument."

Various messages are supported for controlling the instrument through the interfaces.
Messages can be either program messages, sent from the controller such as PC to the instrument, or response messages, sent from the instrument to the controller.

Program Messages

| Controller | | Instrument |

Response Messages
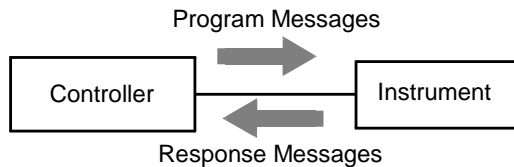
Message types are further categorized as follows.

Messages — Program Messages — Command Messages / Query Messages

Response Messages
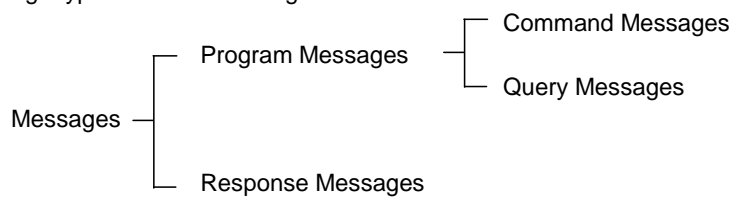
When issuing commands that contain data, make sure that the data is provided in the specified format.

Message Format

■ Program Messages
Program messages can be either Command Messages or Query Messages.

(1) Command Messages
Instructions to control the instrument, such as to change settings or reset
Example: (instruction to set the red measurement range)

:RANGE:R 1

Header portion   Space   Data portion

(2) Query Messages
Requests for responses relating to results of operation or measurement, or the state of instrument settings
Example: (request for the red measurement range that is currently set)

:RANGE:R?

Header portion   Question mark

■ **Response Messages**

When a query message is received, its syntax is checked and a response message is generated.
If an error occurs when a query message is received, no response message is generated for that query.

■ **Command Syntax**

Command names are chosen to mnemonically represent their function, and can be abbreviated. The full command name is called the "long form", and the abbreviated name is called the "short form". The command references in this manual indicate the short form in upper-case letters, extended to the long form in lower case letters, although the commands are not case-sensitive in actual usage.

:RANGE:R? OK (long form)
:RANG:R? OK (short form)
:RAN? Error

■ **Headers**

Headers must always be prefixed to program messages.

(1) Command Program Headers

There are three types of commands: Simple, Compound and Standard.
• Headers for Simple Commands
This header type is a sequence of letters and digits
:ABORt
• Headers for Compound Commands
These headers consist of multiple simple command type headers separated by colons ":"
:RANGe:AUTO:R
• Headers for Standard Commands
This header type begins with an asterisk "*", indicating that it is a standard command defined by IEEE 488.2.
*RST

(2) Query Program Header

These commands are used to interrogate the instrument about the results of operations, measured values and the current states of instrument settings.
As shown by the following examples, a query is formed by appending a question mark "**?**" after a program header.
:FETCh:XY:R?
:RANGe:AUTO:R?

■ **Message Terminators**

This instrument recognizes the following message terminators (delimiters):

• **CR+LF**

■ **Separators**

(1) Message Unit Separator

Multiple messages can be written in one line by separating them with semicolons ";".

:RANGE:R 1; *IDN?

• When messages are combined in this way and if one command contains an error, all subsequent messages up to the next terminator will be ignored.

(2) Header Separator

In a message consisting of both a header and data, the header is separated from the data by a space " " (ASCII code 20H).

:RANGE:R 1

(3) Data Separator

In a message containing multiple data items, commas are required to separate the data items from one another.

:TARGET:DEVIATION:X 0.3333,0.01

■ Data Formats

The instrument uses character data, decimal numeric data and character string data depending on the command.

(1) Character Data

Character data always begins with an alphabetic character, and subsequent characters may be either alphabetic or numeric. Character data is not case-sensitive, although response messages from the instrument are only upper case. When the command data portion contains <1/0/ON/OFF>, the operation will be similar to when 0 is OFF and 1 is ON.

:RANGE:AUTO:R OFF

(2) Decimal Numeric Data

Three formats are used for numeric data, identified as NR1, NR2, and NR3. Numeric values may be signed or unsigned. Unsigned numeric values are handled as positive values. Values exceeding the precision handled by the instrument are rounded to the nearest valid digit.
• NR1   Integer data (e.g.: +12, -23, 34)
• NR2   Fixed-point data (e.g.: +1.23, -23.45, 3.456)
• NR3   Floating-point exponential representation data (e.g.: +1.0E-2, -2.3E+4)
The term "NRf format" includes all three of the above numeric decimal formats.
The instrument accepts NRf format data.   The format of response data is specified for each command, and the data is sent in that format.

:RANGE:R 16

:FETCH:WAVELENGTH:CENTROID:R?
6.3478E+02 ,0

(3) Character string data

• Character string data is enclosed by quotation marks.
• This type of data consists of 8-bit ASCII characters
• As for quotation marks, the sender from the instrument uses double quotes (").

:SYSTEM:MAC?
Response> "00-01-67-07-03-85"

Compound Command Header Omission

When several commands having a common header are combined to form a compound command
(e.g., **:RANGe:AUTO:R** and **:RANGe:AUTO:B**) if they are written together in sequence, the common
portion (here, **:RANGe:AUTO**) can be omitted after its initial occurrence.
This common portion is called the "current path" (analogous to the path concept in computer file storage), and until it
is cleared, the interpretation of subsequent commands presumes that they share the same common portion.

This usage of the current path is shown in the following example:
Full expression
:RANGE:AUTO:R 0;:RANGE:AUTO:G 0;:RANGE:AUTO:B 0

Compacted expression
:RANGE:AUTO:R 0; G 0; B 0

This portion becomes the current path, and can be omitted from the messages immediately following.

The current path is cleared when the power is turned on, by a colon ":" at the start of a command, by a colon "*" at
the start of a command, and when a message terminator is detected.
Standard command messages can be executed regardless of the current path. They have no effect upon the
current path.

A colon ":" is not required at the start of the header of a Simple or Compound command. However, to avoid
confusion with abbreviated forms and operating mistakes, we recommend always placing a colon at the start of a
header.

Output Queue and Input Buffer

Input Buffer

The input buffer capacity of the instrument is 1024 bytes.
If 1024 bytes are allowed to accumulate in this buffer so that it becomes full, the LAN interface bus enters the
waiting state until space is cleared in the buffer.

Note: Ensure that the no command ever exceeds 1024 bytes.

Event Registers

■ Standard Event Status Register (SESR)

The Standard Event Status Register is an 8-bit register.
The Standard Event Status Register is cleared in the following situations:
- When a ***CLS** command is executed
- When an event register query (***ESR?**) is executed
- When the instrument is powered on again

Bit 7	PON	Power-On Flag Set to 1 when the power is turned on, or upon recovery from an outage.
Bit 6	URQ (Unused)	Not used by this instrument User Request
Bit 5	CME	Command error (The command to the message terminator is ignored.) This bit is set to 1 when a received command contains a syntactic or semantic error: • Program header error • Incorrect number of data parameters • Invalid parameter format • Received a command not supported by the instrument • The specified data value is outside of the set range
Bit 4	EXE	Execution Error This bit is set to 1 when a received command cannot be executed for some reason. • The specified setting data cannot be set • Execution is prevented by some other operation being performed
Bit 3	DDE	Device-Dependent Error This bit is set to 1 when a command cannot be executed due to some reason other than a command error, a query error or an execution error.
Bit 2	QYE	Query Error (the output queue is cleared) This bit is set to 1 when a query error is detected by the output queue control. • When the data overflows the output queue • When data in the output queue has been lost
Bit 1	RQC (Unused)	Not used by this instrument Request Control
Bit 0	OPC	Operation Complete • It indicates the execution of an "***OPC**" command. • It indicates the completion of operations of all messages up to the "***OPC**" command

■ Device-Specific Event Status Registers

This instrument provides Event Status Register 0 for controlling events. The Event Status Register is an 8-bit register.
Event Status Registers 0 is cleared in the following situations:
• When a ***CLS** command is executed
• When an Event Status Register 0 query is executed
　(**:ESR0?**)
• When the instrument is powered on again

Standard Operation Register		
Bit 7	-	Unused
Bit 6	-	Unused
Bit 5	-	Unused
Bit 4	-	Unused
Bit 3	-	Unused
Bit 2	IDX	Sampling complete
Bit 1	EOM	Measurement complete
Bit 0	-	Unused

Initialization Items

Item / Initialization Method	At Power-on	*RST Command	:SYSTem: PRESet Command	*CLS Command	Factory Default
LAN IP Address	-	-	0.0.0.0	-	0.0.0.0
LAN Subnet mask	-	-	255.255.255.0	-	255.255.255.0
LAN default gateway	-	-	0.0.0.0	-	0.0.0.0
LAN port	-	-	1024	-	1024
Device-specific functions (measurement range, etc.)	-	●	●	-	●
Output Queue	●	-	-	-	●
Input Buffer	●	-	-	-	●
Event Registers	●*1	-	-	●	●
Current path	●	-	-	-	●

*1. Except the PON bit (bit 7).

Command Execution Time

Command execution time indicates the time for analyzing and processing long form commands.
However, the command execution time for commands with data is the time described in accordance with the data format specified in the <data portion>.

- Display delays may occur depending on the frequency of communication processes and process contents.
- All commands except *TRG are processed sequentially.
- In communications with the client, time must be added for data transmission.
- Wait until measurements stabilize after a change before using a setting command.

Command	Execution time (except communication time)
∗RST :SYSTem:PRESet	300 ms or less *1
:FETCh:WAVelength:DOMinant:#? R, G, or B is entered in #.	100 ms or less
:READ?	Measurement time + 5 ms or less*2
∗TST?	50 ms or less
Commands other than those above	5 ms or less

*1. For details, see Note about ∗RST and :SYSTem:PRESet.
*2. For details, see Note about :READ?.

Errors During Communications

- Command Error
  When message syntax (spelling) is invalid
  When the data format in a command or query is invalid
- Query Error
  When a response message cannot be sent from the instrument as the controller cannot receive it
- Execution Error
  When any character or numerical data that is not specified is set

Color Expressions

Expressions such as R, G, B, and RGB are used in syntaxes and descriptions. Their meanings are as follows.
R: Red
G: Green
B: Blue
RGB: RGB mixed light (Three colors, R, G, and B, are mixed.)

Unit of Radiometric Quantity

The unit of the radiometric quantity is omitted in descriptions. Each instrument uses the unit as described below.
TM6102: [W/m^2]
TM6103: [W/sr•m^2]
TM6104: [W]

Unit of Photometric Quantity

The unit of the photometric quantity is omitted in descriptions. Each instrument uses the unit as described below.
TM6102: [lx]
TM6103: [cd/m^2]
TM6104: [lm]

2 Cautions on Communication Program Creation

The TCP/IP communication performs the process so that large data is sent efficiently. Therefore, when small data such as a command to control the instrument is sent, the send process may not be performed until the size of the send data reaches a certain level. In this case, the response from the instrument becomes slow. Therefore, when creating a communication program, perform the following settings to make the response from the instrument faster.

- For Socket Program
  Set 1 for TCP_NODELAY of the socket option.
  Example: C/C++)
    SOCKET sock;
    BOOL opt;

    •••
    opt = 1;
    setsockopt(sock, IPPROTO_TCP, TCP_NODELAY, (char*)&opt, sizeof(BOOL));

- For .Net Framework
  Set NoDelay of the TcpClient class to true.
  Example: VB)
    Dim tcpClient As System.Net.Sockets.TcpClient

    •••
    tcpClient.NoDelay = True

3 Message List

Messages [ ]: Omissible	Data [ ]: Omissible, ( ): Response data	Description
Standard Commands		
*IDN?	(<Manufacturer name>,<Model name>,<Serial number>,<Software version>)	Queries the Device ID (Identify code).
*RST		Initializes the device.
*TST?	(<PASS/FAIL>)	Initiates a self-test and queries the result.
*TRG		Requests the measurement start.
*OPC		Sets OPC of SESR after all operations that are being executed are completed.
*OPC?		Responds with ASCII "1" after all operations that are being executed are completed.
*WAI		Executes subsequent commands after command processing is completed.
*CLS		Clears the Event Registers and the Status Byte Register.
*ESR?	0 to 255	Reads and clears the Standard Event Status Register (SESR).
Event Registers		
:ESR0?	(0/2/4/6)	Queries Event Status Register 0 of the Standard Operation Register Group.
Communications Settings		
:SYSTem:COMMunicate:LAN:IPADdress	<IP address>	Sets the IP address.
:SYSTem:COMMunicate:LAN:IPADdress?	(<IP address>)	Queries the IP address.
:SYSTem:COMMunicate:LAN:CONTrol	<Port No.>	Sets the LAN port.
:SYSTem:COMMunicate:LAN:CONTrol?	(<Port No.>)	Queries the LAN port.
:SYSTem:COMMunicate:LAN:SMASk	<Subnet mask>	Sets the Subnet mask.
:SYSTem:COMMunicate:LAN:SMASk?	(<Subnet mask>)	Queries the Subnet mask.
:SYSTem:COMMunicate:LAN:GATeway	<Address>	Sets the default gateway.
:SYSTem:COMMunicate:LAN:GATeway?	(<Address>)	Queries the default gateway.
:SYSTem:COMMunicate:LAN:UPDate		Reflects the LAN settings.
:SYSTem:MAC?	(<MAC address>)	Queries the MAC address.
Trigger		
:TRIGger:SOURce	< BUS/ EXTernal >	Sets the trigger source.
:TRIGger:SOURce?	(< BUS/ EXT >)	Queries the trigger source.
:TRIGger:DELay	<Delay time (sec)>	Sets the trigger delay.
:TRIGger:DELay?	(<Delay time (sec)>)	Queries the trigger delay.
:TRIGger:EDGE	<RISE/FALL >	Sets the trigger detection edge.
:TRIGger:EDGE?	(<RISE/FALL >)	Queries the trigger detection edge setting.
Measurement Mode		
:MODE	<NORMal/DARK/PULSe>	Sets the measurement mode.
:MODE	(<NORM/DARK/PULS>)	Queries the measurement mode.
Modulation Frequency Measurement Settings		
:PULSe:AVERaging	<Average times>	Sets the number of average times of the modulation frequency measurement.
:PULSe:AVERaging?	(<Average times>)	Queries the number of average times of the modulation frequency measurement.
:PULSe:EDGE	<RISE/FALL >	Sets the period detection edge of the SYNC signal.
:PULSe:EDGE?	(<RISE/FALL >)	Queries the period detection edge of the SYNC signal.
Modulated Light Function		
:PULSe	<1/0/ON/OFF>	Sets the modulated light function.
:PULSe?	(<1/0 >)	Queries the modulated light function.
:PULSe:FREQuency	<Modulation frequency [Hz]>	Sets the modulation frequency.
:PULSe:FREQuency?	(<Modulation frequency [Hz]>)	Queries the modulation frequency.

Messages [ ]: Omissible	Data [ ]: Omissible, ( ): Response data	Description

Measurement Range

Messages	Data	Description
:RANGe:AUTO:# (# is R, G, or B)	<1/0/ON/OFF>	Sets the auto range function.
:RANGe:AUTO:#? (# is R, G, or B)	(<1/0 >)	Queries the auto range function.
:RANGe:# (# is R, G, or B)	<Measurement range number>	Sets the measurement range.
:RANGe:#? (# is R, G, or B)	(<Measurement range number>)	Queries the measurement range.
:RANGe:AREA:#? (# is R, G, or B)	<Measurement range number>,<Centroid wavelength [nm]> (<Maximum measurable radiometric quantity>)	Queries the maximum measurable radiometric quantity.
:RANGe:TIME?	<Measurement range number> (<Measurement time [sec]>)	Queries the measurement time during normal measurement.

Setting for Color-matching Functions

Messages	Data	Description
:ANGLe	<Setting for Color-matching Functions>	Sets color-matching functions
:ANGLe?	(<Setting for Color-matching Functions>)	Queries the color-matching function setting.

Dark Measurement Settings

Messages	Data	Description
:DARK:TYPE	(<ALL/FIX>)	Sets the dark measurement type.
:DARK:TYPE?	(<ALL/FIX>)	Queries the dark measurement type.
:DARK:AVERaging	<Average times>	Sets the number of average times of the dark measurement.
:DARK: AVERaging?	(<Average times>)	Queries the number of average times of the dark measurement.
:DARK:JUDGment	<1/0/ON/OFF>	Sets the judgment function for the dark measurement result.
:DARK:JUDGment?	(<1/0>)	Queries the judgment function for the dark measurement result.

Dark Estimation

Messages	Data	Description
:DARK:ESTimate	<1/0/ON/OFF>	Sets the dark estimation function.
:DARK:ESTimate?	(<1/0>)	Queries the dark estimation function.
:DARK:ESTimate:RESult?	(<1/0>)	Queries the dark estimation result.

Dark Value Acquisition State

Messages	Data	Description
:DARK:STATe:#? (# is R, G, or B)	<Measurement range number> (<1/0>)	Queries the dark value acquisition state.

Clearing Dark Value

Messages	Data	Description
:DARK:CLEar		Clears the dark value.

Normal Measurement Settings

Messages	Data	Description
:AVERaging	<Average times>	Sets the number of average times of the normal measurement.
:AVERaging?	(<Average times>)	Queries the number of average times of the normal measurement.
:TARGet	<1/0/ON/OFF>	Sets the white balance adjustment assistance function.
:TARGet?	(<1/0>)	Queries the white balance adjustment assistance function.
:TARGet:DEViation:# (# is X or Y)	<Target value>,<Error tolerance>	Sets the target value of the chromaticity (x,y).
:TARGet:DEViation:#? (# is X or Y)	(<Target value>,<Error tolerance>)	Queries the target value of the chromaticity (x,y).
:TARGet:DEViation:PHOTometry	<Target value>,<Error tolerance>	Sets the target value of the photometric quantity.
:TARGet:DEViation:PHOTometry?	(<Target value>,<Error tolerance>)	Queries the target value of the photometric quantity.
:SCALe:WAVelength:# (# is R, G, or B)	<1/0/ON/OFF>	Sets the centroid wavelength input mode.
:SCALe:WAVelength:#? (# is R, G, or B)	(<1/0>)	Queries the centroid wavelength input mode.
:SCALe:WAVelength:DATA:# (# is R, G, or B)	<Centroid wavelength [mm]>	Sets the centroid wavelength value in the centroid wavelength input mode.
:SCALe:WAVelength:DATA:#? (# is R, G, or B)	(<Centroid Wavelength [mm]>)	Queries the centroid wavelength value in the centroid wavelength input mode.
:SCALe:WAVelength:OFFSet	<1/0/ON/OFF>	Sets the centroid wavelength offset function.
:SCALe:WAVelength:OFFSet?	(<1/0 >)	Queries the centroid wavelength offset function.
:SCALe:WAVelength:OFFSet:DATA:#	<Offset value [nm]>	Sets the offset value of the centroid wavelength.
:SCALe:WAVelength:OFFSet:DATA:#?	(<Offset value [nm]>)	Queries the offset value of the centroid wavelength.
:SCALe:RADiometry:GAIN	<1/0/ON/OFF>	Sets the radiometric quantity gain function.
:SCALe:RADiometry:GAIN?	(<1/0 >)	Queries the radiometric quantity gain function.
:SCALe:RADiometry:GAIN:DATA:# (# is R, G, or B)	<Gain value>	Sets the gain value of the radiometric quantity.

Messages [ ]: Omissible	Data [ ]: Omissible, ( ): Response data	Description
:SCALe:RADiometry:GAIN:DATA:#? (# is R, G, or B)	(<Gain value>)	Queries the gain value of the radiometric quantity.
:SCALe:XY:OFFSet	<1/0/ON/OFF>	Sets the chromaticity (x,y) offset function.
:SCALe:XY:OFFSet?	(<1/0 >)	Queries the chromaticity (x,y) offset function.
:SCALe:XY:OFFSet:DATA:# (# is X or Y)	<Offset value>	Sets the offset value of the chromaticity (x,y).
:SCALe:XY:OFFSet:DATA:#? (# is X or Y)	(<Offset value>)	Queries the offset value of the chromaticity (x,y).
:SCALe:PHOTometry:GAIN	<1/0/ON/OFF>	Sets the photometric quantity gain function.
:SCALe:PHOTometry:GAIN?	(<1/0 >)	Queries the photometric quantity gain function.
:SCALe:PHOTometry:GAIN:DATA	<Gain value>	Sets the gain value of the photometric quantity.
:SCALe:PHOTometry:GAIN:DATA?	(<Gain value>)	Queries the gain value of the photometric quantity.

Reading Measured Values

:READ?	• Modulation Frequency Measurement
	  (<Modulation frequency [Hz]>,<Measurement status>)
	• Dark Measurement
	  (<Judgment result>)
	• Normal Measurement
	  (<Chromaticity (x) of RGB mixed light>,<Chromaticity (y) of RGB mixed light>,<Photometric quantity of RGB mixed light>,<Measurement status>)
		Waits for trigger and reads the measured values.

:ABORt		Aborts the measurement or waiting for measurement completion.
:FETCh:WAVelength:CENTroid:#? (# is R, G, or B)	(<Measured value of centroid wavelength [nm]>,<Measurement status>)	Queries the measured value of the centroid wavelength.
:FETCh:WAVelength:DOMinant:#? (# is R, G, or B)	(<Measured value of dominant wavelength [nm]>,<Measurement status>)	Queries the measured value of the dominant wavelength.
:FETCh:RADiometry:#? (# is R, G, B, or RGB)	(<Measured value of radiometric quantity>,<Measurement status>)	Queries the measured value of the radiometric quantity.
:FETCh:XYZ:#? (# is R, G, B, or RGB)	(<X measured value>,<Y measured value>,<Z measured value>,<Measurement status>)	Queries the measured values of the tristimulus values XYZ.
:FETCh:XY:#? (# is R, G, B, or RGB)	(<Measured value of chromaticity (x)>,<Measured value of chromaticity (y)>,<Measurement status>)	Queries the measured values of the chromaticity (x,y).
:FETCh:PHOTometry:#? (# is R, G, B, or RGB)	(<Measured value of photometric quantity>,<Measurement status>)	Queries the measured value of the photometric quantity.
:FETCh:UDVD#? (# is R, G, B, or RGB)	(<Measured value of chromaticity (u')>,<Measured value of chromaticity (v')>,<Measurement status>)	Queries the measured values of the chromaticity (u',v').
:FETCh:TCP?	(<Measured value of correlated color temperature>,<Measurement status>)	Queries the measured value of the correlated color temperature.
:FETCh:DELUv?	(<Measured value of delta uv>,<Measurement status>)	Queries the measured value of the delta uv.
:FETCh:NTSCratio?	(<Measured value of NTSC ratio>,<Measurement status>)	Queries the measured value of the NTSC ratio.
:FETCh:LEVel?	(<Red detection level [%]>,<Green detection level [%]>,<Blue detection level [%]>)	Queries the detection levels.
:FETCh:PULSe?	(<Modulation frequency [%]>,<Measurement status>)	Queries the modulation frequency measurement result.
:FETCh:DARK?	(<Judgment result>)	Queries the dark measurement result.

Reading Target Value of Radiometric Quantity

:TARGet:RESult:#? (# is R, G, or B)	< Target value of radiometric quantity >,<Measurement status>,<Judgment>,<Lower threshold of target value of radiometric quantity >,<Upper threshold of target value of radiometric quantity >	Queries the target value of radiometric quantity
:TARGet:RESult:RGB?	(<Judgment>)	Queries the judgment result to the target value of photometric quantity and the target value of chromaticity (x,y).

Others

:SYSTem:POWer:LED	<1/0/ON/OFF>	Sets the power LED lighting.
:SYSTem:POWer:LED?	(<1/0 >)	Queries the power LED lighting setting.
:SYSTem:PRESet		Executes system reset.
:SYSTem:ERRor?	(<Error information>)	Reads error information.

4 Message Reference

Message Reference Interpretation

< >: Indicates the contents (character or numeric parameters) of the data portion of a message. Character parameters are returned as all capital letters.

Numeric Parameters :
- NRf   Number format may be any of NR1, NR2 and NR3
- NR1   Integer data (e.g.: +12, -23, 34)
- NR2   Fixed-point data (e.g.: +1.23, -23.45, 3.456)
- NR3   Floating-point exponential representation data (e.g.: +1.0E-2, -2.3E+4)

Shows the command description. →

Shows the message syntax.
Explains the command data or response message.
Describes the message.

Shows an example of an actual command application. →

Set and Query Number of Average Times of Modulation Frequency		
Syntax	Command	**:PULSe:AVERaging** <Average Times(NRf)>
	Query	**:PULSe:AVERaging?**
	Response	<Average Times(NR1)>
Description	Command	Sets the number of average times of the modulation frequency measurement.
	Query	Queries the currently set number of average times of the modulation frequency measurement.
Example		**:PULS:AVER 2**
		:PULS:AVER?

Command, Query

Controller	→	Instrument
	←	

Response
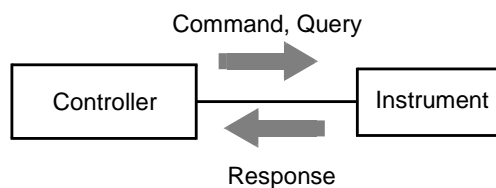
Standard Commands

(1) System Data Commands

Query Device ID (Identify Code)

Syntax	Query	***IDN?**
	Response	\<Manufacturer name\>,\<Model name\>,\<Serial number\>,\<Software version\>
Example		*IDN?
		HIOKI,TM6102,123456789,V1.00

The Device ID is HIOKI TM6102, 123456789, software version 1.00. The \<Model name\> will be the following.

    For TM6102: TM6102
    For TM6103: TM6103
    For TM6104: TM6104

(2) Internal Operation Commands

Initialize Device

Syntax	Command	***RST**
Description		Resets the instrument to its initial state.

Example
    *RST
    *OPC?
    1

Note The communications conditions are not initialized.
- The dark value, dark estimation value, and dark estimation result are also cleared. The Event Status Register is not cleared.
- Be sure to check that the operation is complete using *OPC?. When the communication disconnection process is executed without checking the operation completion, the initialization process may not be executed.

Execute Self-test and Query Result

Syntax	Query	***TST?**
	Response	\<PASS/FAIL\>
Description		Performs the instrument self-check and returns the result.
		Returns PASS when no error occurs and FAIL when an error occurs.

Example
    *TST?
    FAIL

An error occurred. Correct measurement may not be possible. Use :SYSTem:ERRor? to check the details of the error, and then take an appropriate corrective action corresponding to the error.

Request a Sample

Syntax	Command	***TRG**
Description		Performs one measurement when communication triggering (trigger source \<BUS\>) is enabled.

Example
    :TRIG:SOUR BUS
    *TRG

Communication triggering is enabled.

Note: When the trigger source is the external (EXTernal) setting, an execution error occurs.

(3) Synchronized Commands

Set OPC Bit of SESR when Finished with All Pending Operations

Syntax   Command   **∗OPC**

Description   Sets OPC (bit 0) of SESR (Standard Event Status Register) to 1 when all commands prior to the *OPC command have finished processing.

Respond with ASCII "1" when Finished with All Pending Operations

Syntax   Query   **∗OPC?**

          Response   1 (NR1)

Description   Responds with ASCII "1" when all commands prior to the *OPC? command have finished processing.

Wait for Pending Commands to Finish

Syntax   Command   **∗WAI**

Description   The instrument waits until all prior commands finish before executing any subsequent commands.

Description   The measurement completion is not waited for. When you wait for measurement completion, please use any of the following

    ・Confirm a reply of :READ?

    ・Confirm that EOM bit of :ESR0? is set to 1.

(4) Status and Event Control Commands

Clear Event Status Register

Syntax   Command   **∗CLS**

Description   Clears the Standard Event Status Register and Event Status Register 0.

Read and Clear Standard Event Status Register (SESR)

Syntax   Query   **∗ESR?**

          Response   <0 to 255 (NR1)>

Description   Returns the contents of the SESR as an NR1 value from 0 to 255, and then clears the register contents.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	Unused	CME	EXE	DDE	QYE	Unused	OPC

Example   *ESR?

          32

          Bit 5 of the SESR has been set to 1.

Device-Specific Commands

(1) Event Status Register

Query Event Status Register 0

Syntax   Query   **:ESR0?**
Response   <0/2/4/6 (NR1)>

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
-	-	-	-	-	IDX	EOM	-

Description

Example   :ESR0?
6
The sampling complete event and measurement complete event occurred in the instrument.

(2) Communications Settings

Set and Query IP Address in User Setting Mode

Syntax   Command   **:SYSTem:COMMunicate:LAN:IPADdress** <IP address>
Query   **:SYSTem:COMMunicate:LAN:IPADdress?**
Response   <IP address>
    <IP address> = nnn,nnn,nnn,nnn

Description   Command   Sets the IP address.

    Query   Queries the currently set IP address.

Example   :SYST:COMM:LAN:IPAD 192,168,0,2
:SYST:COMM:LAN:UPD
:SYST:COMM:LAN:IPAD?
192,168,0,2

Note   When the IP address is changed by :SYSTem:COMMunicate:LAN:IPADdress,
the change is not reflected until :SYSTem:COMMunicate:LAN:UPDate is executed.

Set and Query LAN Port in User Setting Mode

Syntax   Command   **:SYSTem:COMMunicate:LAN:CONTrol** <Port No.(NRf)>
Query   **:SYSTem:COMMunicate:LAN:CONTrol?**
Response   <Port No.(NR1)>
    <Port No.> = 1 to 9999

Description   Command   Sets the LAN port.

    Query   Queries the currently set LAN port.

Example   :SYST:COMM:LAN:CONT 1024
:SYST:COMM:LAN:UPD
:SYST:COMM:LAN:CONT?
1024

Note   When the port No. is changed by :SYSTem:COMMunicate:LAN:CONTrol,
the change is not reflected until :SYSTem:COMMunicate:LAN:UPDate is executed.

Set and Query Subnet Mask in User Setting Mode

Syntax	Command	**:SYSTem:COMMunicate:LAN:SMASk** <Subnet mask>
	Query	**:SYSTem:COMMunicate:LAN:SMASk?**
	Response	<Subnet mask>
		<Subnet mask> = nnn,nnn,nnn,nnn
Description	Command	Sets the subnet mask.
	Query	Queries the currently set subnet mask.

Example   :SYST:COMM:LAN:SMAS 255,255,255,0
:SYST:COMM:LAN:UPDate
:SYST:COMM:LAN:SMAS?
255,255,255,0

Note   When the Subnet mask is changed by :SYSTem:COMMunicate:LAN:SMASk,
the change is not reflected until :SYSTem:COMMunicate:LAN:UPDate is executed.

Set and Query Default Gateway in User Setting Mode

Syntax	Command	**:SYSTem:COMMunicate:LAN:GATeway** <Address>
	Query	**:SYSTem:COMMunicate:LAN:GATeway?**
	Response	<Address>
		<Address> = nnn,nnn,nnn,nnn
Description	Command	Sets the default gateway.
	Query	Queries the currently set default gateway.

Example   :SYST:COMM:LAN:GAT 192,168,0,100
:SYST:COMM:LAN:UPD
:SYST:COMM:LAN:GAT?
192,168,0,100

Note   When the default gateway is changed by :SYSTem:COMMunicate:LAN:GATeway,
the change is not reflected until :SYSTem:COMMunicate:LAN:UPDate is executed.

Reflect Communication Settings

Syntax	Command	**:SYSTem:COMMunicate:LAN:UPDate**

Example   :SYST:COMM:LAN:IPAD 192,168,0,2
:SYST:COMM:LAN:UPD
:SYST:COMM:LAN:IPAD?
192,168,0,2

Description   Reflects LAN-related settings.

Note   When the LAN-related settings are changed
by :SYSTem:COMMunicate:LAN:IPADdress, :SYSTem:COMMunicate:LAN:CONTrol,
:SYSTem:COMMunicate:LAN:GATeway or :SYSTem:COMMunicate:LAN:SMASk, the
change is not reflected until :SYSTem:COMMunicate:LAN:UPDate is executed.

Query MAC Address

Syntax	Query	**:SYSTem:MAC?**
	Response	<MAC address>
Description	Queries the MAC address.	

Example   :SYST: MAC?
"00-01-67-07-03-85"

(3) Trigger

Set and Query Trigger Source

Syntax	Command	**:TRIGger:SOURce** <BUS/ EXTernal>
	Query	**:TRIGger:SOURce?**
	Response	<BUS/ EXT>

<BUS> = Communication triggering
<EXTernal> = External triggering

Description	Command	Sets the trigger source. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set trigger source.

Example
:TRIG:SOUR BUS
:TRIG:SOUR?
BUS

Note
• When EXT is set, executing *TRG may cause an execution error.
• When BUS is set, the input to the TRG terminal is ignored.

Set and Query Trigger Delay

Syntax	Command	**:TRIGger:DELay** <Delay time(NRf)>
	Query	**:TRIGger:DELay?**
	Response	<Delay time(NR2)>

<Delay time> = 0.0 to 1.0000000 [sec]

Description	Command	Sets the trigger delay. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set trigger delay.

Example
:TRIG:DEL 1
:TRIG:DEL?
1.0000000

Note
• The resolution of the delay time is 100 nsec.
• The modulation frequency measurement is not supported.

Set and Query Trigger Detection Edge

Syntax	Command	**:TRIGger:EDGE** <RISE/FALL>
	Query	**:TRIGger:EDGE?**
	Response	<RISE/FALL>

<RISE> = Starts the measurement on the rising edge of the input signal to the TRG terminal.
<FALL> = Starts the measurement on the falling edge of the input signal to the TRG terminal.

Description	Command	Sets the trigger detection edge. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set trigger detection edge.

Example
:TRIG:EDGE RISE
:TRIG:EDGE?
RISE

(4) Measurement Mode

Set and Query Measurement Mode

Syntax	Command	**:MODE** <NORMal/DARK/PULSe>
	Query	**:MODE?**
	Response	<NORM/DARK/PULS>
		<NORMal> = Normal Measurement
		<DARK> = Dark Measurement
		<PULSe> = Modulation Frequency Measurement

Description	Command	Sets the measurement mode. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set measurement mode.

Example	:MODE NORM
	:MODE?
	NORM

(5) Setting Modulation Frequency Measurement

Set and Query Number of Average Times of Modulation Frequency Measurement

Syntax	Command	**:PULSe:AVERaging** <Average Times(NRf)>
	Query	**:PULSe:AVERaging?**
	Response	<Average Times(NR1)>
		<Average Times> = 1 to 10

Description	Command	Sets the number of average times of the modulation frequency measurement. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set number of average times of the modulation frequency measurement.

Example	:PULS:AVER 2
	:PULS:AVER?
	2

Set and Query Period Detection Edge of SYNC Signal

Syntax	Command	**:PULSe:EDGE** <RISE/FALL>
	Query	**:PULSe:EDGE?**
	Response	< RISE/FALL >
	<RISE> =	This is setting to measure the period between the rising edges of the input signal to the SYNC terminal.
	<FALL> =	This is setting to measure the period between the falling edges of the input signal to the SYNC terminal.

Description	Command	Sets the edge of the SYNC signal that measures the period. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set edge of the SYNC signal.

Example	:PULS:EDGE RISE
	: PULS:EDGE?
	RISE

(6) Modulated Light Function

Set and Query Modulated Light Function

Syntax	Command	**:PULSe** <1/0/ON/OFF>
	Query	**:PULSe?**
	Response	<1/0 (NR1)>
Description	Command	Sets the modulated light function.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set modulated light function.
Example		:PULS ON
		:PULS?
		1
Note		When you change the modulated light function setting, be sure to perform the dark measurement.

Set and Query Modulation Frequency

Syntax	Command	**:PULSe:FREQuency** <Modulation Frequency(NRf)>
	Query	**:PULSe:FREQuency?**
	Response	<Modulation frequency(NR2)>
		<Modulation frequency> = 10.0000 to 300.0000
Description	Command	Sets the modulation frequency.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set modulation frequency.
Example		:PULS:FREQ 60.0
		:PULS:FREQ?
		60.0000
Note		• Even when the modulated light function is OFF, the setting can be performed. However, the setting is not reflected in the internal operation of the instrument.
		• When the modulation frequency is changed in the modulated light function ON state, be sure to perform the dark measurement.

(7) Measurement Range

Set and Query Auto Range Function (# is R, G, or B)

Syntax	Command	**:RANGe:AUTO:#** <1/0/ON/OFF >
	Query	**:RANGe:AUTO:#?**
	Response	< 1/0 (NR1)>
Description	Command	Sets the auto range function. When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set auto range function.

Example

:RANG:AUTO:R ON
:RANG:AUTO:R?
1

:RANG:AUTO:B OFF
:RANG:AUTO:B?
0

Note
- # is R, G, or B.
- When auto range function is turned off during a range search, the measurement range may become the impertinent range.When you turn off an automatic range during the measurement, please set measurement range by all means.

Set and Query Measurement Range (# is R, G, or B)

Syntax	Command	**:RANGe:#** <Measurement range number(NRf)>
	Query	**:RANGe:#?**
	Response	<Measurement range number(NR1)>
		<Measurement range number> = 1 to 16
Description	Command	Sets the measurement range. A larger number increases the sensitivity. (A weak light can be measured.) When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set range.

Example

:RANG:R 15
:RANG:R?
15

:RANG:B 16
:RANG:B?
16

Note
- # is R, G, or B.
- A larger number increases the sensitivity. (A weak light can be measured.)
- When the measurement range is changed in the auto range ON state, the auto range function of the changed color enters the OFF state.

Query Maximum Measurable Radiometric Quantity (**# is R, G, or B**)

Syntax Query   **:RANGe:AREA:#?** <Measurement range number(NRf)>,<Centroid wavelength(NRf)>

         Response   <Maximum measurable radiometric quantity(NR3)>

       <Measurement range> = 1 to 16

       <Centroid wavelength> = For R: 615.00 to 665.00 [nm]

                             For G: 505.00 to 550.00 [nm]

                             For B: 435.00 to 477.00 [nm]

See: "Unit of Radiometric Quantity" (p.9)

Description Queries the maximum measurable radiometric quantity when the specified centroid wavelength is measured in the specified measurement range.

Example (For TM6102)
:RANG:AREA:R? 16,632.8
5.09288E-02
When 632.8 nm is measured in red range 16, the maximum measurable radiometric quantity is 50.9288 [mW/m^2].

:RANG:AREA:G? 16,532
5.90504E-02
When 532 nm is measured in green range 16, the maximum measurable radiometric quantity is 59.2504 [mW/m^2].

Note
• # is R, G, or B.
• Do not send this query during measurement.
• The maximum measurable radiometric quantity acquired by this query is not an absolute value that is ensured.
  Use the acquired value as a reference value.
• The maximum measurable radiometric quantity acquired by this query has an individual difference.

Query Measurement Time during Normal Measurement

Syntax Command
Query   **:RANGe:TIME?** <Measurement range number(NRf)>
Response   <Measurement time(NR3)>

       <Measurement range number> = 1 to 16

       <Measurement time> = Measurement time [sec]

Description Queries the measurement time in the specified range (when the number of average times is 1).

Example
:RANG:TIME? 1
7.7E-02
The measurement time in range 1 is 77 ms.

Note
• Do not send this query during measurement.
• Use the measurement time acquired by this query as a reference value as it is not an absolute time value.

(8) Setting for Color-matching Functions

Set and Query Color-matching Functions

Syntax	Command	**:ANGLe** <Setting for Color-matching Functions(NRf)>
	Query	**:ANGLe?**
	Response	<Setting for Color-matching Functions(NR1)>
		<Setting for Color-matching Functions> = 2,10[°]
Description	Command	Sets the color-matching function setting (2° or 10°).
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set color-matching function setting.

Example
:ANGL 2
:ANGL?
2

Note When 10° is set, the instrument operates as follows.
- The photometric quantity is the value that is measured when the color-matching function setting (2°) is used.
- The correlated color temperature, delta uv, and NTSC ratio cannot be measured. The instrument enters the non-measurement state.

(9) Dark Measurement Settings

Set and Query Dark Measurement Type

Syntax	Command	**:DARK:TYPE** <ALL/FIX >
	Query	**:DARK:TYPE?**
	Response	< ALL/FIX >
		<ALL> = Executes the dark measurement in all ranges.
		<FIX> = Executes the dark measurement in only currently set range (set by RANGe:#).
Description	Command	Sets the dark measurement type.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set dark measurement type.

Example
:DARK:TYPE ALL
:DARK:TYPE?
ALL

Note When the auto range is enabled, the dark measurement is performed in all ranges regardless of this setting.

Query Set Number of Average Times of Dark Measurement

Syntax	Command	**:DARK:AVERaging** <Average Times (NRf)>
	Query	**:DARK:AVERaging?**
	Response	<Average times(NR1)>
		<Average times> = 1 to 100

Description	Command	Sets the number of average times of the dark measurement.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set number of average times of the dark measurement.

Example	:DARK:AVER 2
	:DARK:AVER?
	2

Query Judgment Function for Dark Measurement Result

Syntax	Command	**:DARK:JUDGment** <1/0/ON/OFF >
	Query	**:DARK:JUDGment?**
	Response	<1/0(NR1)>
Description	Command	Sets the judgment function for the dark measurement result.
		• ON is set.
		The response of :READ? or :FETCh:DARK? is 1(PASS) or 0(FAIL) in accordance with the dark measurement environment.
		• OFF is set.
		The response of :READ? or :FETCh:DARK? is always 1 (the dark measurement result is the PASS judgment).
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set judgment function for the dark measurement result.

Example	:DARK:JUDG ON
	:DARK:JUDG?
	1

Note	• When this setting is set to OFF, the normal measurement may not be performed correctly if the dark measurement is performed in bright environments.

(10) Dark Estimation

Set and Query Dark Estimation Function

Syntax	Command	**:DARK:ESTimate** <1/0/ON/OFF >
	Query	**:DARK:ESTimate?**
	Response	<1/0(NR1)>
Description	Command	Sets the dark estimation function.
		If the modulation frequency (:PULSe:FREQuency) is changed when this setting is set to ON, the dark value estimation is executed.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set dark estimation function.

Example Enable the dark estimation function.
:DARK:EST ON
:DARK:EST?
1

Sets the modulation frequency and acquires the dark estimation result.
:PULS ON
:PULS:FREQ 61.0
:DARK:EST:RES?
1

Note • Be sure to check the description of DARK:ESTimate:RESult?.
If the modulation frequency (:PULSe:FREQuency) is changed when this setting is set to ON, be sure to check that the estimation result has succeeded (the response of :DARK:ESTimate:RESult? is 1).
However, the dark estimation fails under the following conditions.
 (1) The modulated light function is OFF.
 (2) No all dark measurement has been performed even when the modulated light function is ON.
• When performing the dark estimation, set the modulated light function to ON beforehand. After that, perform the dark measurement in all ranges of all colors. At this time, it is recommended to set the number of average times of the dark measurement to 10 or more.
• Use the dark estimation with a modulation frequency of ± 5 Hz or less after the dark measurement has been performed. When you make a large change in the modulation frequency, do not use the dark estimation and be sure to perform the dark measurement. Even when the dark estimation result is PASS, the correct dark value may not be acquired.

Query Dark Estimation Result

Syntax	Query	**:DARK:ESTimate:RESult?**
	Response	<1/0(NR1)>
Description	Command	
	Query	Queries the last dark estimation result.
		Response is 1.: PASS judgment. The last dark estimation is succeeded.
		Response is 0.: FAIL judgment. The last dark estimation is failed.
Example		Enable the dark estimation function.
		:DARK:EST ON
		:DARK:EST?
		1
		Sets the modulation frequency and acquires the dark estimation result.
		:PULS ON
		:PULS:FREQ 61.0
		:DARK:EST:RES?
		1
Note		• Be sure to check the description of DARK:ESTimate.
		• When the dark estimation is not performed, the response is 0.
		• The dark estimation result is set to 0 under the following conditons.
		①At Power-on.
		②When reset (*RST, :SYSTem:PRESet) was executed.
		③When modulation light function was set to OFF from ON.
		④When dark measurement was executed.
		⑤When dark was cleared (:DARK:CLEar).

(11) Dark Value Acquisition State

Query Dark Value Acquisition State (# is R, G, or B)

Syntax	Query	**:DARK:STATe:#?** <Measurement range number(NRf)>
	Response	<1/0(NR1)>
		<Measurement range number> = 1 to 16

Description	Command	
	Query	Queries the dark value acquisition state.
		Response is 1.: Already acquired.
		Response is 0.: Not acquired. The default dark is used for the measurement.

Example   :DARK:STAT:R? 1
1
The dark value to be used for red range 1 is already acquired.

:DARK:STAT:B? 16
0
The dark value to be used for blue range 16 is not acquired.

(12) Clearing Dark Value

Clear Dark Value

Syntax	Query	**:DARK:CLEar**
Description	Command	Clears all of the dark data.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	

Note   All of the dark data are cleared and the default dark is used for the next measurement.

(13) Normal Measurement Settings
 (a) Average Times

Set and Query Number of Average Times of Normal Measurement

Syntax	Command	**: AVERaging** <Average times (NRf)>
	Query	**: AVERaging?**
	Response	<Average times(NR1)>
		<Average times> = 1 to 100

Description	Command	Sets the number of average times of the normal measurement.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set number of average times of the normal measurement.

Example   : AVER 2
:AVER?
2

(b) White Balance Adjustment Assistance Function

Set and Query White Balance Adjustment Assistance Function

Syntax	Command	**:TARGet** <1/0/ON/OFF >
	Query	**:TARGet?**
	Response	<1/0(NR1)>
Description	Command	Sets the white balance adjustment assistance function.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set white balance adjustment assistance function.

Example
:TARG ON
:TARG?
1

Set and Query Target Value of Chromaticity (x,y) (# is X or Y)

Syntax	Command	**:TARGet:DEViation:#** <Target value of chromaticity(NRf)>,<Tolerance of chromaticity(NRf)>
	Query	**:TARGet:DEViation:#?**
	Response	<Target value of chromaticity(NR3)>,<Tolerance of chromaticity(NR3)>

<Target value of chromaticity> = For X: Target value of chromaticity x (0.0 to 1.0)
For Y: Target value of chromaticity y (0.0 to 1.0)
<Tolerance of chromaticity> = For X: Tolerance of chromaticity x (0.0 to 1.0)
For Y: Tolerance of chromaticity y (0.0 to 1.0)

The following shows the PASS judgment conditions of the instrument.
Target Value of Chromaticity - Tolerance of Chromaticity ≤ Measured Value of Chromaticity ≤ Target Value of Chromaticity + Tolerance of Chromaticity

Description	Command	Sets the target value and tolerance of the chromaticity (x,y).
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
		When the following conditions are satisfied, the response of :TARGet:RESult:RGB? is the PASS judgment.
		• The measured value of the chromaticity of the RGB mixed light enters a range of the target value of the chromaticity ± the tolerance of the chromaticity.
		• The measured value of the photometric quantity of the RGB mixed light enters a range of the target value of the photometric quantity ± the tolerance of the photometric quantity set by :TARGet:RESult:PHOTometry.
	Query	Queries the currently set target value and tolerance of the chromaticity (x,y).

Example
Sets the target value of the chromaticity (x) to 0.3331 ± 0.01.
:TARG:DEV:X 0.3331,0.01
:TARG:DEV:X?
3.3310E-01,1.0000E-02

Set the target value of the chromaticity (y) to 0.3332 ± 0.02.
:TARG:DEV:Y 0.3332,0.02
:TARG:DEV:Y?
3.3320E-01,2.0000E-02

Note
• # is X or Y.
• The tolerance of the chromaticity that is larger than the target value of the chromaticity cannot be set. When such setting is performed, the setting is changed forcibly so that the tolerance is equal to the target value.

Set and Query Target Value of Photometric Quantity

Syntax Command   **:TARGet:DEViation:PHOTometry** <Target Value of Photometric Quantity(NRf)>,<Tolerance of Photometric Quantity(NRf)>

Query   **:TARGet:DEViation:PHOTometry?**

Response   <Target Value of Photometric Quantity(NR3)>,<Tolerance of Photometric Quantity(NR3)>

<Target Value of Photometric Quantity> = Target photometric quantity
(0.0 to 3.00000E+8)

<Tolerance of Photometric Quantity> = Tolerance of Photometric Quantity
(0.0 to 3.00000E+8)

See: "Unit of Photometric Quantity" (p.9)

The following shows the PASS judgment conditions of the instrument.
Target Value of Photometric Quantity - Tolerance of Photometric Quantity ≤ Measured Value of Photometric Quantity ≤ Target Value of Photometric Quantity + Tolerance of Photometric Quantity

Description Command   Sets the target value and tolerance of the photometric quantity.
When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
When the following conditions are satisfied, the response of :TARGet:RESult:RGB? is the PASS judgment.
- The measured value of the photometric quantity of the RGB mixed light enters a range of the target value of the photometric quantity ± the tolerance of the photometric quantity set by this command.

- The measured value of the chromaticity (x, y) of the RGB mixed light enters a range of the target value of the chromaticity ± the tolerance of the chromaticity set by :TARGet:RESult:#.

Query   Queries the currently set target value and tolerance of the photometric quantity.

Example
(For TM6102)

Set the target value of the photometric quantity to 10000 ± 10 [lx].
:TARG:DEV:PHOT 10000,10
:TARG:DEV: PHOT?
1.00000E+04, 1.00000E+01

Note
- The tolerance of the photometric quantity that is larger than the target value of the photometric quantity cannot be set. When such setting is performed, the setting is changed forcibly so that the tolerance of the photometric quantity is equal to the target value of the photometric quantity.

(c) Centroid Wavelength Input Mode (Correction Function)

Set and Query Centroid Wavelength Input Mode (# is R, G, or B)

Syntax	Command	**:SCALe:WAVelength:#** <1/0/ON/OFF >
	Query	**:SCALe:WAVelength:#?**
	Response	<1/0(NR1)>
Description	Command	Sets the centroid wavelength input mode.

When the centroid wavelength input mode is enabled, the measured value of the centroid wavelength becomes the value set by :SCALe:WAVelength:DATA:#.

When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
• When :SCALe:WAVelength:R is enabled,
  The value set by :SCALe:WAVelength:DATA:R becomes the measured value of the red centroid wavelength.
• When :SCALe:WAVelength:G is enabled,
  The value set by :SCALe:WAVelength:DATA:G becomes the measured value of the green centroid wavelength.
• When :SCALe:WAVelength:B is enabled,
  The value set by :SCALe:WAVelength:DATA: B becomes the measured value of the blue centroid wavelength.

	Query	Queries the currently set centroid wavelength input mode.

Example
:SCAL:WAV:R ON
:SCAL:WAV:R?
1

:SCAL:WAV:G OFF
:SCAL:WAV:G?
0

Note
• # is R, G, or B.
• When this setting is enabled, the auto range operation of the enabled color is disabled regardless of the auto range setting.
• When this setting is enabled, the measurement status is the centroid wavelength input status (3) even after the measurement has been completed normally.

Set and Query Centroid Wavelength (# is R, G, or B)

Syntax	Command	**:SCALe:WAVelength:DATA:#** <Centroid Wavelength (NRf)>
	Query	**:SCALe:WAVelength:DATA:#?**
	Response	<Centroid Wavelength (NR3)>

<Centroid wavelength> = For R: 615.00 to 665.00 [nm]
                         For G: 505.00 to 550.00 [nm]
                         For B: 435.00 to 477.00 [nm]

Description	Command	Sets the centroid wavelength when the centroid wavelength input mode is enabled.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the centroid wavelength when the currently set centroid wavelength input mode is enabled.

Example
:SCAL:WAV:DATA:R 632
:SCAL:WAV:DATA:R?
6.3200E+02

:SCAL:WAV:DATA:G 532
:SCAL:WAV:DATA:G?
5.3200E+02

Note
• # is R, G, or B.
• Be sure to check the description of :SCALe:WAVelength:#.

(d) Centroid Wavelength Offset (Correction Function)

Set and Query Centroid Wavelength Offset Function

Syntax	Command	**:SCALe:WAVelength:OFFSet** <1/0/ON/OFF >
	Query	**:SCALe:WAVelength:OFFSet?**
	Response	<1/0(NR1)>
Description	Command	Sets the centroid wavelength offset function.
		When the centroid wavelength offset function is enabled, the value set by :SCALe:WAVelength:OFFSet:DATA:# is added to the measured value of the centroid wavelength.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set centroid wavelength offset function.
Example		:SCAL:WAV:OFFS ON
		:SCAL:WAV:OFFS?
		1
Note		When the centroid wavelength input mode is enabled, no offset is added regardless of this offset function setting.

Set and Query Offset Value of Centroid Wavelength (# is R, G, or B)

Syntax	Command	**:SCALe:WAVelength:OFFSet:DATA:#** <Offset value(NRf)>
	Query	**:SCALe:WAVelength:OFFSet:DATA:#?**
	Response	<Offset value(NR3)>
		<Offset value> = -2.00 to 2.00 [nm]
Description	Command	Sets the offset value of the centroid wavelength.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
		:SCALe:WAVelength:OFFSet:DATA:R → Offset value of red centroid wavelength
		:SCALe:WAVelength:OFFSet:DATA:G → Offset value of green centroid wavelength
		:SCALe:WAVelength:OFFSet:DATA:B → Offset value of blue centroid wavelength
	Query	Queries the currently set offset value of the centroid wavelength.
		:SCALe:WAVelength:OFFSet:DATA:R? → Offset value of red centroid wavelength
		:SCALe:WAVelength:OFFSet:DATA:G? → Offset value of green centroid wavelength
		:SCALe:WAVelength:OFFSet:DATA:B? → Offset value of blue centroid wavelength
Example		:SCAL:WAV:OFFS:DATA:R 0.1
		:SCAL:WAV:OFFS:DATA:R?
		1.0000E-01
		:SCAL:WAV:OFFS:DATA:G -1.0
		:SCAL:WAV:OFFS:DATA:G?
		-1.0000E+00
Note		• # is R, G, or B.
		• When the centroid wavelength input mode is enabled, no offset is added regardless of this offset function setting.

(e) Radiometric Quantity Gain (Correction Function)

Set and Query Radiometric Quantity Gain Function

Syntax	Command	**:SCALe:RADiometry:GAIN** <1/0/ON/OFF >
	Query	**:SCALe:RADiometry:GAIN?**
	Response	<1/0(NR1)>
Description	Command	Sets the radiometric quantity gain function.

When the radiometric quantity gain function is enabled, the value set by :SCALe:RADiometry:GAIN:DATA:# is added to the measured value of the radiometric quantity.

When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.

	Query	Queries the currently set radiometric quantity gain function.

Example
:SCAL:RAD:GAIN ON
:SCAL:RAD:GAIN?
1

Note A value before it is multiplied by the gain is used to judge an excessive input of the measurement status.

Set and Query Gain Value of Radiometric Quantity (# is R, G, or B)

Syntax	Command	**:SCALe:RADiometry:GAIN:DATA:#** <Gain value(NRf)>
	Query	**:SCALe:RADiometry:GAIN:DATA:#?**
	Response	<Gain value(NR3)>
		<Gain value> = 1.00000E-3 to 1.00000E+3
Description	Command	Sets the gain value of the radiometric quantity.

When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
:SCALe:RADiometry:GAIN:DATA:R → Gain value of red radiometric quantity
:SCALe:RADiometry:GAIN:DATA:G → Gain value of green radiometric quantity
:SCALe:RADiometry:GAIN:DATA:B → Gain value of blue radiometric quantity

	Query	Queries the currently set gain value of the radiometric quantity.

:SCALe:RADiometry:GAIN:DATA:R? → Gain value of red radiometric quantity
:SCALe:RADiometry:GAIN:DATA:G? → Gain value of green radiometric quantity
:SCALe:RADiometry:GAIN:DATA:B? → Gain value of blue radiometric quantity

Example
:SCAL:RAD:GAIN:DATA:R 0.1
:SCAL:RAD:GAIN:DATA:R?
1.00000E-01

:SCAL:RAD:GAIN:DATA:G 10
:SCAL:RAD:GAIN:DATA:G?
1.00000E+01

Note • # is R, G, or B.
• A value before it is multiplied by the gain is used to judge an excessive input of the measurement status.

(f) Chromaticity (x,y) Offset (Correction Function)

Set and Query Chromaticity (x,y) Offset Function

Syntax	Command	**:SCALe:XY:OFFSet** <1/0/ON/OFF >
	Query	**:SCALe:XY:OFFSet?**
	Response	<1/0(NR1)>
Description	Command	Sets the chromaticity (x,y) offset function.
		When the chromaticity (x,y) offset function is enabled, the value set by :SCALe:XY:OFFSet:DATA:# is added to the measured value of the chromaticity (x,y) of the RGB mixed light.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set chromaticity (x,y) offset function.

Example
:SCAL:XY:OFFS ON
:SCAL:XY:OFFS?
1

Note • As a result of addition of the offset value, the chromaticity may become a non-existent value.

Set and Query Offset Value of Chromaticity (x,y) (# is X or Y)

Syntax	Command	**:SCALe:XY:OFFSet:DATA:#** <Offset value(NRf)>
	Query	**:SCALe:XY:OFFSet:DATA:#?**
	Response	<Offset value(NR3)>
		<Offset value> = -1.0000E+00 to 1.0000E+00
Description	Command	Sets the offset value of the chromaticity (x,y).
		The offset value is added to only the measured value of the chromaticity (x,y) of the RGB mixed light.
		:SCALe:XY:GAIN:DATA:X → Offset value of chromaticity (x)
		:SCALe:XY:GAIN:DATA:Y → Offset value of chromaticity (y)
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set offset value of the chromaticity (x,y).
		:SCALe:XY:GAIN:DATA:X? → Offset value of chromaticity (x)
		:SCALe:XY:GAIN:DATA:Y? → Offset value of chromaticity (y)

Example
:SCAL:XY:OFFS:DATA:X -0.5
:SCAL:XY:OFFS:DATA:X?
-5.0000E-01

:SCAL:XY:OFFS:DATA:Y 0.1
:SCAL:XY:OFFS:DATA:Y?
1.0000E-01

Note • # is X or Y.
• As a result of addition of the offset value, the chromaticity may become a non-existent value.
• The tristimulus values XYZ of the RGB mixed light are recalculated using the chromaticity (x,y) of the RGB mixed light on which this offset value has been reflected.

(g) Radiometric Quantity Gain (Correction Function)

Set and Query Photometric Quantity Gain Function

Syntax	Command	**:SCALe:PHOTometry:GAIN** <1/0/ON/OFF >
	Query	**:SCALe:PHOTometry:GAIN?**
	Response	<1/0(NR1)>
Description	Command	Sets the radiometric quantity gain function.
		When the radiometric quantity gain function is enabled, the value set by :SCALe:PHOTometry:GAIN:DATA is added to <u>the measured value of the photometric quantity of the RGB mixed light.</u>
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set photometric quantity gain function.
Example		:SCAL:PHOT:GAIN ON
		:SCAL:PHOT:GAIN?
		1

Note • When the photometric quantity gain is enabled, the tristimulus values XYZ of the RGB mixed light are multiplied by the same gain value.

Set and Query Gain Value of Photometric Quantity

Syntax	Command	**:SCALe:PHOTometry:GAIN:DATA** <Gain value(NRf>
	Query	**:SCALe:PHOTometry:GAIN:DATA?**
	Response	<Gain value(NR3)>
		<Gain value> = 1.00000E-3 to 1.00000E+3
Description	Command	Sets the gain value of the radiometric quantity.
		When the command is accepted, the measured value is cleared and the instrument enters the non-measurement state.
	Query	Queries the currently set gain value of the photometric quantity.
Example		:SCAL:PHOT:GAIN:DATA 0.1
		:SCAL:PHOT:GAIN:DATA?
		1.00000E-01

Note • When the photometric quantity gain is enabled, the tristimulus values XYZ of the RGB mixed light are multiplied by the same gain value.

(14) Reading Measured Values
(a) Measurement Status

When reading a measured value that returns the measurement status, be sure to check the measurement status, and then perform the process corresponding to each status.

Measurement Status	Status	Details → Corrective Action	Priority
10	Error	A system error occurred that affects the measured value. → The repair is needed. Contact your local distributor or the HIOKI International Sales Department at os-com@hioki.co.jp.	High
8	Overflow	The measurement could not be performed in the range where the measurement was performed. → Decrease the sensitivity of the measurement range. (Decrease the measurement range.) If an overflow occurs in the auto range or range 1, this light is out of the measurable range. Additionally, there is a possibility of an excessive input. Check the radiometric quantity of the input laser light.	
7	Underflow	The measurement could not be performed in the range where the measurement was performed. → Increase the sensitivity of the measurement range. (Increase the measurement range.) If an underflow occurs in the auto range or range 16, this light is out of the measurable range. In addition, it becomes the underflow when light of wavelengths outside the measurement range is measured, it becomes the underflow.	
9	Excessive input	A radiometric quantity input larger than the maximum tolerance input is measured. When an excessive input light is measured for an extended period of time, a malfunction may occur. → Do not input a radiometric quantity exceeding the maximum tolerance input.	
6	Unbalance	Among three sensors R, G, and B, the radiometric quantity measured by the sensor of the color indicating unbalance is 1/20 when compared to the sensor that measured the maximum radiometric quantity. The measured value related to this sensor may not be correct. → Do not use the measured value related to the color in the unbalance state. When you use the measured value, input the light that does not cause the unbalance state.	
5	Low input	The detection level is less than 10%. The measurement can be performed, but the measurement cannot be performed in an appropriate range. → Increase the sensitivity of the measurement range. (Increase the measurement range.) Be aware that no dark state cannot be checked in the low input state.	
4	No dark	The following occurs in a range used for the measurement. In this case, the dark value at shipment (default dark value) is used to perform the measurement. (The measurement may not be performed correctly.) • No dark measurement is performed. • The modulation frequency setting used for the dark measurement does not match the modulation frequency used for the measurement. → Execute the dark measurement.	Low
3	Centroid wavelength input	The value set by the user centroid wavelength is determined to the centroid wavelength, and then each measured value is calculated. → When you want to perform the measurement without using the user centroid wavelength value, set the user centroid wavelength function to disabled.	
2	Measurement stop	The measurement was stopped during measurement.	
0	Normal	The measurement could be performed normally.	
1	Non-measurement	No measurement is performed.	

Note: The measurement status with the highest priority among R, G, and B affects the measurement status of the RGB mixed light.

(b) Measurement Value Formats

Measured Value	Format	Non-measurement	Overflow	Underflow	Error
Centroid Wavelength Dominant Wavelength Chromaticity (x,y) Chromaticity (u',v') Correlated Color Temperature Tcp Delta uv NTSC Ratio	□.□□□□E± □□	1.0000E+90	1.0000E+80	1.0000E+70	1.0000E+99
Radiometric Quantity Tristimulus values XYZ Photometric Quantity	□.□□□□□E± □□	1.00000E+90	1.00000E+80	1.00000E+70	1.00000E+99
Modulation Frequency	□.□□□□ Four decimal places	1.0000E+90	1.0000E+80	1.0000E+70	1.0000E+99
Detection level	□.□□ Two decimal places	0.00	100.00	0.00	0.00

Note: When the measured value is negative, the value is prefixed with a negative (-) sign.

(c) Reading Measured Values

Measurement (waits for trigger and reads the measured values)

Syntax	Query	**:READ?**
	Response	(1) Modulation Frequency Measurement (:MODE PULSe Settings)
		<Modulation frequency(NR2)>,<Measurement status(NR1)>

            (2) Dark Measurement (:MODE DARK Settings)
                <Judgment result(NR1)>

            (3) Normal Measurement (:MODE NORMal Settings)
                <Chromaticity (x) of RGB mixed light(NR3)>,<Chromaticity (y) of RGB mixed light(NR3)>,<Photometric quantity of RGB mixed light(NR3)>,<Measurement status(NR1)>

(1) Modulation Frequency Measurement
  <Frequency> = Frequency of the signal input to the SYNC terminal [Hz]

(2) Dark Measurement
  <Judgment result> = 1/0   1: PASS judgment (Dark measurement is succeeded.)
                   0: FAIL judgment (Dark measurement is failed.)

  See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36), "Unit of Photometric Quantity" (p.9)

Description	Changes to the trigger wait state, then reads the measured value after the measurement has been completed.

Example	:TRIG:SOUR BUS
	:PULS ON
	:MODE PULS
	:READ?
	*TRG
	60.0854,0
	:PULS:FREQ 60.0854
	:MODE DARK
	:READ?
	*TRG
	1
	:MODE NORM
	:READ?
	*TRG
	3.7109E-01,3.4633E-01,4.24932E+03,0

Note	• The next command does not execute until measurement is finished. *TRG and :ABORt are received. Please do not transmit *TRG and :ABORt at a time. *TRG is handled earlier even if you transmit a message in order of :ABORt → *TRG. If you transmit both *TRG and :ABORt after :READ? transmission, please let weight more than 500ms enter between *TRG and :ABORt.
	• To cancel the trigger wait state, use :ABORt.
	• Be sure to check that the measurement status is an appropriate value.
	• When this command is accepted, the measured value is cleared, and then the instrument enters the non-measurement state.
	• The normal measurement and dark measurement may take some time depending on the settings. For details about the timeout time until the response of this command is received, see the following.

Measurement Mode	Reference Timeout Time [sec]
Modulation Frequency Measurement	2
Dark Measurement (FIX dark)	0.5 x Number of average times of dark measurement + 1
Dark Measurement (ALL dark)	8 x Number of average times of dark measurement + 1
Normal Measurement (Fixed range)	0.5 x Number of average times of normal measurement + 1
Normal Measurement (Auto range)	1 x Number of average times of normal measurement + 3

Abort Measurement

Syntax Query **:ABORt**

Description Aborts (forcibly terminates) the measurement or waiting for measurement completion by :READ?.

Example *TRG
:ABOR
Aborts the measurement.

:READ?
:ABOR
Aborts the waiting for measurement completion.

Query Measured Value of Centroid Wavelength (# is R, G, or B)

Syntax Query **:FETCh:WAVelength:CENTroid:#?**
Response <Measured value of centroid wavelength(NR3)>,<Measurement status(NR1)>
<Measured value of centroid wavelength> = Unit: [nm]

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured value of the centroid wavelength.

Example :MODE NORM
:READ?
*TRG
3.7109E-01,3.4633E-01,4.24932E+03,0

:FETC:WAV:CENT:R?
6.3427E+02,0
The red centroid wavelength is 634.27 [nm].

:FETC:WAV:CENT:G?
5.4012E+02,0
The green centroid wavelength is 540.12 [nm].

:FETC:WAV:CENT:B?
4.5208E+02,0
The blue centroid wavelength is 452.08 [nm].

Note • # is R, G, or B.
• Be sure to check that the measurement status is an appropriate value.
• When the centroid wavelength input mode is enabled, the set centroid wavelength is the measured value.
• When the measured value of the centroid wavelength is not within the measurable range, the centroid wavelength is treated as unmeasured.
• If the measurement mode is not the normal measurement mode, an execution error occurs.

Query Measured Value of Dominant Wavelength (# is R, G, or B)

Syntax	Query	:FETCh:WAVelength:DOMinant:#?
	Response	<Measured value of dominant wavelength(NR3)>,<Measurement status(NR1)>

<Measured value of dominant wavelength> = Unit: [nm]

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description   Reads the last measured value of the dominant wavelength.

Example
:MODE NORM
:READ?
*TRG
3.7109E-01,3.4633E-01,4.24932E+03,0

:FETC:WAV:DOM:R?
6.3426E+02,0
The red dominant wavelength is 634.26 [nm].

:FETC:WAV:DOM:G?
5.4012E+02,0
The green dominant wavelength is 540.12 [nm].

:FETC:WAV:DOM:B?
4.5208E+02,0
The blue dominant wavelength is 452.08 [nm].

Note
- # is R, G, or B.
- Be sure to check that the measurement status is an appropriate value.
- It takes up to approximately 100 ms to execute this command (not including communication time).
- If the measurement mode is not the normal measurement mode, an execution error occurs.

Query Measured Value of Radiometric Quantity (# is R, G, or B)

Syntax	Query	**:FETCh:RADiometry:#?**
	Response	<Measured value of radiometric quantity(NR3)>,<Measurement status(NR1)>

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36), "Unit of Photometric Quantity" (p.9)

Description   Reads the last measured value of the radiometric quantity.

Example
(For TM6102)

:MODE NORM
:READ?
*TRG
3.7109E-01,3.4633E-01,4.24932E+03,0

:FETC:RAD:R?
7.92924E+00,0
The red radiometric quantity is 7.92924 [W/m^2].

:FETC:RAD:G?
4.53508E+00,0
The green radiometric quantity is 4.53508 [W/m^2].

:FETC:RAD:B?
2.82641E+00,0
The blue radiometric quantity is 2.82641 [W/m^2].

:FETC:RAD:RGB?
1.52907E+01,0
The radiometric quantity of the RGB mixed light is 15.2907 [W/m^2].

Note
• # is R, G, B, or RGB.
• Be sure to check that the measurement status is an appropriate value.
• If the measurement mode is not the normal measurement mode, an execution error occurs.

Query Measured Values of Tristimulus Values XYZ (# is R, G, B, or RGB)

Syntax Query   **:FETCh:XYZ:#?**

Response   <X measured value(NR3)>,<Y measured value(NR3)>,<Z measured
value(NR3)>,<Measurement status(NR1)>

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description   Reads the last measured values of the tristimulus values XYZ.

Example   :MODE NORM
:READ?
*TRG
3.7109E-01,3.4633E-01,4.24932E+03,0

:FETC:XYZ:R?
3.01197E+03,1.21105E+03,1.72926E-01,0
X, Y, and Z of the red tristimulus values XYZ are 3011.97, 1211.05, and 0.172926,
respectively.

:FETC:XYZ:G?
9.04522E+02,2.95730E+03,6.22899E+01,0
X, Y, and Z of the green tristimulus values XYZ are 904.522, 2957.30, and 62.2899,
respectively.

:FETC:XYZ:B?
6.36569E+02,8.09570E+01,3.40454E+03,0
X, Y, and Z of the blue tristimulus values XYZ are 636.569, 80.9570, and 3404.54,
respectively.

:FETC:XYZ:RGB?
4.55306E+03,4.24932E+03, 3.46700E+03,0
X, Y, and Z of the tristimulus values of the RGB mixed light are 4553.06, 4249.23, and
3467.00, respectively.

Note   • # is R, G, B, or RGB.
• Be sure to check that the measurement status is an appropriate value.
• If the measurement mode is not the normal measurement mode, an execution error
occurs.

Query Measured Value of Chromaticity (x,y) (# is R, G, B, or RGB)

Syntax Query **:FETCh:XY:#?**

Response <Measured value of chromaticity (x)(NR3)>,<Measured value of chromaticity (y)(NR3)> ,<Measurement status(NR1)>

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured values of the chromaticity (x,y).

Example :MODE NORM
:READ?
*TRG
3.7109E-01,3.4633E-01,4.24932E+03,0

:FETC:XY:R?
7.1320E-01,2.8676E-01,0
x and y of the red chromaticity (x,y) are 0.71320 and 0.28676, respectively.

:FETC:XY:G?
2.3050E-01,7.5362E-01,0
x and y of the green chromaticity (x,y) are 0.23050 and 0.75362, respectively.

:FETC:XY:B?
1.5443E-01,1.9640E-02,0
x and y of the blue chromaticity (x,y) are 0.15443 and 0.19640, respectively.

:FETC:XY:RGB?
3.7109E-01,3.4633E-01,0
x and y of the chromaticity (x,y) of the RGB mixed light are 0.37109 and 0.34633, respectively.

Note • # is R, G, B, or RGB.
• Be sure to check that the measurement status is an appropriate value.
• If the measurement mode is not the normal measurement mode, an execution error occurs.

Query Measured Value of Photometric Quantity (# is R, G, B, or RGB)

Syntax Query **:FETCh:PHOTometry:#?**

Response <Measured value of photometric quantity(NR3)>,<Measurement status(NR1)>

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36), "Unit of Photometric Quantity" (p.9)

Description Reads the last measured value of the photometric quantity.

Example
(For TM6102)
:MODE NORM
:READ?
*TRG
3.7209E-01,3.4709E-01,1.92834E+03,0

:FETC:PHOT:R?
5.51704E+02,0
The red photometric quantity is 551.704 [lx].

:FETC:PHOT:G?
1.33980E+03,0
The green photometric quantity is 1339.80 [lx].

:FETC:PHOT:B?
3.68350E+01,0
The blue photometric quantity is 36.8350 [lx].

:FETC:PHOT:RGB?
1.92834E+03,0
The photometric quantity of the RGB mixed light is 1928.34 [lx].

Note
• # is R, G, B, or RGB.
• Be sure to check that the measurement status is an appropriate value.
• If the measurement mode is not the normal measurement mode, an execution error occurs.
• When the angle-of-visibility of the color-matching function is set to 10°, the color-matching function with a field-of-view of 2° is used to calculate the photometric quantity.

Query Measured Value of Chromaticity (u',v') (# is R, G, B, or RGB)

Syntax Query **:FETCh:UDVD:#?**

Response <Measured value of chromaticity (u')(NR3)>,<Measured value of chromaticity (v')(NR3)> ,<Measurement status(NR1)>

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured values of the chromaticity (u',v').

Example
(For TM6102)
:MODE NORM
:READ?
*TRG
3.7209E-01,3.4709E-01,1.92834E+03,0

:FETC:UDVD:R?
5.6858E-01,5.1470E-01,0
u' and v' of the red chromaticity (u',v') are 0.56858 and 0.51470, respectively.

:FETC:UDVD:G?
7.9643E-02,5.8559E-01,0
u' and v' of the green chromaticity (u',v') are 0.079643 and 0.58559, respectively.

:FETC:UDVD:B?
2.1049E-01,6.1007E-02,0
u' and v' of the blue chromaticity (u',v') are 0.21049 and 0.061007, respectively.

:FETC:UDVD:RGB?
2.3180E-01,4.8651E-01,0
u' and v' of the chromaticity (u',v') of the RGB mixed light are 0.23180 and 0.48651, respectively.

Note
• # is R, G, B, or RGB.
• Be sure to check that the measurement status is an appropriate value.
• If the measurement mode is not the normal measurement mode, an execution error occurs.

Query Measured Value of Correlated Color Temperature (Tcp)

Syntax Query **:FETCh:TCP?**

Response <Correlated color temperature(NR3)>,<Measurement status(NR1)>
<Correlated color temperature> = Unit: [K]

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured value of the correlated color temperature.

Example
:MODE NORM
:READ?
*TRG
3.7209E-01,3.4709E-01,1.92834E+03,0

:FETC:TCP?
4.0101E+03,0

Note
• When the correlated color temperature is not calculated, it is treated as unmeasured.
• When the delta uv is larger than 0.02, it is treated as unmeasured.
• If the measurement mode is not the normal measurement mode, an execution error occurs.
• The color-matching function with an angle-of-visibility of 10° is not supported. When 10° is set, an unmeasured value is returned as the measured value.

Query Measured Value of Delta uv

Syntax Query **:FETCh:DELUv?**

Response <Delta uv(NR3)>,<Measurement status(NR1)>

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured value of the delta uv.

Example :MODE NORM
:READ?
*TRG
3.7209E-01,3.4709E-01,1.92834E+03,0

:FETC:DELU?
-1.2074E-02,0

Note • When the delta uv is larger than 0.02 or when the delta uv cannot be calculated, it is treated as unmeasured.
• If the measurement mode is not the normal measurement mode, an execution error occurs.
• The color-matching function with an angle-of-visibility of 10° is not supported. When 10° is set, an unmeasured value is returned as the measured value.

Query NTSC Ratio

Syntax Query **:FETCh:NTSCratio?**

Response <NTSC ratio(NR3)>,<Measurement status(NR1)>
<NTSC ratio> = Unit: [%]

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured value of the NTSC ratio.

Example :MODE NORM
:READ?
*TRG
3.7209E-01,3.4709E-01,1.92834E+03,0

:FETC:NTSC?
1.2315E+02,0

Note • When the NTSC ratio cannot be calculated, it is treated as unmeasured.
• If the measurement mode is not the normal measurement mode, an execution error occurs.
• The color-matching function with an angle-of-visibility of 10° is not supported. When 10° is set, an unmeasured value is returned as the measured value.

Query Detection Levels

Syntax Query **:FETCh:LEVel?**

Response <Red detection level(NR2)>,<Green detection level(NR2)>,<Blue detection level(NR2)>

<Detection level of each color> = Unit: [%]

See: "Measurement Value Formats" (p.37)

Description Queries the last measured detection levels.

The detection level shows what percentage of the F.S. of the measured range has been measured.

For example, when the detection level is 20%, the measurement is performed with 20% of the F.S. Therefore, it is better to perform the measurement by increasing the sensitivity of the measurement range.

Example :MODE NORM

:READ?

*TRG

3.7209E-01,3.4709E-01,1.92834E+03,0

:FETC:LEV?

40.60,40.70,56.83

Note • When the manual range is used, use this command to select a range in which the detection level is maximum.

• If the measurement mode is not the normal measurement mode, an execution error occurs.

Query Modulation Frequency Measurement Result

Syntax Query **:FETCh:PULSe?**

Response <Modulation frequency(NR2)>,<Measurement status(NR1)>

<Modulation frequency> = Unit: [Hz]

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36)

Description Reads the last measured value of the modulation frequency.

Example :MODE PULS

:READ?

*TRG

60.0097,0

:FETC:PULS?

60.0097,0

Note • If the measurement mode is not the modulation frequency measurement mode, an execution error occurs.

Query Dark Measurement Result

Syntax Query **:FETCh:DARK?**

Response <Judgment result(NR1)>

<Judgment result> = 1/0   1: PASS judgment (Dark measurement is succeeded.)

0: FAIL judgment (Dark measurement is failed.)

Description Reads the dark measurement result measured last.

Example :MODE DARK

:READ?

*TRG

1

:FETC:DARK?

1

Note • If the measurement mode is not the dark measurement mode, an execution error occurs.

(d) Reading Target Value of Radiometric Quantity

Query Target Value of Radiometric Quantity (# is R, G, or B)

Syntax Query   **:TARGet:RESult:#?**

Response   <Target value of radiometric quantity(NR3)>,<Measurement status(NR1)>,<Judgment(NR1)>,
<Lower threshold of tolerance of radiometric quantity(NR3)>,<Upper thresholds of tolerance of radiometric quantity(NR3)>

<Judgment> = 1/0   1:PASS judgment   0:FAIL judgment

See: "Measurement Value Formats" (p.37), "Measurement Status" (p.36), "Unit of Radiometric Quantity" (p.9)

Description Queries the target value of the actual radiometric quantity and the tolerance of the radiometric quantity necessary to achieve the set target value of the radiometric quantity ± the tolerance of the radiometric quantity and the following conditions for each color's target value of chromaticity (x,y).

- Target Value of Chromaticity (x) - Tolerance of Chromaticity (x) ≤ Measured Value of Chromaticity (x) ≤ Target Value of Chromaticity (x) + Tolerance of Chromaticity (x)
- Target Value of Chromaticity (y) - Tolerance of Chromaticity (y) ≤ Measured Value of Chromaticity (y) ≤ Target Value of Chromaticity (y) + Tolerance of Chromaticity (y)
- Target Value of Photometric Quantity - Tolerance of Photometric Quantity ≤ Measurement Value of Photometric Quantity ≤ Target Value of Photometric Quantity + Tolerance of Photometric Quantity

For the measurement status, the measurement status of the last measured value of the radiometric quantity is returned.

When the measured value of the radiometric quantity enters a range between the upper and lower thresholds, the judgment is PASS.

Example
(For TM6102)

```
:MODE NORM; :TARG ON
:TARG:DEV:X 0.37, 0.05; Y 0.34, 0.05; PHOT 12000, 500
:READ?; *TRG
3.7479E-01,3.4711E-01,1.14464E+04,0

:FETC:RAD:R?
2.14841E+01,0
:TARG:RES:R?
2.24963E+01,0,1,1.90657E+01,2.53785E+01
```
Measured value of red radiometric quantity: 21.4841 [W/m^2]
Target value of red radiometric quantity: 22.4963 [W/m^2]
    Lower threshold of tolerance: 19.0657 [W/m^2]   Upper threshold of tolerance: 25.3785 [W/m^2]
Judgment: PASS judgment (The measured value of the radiometric quantity is between the upper and lower thresholds of the tolerance.)

```
:FETC:RAD:G?
1.21124E+01,0
:TARG:RES:G?
1.26814E+01,0,0,1.25314E+01,1.29146E+01
```
Measured value of green radiometric quantity: 12.1124 [W/m^2]
Target value of green radiometric quantity: 12.6814 [W/m^2]
    Lower threshold of tolerance: 12.5314 [W/m^2]   Upper threshold of tolerance: 12.9146 [W/m^2]
Judgment: FAIL judgment (The measured value of the radiometric quantity is not between the upper and lower thresholds of the tolerance.)
* The green laser needs to be adjusted so that the radiometric quantity enters a range between the upper and lower thresholds of the tolerance.

:FETC:RAD:B?
7.48744E+00,0
:TARG:RES:B?
8.36588E+00,0,1,5.05005E+00,1.27150E+01

Measured value of blue radiometric quantity: 7.48744 [W/m^2]
Target value of blue radiometric quantity: 8.36588 [W/m^2]
       Lower threshold of tolerance: 5.05005 [W/m^2]   Upper threshold of tolerance: 12.7150 [W/m^2]
Judgment: PASS judgment (The measured value of the radiometric quantity is between the upper and lower thresholds of the tolerance.)

Note
- # is R, G, B, or RGB.
- Be sure to check that the measurement status is an appropriate value.
- If the measurement mode is not the modulation frequency measurement mode, an execution error occurs.
- The information acquired by this command should be handled as a reference value. The information that is used for the final judgment is acquired by :TARGet:RESult:RGB?.
- In rare cases, even when the measured values of the radiometric quantities of all colors are between the upper and lower thresholds of the tolerance of the radiometric quantity, the response of :TARGet:RESult:RGB? may be the FAIL judgment. In this case, perform the adjustment so that the radiometric quantity of each color gets close to the adjustment target of the radiometric quantity.
- The floating-point operation is performed inside the instrument. The judgment is performed including fractions after the response digits.
  The value after the display digits is rounded off. Therefore, even when the measurement result is the same as the upper or lower threshold of the adjustment target, the judgment result may vary.

Query Judgment Result to Target Value of Photometric Quantity and Target Value of Chromaticity (x,y)

Syntax Query   **:TARGet:RESult:RGB?**

Response   <Judgment(NR1)>

<Judgment> = 1/0   1:PASS judgment   0:FAIL judgment

Description   Queries if the measured value of the chromaticity (x,y) of the RGB mixed light and the measured value of the photometric quantity satisfy the following conditions.

- Target Value of Chromaticity (x) - Tolerance of Chromaticity (x) ≤ Measured Value of Chromaticity (x) ≤ Target Value of Chromaticity (x) + Tolerance of Chromaticity (x)
- Target Value of Chromaticity (y) - Tolerance of Chromaticity (y) ≤ Measured Value of Chromaticity (y) ≤ Target Value of Chromaticity (y) + Tolerance of Chromaticity (y)
- Target Value of Photometric Quantity - Tolerance of Photometric Quantity ≤ Measurement Value of Photometric Quantity ≤ Target Value of Photometric Quantity + Tolerance of Photometric Quantity

Example
(For TM6102)

:MODE NORM
:TARG ON
:TARG:DEV:X 0.37, 0.05
:TARG:DEV:Y 0.34, 0.05
:TARG:DEV:PHOT 12000, 500
:READ?; *TRG
3.7479E-01,3.4711E-01,1.14464E+04,0

:FETC:RES:RGB?
1

The measured value of the photometric quantity is in a range of the target value of the photometric quantity ± the tolerance of the photometric quantity.
The measured value of the chromaticity (x,y) is in a range of the target value of the chromaticity (x,y) ± the tolerance of the chromaticity (x,y).

Note
- If the measurement mode is not the modulation frequency measurement mode, an execution error occurs.
- The floating-point operation is performed inside the instrument. The judgment is performed including fractions after the response digits.
The value after the display digits are rounded off. Therefore, even when the measurement value is the same as the target ± the tolerance, the judgment result may be FAIL.

(15) Others

Set and Query Power LED Lighting

Syntax	Command	**:SYSTem:POWer:LED** <1/0/ON/OFF >
	Query	**:SYSTem:POWer:LED?**
	Response	<1/0(NR1)>
Description	Command	Sets the power LED lighting.
		ON: Lights up or flashes in accordance with the instrument state.
		OFF: Always off.
	Query	Queries the currently set power LED lighting setting.

Example
:SYST:POW:LED ON
:SYST:POW:LED?
1

Note
• This setting is not stored. It starts in a state of ON at power-on.
• When OFF is set, an error is not notified using the power LED. Use *ESR?
  or :SYSTem:ERRor? to acquire the error information periodically.

Execute System Reset

Syntax Command   **:SYSTem:PRESet**

Description Resets the operation of *RST and the communication setting.

Example
SYST:PRES
*OPC?
1

Note Be sure to check that the operation is complete using *OPC?. When the communication disconnection process is executed without checking the operation completion, the initialization process may not be executed.

However, when the communication mode setting is the user setting mode, the communication is disconnected as the reset process is complete. At this time, the operation completion cannot be checked using *OPC?.

When turning off the power after this command has been executed in the user setting mode, turn off the power after 1 sec. or longer has elapsed.

When you turn off the power immediately after this command has been executed, the initialization process may not be executed.

Read Error Information

Syntax   Query   **:SYSTem:ERRor?**
          Response   <Error No.(NR1)>
           <Error No.> =

32768	16384	8192	4096	2048	1024	512	256
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
RAM error	RSV	RSV	RSV	Mode error	AD error	Measurement error	RSV

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
RSV	Configuration error	Backup error	Storage memory error	RSV	MAC address error	Adjustment value error	ROM error

Description   Queries the error number.

Error contents	Details → Corrective Action
ROM error	An operation error occurred in the internal ROM. → The repair is needed.
Adjustment value error	The adjustment value showed an abnormal value. → The repair is needed.
MAC address error	The MAC address showed an abnormal value. This may cause the communication failure to occur. → The repair is needed.
Storage memory error	The operation of the memory for storage of settings was abnormal. → The repair is needed.
Backup error	The instrument was started with the default settings as the stored settings showed an abnormal value. → When the error is cleared by restarting the instrument, there is no problem.
Configuration error	The configuration at startup failed. → The repair is needed.
AD error	The AD value showed an abnormal value. → The repair is needed.
Mode error	The measurement might be executed in an inappropriate state. →Please inform the details of the processing to the nearest office.
Measurement error	The sampling failed during measurement. → The repair is needed.
RAM error	An operation error occurred in the internal RAM. → The repair is needed.

Example   :SYST:ERR?
          48
          B   The storage error and backup error occurred.

5 Measurement Flow

Basic Measurement Flow

Send Command	Response	Details
:TRIG:SOUR BUS		Makes the settings for triggering from the communication.
Modulation Frequency Measurement		
:MODE PULS		Sets the modulation frequency measurement mode.
:READ?		Sets the measurement complete wait state.
*TRG		Starts the measurement.
-	59.9988, 0	Acquires the response of :READ?.
:PULS ON		Enables the modulated light function.
:PULS:FREQ 59.9988		Sets the modulation requency.
Dark Measurement		
:MODE DARK		Sets the dark measurement mode.
:READ?		Sets the measurement complete wait state.
*TRG		Starts the measurement.
-	1	Acquires the response of :READ?. When 0 is returned, correct the environment, and then perform the dark measurement again.
Normal Measurement		
:MODE NORM		Sets the normal measurement mode.
:READ?		Sets the measurement complete wait state.
*TRG		Starts the measurement.
-	3.7262E-01, 3.4825E-01, 3.71416E+03, 0	Acquires the response of :READ?.
:FETC:WAV:CENT:R?	6.3448E+02, 0	Acquires the centroid wavelength.
:FETC:WAV:CENT:G?	5.4013E+02, 0	
:FETC:WAV:CENT:B?	4.5203E+02, 0	
:FETC:RAD:R?	6.99173E+00, 0	Acquires the radiometric quantity.
:FETC:RAD:G?	3.96547E+00, 0	
:FETC:RAD:B?	2.42578E+00, 0	
:FETC:RAD:RGB?	1.33830E+01, 0	
:FETC:XY:R?	7.1343E-01, 2.8653E-01, 0	Acquires the chromaticity (x,y).
:FETC:XY:G?	2.3057E-01, 7.5357E-01, 0	
:FETC:XY:B?	1.5449E-01, 1.9590E-02, 0	
:FETC:XY:RGB?	3.7262E-01, 3.4825E-01, 0	
:FETC:PHOT:R?	1.05872E+03, 0	Acquires the photometric quantity.
:FETC:PHOT:G?	2.58601E+03, 0	
:FETC:PHOT:B?	6.93143E+01, 0	
:FETC:PHOT:RGB?	3.71416E+03, 0	

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