WT310E/WT310EH/WT332E/WT333E

Digital Power Meter
Communication Interface

USER'S MANUAL

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM WT310E-17EN
2nd Edition

Thank you for purchasing the WT310E, WT310EH, WT332E, or WT333E Digital Power Meter. This Communication Interface User's Manual explains the following interface features and commands.

- USB interface
- GP-IB interface
- RS-232 interface
- Ethernet interface

To ensure correct use, please read this manual thoroughly before beginning operation.
After reading this manual, keep it in a safe place.

List of Manuals

The following manuals, including this one, are provided as manuals for this instrument. Please read all manuals.

Manual Title	Manual No.	Description
WT310E/WT310EH/WT332E/WT333E Digital Power Meter User's Manual	IM WT310E-01EN	The manual explains all features of this instrument, except for the communication interface features, and how to use them.
WT310E/WT310EH/WT332E/WT333E Digital Power Meter Getting Started Guide	IM WT310E-02EN	Provided as a printed manual. The manual explains the handling precautions and basic operations of this instrument and provides an overview of its features.
WT310E/WT310EH/WT332E/WT333E Digital Power Meter Communication Interface User's Manual	IM WT310E-17EN	This guide. This manual explains the communication interface features of this instrument and how to use them.
WT310E/WT310EH/WT332E/WT333E Digital Power Meter	IM WT310E-92Z1	Document for China

PDF files of all the manuals above are included in the accompanying CD.
The "EN" and "Z1" in the manual numbers are the language codes.

Contact information of Yokogawa offices worldwide is provided on the following sheet.

Document No.	Description
PIM 113-01Z2	List of worldwide contacts

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functionality. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of YOKOGAWA is strictly prohibited.
- Safety precautions are provided in the Getting Started Guide, IM WT310E-02EN. Be sure to observe the safety precautions.
- The TCP/IP software of this product and the documents concerning it have been developed/created by YOKOGAWA based on the BSD Networking Software, Release 1 that has been licensed from the Regents of the University of California.

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Revisions

- 1st Edition: September 2015
- 2nd Edition: October 2017

2nd Edition: October 2017 (YMI)

About the USB Interface and Ethernet Interface

- To use the USB communication features, your PC must have the following:
  - Library of this instrument (TMCTL)
  - USB device driver for connecting this instrument to the PC
- To use the Ethernet communication features, your PC must have the following:
  - Library of this instrument (TMCTL)

  You can download the library and driver from the following web page.
  http://tmi.yokogawa.com/

  If you install WTViewerFreePlus in your PC, the above library and driver will be installed automatically.

Sample Programs

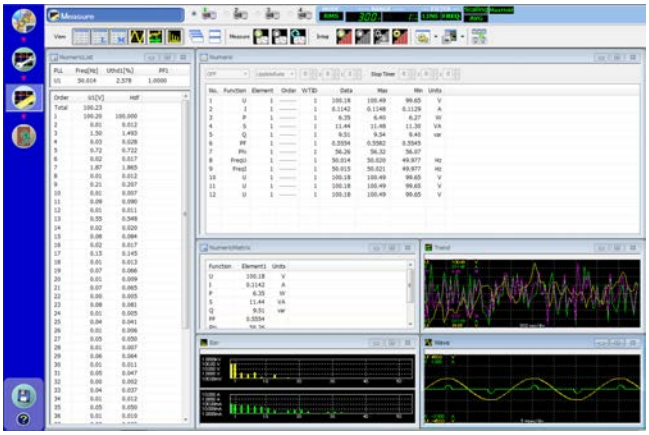
You can download sample programs for this instrument from the following web page:
http://tmi.yokogawa.com/

WTViewerFreePlus

WTViewerFreePlus is a dedicated software application for this instrument. It is included in the accompanying CD.
By using WTViewerFreePlus, you can display measured data on a dedicated window, save measured data to the PC, and change the settings of this instrument from the PC.
For information on how to install and use WTViewerFreePlus, see the WTViewerFreePlus User's Manual, IM 760121-02E.

Example of a Window for Configuring the WT

Example of a Window Showing the Measured Data



Symbols and Notation Used in This Manual

Notes

The notes and cautions in this manual are categorized using the following symbols.

WARNING **Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.**

CAUTION **Calls attention to actions or conditions that could cause light injury to the user or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.**

French

AVERTISSEMENT Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures graves (voire mortelles), et sur les précautions de sécurité pouvant prévenir de tels accidents.

ATTENTION Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures légères ou d'endommager l'instrument ou les données de l'utilisateur, et sur les précautions de sécurité susceptibles de prévenir de tels accidents.

Note Calls attention to information that is important for proper operation of the instrument.

Units

k	Denotes 1000. Example: 100 kHz (frequency)
K	Denotes 1024. Example: 720 KB (file size)

Characters That Appear on the 7-Segment LED

Because this instrument uses a 7-segment LED display, numbers, letters, and mathematical symbols are displayed using special characters in the manner shown below. Some of the characters shown below are not used by this instrument.

0 → 0 A → A K → K U → U ^ (exponentiation) → ^
1 → 1 B → b L → L V → V
2 → 2 C → C **Lowercase c** → c M → M W → W
3 → 3 D → d N → n X → X
4 → 4 E → E O → o Y → Y
5 → 5 F → F P → P Z → Z
6 → 6 G → G Q → q + → +
7 → 7 H → H **Lowercase h** → h R → r – → -
8 → 8 I → I S → S × → x
9 → 9 J → J T → t ÷ → /

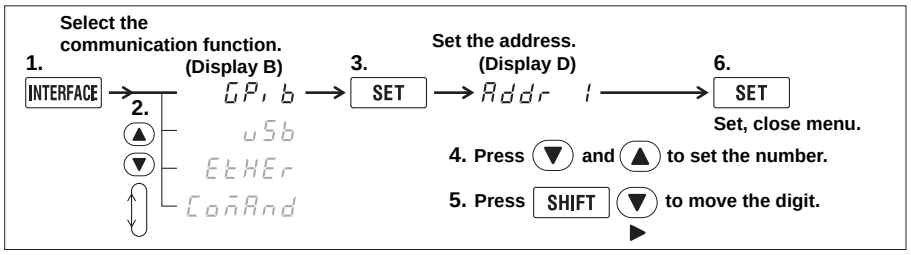
Symbols and Conventions Used in Procedural Explanations

In chapters 1 to 4, the contents of the procedural explanations are indicated using the following symbols.

Procedure

Operations are explained using flowcharts. See the example below for an explanation of how various operations are indicated. All procedures are written under the assumption that you are starting operation at the beginning of the procedure, so you may not need to carry out all the steps in a procedure when you are changing the settings.

Example: Operations for setting the GP-IB address



The above flow chart indicates the following operations.
You can configure items that are blinking.

1. Press **INTERFACE**.
   A menu appears in display B.
2. Use ▲ or ▼ to select GPib.
   Pressing either key cycles through 4 menu items.
3. Press **SET** to confirm the selection of GPib.
   The GPib function menu that you selected in step 2 appears in display D.
4. Use ▲ or ▼ to select the GP-IB address.
5. If necessary, press the **SHIFT** key so that it illuminates, and then press ▼ to move the input digit.
6. Press **SET** to confirm the setting and return the menu display to the measurement data display.
   The selected or set item is confirmed when you press SET.

- When you are making a number positive (no sign) or negative (–) or setting a number, when the digit in the display that the input will be added to is blank, an underscore flashes at the position of the digit.
- While you are performing menu operations, to leave the menu display, press HOLD (ESC). All setting changes that you have confirmed by pressing the SET key will be reflected in the settings.

Explanation

This section describes the setup items and the limitations regarding the procedures.

Symbols Used in the Syntax

The following table contains the symbols that are used in the syntax discussed mainly in chapters 5 and 6. These symbols are referred to as BNF (Backus-Naur Form) symbols. For details on how to write data using these symbols, see pages 5-6 and 5-7.

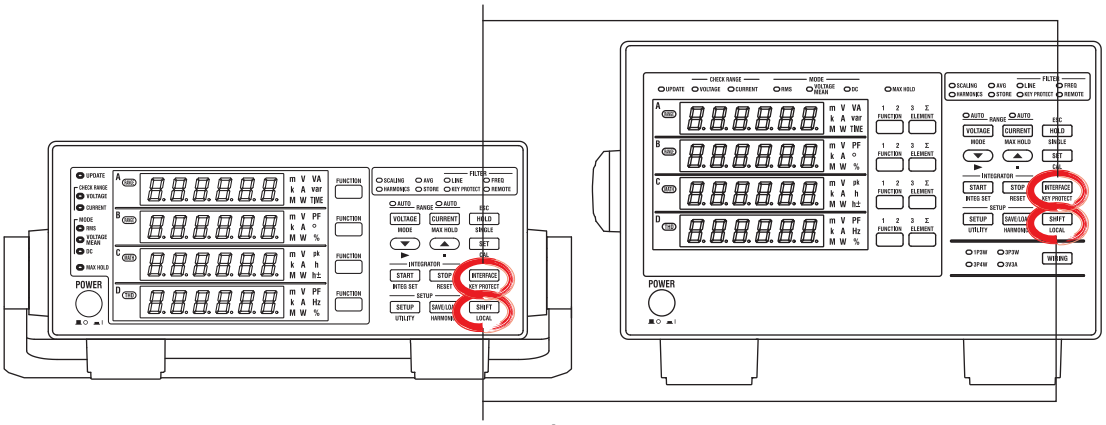
Symbol	Meaning	Example	Example of Input
<>	A defined value	ELEMent<x> <x> = 1 to 3	ELEMENT2
{} |	Select an option in { } Exclusive OR	MODE {RMS|VMEan|DC}	MODE RMS
[]	Can be omitted	NUMeric[:NORMal]:VALue?	NUMERIC:VALUE?

Contents

1.1 Component Names and Functions

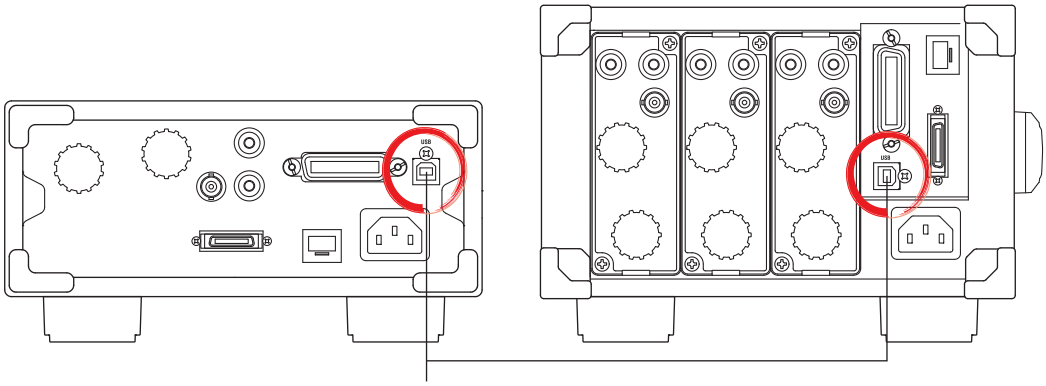
Front Panel

INTERFACE key (page 1-4)
Press this key to view the serial number that is used in USB TMC communication.



LOCAL key
Press this key to switch to local mode. In local mode, remote mode (remote control using communication commands) is cleared, and key operation becomes possible.
This key is disabled when local lockout (see page 1-2) has been activated by a controller.

Rear Panel



USB port
This port is for connecting this instrument to a controller (such as a PC) using a USB cable. For details on how to connect, see page 1-3.

1.2 USB Interface Features and Specifications

USB Interface Features

Reception Feature

- You can use the reception feature to specify the same settings that you specify by using the front panel keys.
- Output requests for measured and computed data, panel setup parameters, and error codes can be received.

Transmission Feature

- This instrument can transmit measured and computed data.
- This instrument can transmit panel setup parameters and the status byte.
- This instrument can transmit error codes when errors occur.

USB Interface Specifications

Item	Specifications
Number of ports	1
Connector	Type B connector (receptacle)
Electrical and mechanical	Complies with USB Rev. 2.0
Supported transfer modes	HS (High Speed; 480 Mbps) and FS (Full Speed; 12 Mbps)
Supported protocols	USBTMC-USB488 (USB Test and Measurement Class Ver. 1.0)
PC system requirements	PC running Windows 8 (32 bit/64bit), Windows 7 (32 bit/64bit), or Windows Vista (32 bit) English and Japanese and with a USB port

Switching between Remote and Local Modes

When Switching from Local to Remote Mode

This instrument switches to remote mode when it is in local mode and it receives a :COMMunicate:REMote ON command from the PC.

- The REMOTE indicator illuminates.
- All keys except the **SHIFT (LOCAL)** key are disabled.
- Settings entered in local mode are retained even when this instrument switches to remote mode.

When Switching from Remote to Local Mode

When this instrument is in remote mode and you press SHIFT (LOCAL), this instrument switches to local mode. However, this does not work if this instrument has received a `:COMMunicate:LOCKout ON` command from the PC. This instrument switches to local mode when it receives a `:COMMunicate:REMote OFF` command from the PC, regardless of the local lockout state.

- The REMOTE indicator turns off.
- Key operations are enabled.
- Settings entered in remote mode are retained even when this instrument switches to local mode.

Note

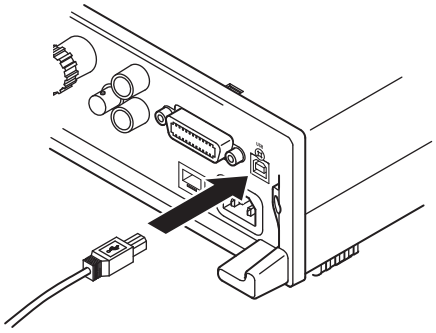
You cannot use the USB interface simultaneously with other interfaces (GP-IB, RS-232, and Ethernet interfaces).

1.3 Connecting to the USB Interface

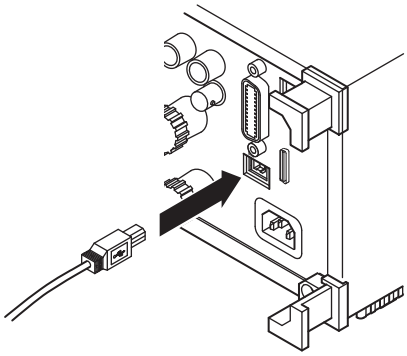
Connection Procedure

Connect the cable as shown below.

WT310E/WT310EH



WT332E/WT333E



Notes on Connection

- Be sure to insert the USB cable connectors firmly into the USB ports.
- If you are connecting multiple devices by using a USB hub, connect this instrument to the USB hub port that is closest to the port that the controller is connected to.
- Do not connect or remove USB cables from the time when this instrument is turned on until operation becomes available (approximately 20 to 30 seconds). Doing so may damage this instrument.
- On the WT310E and WT310EH, it is physically impossible to connect a GP-IB cable and a USB cable at the same time.

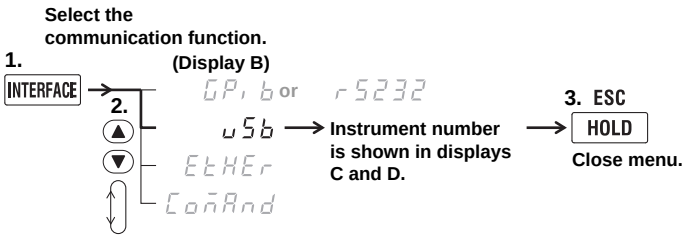
1.4 Configuring the USB Settings of This Instrument

This section explains the following setting for controlling this instrument remotely through a USB interface:

Procedure

Follow the procedure indicated by the thick lines in the following menu.

- **Viewing the serial number that is used in USB TMC communications**



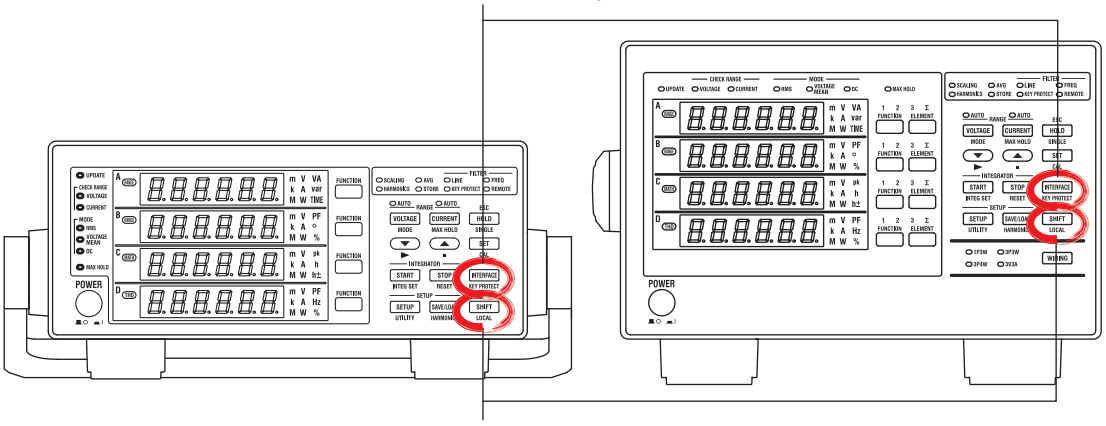
Note

- Only use one communication interface: USB, GP-IB, RS-232, or Ethernet. If you send commands simultaneously from more than one communication interface, this instrument will not execute the commands properly.
- Install the YOKOGAWA USB TMC (Test and Measurement Class) driver on your PC. For information about how to obtain the YOKOGAWA USB TMC driver, contact your nearest YOKOGAWA dealer. You can also access the YOKOGAWA USB driver download web page and download the driver.
  http://tmi.yokogawa.com/
- Do not use USB TMC drivers (or software) supplied by other companies.

2.1 Component Names and Functions

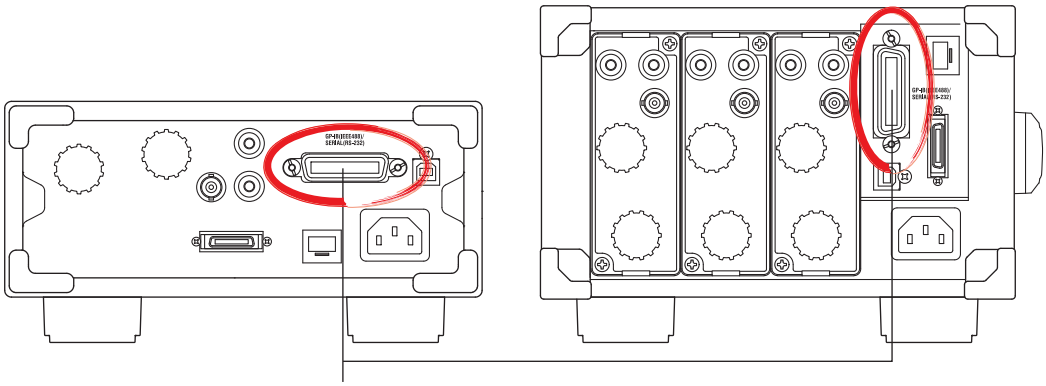
Front Panel

INTERFACE key (page 2-6)
Press this key to set the GP-IB address.



LOCAL key
Press this key to switch to local mode. In local mode, remote mode (remote control using communication commands) is cleared, and key operation becomes possible.
This key is disabled when local lockout (see page 2-3) has been activated by a controller.

Rear Panel



GP-IB port
This port is for connecting this instrument to a controller (such as a PC) using a GP-IB cable. For details on how to connect, see page 2-4.

2.2 GP-IB Interface Features and Specifications

GP-IB Interface Features

Reception Feature

- You can use the reception feature to specify the same settings that you specify by using the front panel keys.
- Output requests for measured and computed data, panel setup parameters, and error codes can be received.

Transmission Feature

- This instrument can transmit measured and computed data.
- This instrument can transmit panel setup parameters and the status byte.
- This instrument can transmit error codes when errors occur.

Note

Talk-only, listen-only, and controller capabilities are not available.

GP-IB Interface Specifications

Item	Specifications
Supported devices	National Instruments Corporation • PCI-GPIB or PCI-GPIB+ • PCIe-GPIB or PCIe-GPIB+ • PCMCIA-GPIB or PCMCIA-GPIB+ (not supported on Windows Vista or Windows 7.) • GPIB-USB-HS Driver NI-488.2M Version 2.8.1 and later
Electrical and mechanical	Conforms to IEEE St'd 488-1978
Functional specifications	See the table below.
Protocol	Conforms to IEEE St'd 488.2-1992
Code	ISO (ASCII) codes
Mode	Addressable mode
Address setting	Press **INTERFACE**, and then select the **GPIB** menu. Set the address to a value between 0 and 30.
Clear remote mode	Press **SHIFT (LOCAL)** to clear remote mode. This is not possible when local lockout has been activated by the controller.

Functional Specifications

Function	Subset Name	Description
Source handshaking	SH1	Full source handshaking capability
Acceptor handshaking	AH1	Full acceptor handshaking capability
Talker	T6	Basic talker capability, serial polling, and untalk on MLA (My Listen Address). No talk-only capability.
Listener	L4	Basic listener capability and unlisten on MTA (My Talk Address). No listen-only capability
Service request	SR1	Full service request capability
Remote local	RL1	Full remote/local capability
Parallel polling	PP0	No parallel polling capability
Device clear	DC1	Full device clear capability
Device trigger	DT1	Device trigger capability
Controller	C0	No controller capability
Electric characteristics	E1	Open collector

Switching between Remote and Local Modes

When Switching from Local to Remote Mode

This instrument switches to remote mode when it is in local mode and it receives a REN (Remote Enable) message from the PC.

- The REMOTE indicator illuminates.
- All keys except the **SHIFT (LOCAL)** key are disabled.
- Settings entered in local mode are retained even when this instrument switches to remote mode.

When Switching from Remote to Local Mode

When this instrument is in remote mode and you press **SHIFT (LOCAL)**, this instrument switches to local mode. This key is disabled when local lockout (see page 2-7) has been activated by a controller.

- The REMOTE indicator turns off.
- Key operations are enabled.
- Settings entered in remote mode are retained even when this instrument switches to local mode.

Note

You cannot use the GP-IB interface simultaneously with other interfaces (USB and Ethernet interfaces).

2.3 Connecting to the GP-IB Interface

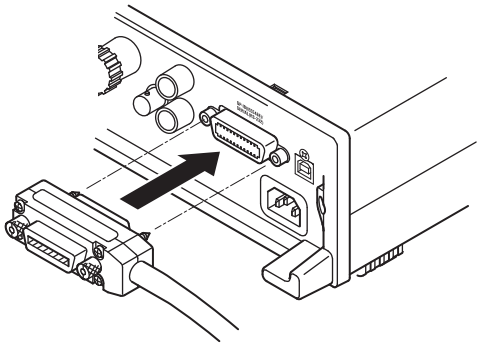
GP-IB Cable

This instrument is equipped with an IEEE St'd 488-1978 24-pin GP-IB connector. Use a GP-IB cable that conforms to this standard.

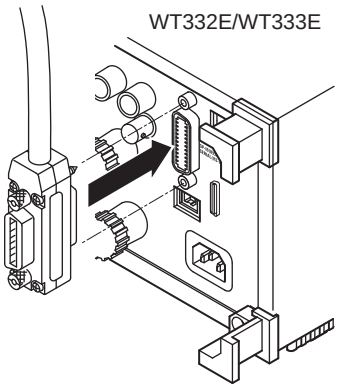
Connection Procedure

Connect the cable as shown below.

WT310E/WT310EH

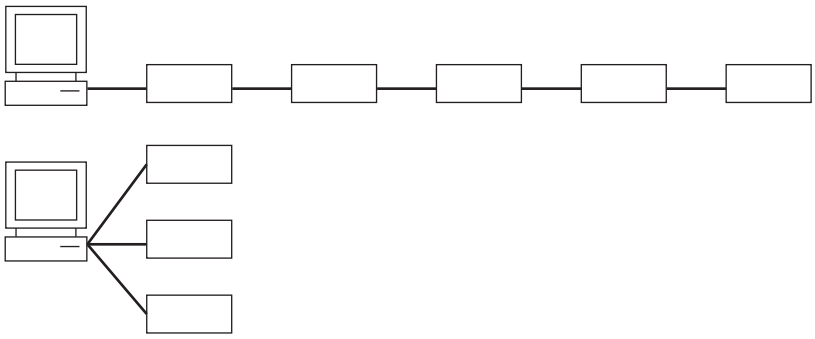


WT332E/WT333E



Notes on Connection

- Firmly tighten the screws on the GP-IB cable connector.
- On the PC end, use a GP-IB board (or card) made by National Instruments. For details, see section 2.2.
- This instrument may not operate properly if this instrument is connected to the PC through converters (such as a GP-IB to USB converter). For more details, contact your nearest YOKOGAWA dealer.
- Several cables can be used to connect multiple devices. However, no more than 15 devices, including the controller, can be connected on a single bus.
- When connecting multiple devices, you must assign a unique address to each device.
- Use cables that are 2 m or shorter in length to connect devices.
- Make sure the total length of all cables does not exceed 20 m.
- When devices are communicating, have at least two-thirds of the devices on the bus turned on.
- To connect multiple devices, wire them in a daisy-chain or star configuration as shown below. You can also mix these configurations. Loop configuration is not allowed.



- On the WT310E and WT310EH, it is physically impossible to connect a GP-IB cable and a USB cable at the same time.

CAUTION

Be sure to turn off the PC and this instrument before you connect or remove communication cables. Otherwise, erroneous operation may result, or the internal circuitry may break.

French

ATTENTION

Veiller à mettre le PC et l'instrument hors tension avant de brancher ou de débrancher les câbles de communication, pour éviter de provoquer des dysfonctionnements ou des courts-circuits internes.

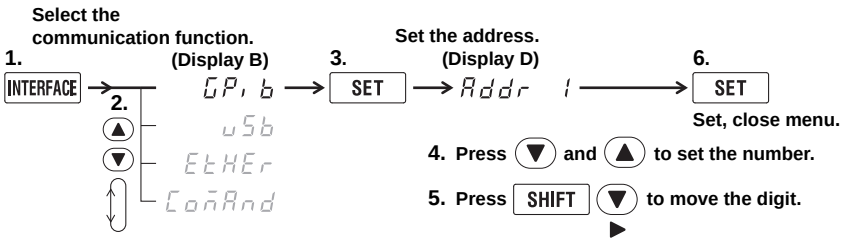
2.4 Configuring the GP-IB Settings of This Instrument

This section explains the following setting for controlling this instrument remotely through a GP-IB interface:

Procedure

Follow the procedure indicated by the thick lines in the following menu.

Setting the GP-IB Address



Note

- Only use one communication interface: USB, GP-IB, or Ethernet. If you send commands simultaneously from more than one communication interface, this instrument will not execute the commands properly.
- When the controller is communicating with this instrument or with other devices through GP-IB, do not change the address.
- Each device that is connected by GP-IB has its own unique address in the GP-IB system. This address is used to distinguish between different devices. Therefore, you must assign a unique address to this instrument when connecting it to a PC or other device.

2.5 Responses to Interface Messages

Responses to Interface Messages

Responses to Uni-Line Messages

- **IFC (Interface Clear)**
  Clears the talker and listener functions. Stops data transmission if it is in progress.
- **REN (Remote Enable)**
  Switches between the remote and local modes.

  IDY (Identify) is not supported.

Responses to Multi-Line Messages (Address commands)

- **GTL (Go To Local)**
  Switches the instrument to local mode.
- **SDC (Selected Device Clear)**
  - Clears the program message (command) being received and the output queue (see page 7-6 for details).
  - Discards *OPC and *OPC? commands that are being executed.
  - Immediately aborts *WAI and COMMunicate:WAIT commands.
- **GET (Group Execute Trigger)**
  The same operation as the *TRG command.

  PPC (Parallel Poll Configure) and TCT (Take Control) are not supported.

Responses to Multi-Line Messages (Universal commands)

- **LLO (Local Lockout)**
  Prohibits switching to local mode by disabling the LOCAL key on the front panel.
- **DCL (Device Clear)**
  The same operation as the SDC message.
- **SPE (Serial Poll Enable)**
  Sets the talker function on all devices on the bus to serial polling mode. The controller will poll each device one by one.
- **SPD (Serial Poll Disable)**
  Clears the serial polling mode of the talker function on all devices on the bus.

  PPU (Parallel Poll Unconfigure) is not supported.

What Are Interface Messages?

Interface messages are also referred to as interface commands or bus commands. They are commands that are issued by the controller. They are classified as follows:

Uni-line Messages

A single control line is used to transmit uni-line messages. The following three types are available.

- IFC (Interface Clear)
- REN (Remote Enable)
- IDY (Identify)

Multi-line Messages

Eight data lines are used to transmit multi-line messages. The messages are classified as follows:

- **Address Commands**

  Some address commands are valid when a device is designated as a listener, and some are valid when it is designated as a talker. The following five commands are available.

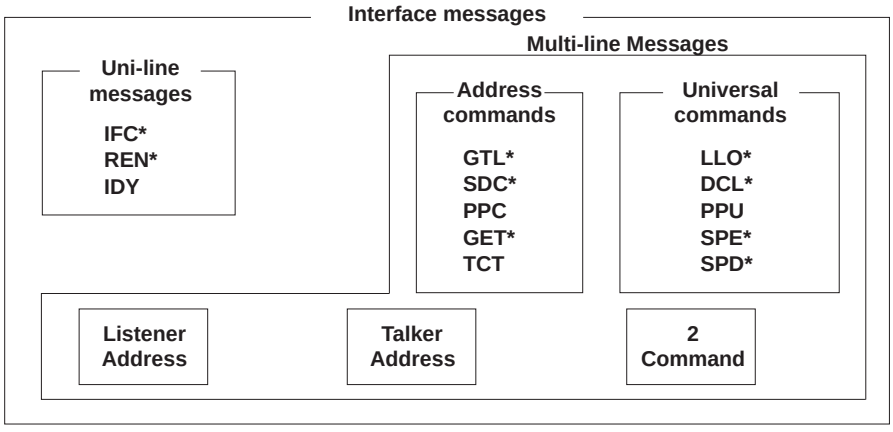
  Commands available to a device designated as a listener
  - GTL (Go To Local)
  - SDC (Selected Device Clear)
  - PPC (Parallel Poll Configure)
  - GET (Group Execute Trigger)

  Commands available to a device designated as a talker
  - TCT (Take Control)

- **Universal Commands**

  Universal commands are available to all devices regardless of their listener or talker designation. The following five commands are available.
  - LLO (Local Lockout)
  - DCL (Device Clear)
  - PPU (Parallel Poll Unconfigure)
  - SPE (Serial Poll Enable)
  - SPD (Serial Poll Disable)

There are other interface messages: listener-address, talk-address, and secondary commands.



This instrument supports interface messages marked with an asterisk.

Note

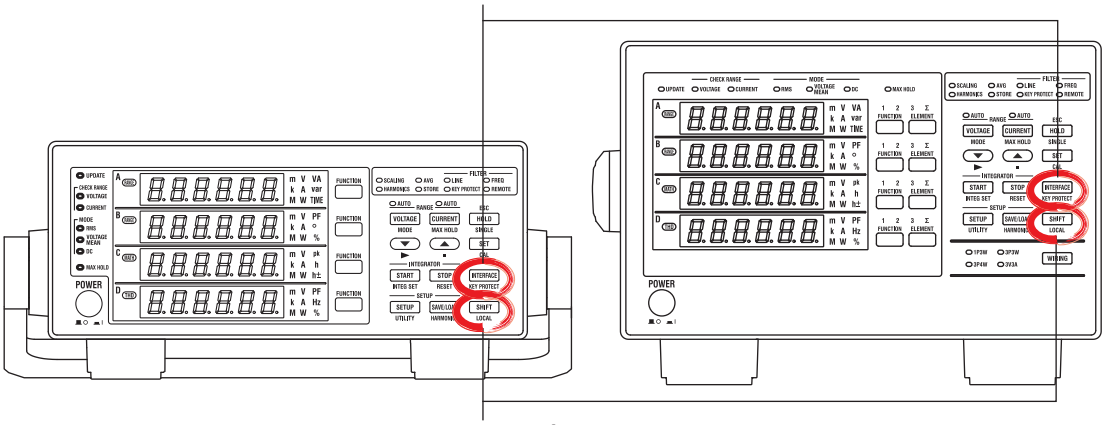
Difference between SDC and DCL

In multi-line messages, SDC messages are those that require talker or listener designation and DCL messages are those that do not require a designation. Therefore, SDC messages are directed at a particular instrument while DCL messages are directed at all instruments on the bus.

3.1 Component Names and Functions

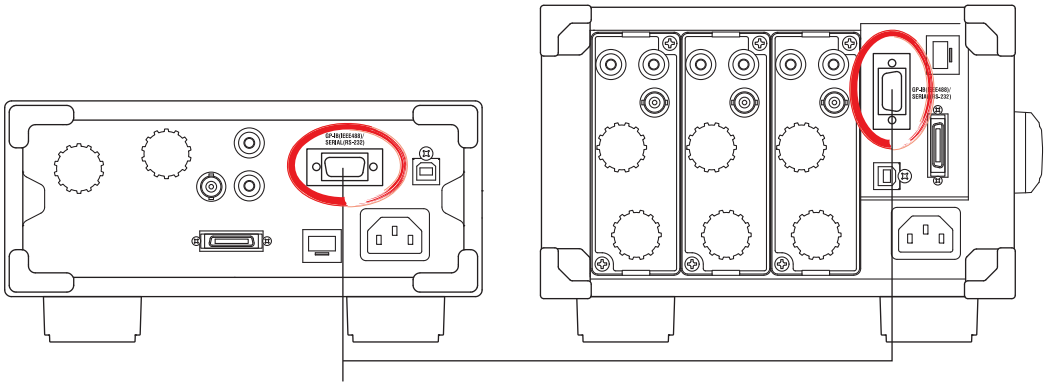
Front Panel

INTERFACE key (page 3-5)
Press this key to set the handshaking, data format, baud rate, or terminator.



LOCAL key
Press this key to switch to local mode. In local mode, remote mode (remote control using communication commands) is cleared, and key operation becomes possible.
This key is disabled when local lockout (see page 3-2) has been activated by a controller.

Rear Panel



RS-232 connector
This port is for connecting this instrument to a controller (such as a PC) using an RS-232 cable. For details on how to connect, see page 3-4.

3.2 RS-232 Interface Features and Specifications

RS-232 Interface Features

Reception Feature

- You can use the reception feature to specify the same settings that you specify by using the front panel keys.
- Output requests for measured and computed data, panel setup parameters, and error codes can be received.

Transmission Feature

- This instrument can transmit measured and computed data.
- This instrument can transmit panel setup parameters and the status byte.
- This instrument can transmit error codes when errors occur.

RS-232 Interface Specifications

Item	Specifications
Electrical specifications	Complies with EIA-574 (EIA-232 (RS-232) standard for 9-pin)
Connection	Point to point
Transmission mode	Full duplex
Synchronization	Start-stop synchronization
Baud rate	1200, 2400, 4800, 9600, 19200, 38400, 57600
Start bit	1 bit (fixed)
Data length	7 or 8 bits
Parity	Even, odd, no parity
Stop bits	1 or 2 bits
Connector	DELC-J9PAF-13L6 (JAE or equivalent)
Hardware handshaking	Select whether to use the CA and CB signals as controller lines or assume that they are always true.
Software handshaking	Transmission and reception can be controlled with X-ON and X-OFF signals. X-ON (ASCII 11H) X-OFF (ASCII 13H)
Receive buffer size	256 bytes.

Switching between Remote and Local Modes

When Switching from Local to Remote Mode

This instrument switches to remote mode when it is in local mode and it receives a `:COMMunicate:REMote ON` command from the PC.

- The REMOTE indicator illuminates.
- All keys except the **SHIFT (LOCAL)** key are disabled.
- Settings entered in local mode are retained even when this instrument switches to remote mode.

When Switching from Remote to Local Mode

When this instrument is in remote mode and you press SHIFT (LOCAL), this instrument switches to local mode. However, this does not work if this instrument has received a :COMMunicate:LOCKout ON command from the PC. This instrument switches to local mode when it receives a :COMMunicate:REMote OFF command from the PC, regardless of the local lockout state.

- The REMOTE indicator turns off.
- Key operations are enabled.
- Settings entered in remote mode are retained even when this instrument switches to local mode.

Note

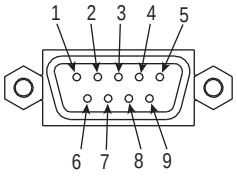
You cannot use the RS-232 interface simultaneously with other communication interfaces (USB and Ethernet interfaces).

3.3 Connecting to the RS-232 Interface

To connect this instrument to a PC, use an interface cable that is compatible with this instrument specifications. Be sure to align the handshaking, data transfer rate, data format, and so on with the PC. For the settings, see section 3.4.

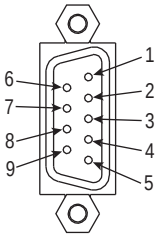
Connector and Signal Names

WT310E/WT310EH



DELC-J9PAF-13L6 or equivalent

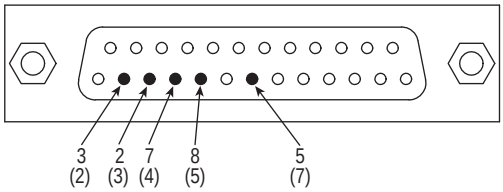
WT332E/WT333E



Pin No.	Signal Name	Input or Output	Function
2	RD (Received Data)	Input	Data received from the PC
3	SD (Send Data)	Output	Data sent to the PC
5	SG (Signal Ground)	----	Signal ground
7	RS (Request to Send)	Output	Handshaking signal for receiving data from the PC
8	CS (Clear to Send)	Input	Handshaking signal for sending data to the PC

* Pins 1, 4, 6, and 9 are not used.

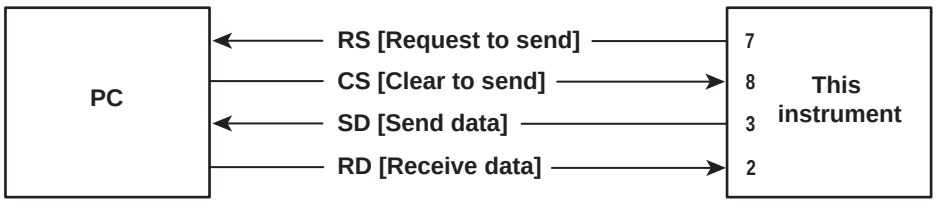
9-pin to 25-pin Adapter and Signal Names



Numbers in parentheses are pin numbers for the 25-pin connector.

Signal Direction

The following figure shows the directions of the signals of this instrument RS-232 interface.



RS-232 Standard Signals and Their JIS and CCITT Abbreviations

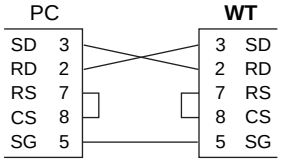
Pin No. (9-pin connector)	Abbreviation			Name
	RS-232	CCITT	JIS	
5	AB (GND)	102	SG	Signal ground
3	BA (TXD)	103	SD	Transmitted data
2	BB (RXD)	104	RD	Received data
7	CB (CTS)	105	RS	Request to send
8	CA (RTS)	106	CS	Clear to send

Signal Wiring Example

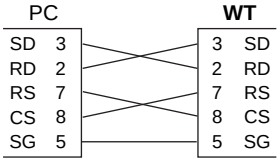
The pin numbers are for the 9-pin connector.

In general, use a crossover cable.

OFF-OFF / XON-XON



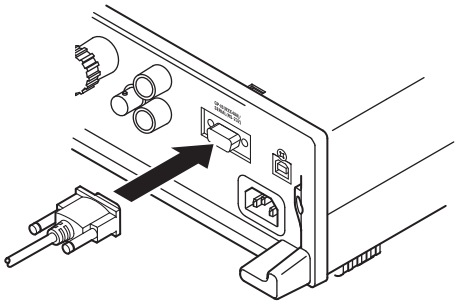
CTS-RTS (CS-RS)



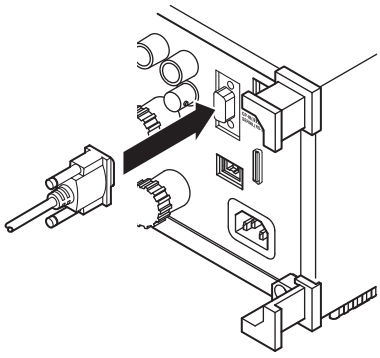
Connection Procedure

Connect the cable as shown below.

WT310E/WT310EH



WT332E/WT333E

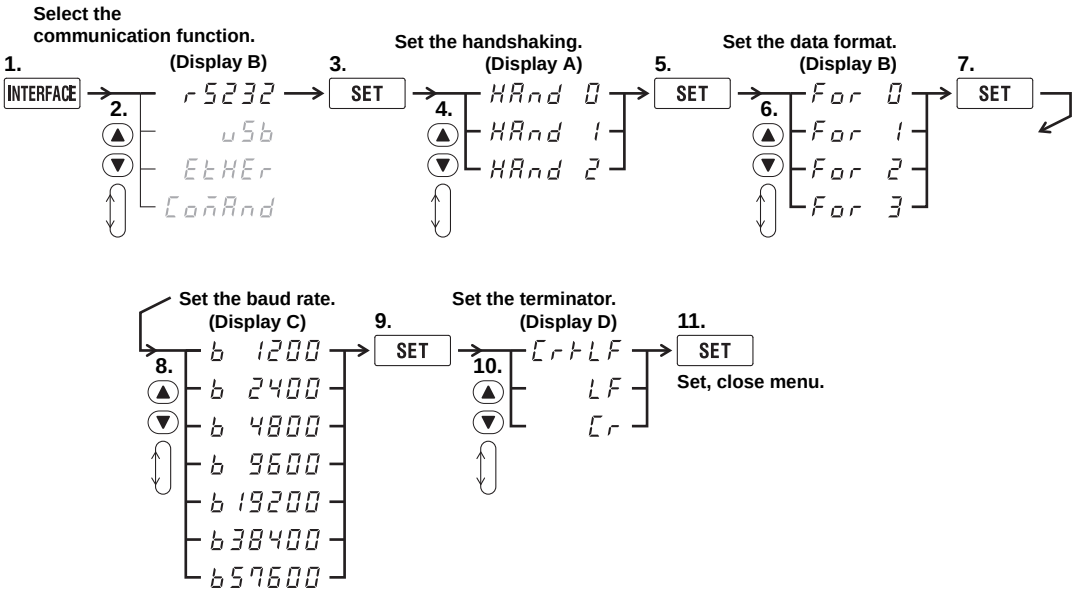


3.4 Configuring the RS-232 Settings of This Instrument

This section explains the following setting for controlling this instrument remotely through a RS-232 interface:

Procedure

Follow the procedure indicated by the thick lines in the following menu.



Note

Only use one communication interface: USB, RS-232, or Ethernet. If you send commands simultaneously from more than one communication interface, this instrument will not execute the commands properly.

Explanation

Handshaking

To use the RS-232 interface to communicate with a PC, the devices on both sides must negotiate a set of rules to ensure the proper transfer of data. This negotiation is called handshaking. Because there are many handshaking methods that can be used between this instrument and the PC, you must make sure that the same method is chosen by both this instrument and the PC.

You can choose any of handshaking methods shown below.
NO-NO, XON-XON, CS-RS

Handshaking		Data Transmission Control (Sending data to the PC)			Data Reception Control (Receiving data from the PC)		
		Software Handshaking	Hardware Handshaking	No handshaking	Software Handshaking	Hardware Handshaking	No handshaking
	WT Menu	Stop sending when X-OFF is received; resume when X-ON is received.	Stop sending when CB (CTS) is false; resume when it is true.		Send X-OFF when the receive buffer is 3/4 full; send X-ON when it is 1/4 full.	Set CA (RTS) to false when the receive buffer is 3/4 full; set CA (RTS) to it is 1/4 full.	
OFF-OFF	HAnd 0			Yes			Yes
XON-XON	HAnd 1	Yes			Yes		
CS-RS	HAnd 2		Yes			Yes	

OFF-OFF

Data Transmission Control

There is no handshaking between this instrument and the PC. The “X-OFF” and “X-ON” signals are treated as data, and the CS signal is ignored.

Data Reception Control

There is no handshaking between this instrument and the PC. When the receive buffer is full, excessive data is discarded.
RS is fixed to true.

XON-XON

Data Transmission Control

Software handshaking is performed between this instrument and the PC. When this instrument receives an “X-OFF” code from the PC while it is sending data, it stops the data transmission. It resumes the operation when it receives a “X-ON” code. The CS signal received from the PC is ignored.

Data Reception Control

Software handshaking is performed between this instrument and the PC. When the free area of the receive buffer falls to 64 bytes, this instrument sends an “X-OFF” code to the PC. When the free area reaches 192 bytes, this instrument sends an “X-ON” code.
RS is fixed to true.

CS-RS

Data Transmission Control

Hardware handshaking is performed between this instrument and the PC. If CS is set to false while this instrument is sending data, it stops the data transmission. Then, if CS is set to true, it resumes the operation. The “X-OFF” and “X-ON” signals are treated as data.

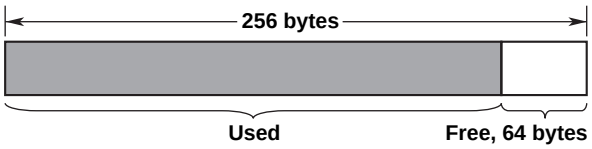
Data Reception Control

Hardware handshaking is performed between this instrument and the PC. When the free area of the receive buffer falls to 64 bytes, this instrument sets RS to false. When the free area reaches 192 bytes, this instrument sets RS to true.

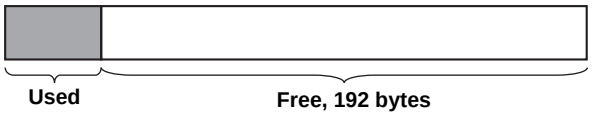
Notes on Data Reception Control

When handshaking is used to control the reception of data, data may still be received from the PC even when the free space in the receive buffer drops below 64 bytes. In such cases, if the receive buffer becomes full, excessive data will be discarded, regardless of the handshaking method. When more space becomes available, data storage resumes.

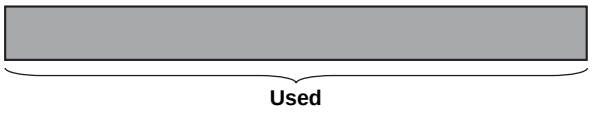
Data reception control using handshaking



When handshaking is in use and the free space in the buffer drops to 64 bytes (because the data in the buffer cannot be passed to the internal program fast enough), data reception stops.



Data continues to be passed to the internal program. If the free space in the buffer reaches 192 bytes, data reception resumes.



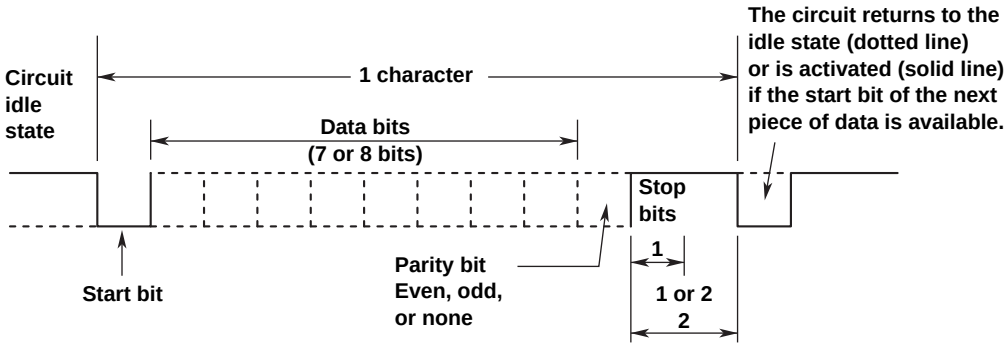
Regardless of the handshaking method, if the buffer becomes full, excessive data will be discarded.

Note

You must design PC programs so that the receive buffers of both this instrument and PC do not become full.

Data Format

The RS-232 interface of this instrument performs communication using start-stop synchronization. In start-stop synchronization, characters are transmitted one at a time. Each character consists of a start bit, data bits, a parity bit, and a stop bit (see the following figure).



Select the data length and parity stop bit from the following options.
8-NO-1, 7-EVEN-1, 7-ODD-1, 7-NO-2

WT Menu	Start bit	Data length	Parity	Stop bits
For 0	1	8	None	1
For 1	1	7	Odd	1
For 2	1	7	Even	1
For 3	1	7	None	2

Baud rate

Select from the following baud rates.
1200, 2400, 4800, 9600, 19200, 38400, 57600

Terminator

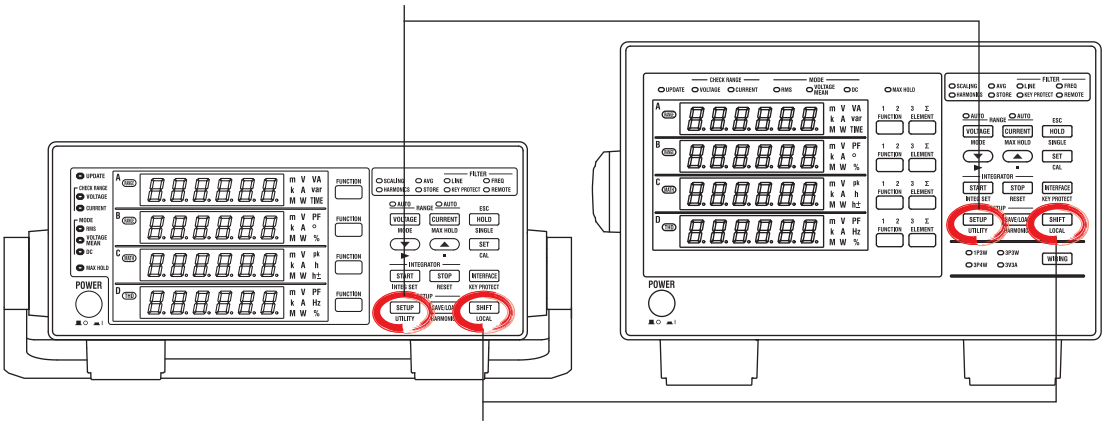
Select the terminator to use when sending data from this instrument.
Cr, Lf, Cr+Lf

Use “LF” or “Cr+Lf” for the terminator when sending data to this instrument.

4.1 Component Names and Functions

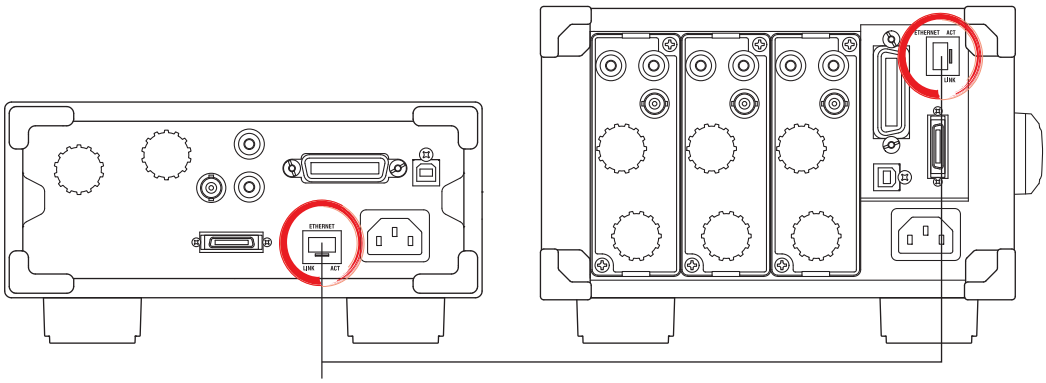
Front Panel

UTILITY key (page 4-4)
Press this key to configure TCP/IP settings.



LOCAL key
Press this key to switch to local mode. In local mode, remote mode (remote control using communication commands) is cleared, and key operation becomes possible.
This key is disabled when local lockout (see page 4-2) has been activated by a controller.

Rear Panel



Ethernet port
This port is for connecting this instrument to a controller (such as a PC) using an Ethernet cable. For details on how to connect, see page 4-3.

4.2 Ethernet Interface Features and Specifications

Ethernet Interface Features

Reception Feature

- You can use the reception feature to specify the same settings that you specify by using the front panel keys.
- Output requests for measured and computed data, panel setup parameters, and error codes can be received.

Transmission Feature

- This instrument can transmit measured and computed data.
- This instrument can transmit panel setup parameters and the status byte.
- This instrument can transmit error codes when errors occur.

Ethernet Interface Specifications

Item	Specifications
Electrical and mechanical	IEEE802.3
Simultaneous connections	1
Communication protocol	TCP/IP (VXI-11, Modbus/TCP)
Connector type	RJ-45

Switching between Remote and Local Modes

When Switching from Local to Remote Mode

This instrument switches to remote mode when it is in local mode and it receives a `:COMMunicate:REMote ON` command from the PC.

- The REMOTE indicator illuminates.
- All keys except the **SHIFT (LOCAL)** key are disabled.
- Settings entered in local mode are retained even when this instrument switches to remote mode.

When Switching from Remote to Local Mode

When this instrument is in remote mode and you press SHIFT (LOCAL), this instrument switches to local mode. However, this does not work if this instrument has received a `:COMMunicate:LOCKout ON` command from the PC. This instrument switches to local mode when it receives a `:COMMunicate:REMote OFF` command from the PC, regardless of the local lockout state.

- The REMOTE indicator turns off.
- Key operations are enabled.
- Settings entered in remote mode are retained even when this instrument switches to local mode.

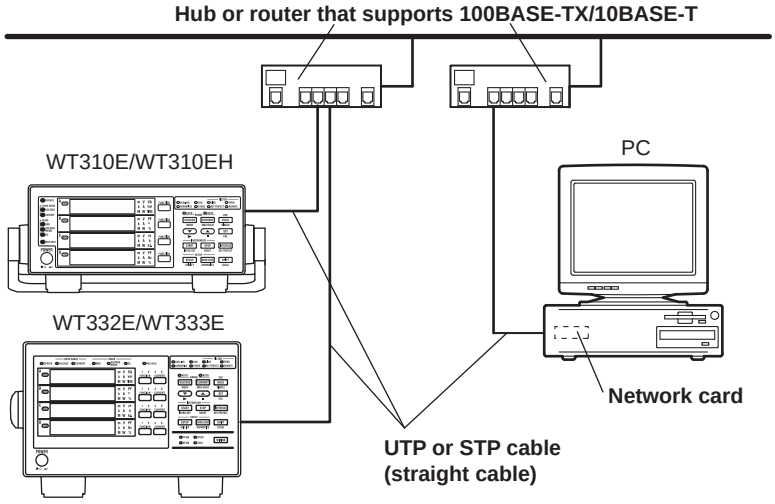
Note

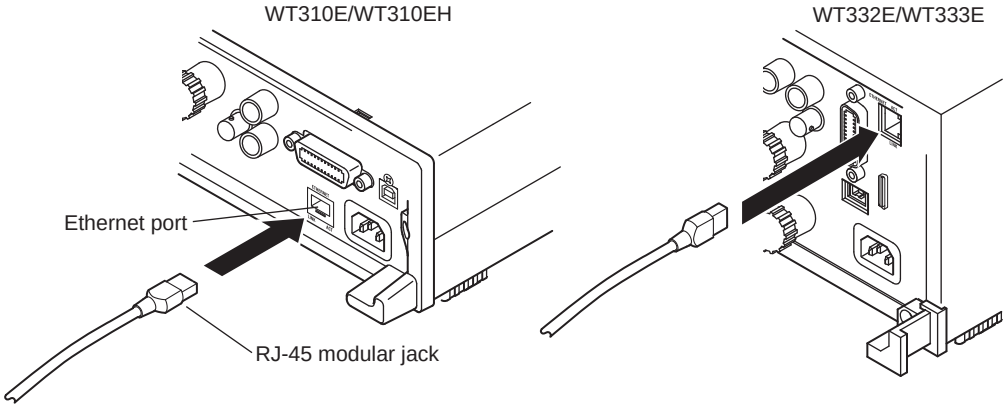
You cannot use the Ethernet interface simultaneously with other interfaces (GP-IB, RS-232, and USB).

4.3 Connecting to the Ethernet Interface

Connection Procedure

Connect a UTP (Unshielded Twisted-Pair) or STP (Shielded Twisted-Pair) cable that is connected to a hub or other network device to the Ethernet port on the rear panel of this instrument.





Notes on Connection

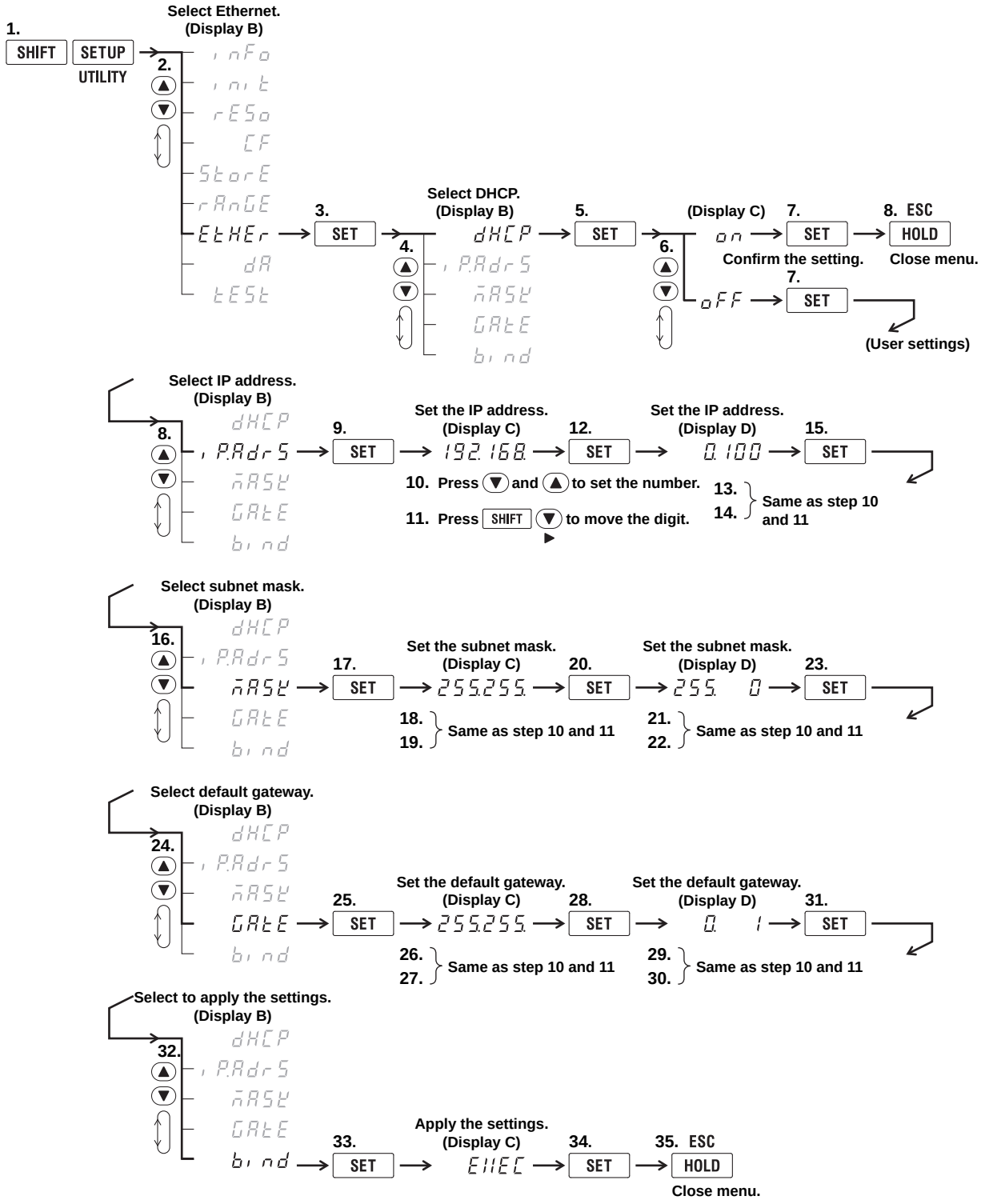
- To connect this instrument to a PC, be sure to use straight cables and to connect through a hub or router. Proper operation is not guaranteed for a one-to-one connection using a crossover cable.
- Use a network cable that supports the data rate of your network.

4.4 Configuring the Ethernet Settings of This Instrument

This section explains the following setting for remotely controlling this instrument via the Ethernet interface:

Procedure

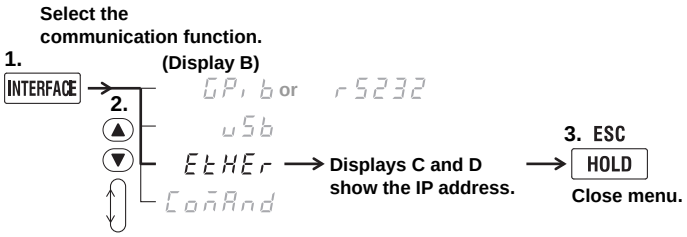
Follow the procedure indicated by the thick lines in the following menu.



Note

Only use one communication interface: USB, GP-IB, RS-232, or Ethernet. If you send commands simultaneously from more than one communication interface, this instrument will not execute the commands properly.

You can view the IP address that has been assigned by the DHCP server or the IP address that you specified by following the procedure below.



Explanation

Configuring the TCP/IP Settings

To use the Ethernet interface, you must specify TCP/IP settings.

DHCP

DHCP is a protocol that temporarily allocates necessary information to a device so that it can connect to the Internet.

ON

If you are connecting this instrument to a network with a DHCP server, you can turn on the DHCP setting. If you do, the IP address will be automatically assigned to this instrument when it is connected to the network, so you do not have to set the address.

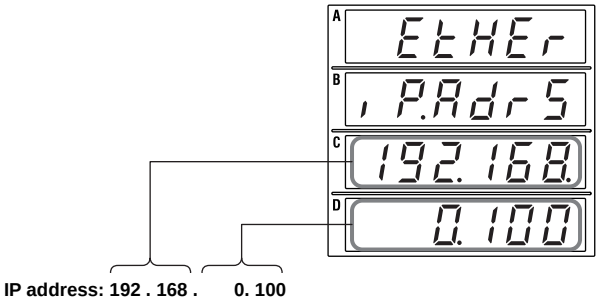
OFF

If you set DHCP to OFF, set the appropriate IP address, subnet mask, and default gateway for your network.

IP Address, Subnet Mask, and Default Gateway

The IP address, subnet mask, and default gateway appear in the following positions on the displays of this instrument.

IP address display example



Applying the Settings

The TCP/IP settings are applied when:

- You select EXEC on the Bind menu and press SET.
- You restart this instrument.

5.1 Messages

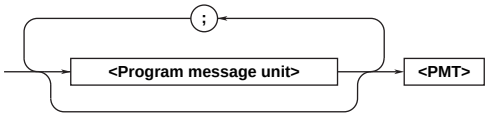
Messages

Messages are used to exchange information between the controller and this instrument. Messages that are sent from the controller to this instrument are called program messages, and messages that are sent from this instrument back to the controller are called response messages.

If a program message contains a command that requests a response (a query), this instrument returns a response message upon receiving the program message. This instrument returns a single response message in response to a single program message.

Program Messages

The program message format is shown below.



<Program Message Unit>

A program message consists of one or more program message units. Each unit corresponds to one command. This instrument executes the commands in the order that they are received.

Separate each program message unit with a semicolon.

For details on the program message syntax, see the next section.

Example `:INPut:MODE RMS;CFACtor 3<PMT>`

Unit **Unit**

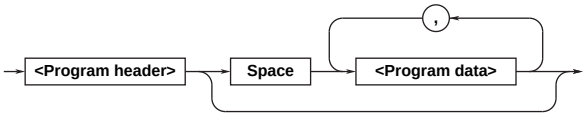
<PMT>

This is a program message terminator. The following three types are available.

NL (new line):	Same as LF (line feed). ASCII code “0AH.”
^END:	The END message as defined by IEEE 488.1 (The data byte that is sent with the END message is the last data byte of the program message.)
NL^END:	NL with an END message attached. (NL is not included in the program message.)

Program Message Unit Syntax

The program message unit syntax is shown below.



<Program Header>

The program header indicates the command type. For details, see page 5-3.

(Program Data>

Attach program data if there are conditions that are required to execute a command. Separate the program data from the header with a space (ASCII code 20H). If there are multiple sets of program data, separate each set with a comma.

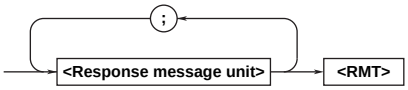
For details, see page 5-6.

Example `:INPut:CFACtor 3<PMT>`

Header Data

Response Messages

The response message syntax is as follows:



<Response Message Unit>

A response message consists of one or more response message units. Each unit corresponds to one response.

Separate each response message unit with a semicolon.

For details on the response message syntax, see the next page.

Example

`:INPUT:FILTER:LINE 0;FREQUENCY 0<RMT>`

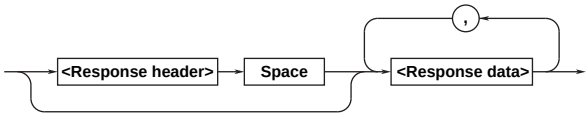
Unit **Unit**

<RMT>

RMT is a response message terminator. It is NL^END.

Response Message Unit Syntax

The response message unit syntax is as follows:



<Response Header>

A response header sometimes precedes the response data. Separate the data from the header with a space. For details, see page 5-5.

<Response Data>

Response data contains the content of the response. If there are multiple sets of response data, separate each set with a comma. For details, see page 5-5.

Example

```
100.00E-03<RMT>   :INPUT:MODE RMS<RMT>
```

Data — Header — Data

If there are multiple queries in a program message, responses are returned in the same order that the queries were received in. In most cases, a single query returns a single response message unit, but there are a few queries that return multiple units. The first response message unit always corresponds to the first query, but the nth response unit may not necessarily correspond to the nth query. Therefore, if you want to make sure that every response is retrieved, divide the program messages into individual messages.

Precautions to Be Taken when Sending and Receiving Messages

- If the controller sends a program message that does not contain a query, the controller can send the next program message at any time.
- If the controller sends a program message that contains a query, the controller must finish receiving the response message before it can send the next program message. If the controller sends the next program message before receiving the response message in its entirety, an error will occur. A response message that is not received in its entirety will be discarded.
- If the controller tries to receive a response message when there is none, an error will occur. If the controller tries to receive a response message before the transmission of the program message is complete, an error will occur.
- If the controller sends a program message containing multiple message units, but the message contains incomplete units, this instrument will try to execute the ones that are believed to be complete. However, these attempts may not always be successful. In addition, if such a message contains queries, this instrument may not necessary return responses.

Deadlock

This instrument can store at least 1024 bytes of messages in its transmit and receive buffers (the number of available bytes varies depending on the operating conditions). If both the transmit and receive buffers become full at the same time, this instrument will no longer be able to operate. This condition is called a deadlock. If this happens, you can resume operation by discarding response messages. Deadlock will not occur if the program message (including the <PMT>) is kept below 1024 bytes. Program messages that do not contain queries never cause deadlocks.

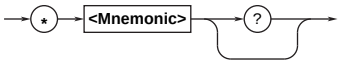
5.2 Commands

Commands

There are three types of commands (program headers) that a controller may send to this instrument. The commands differ in their program header formats.

Common Command Header

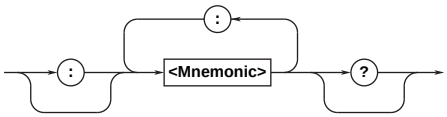
Commands that are defined in IEEE 488.2-1992 are called common commands. The common command header syntax is shown below. Be sure to include an asterisk (*) at the beginning of a common command.



Common command example: `*CLS`

Compound Header

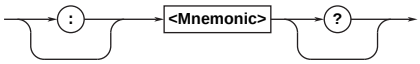
Commands, other than common commands, that are specific to this instrument are classified and arranged in a hierarchy according to their functions. The compound header syntax is shown below. Be sure to use a colon to specify a lower hierarchical level.



Compound header example: `:INPut:MODE`

Simple Header

These commands are functionally independent and are not contained within a hierarchy. The format of a simple header is shown below.



Simple header example: `:HOLD`

Note

A <mnemonic> is an alphanumeric character string.

When Concatenating Commands

- **Command Groups**
  A command group is a group of commands that have common compound headers arranged in a hierarchy. A command group may contain sub-groups.

  Example A portion of the commands from the integration command group
  ```
  :INTEGrate?
  :INTEGrate:MODE
  :INTEGrate:TIMer
  :INTEGrate:STARt
  :INTEGrate:STOP
  :INTEGrate:RESet
  ```

- **When Concatenating Commands of the Same Group**
  This instrument stores the hierarchical level of the command that is currently being executed and processes the next command on the assumption that it belongs to the same level. Therefore, the common header section can be omitted for commands that belong to the same group.
  Example
  ```
  :INTEGrate:MODE NORMal;
  TIMer 1,0,0<PMT>
  ```

- **When Concatenating Commands of Different Groups**
  If the subsequent command does not belong to the same group, place a colon in front of the header (this colon cannot be omitted).
  Example
  ```
  :INTEGrate:MODE NORMal;:INPut:
  MODE RMS<PMT>
  ```

- **When Concatenating Simple Headers**
  If a simple header follows another command, place a colon in front of the simple header (this colon cannot be omitted).
  Example
  ```
  :INTEGrate:MODE NORMal;:HOLD
  ON<PMT>
  ```

- **When Concatenating Common Commands**
  Common commands that are defined in IEEE 488.2-1992 are independent of hierarchy. A colon is not needed before a common command.
  Example
  ```
  :INTEGrate:MODE NORMal;*CLS;:
  INTEGrate:TIMer 1,0,0<PMT>
  ```

- **When Separating Commands with <PMT>**
  If you separate two commands with a terminator, two program messages will be sent. Therefore, the common header must be specified for each command even when commands belonging to the same command group are being concatenated.
  Example
  ```
  :INTEGrate:MODE NORMal<PMT>:
  INTEGrate:TIMer 1,0,0<PMT>
  ```

Upper-level Query

An upper-level query is a query that is made by appending a question mark to a command higher in the group. The controller can receive all of the settings in a group collectively by executing a highest-level query. Some query groups which are comprised of more than three hierarchical levels can output all the lower level settings.

Example `:INTEGrate?<PMT> -> :INTEGRATE :MODE NORMAL;TIMER 0,0,0<RMT>`

The response to an upper-level query can be sent back to this instrument as a program message. This enables the settings that were present when the upper-level query was made to be reproduced later on. However, some upper-level queries do not return setup parameters that are not currently in use. Exercise caution because not all of a group's information is necessarily returned in a response.

Header Interpretation Rules

This instrument interprets the header that it receives according to the rules below.

- Mnemonics are not case sensitive.
  Example "`INPut`" can also be written as "`input`" or "`INPUT`."
- The lower-case characters can be omitted.
  Example "`INPut`" can also be written as "`INPu`" or "`INP`."
- The question mark at the end of a header indicates that it is a query. You cannot omit the question mark.
  Example The shortest abbreviation for "`INPut?`" is "`INP?`."
- If the <x> (value) at the end of a mnemonic is omitted, it is interpreted as a 1.
  Example If "`ELEMent`" is written as "`ELEM`," it means "`ELEMent1`."
- Parts of commands and parameters enclosed in square brackets ([ ]) can be omitted.
  Example "`[:INPut]:SCALing[:STATe] ON`" can be written as "`SCAL ON`."
  However, the last section enclosed in square brackets cannot be omitted in an upper-level query.
  Example "`SCALing?`" and "`SCALing:STATe?`" are different queries.

5.3 Responses

Response

When the controller sends a message unit that has a question mark in its program header (a query), this instrument returns a response message to the query. This instrument returns response messages in one of the following two forms.

- **Response Consisting of a Header and Data**
  Responses that can be used as program messages without any changes are returned with command headers attached.
  Example `:INTEGrate:MODE?<PMT> ->`
  `:INTEGRATE:MODE NORMAL<RMT>`

- **Response Consisting Only of Data**
  Responses that cannot be used as program messages unless changes are made (query-only commands) are returned without headers. However, there are query-only commands whose responses this instrument will attach headers to.
  Example `INTEGrate:STATe?<PMT> ->`
  `RESET<RMT>`

If You Want this instrument to Return Responses without Headers

You can configure this instrument so that even responses that have both headers and data are returned without headers. Use the `COMMunicate:HEADer` command for this purpose.

Abbreviated Form

This instrument normally returns response headers with the lower-case section removed. You can configure this instrument so that full headers are returned. Use the `COMMunicate:VERBose` command for this purpose. The sections enclosed in square brackets ([ ]) are also omitted in the abbreviated form.

5.4 Data

Data

Data contains conditions and values that are written after the header. A space separates the data from the header. Data is classified as follows:

Data	Description
<Decimal>	A value expressed in decimal notation (Example: VT ratio setting `->[:INPut]:SCALing:VT 100`)
<Voltage><Current> <Time>	A physical value (Example: Voltage range setting `->[:INPut]:VOLTage:RANge 150V`)
<Register>	A register value expressed as binary, octal, decimal, or hexadecimal (Example: Extended event register value `->:STATUS:EESE #HFE`)
<Character data>	Predefined character string (mnemonic). Select from the available strings in braces. (Example: Measurement mode selection `->[:INPut]:MODE {RMS|VMEan|DC}`)
<Boolean>	Indicates on and off. Specify ON, OFF, or a value. (Example: Turning data hold on `->:HOLD ON`)
<String data>	An arbitrary character string (Example: Model code response `->:SYSTEM:MODEL "WT310E"`)
<Block data>	Data that contains 8-bit values (Example: Measured data (binary format) response `-> #40012ABCDEFGHIJKL`)

<Decimal>

<Decimal> indicates a value expressed as a decimal number, as shown in the table below. Decimal values are written in the NR form as specified in ANSI X3.42-1975.

Symbol	Meaning	Example		
<NR1>	Integer	`125`	`-1`	`+1000`
<NR2>	Fixed-point number	`125.0`	`-.90`	`+001.`
<NR3>	Floating-point number	`125.0E+0`	`-9E-1`	`+.1E4`
<NRf>	Any of the forms <NR1> to <NR3>			

- This instrument can receive decimal values that are sent from the controller in any of the forms <NR1> to <NR3>. This is expressed as <NRf>.
- This instrument returns a response to the controller in one of the forms from <NR1> to <NR3> depending on the query. The same form is used regardless of the size of the value.
- For the <NR3> form, the plus sign after the “E” can be omitted. You cannot omit the minus sign.
- If a value outside the range is entered, the value is adjusted to the closest value within the range.
- If a value has more significant digits than are available, the value will be rounded.

<Voltage>, <Current>, and <Time>

<Voltage>, <Current>, and <Time> indicate decimal values that have physical significance. A <Multiplier> or <Unit> can be attached to the form that was described earlier. The following types of expressions are possible.

Form	Example
<NRf><Multiplier><Unit>	`5MV`
<NRf><Unit>	`5E-3V`
<NRf><Multiplier>	`5M`
<NRf>	`5E-3`

<Multiplier>

Multipliers that you can use are indicated in the following table.

Symbol	Word	Multiplier
EX	Exa	10^{18}
PE	Peta	10^{15}
T	Tera	10^{12}
G	Giga	10^{9}
MA	Mega	10^{6}
K	Kilo	10^{3}
M	Milli	10^{-3}
U	Micro	10^{-6}
N	Nano	10^{-9}
P	Pico	10^{-12}
F	Femto	10^{-15}

<Unit>

Units that you can use are indicated in the following table.

Symbol	Word	Meaning
V	Volt	Voltage
A	Ampere	Current
S	Second	Time

- <Multiplier> and <Unit> are not case sensitive.
- “U” is used to indicate micro (”μ”).
- “MA” is used for Mega to distinguish it from Milli. However, “MA” is interpreted as milliampere for current.
- If both <Multiplier> and <Unit> are omitted, the basic unit (V, A, or S) is used.
- Response messages are always expressed in the <NR3> form. Additionally, they are returned in the basic form, without a multiplier or unit attached.

<Register>

<Register> indicates an integer, and can be expressed in hexadecimal, octal, or binary as well as a decimal number. This is used when each bit of the value has a particular meaning. The following types of expressions are possible.

Form	Example
<NRf>	1
#H<Hexadecimal value made up of 0 to 9 and A to F>	#H0F
#Q<Octal value made up of 0 to 7>	#Q777
#B<Binary value made up of 0 and 1>	#B001100

- <Register> is not case sensitive.
- Response messages are always expressed in the <NR1> form.

<Character Data>

<Character Data> is a specified string of character data (a mnemonic). It is mainly used to indicate options and is chosen from the character strings given in { }. The data interpretation rules are the same as those described in “Header Interpretation Rules” on page 5-4.

Form	Example
{RMS|VMEan|DC}	RMS

- As with the header, the COMMunicate:VERBose command can be used to select whether to return the response in the full form or in the abbreviated form.
- The COMMunicate:HEADer setting does not affect <Character data>.

<Boolean>

<Boolean> is data that indicates ON or OFF. The following types of expressions are possible.

Form	Example
{ON|OFF|<NRf>}	ON OFF 1 0

- When <NRf> is expressed in the form, “OFF” is selected if the rounded integer value is 0, and “ON” is selected for all other cases.
- A response message is always returned with a 1 if the value is ON and with a 0 if the value is OFF.

<String Data>

<String data> is not a specified character string like <Character data>. It is an arbitrary character string. The character string must be enclosed in single quotation marks (') or double quotation marks (").

Form	Example
<String data>	'ABC' "IEEE488.2-1992"

- If a character string contains a double quotation mark ("), the double quotation mark is expressed as two consecutive quotation marks (""). This rule also applies to single quotation marks.
- A response message is always enclosed in double quotation marks (").
- <String data> is any character string. Therefore, the instrument assumes that the remaining program message units are part of the character string if no closing single (') or double quotation mark (") is encountered. As a result, no error is detected if a quotation mark is omitted.

<Block Data>

<Block data> contains 8-bit values. It is only used in response messages on this instrument. The syntax is as follows:

Form	Example
#N<N-digit decimal number> <Data byte sequence>	#800000010ABCDEFGHIJ

- #N
  Indicates that the data is <Block data>. N indicates the number of succeeding data bytes (digits) in ASCII code.
- <N-digit decimal number>
  Indicates the number of bytes of data (example: 00000010 = 10 bytes).
- <Data byte sequence>
  Expresses the actual data (example: ABCDEFGHIJ).
- Data is comprised of 8-bit values (0 to 255). This means that the ASCII code “0AH,” which stands for “NL,” can also be included in the data. Hence, care must be taken when programming the controller.

5.5 Synchronization with the Controller

Overlap and Sequential Commands

There are two types of commands: overlap and sequential. With overlap commands, the execution of the next command may start before the execution of the previous command is finished. With sequential commands, the execution of the next command is held until the execution of the previous command is finished (even if multiple commands are sent consecutively). All commands of this instrument are sequential commands. Even when only sequential commands are available, there are times when it is necessary to achieve synchronization to properly query the measured data. For example, if you want to query the most recent numeric data each time that the measured data is updated, you can attempt to do this by sending the `:NUMeric[:NORMal]:VALue?` command with some arbitrary timing. However, because this instrument returns the current measured data regardless of whether the measured data has been updated since the previous query, this method may return data that is the same as the previous data. If this happens, you must use the following method to synchronize with the end of measured data updating.

- **Using the STATus:CONDition? Query**
  `STATus:CONDition?` is used to query the contents of the condition register (see page 7-5). You can determine whether the measured data is being updated by reading bit 0 of the condition register. If bit 0 of the condition register is 1, the measured data is being updated. If it is 0, the measured data can be queried.
  However, in the case of this instrument, it is difficult to determine the updating of measured data with `STATus:CONDition?` because the period during which bit 0 of the condition register remains at 1 is very short.

- **Using the Extended Event Register**
  The changes in the condition register can be reflected in the extended event register (see page 6-5 for details).

  Example
  ```
  :STATus:FILTer1 FALL;:STATus:EESE 1;EESR?;*SRE 8<PMT>
  (Read the response to STATus:EESR?)
  Loop
  (Wait for a service request)
  :NUMeric[:NORMal]:VALue?<PMT>
  (Read the response to :NUMeric[]NORMal]:VALue?)
  :STATus:EESR?<PMT>
  (Read the response to STATus:EESR?)
  (Return to Loop)
  ```

  The `STATus:FILTer1 FALL` command sets the transition filter so that bit 0 in the extended event (FILTer1) is set to 1 when bit 0 in the condition register changes from 1 to 0, in other words when the updating of measured data is finished.
  The `STATus:EESE 1` command is used to only change the status byte based on bit 0 in the extended event register.
  The `STATus:EESR?` command is used to clear the extended event register.
  The `*SRE 8` command is used to generate service requests based only on the changes in the extended event register bits.
  The `:NUMeric[:NORMal]:VALue?` command is not executed until a service request is generated.

- **Using the COMMunicate:WAIT Command**
  The `COMMunicate:WAIT` command is used to wait for a specific event to occur.

  Example
  ```
  :STATus:FILTer1 FALL;:STATus:EESR?<PMT>
  (Read the response to STATus:EESR?)
  Loop
  COMMunicate:WAIT 1<PMT>
  :NUMeric[:NORMal]:VALue?<PMT>
  (Read the response to :NUMeric[]NORMal]:VALue?)
  :STATus:EESR?<PMT>
  (Read the response to STATus:EESR?)
  (Return to Loop)
  ```

  For a description of `STATus:FILTer1 FALL` and `STATus:EESR?`, see the previous section about the extended event register.
  The `COMMunicate:WAIT 1` command specifies that the program will wait for bit 0 in the extended event register to be set to 1.
  `:NUMeric[:NORMal]:VALue?` is not executed until bit 0 in the extended event register becomes 1.

6.1 List of Commands

Command	Function	Page
AOUTput Group		
:AOUTput?	Queries all D/A output settings.	6-5
:AOUTput[:NORMal]:PRESet	Sets the D/A output items to their default values.	6-5
:AOUTput[:NORMal]:CHANnel<x>	Sets or queries a D/A output item (function or element).	6-5
:AOUTput[:NORMal]:IRTime	Sets or queries the rated integration time that is used in the D/A output of the integrated value.	6-5
:AOUTput[:NORMal]:MODE<x>	Sets or queries a D/A range mode.	6-5
:AOUTput[:NORMal]:RATE<x>	Sets or queries the maximum and minimum values for when the D/A output is in manual range mode. Sets or queries the comparison upper and lower limits for when the D/A output is in comparator mode.	6-6
COMMunicate group		
:COMMunicate?	Queries all communication settings.	6-7
:COMMunicate:HEADer	Sets or queries whether headers are attached to query responses.	6-7
:COMMunicate:LOCKout	Sets/clears local lockout.	6-7
:COMMunicate:REMote	Sets this instrument to remote or local mode. ON is remote mode.	6-7
:COMMunicate:STATus?	Queries the line-specific status.	6-7
:COMMunicate:VERBose	Sets or queries whether the response to a query is returned fully spelled out or in its abbreviated form.	6-7
:COMMunicate:WAIT	Waits for a specified extended event to occur.	6-7
:COMMunicate:WAIT?	Creates the response that is returned when a specified extended event occurs.	6-7
DISPlay group		
:DISPlay?	Queries all display settings.	6-8
:DISPlay:NORMal?	Queries all normal measurement data display settings.	6-8
:DISPlay[:NORMal]:ITEM<x>	Sets or queries a normal measurement data display item.	6-8
:DISPlay:HARMonics?	Queries all harmonic measurement data display settings.	6-8
:DISPlay:HARMonics:ITEM<x>	Sets or queries a harmonic measurement data display item.	6-8
HARMonics Group		
:HARMonics?	Queries all harmonic measurement settings.	6-10
:HARMonics:PLLSource	Sets or queries the PLL source.	6-10
:HARMonics:ORDer	Sets or queries the maximum and minimum harmonic orders that are analyzed.	6-10
:HARMonics:THD	Sets or queries the equation used to compute the THD (total harmonic distortion).	6-10
:HARMonics:DISPlay?	Queries all harmonic measurement display settings.	6-10
:HARMonics:DISPlay[:STATe]	Sets or queries the on/off state of harmonic measurement data display.	6-10
:HARMonics:DISPlay:ORDer	Sets or queries the harmonic order of the harmonic component that is shown in display B for the harmonic measurement data display.	6-10
HOLD Group		
:HOLD	Sets or queries the on/off state of the output hold feature for display, communication, and other types of data.	6-11
INPut Group		
:INPut?	Queries all input settings.	6-12
[:INPut]:CFACtor	Sets or queries the crest factor.	6-12
[:INPut]:WIRing	Sets or queries the wiring system.	6-12
[:INPut]:MODE	Sets or queries the voltage and current measurement mode.	6-12
[:INPut]:VOLTage?	Queries all voltage measurement settings.	6-12
[:INPut]:VOLTage:RANGe	Sets or queries the voltage range.	6-12
[:INPut]:VOLTage:AUTO	Sets or queries the voltage auto range on/off state.	6-12
[:INPut]:VOLTage:CONFig	Sets or queries the valid voltage range.	6-12

Command	Function	Page
[:INPut]:VOLTage:POJump	Sets or queries the jump destination range that is used when a voltage peak over-range occurs.	6-13
[:INPut]:CURRent?	Queries all electric current measurement settings.	6-13
[:INPut]:CURRent:RANGe	Sets or queries the current range.	6-13
[:INPut]:CURRent:AUTO	Sets or queries the current auto range on/off state.	6-13
[:INPut]:CURRent:CONFig	Sets or queries the valid current range.	6-13
[:INPut]:CURRent:POJump	Sets or queries the jump destination range that is used when a current peak over-range occurs.	6-13
[:INPut]:CURRent:EXTSensor:CONFig	Sets or queries the valid external current sensor range.	6-13
[:INPut]:CURRent:EXTSensor:POJump	Sets or queries the jump destination range that is used when a current peak over-range occurs.	6-14
[:INPut]:CURRent:SRATio?	Queries the external current sensor conversion ratios of all elements.	6-14
[:INPut]:CURRent:SRATio[:ALL]	Collectively sets the external current sensor conversion ratios of all elements.	6-14
[:INPut]:CURRent:SRATio:ELEMent<x>	Sets or queries the external current sensor conversion ratio of the specified element.	6-14
[:INPut]:RCONfig	Sets or queries the on/off state of the range configuration (valid range selection) feature.	6-14
[:INPut]:SCALing?	Queries all scaling settings.	6-14
[:INPut]:SCALing[:STATe]	Sets or queries the scaling on/off state.	6-14
[:INPut]:SCALing:{VT|CT|SFACtor}?	Queries the VT ratios, CT ratios, or power coefficients of all elements.	6-14
[:INPut]:SCALing:{VT|CT|SFACtor}[:ALL]	Collectively sets the VT ratio, CT ratio, or power coefficient of all elements.	6-14
[:INPut]:SCALing:{VT|CT|SFACtor}:ELEMent<x>	Sets or queries the VT ratio, CT ratio, or power coefficient of the specified element.	6-14
[:INPut]:SYNChronize	Sets or queries the synchronization source.	6-14
[:INPut]:FILTer?	Queries all input filter settings.	6-15
[:INPut]:FILTer:LINE	Sets or queries the line filter.	6-15
[:INPut]:FILTer:FREQuency	Sets or queries the frequency filter.	6-15
[:INPut]:POVer?	Queries the peak over-range information.	6-15
[:INPut]:CRANge?	Sets or queries the check range status.	6-15

INTEGrate Group

:INTEGrate?	Queries all integration settings.	6-16
:INTEGrate:MODE	Sets or queries the integration mode.	6-16
:INTEGrate:TIMer	Sets or queries the integration timer value.	6-16
:INTEGrate:STARt	Starts integration.	6-16
:INTEGrate:STOP	Stops integration.	6-16
:INTEGrate:RESet	Resets the integrated value.	6-16
:INTEGrate:STATe?	Queries the integration status.	6-16

MATH Group

:MATH	Sets or queries the MATH equation.	6-17

MEASure Group

:MEASure?	Queries all measured and computed data output settings.	6-18
:MEASure:AVERaging?	Queries all averaging settings.	6-18
:MEASure:AVERaging[:STATe]	Sets or queries the on/off state of averaging.	6-18
:MEASure:AVERaging:TYPE	Sets or queries the averaging type.	6-18
:MEASure:AVERaging:COUNt	Sets or queries the averaging coefficient.	6-18
:MEASure:MHOLd	Sets the MAX hold on/off state.	6-18

Command	Function	Page
NUMeric Group		
:NUMeric?	Queries all numeric data output settings.	6-19
:NUMeric:FORMat	Sets or queries the numeric data format.	6-19
:NUMeric:NORMal?	Queries all numeric data output settings.	6-19
:NUMeric[:NORMal]:VALue?	Queries the numeric data.	6-19
:NUMeric[:NORMal]:NUMber	Sets or queries the number of numeric data items that are transmitted by the :NUMeric[:NORMal]:VALue? command.	6-19
:NUMeric[:NORMal]:ITEM<x>	Sets or queries the specified numeric data output item (function, element, and harmonic order).	6-20
:NUMeric[:NORMal]:PRESet	Presets the numeric data output item pattern.	6-20
:NUMeric[:NORMal]:CLEar	Clears numeric data output items (sets the items to NONE).	6-20
:NUMeric[:NORMal]:DELete	Deletes numeric data output items.	6-20
:NUMeric[:NORMal]:HEADer?	Queries the numeric data header.	6-20
:NUMeric:LIST?	Queries all harmonic measurement numeric list data output settings.	6-21
:NUMeric:LIST:VALue?	Queries the harmonic measurement numeric list data.	6-21
:NUMeric:LIST:NUMber	Sets or queries the number of numeric list data items that are transmitted by :NUMeric:LIST:VALue?.	6-21
:NUMeric:LIST:ORDer	Sets or queries the maximum output harmonic order of the harmonic measurement numeric list data.	6-21
:NUMeric:LIST:SELect	Sets or queries the output components of the harmonic measurement numeric list data.	6-21
:NUMeric:LIST:ITEM<x>	Sets or queries the output item (function and element) of the specified harmonic measurement numeric list data item.	6-22
:NUMeric:LIST:PRESet	Presets the harmonic measurement numeric list data output item pattern.	6-22
:NUMeric:LIST:CLEar	Clears harmonic measurement numeric list data output items (sets the items to NONE).	6-22
:NUMeric:LIST:DELete	Deletes harmonic measurement numeric list data output items.	6-22
:NUMeric:HOLD	Sets or queries the on/off (hold/release) status of the numeric data hold feature.	6-23
RATE Group		
:RATE	Sets or queries the data update interval.	6-29
:RATE:AUTO?	Queries all applicable settings for when the data update interval is set to Auto.	6-29
:RATE:AUTO:TIMeout	Sets or queries the timeout for when the data update interval is set to Auto.	6-29
:RATE:AUTO:SYNChronize	Sets or queries the synchronization source for when the data update interval is set to Auto.	6-29
RECall Group		
:RECall:NUMber?	Queries the number of blocks of measured data that is stored.	6-30
:RECall[:NORMal]:VALue?	Queries the numeric data at the specified block number.	6-30
:RECall:LIST:VALue?	Queries the numeric list data of harmonic measurement at the specified block number.	6-30
:RECall:PANel	Loads a setup parameter file.	6-30
STATus group		
:STATus?	Queries all the settings for the communication status feature.	6-31
:STATus:CONDition?	Queries the contents of the condition register.	6-31
:STATus:EESE	Sets or queries the extended event enable register.	6-31
:STATus:EESR?	Queries the contents of the extended event register and clears the register.	6-31
:STATus:ERRor?	Queries the error code and message of the last error that has occurred (top of the error queue).	6-31
:STATus:FILTer<x>	Sets or queries the transition filter.	6-31
:STATus:QENable	Sets or queries whether messages other than errors will be stored to the error queue (ON) or not (OFF).	6-31
:STATus:QMESsage	Sets or queries whether message information will be attached to the response to the STATus:ERRor? query (ON/OFF).	6-31
:STATus:SPOLl?	Executes serial polling.	6-31

Command	Function	Page
STORe Group		
:STORe?	Queries all storage settings.	6-32
:STORe[:STATe]	Sets or queries the storage on/off state.	6-32
:STORe:INTerval	Sets or queries the storage interval.	6-32
:STORe:PANel	Saves setup parameters to a file.	6-32
SYSTem Group		
:SYSTem?	Queries all system settings.	6-33
:SYSTem:MODel?	Queries the model code.	6-33
:SYSTem:SUFFix?	Queries the suffix code.	6-33
:SYSTem:SERial?	Queries the serial number.	6-33
:SYSTem:VERsion[:FIRMware]?	Queries the firmware version.	6-33
:SYSTem:KLOCk	Sets or queries the on/off state of the key protection.	6-33
:SYSTem:RESolution	Sets or queries the numeric data display resolution.	6-33
:SYSTem:COMMunicate:COMMand	Sets or queries the command type.	6-33
:SYSTem:COMMunicate:ETHernet:MACaddress?	Sets or queries the Ethernet MAC address.	6-33
Common Command Group		
*CAL?	Executes zero calibration (zero-level compensation, the same operation as pressing CAL (SHIFT+SET)) and queries the result.	6-34
*CLS	Clears the standard event register, extended event register, and error queue.	6-34
*ESE	Sets or queries the standard event enable register.	6-34
*ESR?	Queries and clears the standard event register.	6-34
*IDN?	Queries the instrument model.	6-34
*OPC	Sets bit 0 (the OPC bit) of the standard event register to 1 upon the completion of the specified overlap command.	6-34
*OPC?	Returns ASCII code 1 if the specified overlap command has finished.	6-35
*OPT?	Queries the installed options.	6-35
*RST	Initializes the settings.	6-35
*SRE	Sets or queries the service request enable register value.	6-35
*STB?	Queries the Status Byte Register value.	6-35
*TRG	Executes single measurement (the same operation as when SINGLE (SHIFT+HOLD) is pressed).	6-35
*TST?	Executes a self-test and queries the result.	6-36
*WAI	Holds the execution of the subsequent command until the completion of the specified overlap command.	6-36

6.2 AOUTput Group

The commands in this group deal with D/A output.
You can make the same settings and queries that you can by pressing the UTILITY key on the front panel and then using the dA menu or by pressing the INTEG SET key and then using the dAtimE menu. The commands in this group are only valid on models with the D/A output (/DA4 or /DA12) option.

:AOUTput?

Function Queries all D/A output settings.
Syntax `:AOUTput?`

:AOUTput[:NORMal]:PRESet

Function Sets the D/A output items to their default values.
Syntax `:AOUTput[:NORMal]:PRESet {NORMal|INTEGrate}`
Example `:AOUTPUT:NORMAL:PRESET NORMAL`

:AOUTput[:NORMal]:CHANnel<x>

Function Sets or queries a D/A output item (function or element).
Syntax `:AOUTput[:NORMal]:CHANnel<x> {NONE|<Function>[,<Element>]}`
`:AOUTput[:NORMal]:CHANnel<x>?`
`<x>` = 1 to 12 (output channel)
`NONE` = no output item
`<Function>` = {U|I|P|S|Q|LAMBda|PHI|FU|FI|WH|WHP|WHM|AH|AHP|AHM|MATH|UPeak|IPeak}
`<Element>` = {<NRf>|SIGMa}
(`<NRf>` = 1 to 3)
Example
```
:AOUTPUT:NORMAL:CHANNEL1 U,1
:AOUTPUT:NORMAL:CHANNEL1?
-> :AOUTPUT:NORMAL:CHANNEL1 U,1
```
Description
- For details on <Function>, see "Function Option List (1)" on page 6-24.
- If <Element> is omitted, the element is set to 1.
- For {MATH}, <Element> does not need to be specified. In responses, <Element> is omitted.

:AOUTput[:NORMal]:IRTime

Function Sets or queries the rated integration time that is used in the D/A output of the integrated value.
Syntax `:AOUTput[:NORMal]:IRTime {<NRf>,<NRf>,<NRf>}`
`:AOUTput[:NORMal]:IRTime?`
{<NRf>,<NRf>,<NRf>} = 0,0,0 to 10000,0,0
First <NRf> = 0 to 10000 (hour)
Second <NRf> = 0 to 59 (minute)
Third <NRf> = 0 to 59 (second)
Example
```
:AOUTPUT:NORMAL:IRTIME 1,0,0
:AOUTPUT:NORMAL:IRTIME?
-> :AOUTPUT:IRTIME 1,0,0
```

:AOUTput[:NORMal]:MODE<x>

Function Sets or queries a D/A range mode.
Syntax `:AOUTput[:NORMal]:MODE<x> {FIXed|MANual|COMPare}`
`:AOUTput[:NORMal]:MODE<x>?`
`<x>` = 1 to 12 (output channel)
Example
```
:AOUTPUT:NORMAL:MODE1 FIXED
:AOUTPUT:NORMAL:MODE1?
-> :AOUTPUT:NORMAL:MODE1 FIXED
```
Description
- FIXed = Fixed range mode (default value)
  Outputs +5 V when the rated value of each measurement function is received.
- MANual = Manual range mode
  The displayed values of the measurement function when +5 V and –5 V are output as D/A output can be set to any values of your choice. This enables the D/A output to be expanded or reduced for each channel (D/A zoom).
- COMPare = Comparator mode
  By comparing with the comparator limits, this instrument outputs +5 V, 0 V, or –5 V. Relay contact output, like that of the WT210/WT230, can be emulated by driving a relay with the output voltage.

:AOUTput[:NORMal]:RATE<x>

Function Sets or queries the maximum and minimum values for when the D/A output is in manual range mode. Sets or queries the comparison upper and lower limits for when the D/A output is in comparator mode.

Syntax
```
:AOUTput[:NORMal]:RATE<x>
{<NRf>,<NRf>}
:AOUTput[:NORMal]:RATE<x>?
```
<x> = 1 to 12 (output channel)
<Element> = {<NRf>|SIGMA}
<NRf> = -9.999E+12 to 9.999E+12

Example
```
:AOUTPUT:NORMAL:RATE1 100,-100
:AOUTPUT:NORMAL:RATE1?
-> :AOUTPUT:NORMAL:RATE1 100.0E+00,
-100.0E+00
```

Description
- When the D/A output is in manual range mode (:AOUTput[:NORMal]:MODE<x> MANual) Set the rated value for +5 V output and then that for –5 V output.
- When the D/A output is in comparator mode (:AOUTput[:NORMal]:MODE<x> COMPare) Set the upper limit and then the lower limit.
- When the D/A output is in fixed range mode (:AOUTput[:NORMal]:MODE<x> FIXed) There is no need to set these values. (The values do not affect the output operation.)

6.3 COMMunicate group

The commands in this group deal with communications.
There are no front panel keys that correspond to the commands in this group.

:COMMunicate?

Function Queries all communication settings.
Syntax `:COMMunicate?`

:COMMunicate:HEADer

Function Sets or queries whether headers are attached to query responses.
Syntax
```
:COMMunicate:HEADer {<Boolean>}
:COMMunicate:HEADer?
```
Example
```
:COMMUNICATE:HEADER ON
:COMMUNICATE:HEADER?
-> :COMMUNICATE:HEADER 1
```
Description Example of a response with a header
:INPUT:VOLTAGE:RANGE 150.0E+00
Example of a response without a header
150.0E+00

:COMMunicate:LOCKout

Function Sets/clears local lockout.
Syntax
```
:COMMunicate:LOCKout {<Boolean>}
:COMMunicate:LOCKout?
```
Example
```
:COMMUNICATE:LOCKOUT ON
:COMMUNICATE:LOCKOUT?
-> :COMMUNICATE:LOCKOUT 1
```

:COMMunicate:REMote

Function Sets this instrument to remote or local mode. ON is remote mode.
Syntax
```
:COMMunicate:REMote {<Boolean>}
:COMMunicate:REMote?
```
Example
```
:COMMUNICATE:REMOTE ON
:COMMUNICATE:REMOTE?
-> :COMMUNICATE:REMOTE 1
```

:COMMunicate:STATus?

Function Queries the line-specific status.
Syntax `:COMMunicate:STATus?`
Example
```
:COMMUNICATE:STATUS?
-> 0
```
Description The meaning of each status bit is as follows:

Bit	RS-232
0	Parity error
1	Framing error
2	Break character detection
3 and higher	Always zero

When an event occurs, the corresponding bit is set in the status. When the bit is read, it is cleared.
Zero is returned for interfaces other than RS-232.

:COMMunicate:VERBose

Function Sets or queries whether the response to a query is returned fully spelled out or in its abbreviated form.
Syntax
```
:COMMunicate:VERBose {<Boolean>}
:COMMunicate:VERBose?
```
Example
```
:COMMUNICATE:VERBOSE ON
:COMMUNICATE:VERBOSE?
-> :COMMUNICATE:VERBOSE 1
```
Description Example of a response fully spelled out
:INPUT:VOLTAGE:RANGE 150.0E+00
Example of a response in abbreviated form
:VOLT:RANG 150.0E+00

:COMMunicate:WAIT

Function Waits for a specified extended event to occur.
Syntax `:COMMunicate:WAIT <Register>`
<Register> = 0 to 65535 (extended event register, see page 7-5)
Example `:COMMUNICATE:WAIT 1`
Description For information about how to synchronize a program using COMMunicate:WAIT, see page 5-8.

:COMMunicate:WAIT?

Function Creates the response that is returned when a specified extended event occurs.
Syntax `:COMMunicate:WAIT? <Register>`
<Register> = 0 to 65535 (extended event register; see page 7-5.)
Example `:COMMUNICATE:WAIT? 65535 -> 1`

6.4 DISPlay group

The commands in this group deal with the display.
You can make the same settings and queries that you can by using keys such as the FUNCTION and ELEMENT keys on the front panel.

:DISPlay?

Function Queries all display settings.
Syntax :DISPlay?

:DISPlay:NORMal?

Function Queries all normal measurement data display settings.
Syntax :DISPlay:NORMal?

:DISPlay[:NORMal]:ITEM<x>

Function Sets or queries a normal measurement data display item.
Syntax :DISPlay[:NORMal]:ITEM<x> <Function>[,<Element>]}
:DISPlay[:NORMal]:ITEM<x>?
<x> = 1 to 4 (display)
Function of display A (<x>=1)
<Function> = {U|I|P|S|Q|TIME}
Function of display B (<x>=2)
<Function> = {U|I|P|LAMBda|PHI}
Function of display C (<x>=3)
<Function> = {U|I|P|UPPeak|UMPeak|IPPeak|IMPeak|PPPeak|PMPeak|WH|WHP|WHM|AH|AHP|AHM|MATH}
Function of display D (<x>=4)
<Function> = {U|I|P|LAMBda|FU|FI|UTHD|ITHD}
<Element> = {<NRf>|SIGMa}
(<NRf> = 1 to 3)
Example :DISPLAY:NORMAL:ITEM1 U,1
:DISPLAY:NORMAL:ITEM1?
-> :DISPLAY:NORMAL:ITEM1 U,1
Description
- For details on <Function>, see “Numeric Data Display Functions” on the next page.
- If <Element> is omitted, the element is set to 1.
- For {TIME|MATH}, <Element> does not need to be specified. In responses, <Element> is omitted.
- {UTHD|ITHD} can be selected only on models with the harmonic measurement (/G5) option.

:DISPlay:HARMonics?

Function Queries all harmonic measurement data display settings.
Syntax :DISPlay:HARMonics?

:DISPlay:HARMonics:ITEM<x>

Function Sets or queries a harmonic measurement data display item.
Syntax :DISPlay:HARMonics:ITEM<x> {<Function>[,<Element>]}
:DISPlay:HARMonics:ITEM<x>?
<x> = 1 to 4 (display)
Function of display A (<x>=1)
<Function> = {U|I|P|ORDer}
Function of display B (<x>=2)
<Function> = {U|I|P|UHDF|IHDF|PHDF|PHIU|PHII}
Function of display C (<x>=3)
<Function> = {U|I|P}
Function of display D (<x>=4)
<Function> = {U|I|P|LAMBda|FU|FI|UTHD|ITHD}
<Element> = {<NRf>} (<NRf> = 1 to 3)
Example :DISPLAY:HARMONICS:ITEM2 I,1
:DISPLAY:HARMONICS:ITEM2?
-> :DISPLAY:HARMONICS:ITEM2 I,1
Description
- For details on <Function>, see “Numeric Data Display Functions” on the next page.
- If <Element> is omitted, the element is set to 1.
- For {ORDer}, <Element> does not need to be specified. In responses, <Element> is omitted.

Numeric Data Display Functions

Applicable command

```
:DISPlay[:NORMal]:ITEM<x> {<Function>[,<Element>]}
```

<Function>	Function	WT Indicator	<Element>	WT Displays			
				A	B	C	D
				1	2	3	4
U	Voltage U	[V]	Yes	Yes	Yes	Yes	Yes
I	Current I	[A]	Yes	Yes	Yes	Yes	Yes
P	Active power P	[W]	Yes	Yes	Yes	Yes	Yes
S	Apparent power S	[VA]	Yes	Yes			
Q	Reactive power Q	[var]	Yes	Yes			
LAMBda	Power factor λ	[PF]	Yes		Yes		Yes
PHI	Phase difference Φ	[°]	Yes		Yes		
FU	Voltage frequency fU	[V Hz]	Yes				Yes
FI	Current frequency fI	[A Hz]	Yes				Yes
UPPeak	Maximum voltage: U+pk	[V pk]	Yes			Yes	
UMPeak	Minimum voltage: U–pk	[V pk]	Yes			Yes	
IPPeak	Maximum current: I+pk	[A pk]	Yes			Yes	
IMPeak	Minimum current: I–pk	[A pk]	Yes			Yes	
PPPeak	Maximum power: P+pk	[W pk]	Yes			Yes	
PMPeak	Minimum power: P–pk	[W pk]	Yes			Yes	
TIME	Integration time	[TIME]	No	Yes			
WH	Watt hour WP	[W h]	Yes			Yes	
WHP	Positive watt hour WP+	[W h±]	Yes			Yes	
WHM	Negative watt hour WP-	[W h±]	Yes			Yes	
AH	Ampere hour q	[A h]	Yes			Yes	
AHP	Positive ampere hour q+	[A h±]	Yes			Yes	
AHM	Negative ampere hour q-	[A h±]	Yes			Yes	
MATH	Computed value, such as efficiency	[MATH]	No			Yes	
UTHD	Total harmonic distortion of voltage Uthd	[THD V %]	Yes				Yes
ITHD	Total harmonic distortion of current Ithd	[THD A %]	Yes				Yes

Yes: Required. No: Not required.

Applicable command

```
:DISPlay:HARMonics:ITEM<x> {<Function>[,<Element>]}
```

<Function>	Function	WT Indicator	<Element>	WT Displays			
				A	B	C	D
				1	2	3	4
ORDer	Harmonic order	“or. 01”	No	Yes			
U	Voltage U	[V]	Yes	Yes	Yes	Yes	Yes
I	Current I	[A]	Yes	Yes	Yes	Yes	Yes
P	Active power P	[W]	Yes	Yes	Yes	Yes	Yes
PHIU	Phase difference between harmonic voltage U(k) and the fundamental wave U(1) ΦU( )	[V °]	Yes		Yes		
PHII	Phase difference between harmonic current I(k) and the fundamental wave I(1) ΦI( )	[A °]	Yes		Yes		
UHDF	Harmonic voltage distortion factor Uhdf( )	[V %]	Yes		Yes		
IHDF	Harmonic current distortion factor Ihdf( )	[A %]	Yes		Yes		
PHDF	Harmonic active power distortion factor Phdf( )	[W %]	Yes		Yes		
LAMBda	Power factor of fundamental signal λ(1)	[PF]	Yes				Yes
FU	Voltage frequency fU	[V Hz]	Yes				Yes
FI	Current frequency fI	[A Hz]	Yes				Yes
UTHD	Total harmonic distortion of voltage Uthd	[THD V %]	Yes				Yes
ITHD	Total harmonic distortion of current Ithd	[THD A %]	Yes				Yes

Yes: Required. No: Not required.

6.5 HARMonics Group

The commands in this group deal with harmonic measurement.
You can make the same settings and queries that you can make by pressing HARMONICS on the front panel.
The commands in this group are valid only on models with the harmonic measurement (/G5) option.

:HARMonics?

Function Queries all harmonic measurement settings.
Syntax `:HARMonics?`

:HARMonics:PLLSource

Function Sets or queries the PLL source.
Syntax `:HARMonics:PLLSource {U<x>|I<x>}`
`:HARMonics:PLLSource?`
`<x>` = 1 to 3 (element)
Example `:HARMONICS:PLLSOURCE U1`
`:HARMONICS:PLLSOURCE?`
`-> :HARMONICS:PLLSOURCE U1`

:HARMonics:ORDer

Function Sets or queries the maximum and minimum harmonic orders that are analyzed.
Syntax `:HARMonics:ORDer {<NRf>,<NRf>}`
`:HARMonics:ORDer?`
First `<NRf>` = 1 (minimum harmonic order that is analyzed, fixed at 1)
Second `<NRf>` = 1 to 50 (maximum harmonic order that is analyzed)
Example `:HARMONICS:ORDER 1,50`
`:HARMONICS:ORDER?`
`-> :HARMONICS1:ORDER 1,50`

:HARMonics:THD

Function Sets or queries the equation used to compute the THD (total harmonic distortion).
Syntax `:HARMonics:THD {TOTal|FUNDamental}`
`:HARMonics:THD?`
Example `:HARMONICS:THD FUNDAMENTAL`
`:HARMONICS:THD?`
`-> :HARMONICS:THD FUNDAMENTAL`

:HARMonics:DISPlay?

Function Queries all harmonic measurement display settings.
Syntax `:HARMonics:DISPlay?`

:HARMonics:DISPlay[:STATe]

Function Sets or queries the on/off state of harmonic measurement data display.
Syntax `:HARMonics:DISPlay[:STATe]`
`{<Boolean>}`
`:HARMonics:DISPlay:STATe?`
Example `:HARMONICS:DISPLAY:STATE ON`
`:HARMONICS:DISPLAY:STATE?`
`-> :HARMONICS:DISPLAY:STATE 1`

:HARMonics:DISPlay:ORDer

Function Sets or queries the harmonic order of the harmonic component that is shown in display B for the harmonic measurement data display.
Syntax `:HARMonics:DISPlay:ORDer {<NRf>}`
`:HARMonics:DISPlay:ORDer?`
`<NRf>` = 1 to 50 (harmonic order)
Example `:HARMONICS:DISPLAY:ORDER 1`
`:HARMONICS:DISPLAY:ORDER?`
`-> :HARMONICS:DISPLAY:ORDER 1`

6.6 HOLD Group

The command in this group deals with the output data hold feature.
You can make the same settings and queries that you can make by pressing HOLD on the front panel.

:HOLD

Function Sets or queries the on/off state of the output hold feature for display, communication, and other types of data.

Syntax
```
:HOLD {<Boolean>}
:HOLD?
```

Example
```
:HOLD OFF
:HOLD? -> :HOLD 0
```

6.7 INPut Group

The commands in this group deal with the measurement conditions of the input elements.
You can make the same settings and queries that you can by pressing the WIRING, MODE, VOLTAGE, CURRENT, or UTILITY key on the front panel and then using the CF or rAnGE menu or by pressing the SETUP key and then using the SCALE, rAtio, SYnC, L.FiLt, or F.FiLt menu.

:INPut?

Function Queries all input settings.
Syntax `:INPut?`

[:INPut]:CFACtor

Function Sets or queries the crest factor.
Syntax `[:INPut]:CFACtor {<NRf>|A6}`
`[:INPut]:CFACtor?`
`<NRf>` = 3, 6
`A6` = Display range expand mode (6A) for crest factor 6
Example
```
:INPUT:CFACTOR 3
:INPUT:CFACTOR?
-> :INPUT:CFACTOR 3
```

[:INPut]:WIRing

Function Sets or queries the wiring system.
Syntax `[:INPut]:WIRing {(P1W2|P1W3|P3W3|P3W4|V3A3)}`
`[:INPut]:WIRing?`
`P1W2` = Single-phase, two-wire system `[1P2W]`
`P1W3` = Single-phase, three-wire system `[1P3W]`
`P3W3` = Three-phase, three-wire system `[3P3W]`
`P3W4` = Three-phase, four-wire system `[3P4W]`
`V3A3` = Three-phase, three-wire system with a three-voltage, three-current method `[3V3A]`
Example
```
:INPUT:WIRING P1W3
:INPUT:WIRING?
-> :INPUT:WIRING P1W3
```
Description
- For the WT310E and WT310EH, the wiring system is fixed to P1W2. No other setting is allowed.
- For the WT332E and WT333E, the wiring system cannot be set to P1W2.

[:INPut]:MODE

Function Sets or queries the voltage and current measurement mode.
Syntax `[:INPut]:MODE {RMS|VMEan|DC}`
`[:INPut]:MODE?`
Example
```
:INPUT:MODE RMS
:INPUT:MODE? -> :INPUT:MODE RMS
```

[:INPut]:VOLTage?

Function Queries all voltage measurement settings.
Syntax `[:INPut]:VOLTage?`

[:INPut]:VOLTage:RANGe

Function Sets or queries the voltage range.
Syntax `[:INPut]:VOLTage:RANGe {<Voltage>}`
`[:INPut]:VOLTage:RANGe?`
- When the crest factor is set to 3

<Voltage> = 15, 30, 60, 150, 300, 600(V)
- When the crest factor is set to 6 or 6A

<Voltage> = 7.5, 15, 30, 75, 150, 300(V)

Example
```
:INPUT:VOLTAGE:RANGE 600V
:INPUT:VOLTAGE:RANGE?
-> :INPUT:VOLTAGE:RANGE 600.0E+00
```

[:INPut]:VOLTage:AUTO

Function Sets or queries the voltage auto range on/off state.
Syntax `[:INPut]:VOLTage:AUTO {<Boolean>}`
`[:INPut]:VOLTage:AUTO?`
Example
```
:INPUT:VOLTAGE:AUTO ON
:INPUT:VOLTAGE:AUTO?
-> :INPUT:VOLTAGE:AUTO 1
```

[:INPut]:VOLTage:CONFig

Function Sets or queries the valid voltage range.
Syntax `[:INPut]:VOLTage:CONFig {ALL|<Voltage>[,<Voltage>][,<Voltage>]...}`
`[:INPut]:VOLTage:CONFig?`
`ALL` = All ranges are valid.
`<Voltage>` = See (`:INPut:VOLTage:RANGe`).
Example
```
:INPUT:VOLTAGE:CONFIG ALL
:INPUT:VOLTAGE:CONFIG?
-> :INPUT:VOLTAGE:CONFIG ALL
:INPUT:VOLTAGE:CONFIG 600,150,15
:INPUT:VOLTAGE:CONFIG?
-> :INPUT:VOLTAGE:CONFIG 600.0E+00,
150.0E+00,15.0E+00
```
Description In the parameters, list the voltage ranges that you want to enable. To enable all the ranges, specify the parameter “ALL.”

[:INPut]:VOLTage:POJump

Function Sets or queries the jump destination range that is used when a voltage peak over-range occurs.

Syntax
```
[:INPut]:VOLTage:POJump
{OFF|<Voltage>}
[:INPut]:VOLTage:POJump?
```
OFF = No jump destination voltage range
<Voltage> = See (:INPut:VOLTage:RANGe).

Example
```
:INPUT:VOLTAGE:POJUMP 600V
:INPUT:VOLTAGE:POJUMP?
-> :INPUT:VOLTAGE:POJUMP 600.0E+00
```

[:INPut]:CURRent?

Function Queries all electric current measurement settings.

Syntax
```
[:INPut]:CURRent?
```

[:INPut]:CURRent:RANGe

Function Sets or queries the current range.

Syntax
```
[:INPut]:CURRent:RANGe
{<Current>|(EXTernal,<Voltage>)}
[:INPut]:CURRent:RANGe?
```
- For direct current input
- When the crest factor is set to 3
  <Current> = 5, 10, 20, 50, 100, 200, 500(mA), 1, 2, 5, 10, 20(A) (WT310E)
  <Current> = 1, 2, 5, 10, 20, 40(A) (WT310EH)
  <Current> = 0.5, 1, 2, 5, 10, 20(A) (WT332E, WT333E)
- When the crest factor is set to 6 or 6A
  <Current> = 2.5, 5, 10, 25, 50, 100, 250(mA), 0.5, 1, 2.5, 5, 10(A) (WT310E)
  <Current> = 0.5, 1, 2.5, 5, 10, 20(A) (WT310EH)
  <Current> = 0.25, 0.5, 1, 2.5, 5, 10(A) (WT332E, WT333E)
- For external current sensor input
- When the crest factor is set to 3
  <Voltage> = 2.5, 5, 10(V) (/EX1)
  <Voltage> = 50, 100, 200, 500(mV), 1, 2(V) (/EX2)
- When the crest factor is set to 6 or 6A
  <Voltage> = 1.25, 2.5, 5(V) (/EX1)
  <Voltage> = 25, 50, 100, 250(mV), 0.5, 1(V) (/EX2)

Example
```
:INPUT:CURRENT:RANGE 20A
:INPUT:CURRENT:RANGE?
-> :INPUT:CURRENT:RANGE 20.0E+00
:INPUT:CURRENT:RANGE EXTERNAL,10V
:INPUT:CURRENT:RANGE?
-> :INPUT:CURRENT:RANGE
EXTERNAL,10.0E+00
```

Description EXTernal and <Voltage> can only be selected on models with the external current sensor input (/EX1 or /EX2) option.

[:INPut]:CURRent:AUTO

Function Sets or queries the current auto range on/off state.

Syntax
```
[:INPut]:CURRent:AUTO {<Boolean>}
[:INPut]:CURRent:AUTO?
```

Example
```
:INPUT:CURRENT:AUTO ON
:INPUT:CURRENT:AUTO?
-> :INPUT:CURRENT:AUTO 1
```

[:INPut]:CURRent:CONFig

Function Sets or queries the valid current range.

Syntax
```
[:INPut]:CURRent:CONFig {ALL|<Current>
[,<Current>][,<Current>]...}
[:INPut]:CURRent:CONFig?
```
ALL = All ranges are valid.
<Current> = See (:INPut:CURRent:RANGe).

Example
```
:INPUT:CURRENT:CONFIG ALL
:INPUT:CURRENT:CONFIG?
-> :INPUT:CURRENT:CONFIG ALL
:INPUT:CURRENT:CONFIG 20,5,1
:INPUT:CURRENT:CONFIG?
-> :INPUT:CURRENT:CONFIG
20.0E+00,5.0E+00,1.0E+00
```

Description In the parameters, list the current ranges that you want to enable. To enable all the ranges, specify the parameter “ALL.”

[:INPut]:CURRent:POJump

Function Sets or queries the jump destination range that is used when a current peak over-range occurs.

Syntax
```
[:INPut]:CURRent:POJump
{OFF|<Current>}
[:INPut]:CURRent:POJump?
```
OFF = No jump destination current range
<Current> = See (:INPut:CURRent:RANGe).

Example
```
:INPUT:CURRENT:POJUMP 20A
:INPUT:CURRENT:POJUMP?
-> :INPUT:CURRENT:POJUMP 20.0E+00
```

[:INPut]:CURRent:EXTSensor:CONFig

Function Sets or queries the valid external current sensor range.

Syntax
```
[:INPut]:CURRent:EXTSensor:CONFig
{ALL|<Voltage>[,<Voltage>]
[,<Voltage>]...}
[:INPut]:CURRent:EXTSensor:CONFig?
```
ALL = All ranges are valid.
<Voltage> = See (:INPut:CURRent:RANGe).

Example
```
:INPUT:CURRENT:EXTSENSOR:CONFIG ALL
:INPUT:CURRENT:EXTSENSOR:CONFIG? ->
:INPUT:CURRENT:EXTSENSOR:CONFIG ALL
:INPUT:CURRENT:EXTSENSOR:CONFIG
2,0.5,0.1
:INPUT:CURRENT:EXTSENSOR:CONFIG?
-> :INPUT:CURRENT:EXTSENSOR:CONFIG
2.00E+00,500.0E-03,100.0E-03
```

Description In the parameters, list the external current sensor ranges that you want to enable. To enable all the ranges, specify the parameter “ALL.”

[:INPut]:CURRent:EXTSensor:POJump

Function Sets or queries the jump destination range that is used when a current peak over-range occurs.

Syntax
```
[:INPut]:CURRent:EXTSensor:POJump
{OFF|<Voltage>}
[:INPut]:CURRent:EXTSensor:POJump?
```
OFF = No jump destination current range
<Voltage> = See (:INPut:CURRent:RANGe).

Example
```
:INPUT:CURRENT:EXTSENSOR:POJUMP 2V
:INPUT:CURRENT:EXTSENSOR:POJUMP?
-> :INPUT:CURRENT:EXTSENSOR:POJUMP
2.00E+00
```

[:INPut]:CURRent:SRATio?

Function Queries the external current sensor conversion ratios of all elements.

Syntax
```
[:INPut]:CURRent:SRATio?
```

Description This command is only valid on models with the external current sensor input (/EX1 or /EX2) option.

[:INPut]:CURRent:SRATio[:ALL]

Function Collectively sets the external current sensor conversion ratios of all elements.

Syntax
```
[:INPut]:CURRent:SRATio[:ALL]
{<NRf>}
```
<NRf> = 0.001 to 9999.

Example
```
:INPUT:CURRENT:SRATIO:ALL 10
```

[:INPut]:CURRent:SRATio:ELEMent<x>

Function Sets or queries the external current sensor conversion ratio of the specified element.

Syntax
```
[:INPut]:CURRent:SRATio:ELEMent<x>
{<NRf>}
[:INPut]:CURRent:SRATio:ELEMent<x>?
```
<x> = 1 to 3 (element)
<NRf> = 0.001 to 9999.

Example
```
:INPUT:CURRENT:SRATIO:ELEMENT1 10
:INPUT:CURRENT:SRATIO:ELEMENT1?
-> :INPUT:CURRENT:SRATIO:ELEMENT1
10.00
```

[:INPut]:RCONfig

Function Sets or queries the on/off state of the range configuration (valid range selection) feature.

Syntax
```
[:INPut]:RCONfig {<Boolean>}
[:INPut]:RCONfig?
```

Example
```
:INPUT:RCONFIG OFF
:INPUT:RCONFIG? -> :INPUT:RCONFIG 0
```

Description The following commands are enabled only when this command is set to ON. Measurement range can be skipped.
```
:INPut:VOLTage:CONFig
:INPut:VOLTage:POJump
:INPut:CURRent:CONFig
:INPut:CURRent:POJump
:INPut:CURRent:EXTSensor:CONFig
:INPut:CURRent:EXTSensor:POJump
```

[:INPut]:SCALing?

Function Queries all scaling settings.

Syntax
```
[:INPut]:SCALing?
```

[:INPut]:SCALing[:STATe]

Function Sets or queries the scaling on/off state.

Syntax
```
[:INPut]:SCALing[:STATe] {<Boolean>}
[:INPut]:SCALing:STATe?
```

Example
```
:INPUT:SCALING:STATE OFF
:INPUT:SCALING:STATE?
-> :INPUT:SCALING:STATE 0
```

[:INPut]:SCALing:{VT|CT|SFACtor}?

Function Queries the VT ratios, CT ratios, or power coefficients of all elements.

Syntax
```
[:INPut]:SCALing:{VT|CT|SFACtor}?
```

[:INPut]:SCALing:{VT|CT|SFACtor}[:ALL]

Function Collectively sets the VT ratio, CT ratio, or power coefficient of all elements.

Syntax
```
[:INPut]:SCALing:{VT|CT|SFACtor}
[:ALL] {<NRf>}
```
<NRf> = 0.001 to 9999.

Example
```
:INPUT:SCALING:VT:ALL 1
```

[:INPut]:SCALing:{VT|CT|SFACtor}:ELEMent<x>

Function Sets or queries the VT ratio, CT ratio, or power coefficient of the specified element.

Syntax
```
[:INPut]:SCALing:{VT|CT|SFACtor}
:ELEMent<x> {<NRf>}
[:INPut]:SCALing:{VT|CT|SFACtor}
:ELEMent<x>?
```
<x> = 1 to 3 (element)
<NRf> = 0.001 to 9999.

Example
```
:INPUT:SCALING:VT:ELEMENT1 1
:INPUT:SCALING:VT:ELEMENT1?
-> :INPUT:SCALING:VT:ELEMENT1 1.000
```

[:INPut]:SYNChronize

Function Sets or queries the synchronization source.

Syntax
```
[:INPut]:SYNChronize
{VOLTage|CURRent|OFF}
[:INPut]:SYNChronize?
```

Example
```
:INPUT:SYNCHRONIZE VOLTAGE
:INPUT:SYNCHRONIZE?
-> :INPUT:SYNCHRONIZE VOLTAGE
```

[:INPut]:FILTer?

Function Queries all input filter settings.

Syntax `[:INPut]:FILTer?`

[:INPut]:FILTer:LINE

Function Sets or queries the line filter.

Syntax
```
[:INPut]:FILTer:LINE {<Boolean>}
[:INPut]:FILTer:LINE?
```

Example
```
:INPUT:FILTER:LINE OFF
:INPUT:FILTER:LINE?
-> :INPUT:FILTER:LINE 0
```

[:INPut]:FILTer:FREQuency

Function Sets or queries the frequency filter.

Syntax
```
[:INPut]:FILTer:FREQuency
{<Boolean>}
[:INPut]:FILTer:FREQuency?
```

Example
```
:INPUT:FILTER:FREQUENCY OFF
:INPUT:FILTER:FREQUENCY?
-> :INPUT:FILTER:FREQUENCY 0
```

[:INPut]:POVer?

Function Queries the peak over-range information.

Syntax `[:INPut]:POVer?`

Example `:INPUT:POVER? -> 0`

Description
- The peak over-range information of each element is mapped as shown below. For the response, the sum of the values of each bit is returned in decimal format.
- For example, a response of 16 indicates that a peak over-range is occurring at U3.

7	6	5	4	3	2	1	0
		I3	U3	I2	U2	I1	U1

[:INPut]:CRANge?

Function Sets or queries the check range status.

Syntax `[:INPut]:CRANge?`

Example `:INPUT:CRANGE? -> 0`

Description
- The CHECK RANGE LED status is mapped as shown below. For the response, the sum of the values of each bit is returned in decimal format.
- For example, a response of 0 indicates appropriate range. A response of 64 indicates that a current over-range is occurring.

7	6	5	4	3	2	1	0
AP	AO	AH	AL	VP	VO	VH	VL

VL : The voltage is at the condition for reducing the auto range or less.
VH : The voltage exceeds the condition for raising the auto range.
VO : The voltage is over-range.
VP : The voltage is peak over-range.
AL : The current is at the condition for reducing the auto range or less.
AH : The current exceeds the condition for raising the auto range.
AO : The current is over-range.
AP : The current is peak over-range.

- For information on the color of the LED and the condition to light, see “Auto Range Monitor Indications” in section 1.5 in the Getting Started Guide, IM WT310E-02EN.

6.8 INTEGrate Group

The commands in this group deal with integration.
You can make the same settings and queries that you can make by pressing INTEG SET, START, STOP, and RESET on the front panel.

:INTEGrate?
Function Queries all integration settings.
Syntax :INTEGrate?

:INTEGrate:MODE
Function Sets or queries the integration mode.
Syntax :INTEGrate:MODE {NORMal|CONTinuous}
:INTEGrate:MODE?
NORMal = Standard integration mode
CONTinuous = Continuous integration mode
Example :INTEGRATE:MODE NORMAL
:INTEGRATE:MODE?
-> :INTEGRATE:MODE NORMAL

:INTEGrate:TIMer
Function Sets or queries the integration timer value.
Syntax :INTEGrate:TIMer {<NRf>,<NRf>,<NRf>}
:INTEGrate:TIMer?
{<NRf>,<NRf>,<NRf>} = 0,0,0 to 10000,0,0
First <NRf> = 0 to 10000 (hours)
Second <NRf> = 0 to 59 (minutes)
Third <NRf> = 0 to 59 (seconds)
Example :INTEGRATE:TIMER 1,0,0
:INTEGRATE:TIMER?
-> :INTEGRATE:TIMER 1,0,0

:INTEGrate:STARt
Function Starts integration.
Syntax :INTEGrate:STARt
Example :INTEGRATE:START

:INTEGrate:STOP
Function Stops integration.
Syntax :INTEGrate:STOP
Example :INTEGRATE:STOP

:INTEGrate:RESet
Function Resets the integrated value.
Syntax :INTEGrate:RESet
Example :INTEGRATE:RESET

:INTEGrate:STATe?
Function Queries the integration status.
Syntax :INTEGrate:STATe?
Example :INTEGRATE:STATE? -> RESET
Description • The response is as follows:
RESet = Integration reset
STARt = Integration in progress
STOP = Integration stop
ERRor = Abnormal integration termination (integration overflow, power failure)
TIMeup = Integration stop due to integration timeout

6.9 MATH Group

The commands in this group deal with computations. You can make the same settings and queries that you can by pressing SETUP on the front panel and using the MAtH menu.

:MATH

Function Sets or queries the MATH equation.

Syntax `:MATH {EFFiciency|CFU<x>|CFI<x>|ADD|SUB|MUL|DIV|DIVA|DIVB|AVW<x>}`
`:MATH?`
`<x>` of `{CFU|CFI} = 1 to 3` (element)
`<x>` of `{AVW} = 1 to 3` (element), `4 (Σ)`

Example `:MATH CFU1`
`:MATH? -> :MATH CFU1`

Description The equations that correspond to each option are as follows:
EFFiciency : Efficiency (valid only on the WT332E/WT333E)
CFU : Voltage crest factor
CFI : Current crest factor
ADD : A+B
SUB : A-B
MUL : A×B
DIV : A/B
DIVA: A/B^2
DIVB: A^2/B
AVW : Average active power during integration

6.10 MEASure Group

The commands in this group deal with computation.
You can make the same settings and queries that you can by pressing SETUP on the front panel and using the AVG menu or by pressing MAX HOLD on the front panel.

:MEASure?

Function Queries all measured and computed data output settings.
Syntax `:MEASure?`

:MEASure:AVERaging?

Function Queries all averaging settings.
Syntax `:MEASure:AVERaging?`

:MEASure:AVERaging[:STATe]

Function Sets or queries the on/off state of averaging.
Syntax `:MEASure:AVERaging[:STATe] {<Boolean>}`
`:MEASure:AVERaging:STATe?`
Example `:MEASURE:AVERAGING:STATE ON`
`:MEASURE:AVERAGING:STATE?`
`-> :MEASURE:AVERAGING:STATE 1`

:MEASure:AVERaging:TYPE

Function Sets or queries the averaging type.
Syntax `:MEASure:AVERaging:TYPE {LINear|EXPonent}`
`:MEASure:AVERaging:TYPE?`
Example `:MEASURE:AVERAGING:TYPE LINEAR`
`:MEASURE:AVERAGING:TYPE?`
`-> :MEASURE:AVERAGING:TYPE LINEAR`
Description The averaging of harmonic measurement functions (option) is only valid when the type is set to EXPonent. For details, see the User's Manual, IM WT310E-01EN.

:MEASure:AVERaging:COUNt

Function Sets or queries the averaging coefficient.
Syntax `:MEASure:AVERaging:COUNt {<NRf>}`
`:MEASure:AVERaging:COUNt?`
`<NRf>` = 8, 16, 32, 64 (moving average count or attenuation constant)
Example `:MEASURE:AVERAGING:COUNT 8`
`:MEASURE:AVERAGING:COUNT?`
`-> :MEASURE:AVERAGING:COUNT 8`
Description The averaging of harmonic measurement functions (option) is only valid when TYPE is set to EXPonent (attenuation constant). For details, see the User's Manual, IM WT310E-01EN.

:MEASure:MHOLd

Function Sets the MAX hold on/off state.
Syntax `:MEASure:MHOLd {<Boolean>}`
`:MEASure:MHOLd?`
Example `:MEASURE:MHOLD ON`
`:MEASURE:MHOLD? -> :MEASURE:MHOLD 1`

6.11 NUMeric Group

The command in this group deal with numeric data output.
There are no front panel keys that correspond to the commands in this group.
The commands in the DISPlay group are used to make the same settings and queries as the FUNCTION and ELEMENT keys on the front panel.

:NUMeric?

Function Queries all numeric data output settings.
Syntax `:NUMeric?`

:NUMeric:FORMat

Function Sets or queries the numeric data format.
Syntax `:NUMeric:FORMat {ASCii|FLOat}`
`:NUMeric:FORMat?`
Example `:NUMERIC:FORMAT ASCII`
`:NUMERIC:FORMAT?`
`-> :NUMERIC:FORMAT ASCII`
Description
- The format of the numeric data that is output varies depending on how this command is set. The different formats are explained below.

(1) ASCii
Physical values are output in the <NR3> format.(Only the elapsed integration time—TIME—is output in <NR1> format.)
The data items are separated by commas.

(2) FLOat
A header (for example, "#240" or "#3208") is added in front of each numeric data block.
A physical value in IEEE single-precision floating point (4-byte) format follows the header.
The byte order of the data of each item is MSB First.

- For the formats of each individual numeric data item, see "Numeric Data Formats" at the end of this group of commands (page 6-25).

:NUMeric:NORMal?

Function Queries all numeric data output settings.
Syntax `:NUMeric:NORMal?`
Description The number of numeric data items output by :NUMeric[:NORMal]:ITEM<x> is determined by :NUMeric[:NORMal]NUMber.

:NUMeric[:NORMal]:VALue?

Function Queries the numeric data.
Syntax `:NUMeric[:NORMal]:VALue? {<NRf>}`
`<NRf>` = 1 to 255 (item number)
Example
- When <NRf> is specified
  `:NUMERIC:NORMAL:VALUE? 1`
  `-> 103.79E+00`
- When <NRf> is omitted
  `:NUMERIC:NORMAL:VALUE?`
  `-> 103.79E+00,1.0143E+00,105.27E+00,..`(omitted)`..,50.001E+00`
- When `:NUMeric:FORMat` is set to {FLOat}
  `:NUMERIC:NORMAL:VALUE?`
  `-> #N` (N-digit byte number)(data byte sequence)

Description
- If <NRf> is specified, only the numeric data for the specified item is output.
- If <NRf> is omitted, the numeric data items from 1 to the number specified by the : NUMeric[:NORMal]:NUMber command are output in order.
- For the formats of each individual numeric data output item, see "Numeric Data Formats" at the end of this group of commands (page 6-25).

:NUMeric[:NORMal]:NUMber

Function Sets or queries the number of numeric data items that are transmitted by the :NUMeric[:NORMal]:VALue? command.
Syntax `:NUMeric[:NORMal]:NUMber {<NRf>|ALL}`
`:NUMeric[:NORMal]:NUMber?`
`<NRf>` = 1 to 255(ALL)
Example `:NUMERIC:NORMAL:NUMBER 10`
`:NUMERIC:NORMAL:NUMBER`
`-> :NUMERIC:NORMAL:NUMBER 10`
Description
- If the parameter is omitted from the :NUMeric[:NORMal]:VALue? command, the numeric data items from 1 to the specified value are output in order.
- By default, the number of numeric data items is set to 10.

:NUMeric[:NORMal]:ITEM<x>

Function Sets or queries the specified numeric data output item (function, element, and harmonic order).

Syntax
```
:NUMeric[:NORMal]:ITEM<x> {NONE|
<Function>[,<Element>][,<Order>]}
:NUMeric[:NORMal]:ITEM<x>?
```
<x> = 1 to 255 (item number)
NONE = No output item
<Function> = {U|I|P|S|Q|...}
<Element> = {<NRf>|SIGMa}
(<NRf> = 1 to 3)
<Order> = {TOTal|DC|<NRf>}
(<NRf> = 1 to 50)

Example
```
:NUMERIC:NORMAL:ITEM1 U,1
:NUMERIC:NORMAL:ITEM1?
-> :NUMERIC:NORMAL:ITEM1 U,1
:NUMERIC:NORMAL:ITEM1 UK,1,1
:NUMERIC:NORMAL:ITEM1?
-> :NUMERIC:NORMAL:ITEM1 UK,1,1
```

Description
- For details on <Function> options, see "Function Option List (1)" at the end of this group of commands (page 6-24).
- If <Element> is omitted, the element is set to 1.
- If <Order> is omitted, the order is set to TOTal.
- <Element> and <Order> are omitted from responses to functions that do not need them.
- This instrument does not measure data for <Order> = DC.

:NUMeric[:NORMal]:PRESet

Function Presets the numeric data output item pattern.

Syntax
```
:NUMeric[:NORMal]:PRESet {<NRf>}
```
<NRf> = 1 to 4

Example
```
:NUMERIC:NORMAL:PRESET 1
```

Description
- For information about the output items that are preset, see "(1) Preset Patterns for Numeric Data Items" on page 6-26 at the end of the commands for this group.
- By default, the output items of Pattern 2 are selected.

:NUMeric[:NORMal]:CLEar

Function Clears numeric data output items (sets the items to NONE).

Syntax
```
:NUMeric[:NORMal]:CLEar
{ALL|<NRf>[,<NRf>]}
```
ALL = Clear all items
First <NRf> = 1 to 255 (the number of the first item to clear)
Second <NRf> = 1 to 255 (the number of the last item to clear)

Example
```
:NUMERIC:NORMAL:CLEAR ALL
```

Description If the 2nd <NRf> is omitted, the output item specified by the first and all following output items (up to number 255) are cleared.

:NUMeric[:NORMal]:DELete

Function Deletes numeric data output items.

Syntax
```
:NUMeric[:NORMal]:DELete
{<NRf>[,<NRf>]}
```
1st <NRf> = 1 to 255 (the number of the first item to delete)
Second <NRf> = 1 to 255 (the number of the last item to delete)

Example
```
:NUMERIC:NORMAL:DELETE 1
```
(Deletes ITEM1 and shifts ITEM2 and subsequent items forward)
```
:NUMERIC:NORMAL:DELETE 1,3
```
(Deletes ITEM1 to ITEM3 and shifts ITEM4 and subsequent items forward)

Description
- When output items are deleted, subsequent items shift forward to fill the empty positions. Empty positions at the end are set to NONE.
- If the second <NRf> is omitted, only the output item specified by the first number is deleted.

:NUMeric[:NORMal]:HEADer?

Function Queries the numeric data header.

Syntax
```
:NUMeric[:NORMal]:HEADer? {<NRf>}
```
<NRf> = 1 to 255 (item number)

Example
- When <NRf> is specified
```
:NUMERIC:NORMAL:HEADER? 1
-> U-E1
```
- When <NRf> is omitted (when :NUMeric[:NORMal]:NUMber is set to 3)
```
:NUMERIC:NORMAL:HEADER?
-> U-E1,I-E1,P-E1
```

Description
- The data name (header) of the output item is generated.
- If <NRf> is specified, only the data name for the specified item number is output.
- If <NRf> is omitted, the data names of the items from 1 to the number specified by the :NUMeric[:NORMal]:NUMber command are output in order.

:NUMeric:LIST?

Function Queries all harmonic measurement numeric list data output settings.

Syntax :NUMeric:LIST?

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- The number of numeric list data items output by :NUMeric:LIST:ITEM<x> is determined by :NUMeric:LIST:NUMber.

:NUMeric:LIST:VALue?

Function Queries the harmonic measurement numeric list data.

Syntax :NUMeric:LIST:VALue? {<NRf>}
<NRf> = 1 to 32 (item number)

Example
- When <NRf> is specified
  :NUMERIC:LIST:VALUE? 1
  -> 103.58E+00,NAN,103.53E+00
  ,0.09E+00,2.07E+00,0.04E+00,..
  (omitted)..,0.01E+00,0.01E+00
  (up to 52 data values)
- When <NRf> is omitted (when :NUMeric:LIST:NUMber is set to 5)
  :NUMERIC:LIST:VALUE?
  -> 103.58E+00,NAN,103.53E+00
  ,0.09E+00,2.07E+00,0.04E+00,..
  (omitted)..,0.00E+00,0.00E+00
  (up to 52*5 = 260 data values)
- When :NUMeric:FORMat is set to {FLOat}
  :NUMERIC:LIST:VALUE?
  -> #N (N-digit byte number)(data byte sequence)

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- A single numeric list data item consists of up to 52 items of numeric data in the following order: TOTal, DC, 1st harmonic, ..., :NUMeric:LIST:ORDer.
- If <NRf> is specified, only the numeric list data of the specified item number is output (up to 52 items of data).
- If <NRf> is omitted, the numeric list data of item numbers from 1 to :NUMeric:LIST:NUMber is output in order (up to 52 times the number specified by :NUMeric:LIST:NUMber).
- For the formats of each individual numeric data output item, see “Numeric Data Formats” at the end of this group of commands (page 6-25).
- This instrument does not measure data for the DC component. It is always “NAN.”

:NUMeric:LIST:NUMber

Function Sets or queries the number of numeric list data items that are transmitted by :NUMeric:LIST:VALue?.

Syntax :NUMeric:LIST:NUMber {<NRf>|ALL}
:NUMeric:LIST:NUMber?
<NRf> = 1 to 32(ALL)

Example :NUMERIC:LIST:NUMBER 5
:NUMERIC:LIST:NUMBER
-> :NUMERIC:LIST:NUMBER 5

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- If the parameter is omitted from the :NUMeric:LIST:VALue? command, the numeric list data items from 1 to the specified value are output in order.
- By default, the number of numeric list data items is set to 1.

:NUMeric:LIST:ORDer

Function Sets or queries the maximum output harmonic order of the harmonic measurement numeric list data.

Syntax :NUMeric:LIST:ORDer {<NRf>|ALL}
:NUMeric:LIST:ORDer?
<NRf> = 1 to 50(ALL)

Example :NUMERIC:LIST:ORDER 50
:NUMERIC:LIST:ORDER?
-> :NUMERIC:LIST:ORDER 50

Description This is only valid on models with the harmonic measurement (/G5) option.

:NUMeric:LIST:SELect

Function Sets or queries the output components of the harmonic measurement numeric list data.

Syntax :NUMeric:LIST:SELect {EVEN|ODD|ALL}
:NUMeric:LIST:SELect?

Example :NUMERIC:LIST:SELECT ALL
:NUMERIC:LIST:SELECT?
-> :NUMERIC:LIST:SELECT ALL

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- The available options are explained below.
  EVEN = Outputs the components of TOTal, DC, and even-order harmonics
  ODD = Outputs the components of TOTal, DC, and odd-order harmonics
  ALL = Outputs all components

:NUMeric:LIST:ITEM<x>

Function Sets or queries the output item (function and element) of the specified harmonic measurement numeric list data item.

Syntax `:NUMeric:LIST:ITEM<x> {NONE|<Function>,<Element>}`
`:NUMeric:LIST:ITEM<x>?`
`<x> = 1 to 32` (item number)
`NONE` = No output item
`<Function>` = `{U|I|P|PHIU|PHII|UHDF|IHDF|PHDF}`
`<Element>` = `{<NRf>}(<NRf> = 1 to 3)`

Example
```
:NUMERIC:LIST:ITEM1 U,1
:NUMERIC:LIST:ITEM1?
-> :NUMERIC:LIST:ITEM1 U,1
```

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- For details on <Function> options, see "Function Option List (2)" at the end of this group of commands (page 6-24).

:NUMeric:LIST:PRESet

Function Presets the harmonic measurement numeric list data output item pattern.

Syntax `:NUMeric:LIST:PRESet {<NRf>}`
`<NRf> = 1 to 4`

Example `:NUMERIC:LIST:PRESET 1`

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- For information about the output items that are preset, see "(2) Preset Patterns for Harmonic Measurement Numeric List Data Output Items" on page 6-28 at the end of the commands for this group.
- By default, the output items of Pattern 2 are selected.

:NUMeric:LIST:CLEar

Function Clears harmonic measurement numeric list data output items (sets the items to NONE).

Syntax `:NUMeric:LIST:CLEar {ALL|<NRf>[,<NRf>]}`
`ALL` = Clear all items
First `<NRf>` = 1 to 32 (the number of the first item to clear)
Second `<NRf>` = 1 to 32 (the number of the last item to clear)

Example `:NUMERIC:LIST:CLEAR ALL`

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- If the 2nd <NRf> is omitted, the output item specified by the first number and all following output items (up to number 32) are cleared.

:NUMeric:LIST:DELete

Function Deletes harmonic measurement numeric list data output items.

Syntax `:NUMeric:LIST:DELete {<NRf>[,<NRf>]}`
1st `<NRf>` = 1 to 32 (the number of the first item to delete)
Second `<NRf>` = 1 to 32 (the number of the last item to delete)

Example `:NUMERIC:LIST:DELETE 1` (Deletes ITEM1 and shifts ITEM2 and subsequent items forward)
`:NUMERIC:LIST:DELETE 1,3` (Deletes ITEM1 to ITEM3 and shifts ITEM4 and subsequent items forward)

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- When output items are deleted, subsequent items shift forward to fill the empty positions. Empty positions at the end are set to NONE.
- If the second <NRf> is omitted, only the output item specified by the first number is deleted.

:NUMeric:HOLD

Function Sets or queries the on/off (hold/release) status of the numeric data hold feature.

Syntax
```
:NUMeric:HOLD {<Boolean>}
:NUMeric:HOLD?
```

Example
```
:NUMERIC:HOLD ON
:NUMERIC:HOLD? -> :NUMERIC:HOLD 1
```

Description
- If :NUMeric:HOLD is set to ON before :NUMeric[:NORMal]:VALue? or :NUMeric:LIST:VALue? is executed, all the numeric data at that point in time can be held internally.
- As long as :NUMeric:HOLD is set to ON, numeric data is held even when the numeric data on the screen is updated.
- For example, if you wish to retrieve various types of numeric data from each element at the same point in time, use the following commands:
  :NUMeric:HOLD ON
  :NUMeric[:NORMal]:ITEM1 U,1;ITEM2 I,1;...
  (Set the numeric data items of element 1.)
  :NUMeric[:NORMal]:VALue?
  (Receive the numeric data of element 1.)
  :NUMeric[:NORMal]:ITEM1 U,2;ITEM2 I,2;...
  (Set the numeric data items of element 2.)
  :NUMeric[:NORMal]:VALue?
  (Receive the numeric data of element 2.)
  :NUMeric[:NORMal]:ITEM1 U,3;ITEM2 I,3;...
  (Set the numeric data items of element 3.)
  :NUMeric[:NORMal]:VALue?
  (Receive the numeric data of element 3.)
  :NUMeric:HOLD OFF
- If :NUMeric:HOLD is set to ON after having already been set to ON before, the numeric data is cleared, and the most recent numeric data is held internally. When retrieving numeric data continuously, this method can be used to circumvent the need to repeatedly set :NUMeric:HOLD to OFF.

Function Option List (Settings That Can Be Used for <Function>)

(1) Numeric data functions

Applicable commands

```
:NUMeric[:NORMal]:ITEM<x> {NONE|<Function>[,<Element>][,<Order>]}
:AOUTput[:NORMal]:CHANnel<x> {NONE|<Function>[,<Element>]}
```

<Function>	Function	WT Indicator	<Element>	<Order>
U	Voltage U	[V]	Yes	No
I	Current I	[A]	Yes	No
P	Active power P	[W]	Yes	No
S	Apparent power S	[VA]	Yes	No
Q	Reactive power Q	[var]	Yes	No
LAMBda	Power factor λ	[PF]	Yes	No
PHI	Phase difference Φ	[°]	Yes	No
FU	Voltage frequency fU	[V Hz]	Yes	No
FI	Current frequency fI	[A Hz]	Yes	No
UPPeak	Maximum voltage: U+pk	[V pk]	Yes	No
UMPeak	Minimum voltage: U–pk	[V pk]	Yes	No
IPPeak	Maximum current: I+pk	[A pk]	Yes	No
IMPeak	Minimum current: I–pk	[A pk]	Yes	No
PPPeak	Maximum power: P+pk	[W pk]	Yes	No
PMPeak	Minimum power: P–pk	[W pk]	Yes	No
TIME	Integration time	[TIME]	No	No
WH	Watt hour WP	[W h]	Yes	No
WHP	Positive watt hour WP+	[W h±]	Yes	No
WHM	Negative watt hour WP-	[W h±]	Yes	No
AH	Ampere hour q	[A h]	Yes	No
AHP	Positive ampere hour q+	[A h±]	Yes	No
AHM	Negative ampere hour q-	[A h±]	Yes	No
MATH	Computed value, such as efficiency	[MATH]	No	No
URANge	Voltage range		No	No
IRANge	Current range		No	No
URMS	True rms voltage Urms		Yes	No
UMN	Rectified mean voltage calibrated to the rms value Umn		Yes	No
UDC	Simple voltage average Udc		Yes	No
URMN	Rectified mean voltage Urmn		Yes	No
UAC	AC voltage component Uac		Yes	No
IRMS	True rms current Irms		Yes	No
IMN	Rectified mean current calibrated to the rms value Imn		Yes	No
IDC	Simple current average Idc		Yes	No
IRMN	Rectified mean current Irmn		Yes	No
IAC	AC current component Iac		Yes	No
Functions used in AOUTput[:NORMal]:CHANnel<x>				
UPeak	Voltage peak Upk	[V pk]	Yes	No
IPeak	Current peak Ipk	[A pk]	Yes	No
Functions that require the harmonic measurement (/G5) option				
UK	Rms voltage of harmonic order k U(k)	[V]	Yes	Yes
IK	Rms current of harmonic order k I(k)	[A]	Yes	Yes
PK	Active power of harmonic order k P(k)	[W]	Yes	Yes
LAMBDAK	Power factor of harmonic order k λ(k)	[PF]	Yes	Yes (k=1 only)
PHIK	Phase difference between the voltage and current of harmonic order k φ(k)	[V °] or [A °]	Yes	Yes (k=1 only)
PHIUk	Phase difference between harmonic voltage U(k) and the fundamental wave U(1) φU(k)	[V °]	Yes	Yes (k=2 and higher)
PHIIk	Phase difference between harmonic current I(k) and the fundamental wave I(1) φI(k)	[A °]	Yes	Yes (k=2 and higher)
UHDFk	Harmonic distortion factor of voltage Uhdf(k)	[V %]	Yes	Yes
IHDFk	Harmonic distortion factor of current Ihdf(k)	[A %]	Yes	Yes
PHDFk	Harmonic distortion factor of active power Phdf(k)	[W %]	Yes	Yes
UTHD	Total harmonic distortion of voltage Uthd	[THD V %]	Yes	No
ITHD	Total harmonic distortion of current Ithd	[THD A %]	Yes	No

<Function>	Function	WT Indicator	<Element>	<Order>
FPLL	PLL source frequency fPLL	[V Hz] or [A Hz]	No	No

Yes: Required. No: Not required.

(2) Numeric List Data Output Functions (These functions require the harmonic measurement (/G5) option)

Applicable command

`:NUMeric:LIST:ITEM<x> {NONE|<Function>,<Element>}`

<Function>	Function
U	Voltage U( )
I	Current I( )
P	Active power P( )
PHIU	Phase difference between harmonic voltage U(k) and the fundamental wave U(1) φU( )
PHII	Phase difference between harmonic current I(k) and the fundamental wave I(1) φI(k)
UHDF	Harmonic distortion factor of voltage Uhdf( )
IHDF	Harmonic distortion factor of current Ihdf( )
PHDF	Harmonic distortion factor of active power Phdf( )

Numeric Data Format

(1)Normal Data

- Integrated values WH, WHP, WHM, AH, AHP, and AHM
  ASCII: <NR3> format (mantissa: up to 6 digits, exponent: 2 digits. Example: [-]123.456E+00)
  FLOAT: IEEE single-precision floating point (4-byte) format
- Elapsed integration time (TIME)
  ASCII: <NR1> format in units of seconds. Example: 3600 for 1 hour (1:00:00).
  FLOAT: IEEE single-precision floating point (4-byte) format in units of seconds. Example: 0x45610000 for 1 hour (1:00:00).
- No items (NONE)
  ASCII: NAN (Not A Number)
  FLOAT: 0x7E951BEE (9.91E+37)
- Other
  ASCII: <NR3> format (mantissa: up to 5 digits, exponent: 2 digits. Example: [-]123.45.456E+00)
  FLOAT: IEEE single-precision floating point (4-byte) format

(2)Error Data

- Data does not exist (the display shows "---------")
  ASCII: NAN (Not A Number)
  FLOAT: 0x7E951BEE (9.91E+37)
- Over-range (the display shows "---O L---")
- Overflow (the display shows "---O F---")
- Data over (the display shows " Error ")
  ASCII: INF (INFinity)
  FLOAT: 0x7E94F56A (9.9E+37)

Note

In 180° (Lead/Lag) display, the phase differences Φ (PHI) of elements 1 to 3 are output in the range between –180.0 to 180.0 with lead (D) and lag (G) set to negative and positive values, respectively.

*** Preset Patterns for Numeric Data Items**

The Function Option List contains a list of the function names used in commands and their corresponding functions and panel LED indicators.

Note

This list indicates the measurement function and element that are assigned to each item number (ITEM <x>). Items that are not set to be measured are displayed or output in the same fashion as when the data does not exist. For example, if frequency FI of the current of element 2 is not set to be measured, the output of ITEM19 in pattern 2 is the same as the output when the data does not exist (NAN if the data format is ASCII).

(1)Preset Patterns for Numeric Data Items

These patterns apply to the :NUMeric[:NORMal]:PRESet command.

Pattern 1

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4 to 6	U to P	2
7 to 9	U to P	3
10 to 12	U to P	SIGMA
13 to 255	NONE	

Pattern 2

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4	S	1
5	Q	1
6	LAMBda	1
7	PHI	1
8	FU	1
9	FI	1
10	NONE	
11 to 19	U to FI	2
20	NONE	
21 to 29	U to FI	3
30	NONE	
31 to 39	U to FI	SIGMA
40	NONE	
41 to 255	NONE	

Pattern 3

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4	S	1
5	Q	1
6	LAMBda	1
7	PHI	1
8	FU	1
9	FI	1
10	UPPeak	1
11	UMPeak	1
12	IPPeak	1
13	IMPeak	1
14	PPPeak	1
15	PMPeak	1
16 to 30	U to PMPeak	2
31 to 45	U to PMPeak	3
46 to 60	U to PMPeak	SIGMA
61 to 255	NONE	

Pattern 4

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4	S	1
5	Q	1
6	LAMBda	1
7	PHI	1
8	FU	1
9	FI	1
10	UPPeak	1
11	UMPeak	1
12	IPPeak	1
13	IMPeak	1
14	TIME	1
15	WH	1
16	WHP	1
17	WHM	1
18	AH	1
19	AHP	1
20	AHM	1
21 to 40	U to AHM	2
41 to 60	U to AHM	3
61 to 80	U to AHM	SIGMA
81 to 255	NONE	

(2)Preset Patterns for Harmonic Measurement Numeric List Data Output Items

These patterns apply to the `:NUMeric:LIST:PRESet` command.

Pattern 1

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4 to 6	U to P	2
7 to 9	U to P	3
10 to 32	NONE	

Pattern 2

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4	PHIU	1
5	PHII	1
6 to 10	U to PHII	2
11 to 15	U to PHII	3
16 to 32	NONE	

Pattern 3

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4	UHDF	1
5	IHDF	1
6	PHDF	1
7 to 12	U to PHDF	2
13 to 18	U to PHDF	3
19 to 32	NONE	

Pattern 4

ITEM<x>	<Function>	<Element>
1	U	1
2	I	1
3	P	1
4	PHIU	1
5	PHII	1
6	UHDF	1
7	IHDF	1
8	PHDF	1
9 to 16	U to PHDF	2
17 to 24	U to PHDF	3
25 to 32	NONE	

6.12 RATE Group

The command in this group deals with the data update interval. You can make the same settings and queries that you can by pressing SETUP on the front panel and using the u.rAtE menu.

:RATE

Function Sets or queries the data update interval.

Syntax `:RATE {<Time>|AUTO}`
`:RATE?`
<Time> = `100`, `250`, `500(ms)`, `1`, `2`, `5`, `10`, `20(s)`

Example `:RATE 250MS`
`:RATE? -> :RATE 250.0E-03`

:RATE:AUTO?

Function Queries all applicable settings for when the data update interval is set to Auto.

Syntax `:RATE:AUTO?`

:RATE:AUTO:TIMeout

Function Sets or queries the timeout for when the data update interval is set to Auto.

Syntax `:RATE:AUTO:TIMeout {<NRf>}`
`:RATE:AUTO:TIMeout?`
<NRf> = `1`, `5`, `10`, `20(s)`

Example `:RATE:AUTO:TIMEOUT 1`
`:RATE:AUTO:TIMEOUT?`
`-> :RATE:AUTO:TIMEOUT 1`

:RATE:AUTO:SYNChronize

Function Sets or queries the synchronization source for when the data update interval is set to Auto.

Syntax `:RATE:AUTO:SYNChronize {U<x>|I<x>}`
`:RATE:AUTO:SYNChronize?`
<x> = `1` to `3` (element)

Example `:RATE:AUTO:SYNCHRONIZE U1`
`:RATE:AUTO:SYNCHRONIZE?`
`-> :RATE:AUTO:SYNCHRONIZE U1`

6.13 RECall Group

The commands in this group deal with outputting stored measured data and loading setup parameters. You can make the same settings that you can by pressing SAVE/LOAD on the front panel and using the LoAd menu. There are no front panel keys that output measured data that is stored.

:RECall:NUMber?

Function Queries the number of blocks of measured data that is stored.

Syntax `:RECall:NUMber?`

Example `:RECALL:NUMBER? -> 600`

:RECall[:NORMal]:VALue?

Function Queries the numeric data at the specified block number.

Syntax `:RECall[:NORMal]:VALue? {<NRf>}`
<NRf> = 1 to 9000 (block number)

Description
- Always specify <NRf>. The numeric data at the specified block number will be returned.
- If you omit <NRf> or specify a number greater than the number of blocks that contain stored measured data (the number returned by : RECall:NUMber?), the entire returned numeric data will be “NAN” (no data).
- The output items and format are the same as those of “:NUMeric[:NORMal]:VALue? (when the item number is not specified).” To set the output items and format, use the NUMeric group commands.

:RECall:LIST:VALue?

Function Queries the numeric list data of harmonic measurement at the specified block number.

Syntax `:RECall:LIST:VALue? {<NRf>}`
<NRf> = 1 to 600 (block number)

Description
- This is only valid on models with the harmonic measurement (/G5) option.
- Always specify <NRf>. The numeric list data at the specified block number will be returned.
- If you omit <NRf> or specify a number greater than the number of blocks that contain stored measured data (the number returned by : RECall:NUMber?), the entire returned numeric list data will be “NAN” (no data).
- The output items and format are the same as those of “:NUMeric:LIST:VALue? (when the item number is not specified).” To set the output items and format, use the NUMeric group commands.

:RECall:PANel

Function Loads a setup parameter file.

Syntax `:RECall:PANel {<NRf>}`
<NRf> = 1 to 4 (file number)

6.14 STATus group

The commands in this group are used to make settings and queries related to the status report. There are no front panel keys that correspond to the commands in this group. For information about status reports, see chapter 7.

:STATus?

Function Queries all the settings for the communication status feature.
Syntax `:STATus?`

:STATus:CONDition?

Function Queries the contents of the condition register.
Syntax `:STATus:CONDition?`
Example `:STATUS:CONDITION? -> 16`
Description For information about the condition register, see chapter 7, “Status Reports.”

:STATus:EESE

Function Sets or queries the extended event enable register.
Syntax `:STATus:EESE <Register>`
`:STATus:EESE?`
`<Register>` = 0 to 65535
Example `:STATUS:EESE #B0000000000000000`
`:STATus:EESE?`
`-> :STATUS:EESE 0`
Description For information about the extended event enable register, see chapter 7, “Status Reports.”

:STATus:EESR?

Function Queries the contents of the extended event register and clears the register.
Syntax `:STATus:EESR?`
Example `:STATUS:EESR? -> 0`
Description For information about the extended event register, see chapter 7, “Status Reports.”

:STATus:ERRor?

Function Queries the error code and message of the last error that has occurred (top of the error queue).
Syntax `:STATus:ERRor?`
Example `:STATUS:ERROR?`
`-> 113,"Underfined Header"`
Description
- If no errors have occurred, 0,”No error” is returned.
- You can use the :STATus:QMESsage command to specify whether the message is included.

:STATus:FILTer<x>

Function Sets or queries the transition filter.
Syntax `:STATus:FILTer<x> {RISE|FALL|BOTH|NEVer}`
`:STATus:FILTer<x>?`
<x> = 1 to 16
Example `:STATUS:FILTER2 RISE`
`:STATus:FILTER2?`
`-> :STATUS:FILTER2 RISE`
Description
- Set how each bit in the condition register must change to trigger the setting of an event. If a bit is set to RISE, an event is set when the bit changes from 0 to 1.
- For information about the transition filter, see chapter 7, “Status Reports.”

:STATus:QENable

Function Sets or queries whether messages other than errors will be stored to the error queue (ON) or not (OFF).
Syntax `:STATus:QENable {<Boolean>}`
`:STATus:QENable?`
Example `:STATUS:QENABLE ON`
`:STATus:QENABLE?`
`-> :STATus:QENABLE 1`

:STATus:QMESsage

Function Sets or queries whether message information will be attached to the response to the STATus:ERRor? query (ON/OFF).
Syntax `:STATus:QMESsage {<Boolean>}`
`:STATus:QMESsage?`
Example `:STATUS:QMESSAGE ON`
`:STATus:QMESSAGE?`
`-> :STATus:QMESSAGE 1`

:STATus:SPOLl?

Function Executes serial polling.
Syntax `:STATus:SPOLl?`
Example `:STATUS:SPOLL? -> :STATUS:SPOLL 0`

6.15 STORe Group

The commands in this group deal with storing measured data and saving setup parameters. You can make the same settings and queries that you can by pressing the UTILITY key on the front panel and then using the StorE menu or by pressing the SAVE/LOAD key and then using the SAVE menu.

:STORe?

Function Queries all storage settings.
Syntax `:STORe?`

:STORe[:STATe]

Function Sets or queries the storage on/off state.
Syntax `:STORe[:STATe] {<Boolean>}`
`:STORe:STATe?`
Example `:STORE:STATE ON`
`:STORE:STATE? -> :STORE:STATE 1`

:STORe:INTerval

Function Sets or queries the storage interval.
Syntax `:STORe:INTerval {<NRf>,<NRf>,<NRf>}`
`:STORe:INTerval?`
{<NRf>,<NRf>,<NRf>} = 0,0,0 to 99,59,59
First <NRf> = 0 to 99 (hours)
Second <NRf> = 0 to 59 (minutes)
Third <NRf> = 0 to 59 (seconds)
Example `:STORE:INTERVAL 0,0,0`
`:STORE:INTERVAL?`
`-> :STORE:INTERVAL 0,0,0`

:STORe:PANel

Function Saves setup parameters to a file.
Syntax `:STORe:PANel {<NRf>}`
<NRf> = 1 to 4 (file number)
Example `:STORE:PANEL 1`

6.16 SYSTem Group

The commands in this group deal with the system. You can make the same settings and queries that you can by pressing the UTILITY key on the front panel and then using the inFo or rESo menu or by pressing the KEY PROTECT or INTERFACE key.

:SYSTem?

Function Queries all system settings.
Syntax `:SYSTem?`

:SYSTem:MODel?

Function Queries the model code.
Syntax `:SYSTem:MODel?`
Example `:SYSTEM:MODEL?`
`-> :SYSTEM:MODEL "WT310E"`
Description Returns the Model item of the Utility -> Info menu.

:SYSTem:SUFFix?

Function Queries the suffix code.
Syntax `:SYSTem:SUFFix?`
Example `:SYSTEM:SUFFIX?`
`-> :SYSTEM:SUFFIX "-C1-D/C7/EX1/G5/DA4"`
Description Returns the Suffix item string of the Utility -> Info menu.

:SYSTem:SERial?

Function Queries the serial number.
Syntax `:SYSTem:SERial?`
Example `:SYSTEM:SERIAL?`
`-> :SYSTEM:SERIAL "123456789A"`
Description Returns the No. item string of the Utility -> Info menu.

:SYSTem:VERsion[:FIRMware]?

Function Queries the firmware version.
Syntax `:SYSTem:VERsion[:FIRMware]?`
Example `:SYSTEM:VERSION:FIRMWARE? -> "1.01"`
Description Returns the Ver. item string of the Utility -> Info menu.

:SYSTem:KLOCk

Function Sets or queries the on/off state of the key protection.
Syntax `:SYSTem:KLOCk {<Boolean>}`
`:SYSTem:KLOCk?`
Example `:SYSTEM:KLOCK OFF`
`:SYSTEM:KLOCK? -> :SYSTEM:KLOCK 0`

:SYSTem:RESolution

Function Sets or queries the numeric data display resolution.
Syntax `:SYSTem:RESolution {<NRf>}`
`:SYSTem:RESolution?`
`<NRf>` = 4, 5 (digit)
Example `:SYSTEM:RESOLUTION 5`
`:SYSTEM:RESOLUTION?`
`-> :SYSTEM:RESOLUTION 5`

:SYSTem:COMMunicate:COMMand

Function Sets or queries the command type.
Syntax `:SYSTem:COMMunicate:COMMand {WT300E|WT300|WT200}`
`:SYSTem:COMMunicate:COMMand?`
Example `:SYSTEM:COMMUNICATE:COMMAND WT300E`
`:SYSTEM:COMMUNICATE:COMMAND?`
`-> :SYSTEM:COMMUNICATE:COMMAND WT300E`

:SYSTem:COMMunicate:ETHernet:MACaddress?

Function Sets or queries the Ethernet MAC address.
Syntax `:SYSTem:COMMunicate:ETHernet:MACaddress?`
Example `:SYSTEM:COMMUNICATE:ETHERNET:MACADDRESS?`
`-> :SYSTEM:COMMUNICATE:ETHERNET:MACADDRESS "000064_809_413"`
Description This command is only valid on models with the Ethernet interface (/C7) option.

6.17 Common Command Group

The commands in this group are defined in IEEE 488.2-1992 and are independent from the instrument's individual functions. There are no front panel keys that correspond to the commands in this group.

*CAL?

Function Executes zero calibration (zero-level compensation, the same operation as pressing CAL (SHIFT+SET)) and queries the result.
Syntax `*CAL?`
Example `*CAL? -> 0`
Description If the zero-level compensation ends normally, 0 is returned. If an error is detected, 1 is returned.

*CLS

Function Clears the standard event register, extended event register, and error queue.
Syntax `*CLS`
Example `*CLS`
Description
- If the *CLS command is located immediately after the program message terminator, the output queue is also cleared.
- For information about each register and queue, see chapter 7.

*ESE

Function Sets or queries the standard event enable register.
Syntax `*ESE {<NRf>}`
`*ESE?`
`<NRf>` = `0` to `255`
Example `*ESE 251`
`*ESE? -> 251`
Description
- Specify the value as a sum of the values of each bit in decimal format.
- For example, specifying *ESE 251 will cause the standard enable register to be set to 11111011. In this case, bit 2 of the standard event register is disabled. This means that bit 5 (ESB) of the status byte register is not set to 1, even if a query error occurs.
- The default value is *ESE 0 (all bits disabled).
- A query using *ESE? will not clear the contents of the standard event enable register.
- For information about the standard event enable register, see page 7-4.

*ESR?

Function Queries and clears the standard event register.
Syntax `*ESR?`
Example `*ESR? -> 32`
Description
- A sum of the values of each bit is returned in decimal format.
- When an SRQ is sent, you can check what types of events have occurred.
- For example, if a value of 32 is returned, this indicates that the standard event register is set to 00100000. This means that the SRQ occurred due to a command syntax error.
- A query using *ESR? will clear the contents of the Standard Event Register.
- For information about the standard event register, see page 7-4.

*IDN?

Function Queries the instrument model.
Syntax `*IDN?`
Example `*IDN? ->`
`YOKOGAWA,WT310E,123456789A,F1.01`
Description
- The information is returned in this form: <manufacture>, <model>, <serial number>, <firmware version>.
- For details on the model, see "Checking the Package Contents" in the Getting Started Guide, IM WT310E-02EN.

*OPC

Function Sets bit 0 (the OPC bit) of the standard event register to 1 upon the completion of the specified overlap command.
Syntax `*OPC`
Example `*OPC`
Description
- This instrument does not have overlap commands. The OPC bit is always set to 1.

*OPC?

Function Returns ASCII code 1 if the specified overlap command has finished.
Syntax `*OPC?`
Example `*OPC? -> 1`
Description This instrument does not have overlap commands. 1 is always returned.

*OPT?

Function Queries the installed options.
Syntax `*OPT?`
Example `*OPT? -> C1,C7,EX1,G5,DA4`
Description
- This command returns whether the GP-IB (C1), RS-232 (C2), Ethernet communication (C7), external current sensor input (EX1, 2.5 V/5 V/10 V), external current sensor input (EX2, 50 mV/100 mV/200 mV/500 mV/1 V/2 V), harmonic measurement (G5), 4-channel D/A output (DA4, for the WT310E and WT310EH), and 12-channel D/A output (DA12, for the WT332E and WT333E) are available.
- The *OPT? query must be the last query of a program message.
  An error occurs if there is a query after the *OPT query.

*RST

Function Initializes the settings.
Syntax `*RST`
Example `*RST`
Description All settings except communication settings are reset to their factory default values. For details on initialization, see section 8.2 in the User's Manual, IM WT310E-01EN.

*SRE

Function Sets or queries the service request enable register value.
Syntax `*SRE {<NRf>}`
`*SRE?`
`<NRf>` = `0` to `255`
Example `*SRE 239`
`*SRE?`
`-> 175` (because the bit 6, MSS, setting is ignored)
Description
- Specify the value as a sum of the values of each bit in decimal format.
- For example, specifying *SRE 239 will cause the standard enable register to be set to 11101111. In this case, bit 4 of the service request enable register is disabled. This means that bit 4 (MAV) of the status byte register is not set to 1, even if the output queue is not empty.
- Bit 6 (MSS) of the status byte register is the MSS bit itself and is therefore ignored.
- The default value is *SRE 0 (all bits disabled).
- A query using *SRE? will not clear the contents of the service request enable register.
- For information about the service request enable register, see page 7-3.

*STB?

Function Queries the Status Byte Register value.
Syntax `*STB?`
Example `*STB? -> 4`
Description
- A sum of the values of each bit is returned as a decimal value.
- Because the register is read without executing serial polling, bit 6 is an MSS bit, not an RQS bit.
- For example, if a value of 4 is returned, this indicates that the status byte register is set to 00000100. This means that the error queue is not empty (in other words, an error occurred).
- A query using *STB? will not clear the contents of the status byte register.
- For information about the status byte register, see page 7-3.

*TRG

Function Executes single measurement (the same operation as when SINGLE (SHIFT+HOLD) is pressed).
Syntax `*TRG`
Example `*TRG`
Description A multi-line message GET (Group Execute Trigger) will perform the same operation as this command.

*TST?

Function Executes a self-test and queries the result.

Syntax `*TST?`

Example `*TST? -> 0`

Description
- The self-test consists of tests of each kind of internal memory.
- This command returns 0 if the self-test is successful and 1 if it is not.
- It takes approximately 6 seconds for the test to complete. When receiving a response from this instrument, set the timeout to a relatively large value.

*WAI

Function Holds the execution of the subsequent command until the completion of the specified overlap command.

Syntax `*WAI`

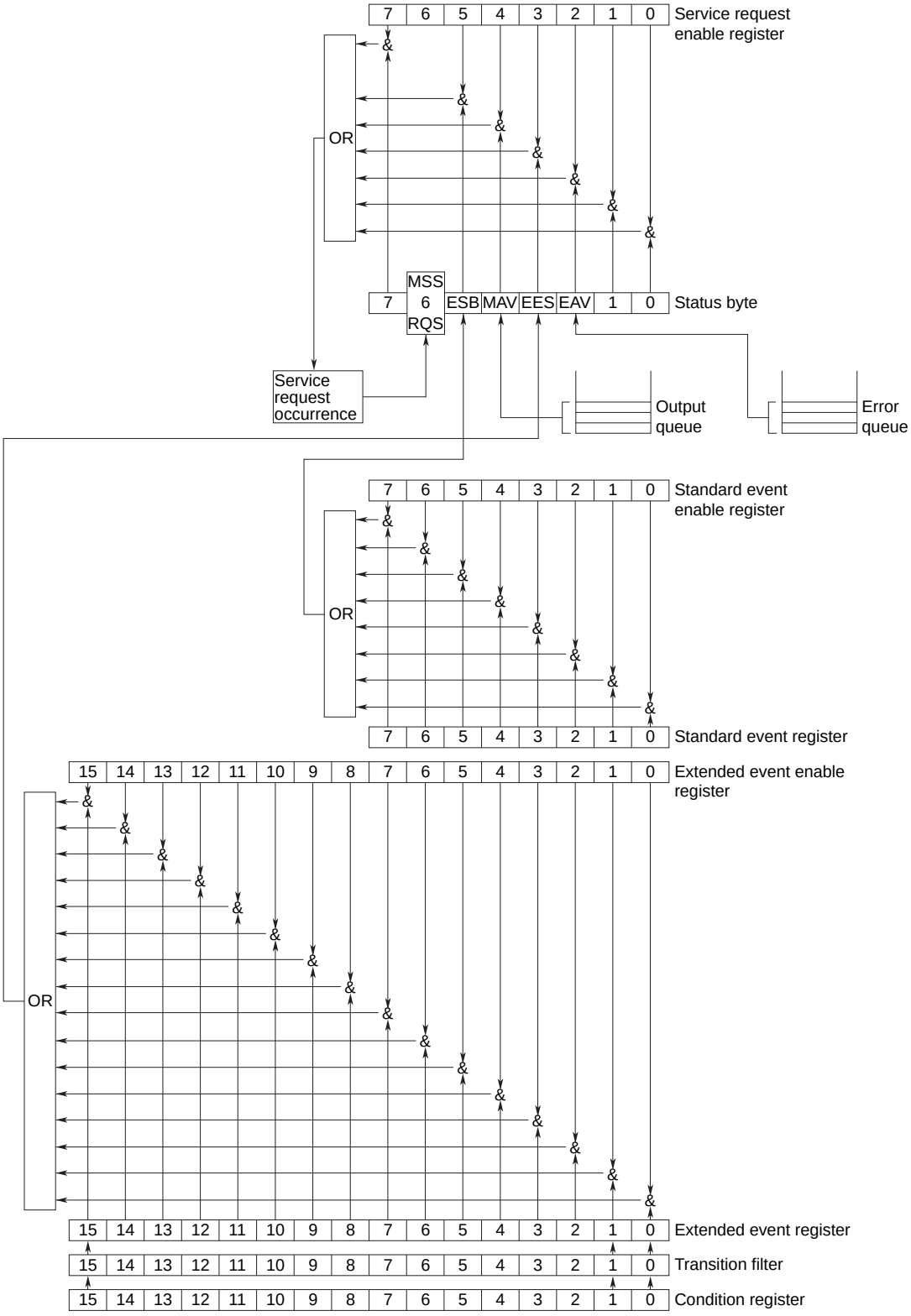
Example `*WAI`

Description This instrument does not have overlap commands. This command will be ignored.

7.1 About Status Reports

Status Reports

The figure below shows the format of status reports that are read by serial polling. This status report format is an extended version of the status report format defined in IEEE 488.2-1992.



Overview of Registers and Queues

Name	Function	Write	Read
Status byte	–	–	Serial polling (RQS), *STB?(MSS)
Service request enable register	Status byte mask	*SRE	*SRE?
Standard event register	Indicates device status changes	–	*ESR?
Standard event enable register	Standard event register mask	*ESE	*ESE?
Extended event register	Indicates device status changes	–	STATus:EESR?
Extended event enable register	Extended event register mask	STATus:EESE	STATus:EESE?
Condition register	Current device status	–	STATus:CONDition?
Transition filter	Conditions that change the extended event register	STATus:FILTer<x>	STATus:FILTer<x>?
Output queue	Stores response messages for queries	Query commands	
Error queue	Stores error numbers and messages	–	STATus:ERRor?

Registers and Queues That Affect the Status Byte

The following registers affect the status byte bits.

Register	Affected Status Byte Bit
Standard event register	Sets bit 5 (ESB) to 1 or 0
Output queue	Sets bit 4 (MAV) to 1 or 0
Extended event register	Sets bit 3 (EES) to 1 or 0
Error queue	Sets bit 2 (EAV) to 1 or 0

Enable Registers

The following registers are used to mask a bit so that the bit will not affect the status byte even when it is set to 1.

Masked Register	Mask Register
Status byte	Service request enable register
Standard event register	Standard event enable register
Extended event register	Extended event enable register

Reading and Writing to Registers

For example, use the *ESE command to set the standard event enable register bits to 1 and 0. You can use the *ESE? command to query whether the standard event enable register bits are ones or zeros. For details on these commands, see chapter 6.

7.2 Status Byte

Status Byte

- **Bits 0, 1, and 7**
  Not used (always 0)
- **Bit 2 EAV (Error Available)**
  This bit is 1 when the error queue is not empty. In other words, this bit is set to 1 when an error occurs. For details, see page 7-6.
- **Bit 3 EES (Extend Event Summary Bit)**
  This bit is set to 1 when the logical AND of the extended event register and the extended event enable register is 1. In other words, this bit is set to 1 when a certain event takes place inside the instrument. For details, see page 7-5.
- **Bit 4 MAV (Message Available)**
  This bit is 1 when the output queue is not empty. In other words, this bit is set to 1 when there is data to be transmitted in response to a query. For details, see page 7-6.
- **Bit 5 ESB (Event Summary Bit)**
  This bit is set to 1 when the logical AND of the standard event register and the standard event enable register is 1. In other words, this bit is set to 1 when a certain event takes place inside the instrument. For details, see page 7-4.
- **Bit 6 RQS (Request Service)/MSS (Master Status Summary)**
  This bit is 1 when the logical AND of the status byte excluding bit 6 and the service request enable register is 1. In other words, this bit is set to 1 when the instrument requests service from the controller. RQS is set to 1 when the MSS bit changes from 0 to 1 and is cleared when serial polling is carried out or when the MSS bit changes to 0.

Bit Masking

To mask a bit in the status byte so that it does not cause an SRQ, set the corresponding bit of the service request enable register to 0.
For example, to mask bit 2 (EAV) so that service is not requested when an error occurs, set bit 2 of the service request enable register to 0. Do this using the `*SRE` command. To query whether each bit of the service request enable register is 1 or 0, use `*SRE?`. For details on the `*SRE` command, see chapter 6.

Status Byte Operation

A service request is issued when bit 6 in the status byte becomes 1. Bit 6 is set to 1 when any other bit becomes 1 (when the corresponding bit of the service request enable register is also set to 1). For example, if an event occurs and the logical OR of a standard event register bit and its corresponding enable register bit is 1, then bit 5 (ESB) is set to 1. At this point, if bit 5 of the service request enable register is 1, bit 6 (MSS) is set to 1, and this instrument requests service from the controller.
You can check what type of event occurred by reading the contents of the status byte.

Reading the Status Byte

There are two ways to read the contents of the status byte.

- ***STB? query**
  Bit 6 functions as MSS when a query is made using `*STB?`. This causes the MSS to be read. This query does not cause any of the status byte bits to be cleared after the status byte is read.
- **Serial polling**
  Serial polling causes bit 6 to function as an RQS bit. This causes the RQS to be read. After the status byte is read, only the RQS bit is cleared. You cannot read the MSS bit when serial polling is used.

Clearing the Status Byte

There is no way to clear all the bits in the status byte. The bits that are cleared for each operation are shown below.

- ***STB? query**
  None of the bits are cleared.
- **Serial polling**
  Only the RQS bit is cleared.
- **When a *CLS command is received**
  When a `*CLS` command is received, the status byte itself is not cleared, but the contents of the standard event register, which affects the bits in the status byte, are cleared. As a result, the corresponding status byte bits are cleared. Because the output queue is not cleared with a `*CLS` command, bit 4 (MAV) in the status byte is not affected. However, the output queue will be cleared if the `*CLS` command is received just after a program message terminator.

7.3 Standard Event Register

Standard Event Register

7	6	5	4	3	2	1	0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

- **Bit 7 PON (Power ON)**
  This bit is set to 1 when the instrument is turned on.
- **Bit 6 URQ (User Request)**
  Not used (always 0)
- **Bit 5 CME (Command Error)**
  This bit is set to 1 when there is a command syntax error.
  Example Command names are misspelled, or character data that is not one of the available options has been received.
- **Bit 4 EXE (Execution Error)**
  This bit is set to 1 when the command syntax is correct, but the command cannot be executed in the current state.
  Example Parameters are out of range, or a command has been received for an option that is not installed.
- **Bit 3 DDE (Device Error)**
  This bit is set to 1 when a command cannot be executed for internal reasons other than a command syntax error or command execution error.
- **Bit 2 QYE (Query Error)**
  This bit is set to 1 when a query command is received, but the output queue is empty or the data is lost.
  Example There is no response data, or data is lost due to an overflow in the output queue.
- **Bit 1 RQC (Request Control)**
  Not used (always 0)
- **Bit 0 OPC (Operation Complete)**
  This bit is set to 1 upon the completion of the operation designated by the *OPC command (see chapter 6 for details).

Bit Masking

To mask a certain bit of the standard event register so that it does not cause bit 5 (ESB) in the status byte to change, set the corresponding bit of the standard event enable register to 0.
For example, to mask bit 2 (QYE) so that ESB will not be set to 1 even if a query error occurs, set bit 2 of the standard event enable register to 0. Do this using the *ESE command. To query whether each bit of the standard event enable register is 1 or 0, use *ESE?.
For details on the *ESE command, see chapter 6.

Standard Event Register Operation

The standard event register indicates eight types of events that occur inside the instrument. When one of the bits in this register becomes 1 (and the corresponding bit of the standard event enable register is also 1), bit 5 (ESB) in the status byte is set to 1.
Example
1. A query error occurs.
2. Bit 2 (QYE) is set to 1.
3. When bit 2 of the standard event enable register is 1, bit 5 (ESB) in the status byte is set to 1.

You can also check what type of event occurred in this instrument by reading the contents of the standard event register.

Reading the Standard Event Register

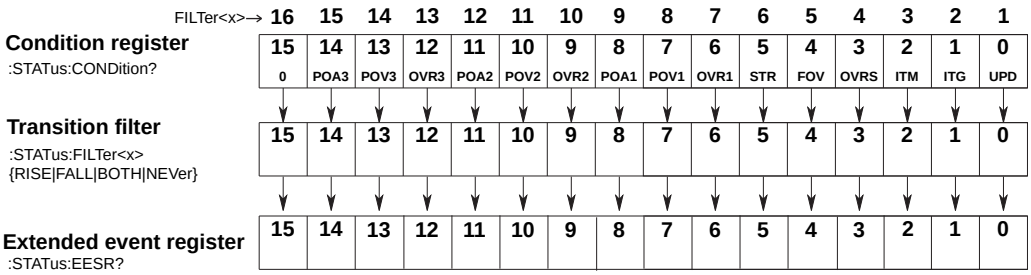
You can use the *ESR? command to read the contents of the standard event register. The register is cleared after it is read.

Clearing the Standard Event Register

The standard event register is cleared in the following three cases.
- When the contents of the standard event register are read using the *ESR command.
- When a *CLS command is received.
- When this instrument is restarted.

7.4 Extended Event Register

The extended event register receives information about changes in the condition register, which indicates the instrument's internal condition. The information is the result of edge detection performed by the transition filter.



The condition register bits are described below.

Bit 0	UPD (Updating)	Set to 1 when the measured data is being updated. UPD changing from 1 to 0 indicates that updating has been completed.
Bit 1	ITG (Integrate Busy)	Set to 1 during integration.
Bit 2	ITM (Integrate Timer Busy)	Set to 1 when the integration timer is operating.
Bit 3	OVRS (Σ results overflow)	Set to 1 when the computed result of Σ overflows.
Bit 4	FOV (Frequency Over)	Set to 1 when the frequency is outside the measurement range.
Bit 5	STR (Store busy)	Set to 1 during storage.
Bit 6	OVR1 (Element1 mesured data over)	Set to 1 when the voltage or current of element 1 exceeds its range.
Bit 7	POV1 (Element1 voltage peak over)	Set to 1 when a peak over-range is detected in the element 1 voltage.
Bit 8	POA1 (Element1 current peak over)	Set to 1 when a peak over-range is detected in the element 1 current.
Bit 9	OVR2 (Element2 mesured data over)	Set to 1 when the voltage or current of element 2 exceeds its range.
Bit 10	POV2 (Element2 voltage peak over)	Set to 1 when a peak over-range is detected in the element 2 voltage.
Bit 11	POA2 (Element2 current peak over)	Set to 1 when a peak over-range is detected in the element 2 current.
Bit 12	OVR3 (Element3 mesured data over)	Set to 1 when the voltage or current of element 3 exceeds its range.
Bit 13	POV3 (Element3 voltage peak over)	Set to 1 when a peak over-range is detected in the element 3 voltage.
Bit 14	POA3 (Element3 current peak over)	Set to 1 when a peak over-range is detected in the element 3 current.

The transition filter parameters detect changes in the specified condition register bits (numeric suffixes 1 to 16) and overwrite the extended event register in the following ways.

RISE	The specified extended event register bit is set to 0 when the corresponding condition register bit changes from 1 to 1.
FALL	The specified extended event register bit is set to 1 when the corresponding condition register bit changes from 0 to 1.
BOTH	The specified extended event register bit is set to 1 when the corresponding condition register bit changes from 0 to 1 or from 1 to 0.
NEVer	Always zero.

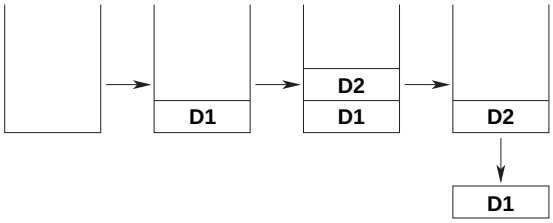
7.5 Output and Error Queues

Output Queue

The output queue stores query response messages. For example, if you send a `:NUMeric[:NORMal]:VALue?` command, which requests for the transmission of measured data, the data is stored in the output queue until it is read.
As shown below, data is stored in order and read from the oldest message first. The output queue is cleared in the following cases.

- When a new message is received from the controller.
- When a deadlock occurs (see page 5-2).
- When a device clear command (DCL or SDC) is received.
- When this instrument is restarted.

The `*CLS` command does not clear the output queue. You can determine whether or not the output queue is empty by checking bit 4 (MAV) in the status byte.



Error Queue

When an error occurs, the error queue stores the error number and message. For example, if the instrument receives an incorrect program message from the controller, the error number (113) and the error message (“Undefined header”) are stored in the error queue when the instrument displays the error message.
You can use the `:STATus:ERRor?` query to read the contents of the error queue. Like the output queue, the messages in the error queue are read from the oldest one first.
If the error queue overflows, the last message is replaced with the following message: 350, “Queue overflow.”
The error queue is cleared in the following cases.

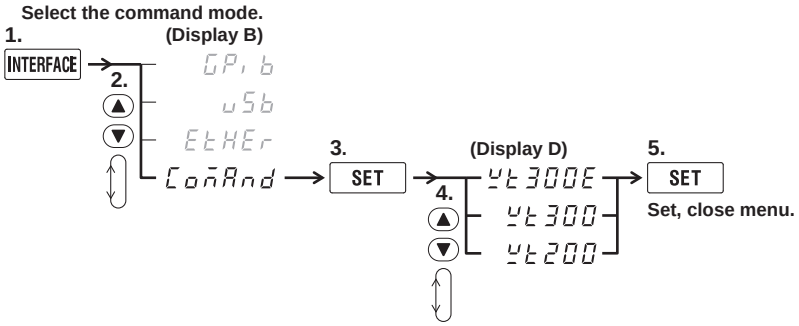
- When a `*CLS` command is received.
- When this instrument is restarted.

You can determine whether or not the error queue is empty by checking bit 2 (EAV) in the status byte.

8.1 WT210/WT230 Compatible Command Mode

Procedure

Follow the procedure indicated by the thick lines in the following menu.



Explanation

Many of the functions of this instrument can be controlled with the legacy model WT210/WT230 communication commands. For these functions, WT210/WT230 communication programs can be used on this instrument.

Command Mode

- WT300E: Command mode in which communication commands of this instrument are used
  These commands are not compatible with WT210/WT230 communication commands.
- WT300: Command mode in which the commands are compatible with WT310/WT310HC/WT332/WT333 communication commands. The responses to the *IDN? and :SYSTem:SUFFix? commands will be those of the WT310/WT310HC/WT332/WT333.

All other commands are the same as when the command mode is set to WT300E.

- WT200: Command mode in which the commands are compatible with WT210/WT230 communication commands.

Compatibility with WT210/WT230 communication commands is as follows:

Symbols used in tables

- A: Compatible
- B: Partial limitation
- C: Command accepted but does not work
- D: Command not accepted

Note

For details on WT210/WT230 communication commands, see the WT210/WT230 User's Manual.

AOUTput Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
D/A output item (during normal measurement)	AOUTput:CHANnel<x> <x> = 1 to 12 (for /DA12) 1 to 4 (for /DA4, /CMP)	A		B	NONE = No output item <Function> = {U|I|P|S|Q|LAMBda|PHI|FU|FI|WH|WHP|WHM|AH|AHP|AHM|MATH|UPeak|IPeak} <Element> = {<NRf>|SIGMa} (<NRf> = 1 to 3)
Sets or queries the rated integration time.	:AOUTput:IRTime	B	Cannot be set with a string.	B	Cannot be set with a string.
Resets settings to their defaults.	:AOUTput:PRESet	A		A	

COMMunicate group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries whether headers are attached to response data.	:COMMunicate:HEADer	A		A	
Sets/clears local lockout.	:COMMunicate:LOCKout	A		A	
Sets remote or local mode.	:COMMunicate:REMote	A		A	
Queries the line-specific status.	:COMMunicate:STATus?	A		A	
Sets or queries whether query responses are returned in full or abbreviated form.	:COMMunicate:VERBose	A		A	
Waits for the specified extended event to occur.	:COMMunicate:WAIT	A		A	
Creates a response for the specified extended event.	:COMMunicate:WAIT?	A		A	

CONFigure Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Queries all averaging settings.	[:CONFigure]:AVERaging?	A		D	:MEASure:AVERaging?
Sets or queries the on/off state of averaging.	[:CONFigure]:AVERaging[:STATe]	A		D	:MEASure:AVERaging[:STATe]
Sets or queries the averaging type.	[:CONFigure]:AVERaging:TYPE	A		D	:MEASure:AVERaging:TYPE :MEASure:AVERaging:COUNt
Sets or queries the crest factor.	[:CONFigure]:CFACtor	A		D	[:INPut]:CFACtor
Queries all current range settings.	[:CONFigure]:CURRent?	A		D	[:INPut]:CURRent?
Sets or queries the current auto range on/off state.	[:CONFigure]:CURRent:AUTO	A		D	[:INPut]:CURRent:AUTO
Queries all external current sensor scaling constant settings.	[:CONFigure]:CURRent:ESCaling?	A		D	[:INPut]:CURRent:SRATio?
Sets the external current sensor scaling constant on all elements at once.	[:CONFigure]:CURRent:ESCaling[:ALL]	A	You can set the external current sensor scaling constant using the “A/FS(mV)” form, just like the WT210/WT230 computation method. FS = External current sensor range rating	D	[:INPut]:CURRent:SRATio[:ALL]
Sets or queries the external current sensor scaling constant of an element.	[:CONFigure]:CURRent:ESCaling:ELEMent<x>	A		D	[:INPut]:CURRent:SRATio:ELEMent<x>
Sets or queries the current range.	[:CONFigure]:CURRent:RANGe	A		D	[:INPut]:CURRent:RANGe
Sets or queries the frequency filter on/off state.	[:CONFigure]:FILTer	A		D	[:INPut]:FILTer:FREQuency
Sets or queries the line filter on/off state.	[:CONFigure]:LFILter	A		D	[:INPut]:FILTer:LINE
Sets or queries the MAX hold on/off state.	[:CONFigure]:MHOLd[:STATe]	A		D	:MEASure:MHOLd
Sets or queries the measurement mode.	[:CONFigure]:MODE	A		D	[:INPut]:MODE
Queries all scaling settings.	[:CONFigure]:SCALing?	A		D	[:INPut]:SCALing?
Queries the {voltage|current|power} scaling constant.	[:CONFigure]:SCALing:{PT|CT|SFACtor}?	A		D	[:INPut]:SCALing:{VT|CT|SFACtor}?
Sets the {voltage|current|power} scaling constant on all elements at once.	[:CONFigure]:SCALing:{PT|CT|SFACtor}[:ALL]	A		D	[:INPut]:SCALing:{VT|CT|SFACtor}[:ALL]
Sets or queries the {voltage|current|power} scaling constant of an element.	[:CONFigure]:SCALing:{PT|CT|SFACtor}:ELEMent<x>	A		D	[:INPut]:SCALing:{VT|CT|SFACtor}:ELEMent<x>
Sets or queries the scaling on/off state.	[:CONFigure]:SCALing[:STATe]	A		D	[:INPut]:SCALing[:STATe]

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the measurement synchronization source.	[:CONFigure]:SYNChronize	A		D	[:INPut]:SYNChronize
Queries all voltage range settings.	[:CONFigure]:VOLTage?	A		D	[:INPut]:VOLTage?
Sets or queries the voltage auto range on/off state.	[:CONFigure]:VOLTage:AUTO	A		D	[:INPut]:VOLTage:AUTO
Sets or queries the voltage range.	[:CONFigure]:VOLTage:RANGe	A		D	[:INPut]:VOLTage:RANGe
Sets or queries the wiring system.	[:CONFigure]:WIRing	A		D	[:INPut]:WIRing

DISPlay Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the element to be displayed.	:DISPlay<x>:ELEMent <x> = 1 to 3 1: Display A 2: Display B 3: Display C	A		D	Normal measurement data: :DISPlay[:NORMal]:ITEM<x> {<Function>[,<Element>]} Harmonic measurement data: :DISPlay:HARMonics:ITEM<x> {<Function>[,<Element>]}
Sets or queries the function to be displayed.	:DISPlay<x>:FUNCtion <x> = 1 to 3 1: Display A 2: Display B 3: Display C	A	When you set the following functions, the content of display D changes. • During normal measurement •VHZ •AHZ • During harmonic measurement •VTHD •ATHD •PF	D	
Sets or queries the content to be displayed.	:DISPlay<x>:MODE	B	Supports {VALue|RANGe}.	B	
Sets or queries the number of displayed digits.	:DISPlay<x>:RESolution	A		D	:SYSTem:RESolution {<NRf>}

HARMonics Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the harmonic order of the harmonic component that is shown in display B for the harmonic measurement data display.	:HARMonics:DISPlay:ORDer	A		A	
Sets or queries the harmonic measurement source element.	:HARMonics:ELEMent	A		D	All elements are subject to harmonic measurement, so setting this is not necessary.
Sets or queries the on/off state of harmonic measurement mode.	:HARMonics[:STATe]	A		D	:HARMonics:DISPlay[:STATe]
Sets or queries the PLL source.	:HARMonics:SYNChronize	A		D	:HARMonics:PLLSource
Sets or queries the equation used to compute the THD (total harmonic distortion).	:HARMonics:THD	A		D	:HARMonics:THD {FUNDamental|TOTal}

INTEGrate Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the integration mode.	:INTEGrate:MODE	A		A	
Resets the integrated value.	:INTEGrate:RESet	A		A	
Starts integration.	:INTEGrate:STARt	A		A	
Stops integration.	:INTEGrate:STOP	A		A	
Sets or queries the integration timer value.	:INTEGrate:TIMer	B	Cannot be set with a string.	B	Cannot be set with a string.

MATH Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the equation of four arithmetic operations.	:MATH:ARIThmetic	A		D	:MATH {EFFiciency|CFU<x>|CFI <x>|ADD|SUB|MUL|DIV|DIVA| DIVB|AVW<x>} EFFiciency: Efficiency CFU<x>,CFI<x> : Voltage and current crest factor<x> = 1 to 3 (element) AVW<x> : Average active power during integration <x> = 1 to 3 (element), 4 (Σ)
Sets or queries the average active power computation while integration is in progress.	:MATH:AVERage	A		D	
Sets or queries the crest factor equation.	:MATH:CFACtor	A		D	
Sets or queries the computation type.	:MATH:TYPE	A		D	

MEASure Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Queries all harmonic measurement data settings.	:MEASure:HARMonics?	A		D	:NUMeric:LIST?
Queries all settings related to the communication output items of harmonic measurement data.	:MEASure:HARMonics:ITEM?	A		D	:NUMeric:LIST:ITEM<x>
Sets the communication output on/off states of all harmonic measurement functions to a preset pattern at once.	:MEASure:HARMonics:ITEM: PRESet	A		D	:NUMeric:LIST:PRESet
Sets or queries the communication output on/off state of a harmonic measurement function.	:MEASure:HARMonics: ITEM:{<harmonic measurement function>|SYNChronize}	A		D	:NUMeric:LIST:ITEM<x>
Queries the harmonic measurement data that has been set with commands that start with “MEASure: HARMonics:ITEM.”	:MEASure:HARMonics:VALue? :MEASure:HARMonics:BINary?	A		D	(1) :NUMeric:FORMat {ASCii|FLOat} (2) :NUMeric:LIST:VALue?
Sets or queries the additional information output on/off state for when outputting measured/ computed data in binary format.	:MEASure:HEADer	C	Setting and querying are possible, but setting this command to ON will not cause additional information to be output.	D	
Queries all normal measurement data settings.	:MEASure:NORMal?	A		D	:NUMeric:NORMal?
Queries all settings related to the communication output items of normal measurement data.	:MEASure[:NORMal]:ITEM?	A		D	:NUMeric:NORMal?
Sets the communication output on/off states of all normal measurement functions to a preset pattern at once.	:MEASure[:NORMal]:ITEM: PRESet	A		D	:NUMeric[:NORMal]:PRESet

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Queries the communication output setting of the specified normal measurement function.	:MEASure[:NORMal]:ITEM:<normal measurement function>?	A		D	:NUMeric:NORMal?
Sets the communication output on/off state of the specified normal measurement function on all valid elements or Σ at once.	:MEASure[:NORMal]:ITEM:<normal measurement function>[:ALL]	A		D	:NUMeric[:NORMal]:ITEM<x>
Sets or queries the communication output on/off state of the specified normal measurement function on the specified element.	:MEASure[:NORMal]:ITEM:<normal measurement function>:ELEMent<x>	A		D	
Sets or queries the communication output on/off state of the specified normal measurement function on Σ.	:MEASure[:NORMal]:ITEM:<normal measurement function>:SIGMa	A		D	
Sets or queries the communication output on/off state of {elapsed integration time|MATH}.	:MEASure[:NORMal]:ITEM:{TIME|MATH}	A		D	
Queries the normal measurement data that has been set with commands that start with “MEASure[:NORMal]:ITEM.”	:MEASure[:NORMal]:VALue? :MEASure[:NORMal]:BINary?	A		D	(1) :NUMeric:FORMat {ASCii|FLOat} (2) :NUMeric[:NORMal]:VALue?

RECall Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the recall interval.	:RECall:INTerval	D	The function for recalling to the screen of this instrument is not available.	D	
Loads a setup parameter file.	:RECall:PANel	A		A	
Sets or queries the recall on/off state.	:RECall[:STATe]	D	The function for recalling to the screen of this instrument is not available.	D	

RELay Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the comparator function.	:RELay:…	D	No comparator function	D	

SAMPle Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the output data (display, communication, etc.) hold state.	:SAMPle:HOLD	A		A	:HOLD
Sets or queries the data update interval.	:SAMPle:RATE	A		A	:RATE

STATus Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Queries the contents of the condition register.	:STATus:CONDition?	A		A	
Sets or queries the extended event enable register.	:STATus:EESE	A		A	
Queries the contents of the extended event register and clears the register.	:STATus:EESR?	A		A	
Queries the error code and message of the last error that has occurred (top of the error queue).	:STATus:ERRor?	A		A	
Sets or queries the transition filter.	:STATus:FILTer<x> <x> = 1 to 16	A		A	
Sets or queries whether message information will be attached to the response to the STATus:ERRor? query.	:STATus:QMESsage	A		A	
Executes serial polling.	:STATus:SPOLl?	A		A	

STORe Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Sets or queries the storage interval.	:STORe:INTerval	B	Cannot be set with a string.	B	Cannot be set with a string.
Save setup parameters to a file.	:STORe:PANel	A		A	
Sets or queries the storage on/off state.	:STORe[:STATe]	A		A	

Common Command Group

Function	WT210/WT230 Command	Command of This Instrument			
		Command Mode: WT200		Command Mode: WT300, WT300E	
Performs zero-level compensation and queries the result.	*CAL?	A		A	
Clears the standard event register, extended event register, and error queue.	*CLS	A		A	
Sets or queries the standard event enable register.	*ESE	A		A	
Queries and clears the standard event register.	*ESR?	A		A	
Queries the model information.	*IDN?	A		A	
Queries the option information.	*OPT?	A		A	
Sets or queries whether registers will be cleared at power-on.	*PSC	D		D	
Initializes setup parameters.	*RST	A		A	
Sets or queries the service request enable register.	*SRE	A		A	
Queries the Status Byte Register value.	*STB?	A		A	
Executes the same operation as the TRIG (SHIFT+HOLD) key on the front panel.	*TRG	A		A	
Performs a self-test and queries the result.	*TST?	A		A	

Correspondence Table of WT210/WT230 Functions and Functions of This Instrument

Function expressions are shown below. For the WT210/WT230 compatible command mode, see the WT210/WT230 column.

WT210/ WT230	This Instrument	Notes
Normal measurement		
V	U	
A	I	
W	P	
VA	S	
VAR	Q	
PF	LAMBda	
DEGRee	PHI	
VHZ	FU	
AHZ	FI	
WH	WH	
WHP	WHP	
WHM	WHM	
AH	AH	
AHP	AHP	
AHM	AHM	
VPK	UPeak	The larger of the absolute values UPPeak and UMPeak
APK	IPeak	The larger of the absolute values IPPeak and IMPeak
TIME {}	TIME	
MATH	MATH	
	UPPeak	1
	UMPeak	1
	IPPeak	1
	IMPeak	1
	PPPeak	1
	PMPeak	1
Harmonic measurement		
V	U	
A	I	
W	P	
PF	LAMBda	
VHZ	FU	
AHZ	FI	
VTHD	UTHD	
ATHD	ITHD	
VCON	UHDF	
ACON	IHDF	
WCON	PHDF	
VDEG	PHIU	
ADEG	PHII	
ORDer	ORDer	

1 New functions on this instrument

9.1 Overview of Modbus/TCP Communication

Modbus/TCP is one of the communication protocols used to communicate with PCs, PLCs (sequencers), and the like using the TCP/IP protocol over Ethernet or other networks. This communication protocol is used to read and write to the instrument's internal registers and exchange data with connected devices.
Hereafter, host devices such as PCs will be referred to as client devices.
This instrument can be connected to an IEEE802.3 network (100BASE-TX/10BASE-T).
The Modbus/TCP protocol typically uses port number 502 to perform communication.

Component Names and Functions

For the names and functions of Ethernet interface components used in Modbus/TCP communication, see section 4.1.

Modbus/TCP Function and Specifications

Ethernet Interface Specifications Used in Modbus/TCP Communication

Item	Specifications
Ports	1
Connector type	RJ-45
Electrical and mechanical specifications	Complies with IEEE802.3
Transmission system	Ethernet (100BASE-TX/10BASE-T)
Communication protocol	TCP/IP
Supported services	DHCP, remote control (VXI-11, Modbus/TCP)
Port number	VXI-11: 1024/tcp Modbus/TCP: 502/tcp

This instrument runs as a Modbus server. The number of simultaneous connections is 1.

Connection Procedure

Connect a UTP (Unshielded Twisted-Pair) or STP (Shielded Twisted-Pair) cable that is connected to a hub or other network device to the Ethernet port on the instrument's rear panel.
For details, see section 4.3.

Instrument Configuration

TCP/IP configuration is required. For details, see section 4.4.

9.2 Communication with Client Devices

List of Function Codes

This instrument supports the following function codes.

Code	Function	Description
03	Reads the hold register	Continuous reading from 0001 to 0010 is possible.
04	Reads the input register	Up to 125 values can be read continuously from 0001 to 3008.
06	Writes to the hold register	Writing is possible only to one register in the range of 0001 to 0010.

Specifying Registers

Registers are specified from a client device in the following manner.

- If an off-the-shelf SCADA or the like is used, specify the Ref No. (reference number) listed in section 9.3, “Register Functions and Applications.”
- In the case of a communication program that you create, specify the H No. (relative number) listed in section 9.3, “Register Functions and Applications.”

Example: To specify the voltage data of element 1 (float upper bytes) (input register: 0101)

- For a request using an off-the-shelf SCADA or the like, specify Ref No. 30101.
- For a request using a communication program that you create, specify H No. 0064.

9.3 Register Functions and Applications

Measured data, setup data, and other types of data of this instrument are assigned to the internal registers for Modbus/TCP. A client device can send commands to this instrument using Modbus/TCP communication to read and write to the internal registers of this instrument. This enables measured data and the like to be retrieved and the instrument to be controlled such as starting integration.

Register Assignments

	Register Number	Group	Description
Input register	0001 to 0012	Measured data, status	Data not dependent on element/Σ, status
	0101 to 0194	Measured data (element 1)	Normal and harmonic measurement data of element 1
	0201 to 0294	Measured data (element 2)	Normal and harmonic measurement data of element 2
	0301 to 0394	Measured data (element 3)	Normal and harmonic measurement data of element 3
	0401 to 0446	Measured data (Σ)	Normal measurement data of wiring unit Σ
	2001 to 2510	Communication output item data	Measured data synchronized with communication output item settings (:NUMeric[:NORMal]:ITEM<x> command)
	3001 to 3008	Instrument display item data	Measured data synchronized with the instrument display of normal measurement (Display A to Display D)
Hold register	0001 to 0010	Control data	Hold register values, control integration operation
Other		Reserved area (blank)	Not to be used. Operation not guaranteed if written to.

Register Map (Input Register)

Reg No.	Ref No.	H No.	Register Name		Register Description		Notes
Data not dependent on status, element, or wiring unit							
0001	30001	0000	Update Count		Data update counter	(uint 16)	0 to 65535
0002	30002	0001					
0003	30003	0002	Peak Over		Peak over-range status	(uint 16)	0 to 63 (0x003f)
0004	30004	0003	Check Range		Check range status	(uint 16)	0 to 136 (0x0088)
0005	30005	0004	URange	H	Voltage range	(float, upper 2 bytes)	
0006	30006	0005		L		(float, lower 2 bytes)	
0007	30007	0006	IRange	H	Current range	(float, upper 2 bytes)	
0008	30008	0007		L		(float, lower 2 bytes)	
0009	30009	0008	MATH	H	Computed value, such as efficiency	(float, upper 2 bytes)	
0010	30010	0009		L		(float, lower 2 bytes)	
0011	30011	000A	fPLL	H	PLL source frequency	(float, upper 2 bytes)	
0012	30012	000B		L		(float, lower 2 bytes)	
Element 1 normal measurement data							
0101	30101	0064	U1	H	Voltage 1	(float, upper 2 bytes)	
0102	30102	0065		L		(float, lower 2 bytes)	
0103	30103	0066	I1	H	Current 1	(float, upper 2 bytes)	
0104	30104	0067		L		(float, lower 2 bytes)	
0105	30105	0068	P1	H	Active power 1	(float, upper 2 bytes)	
0106	30106	0069		L		(float, lower 2 bytes)	
0107	30107	006A	S1	H	Apparent power 1	(float, upper 2 bytes)	
0108	30108	006B		L		(float, lower 2 bytes)	
0109	30109	006C	Q1	H	Reactive power 1	(float, upper 2 bytes)	
0110	30110	006D		L		(float, lower 2 bytes)	
0111	30111	006E	Lambda1	H	Power factor (λ) 1	(float, upper 2 bytes)	
0112	30112	006F		L		(float, lower 2 bytes)	
0113	30113	0070	Phi1	H	Phase difference (φ) 1	(float, upper 2 bytes)	
0114	30114	0071		L		(float, lower 2 bytes)	
0115	30115	0072	fU1	H	Voltage 1 frequency	(float, upper 2 bytes)	
0116	30116	0073		L		(float, lower 2 bytes)	
0117	30117	0074	fI1	H	Current 1 frequency	(float, upper 2 bytes)	
0118	30118	0075		L		(float, lower 2 bytes)	
0119	30119	0076	U+pk1	H	Maximum voltage 1	(float, upper 2 bytes)	
0120	30120	0077		L		(float, lower 2 bytes)	
0121	30121	0078	U-pk1	H	Minimum voltage 1	(float, upper 2 bytes)	
0122	30122	0079		L		(float, lower 2 bytes)	
0123	30123	007A	I+pk1	H	Maximum current 1	(float, upper 2 bytes)	
0124	30124	007B		L		(float, lower 2 bytes)	
0125	30125	007C	I-pk1	H	Minimum current 1	(float, upper 2 bytes)	
0126	30126	007D		L		(float, lower 2 bytes)	
0127	30127	007E	P+pk1	H	Maximum power 1	(float, upper 2 bytes)	
0128	30128	007F		L		(float, lower 2 bytes)	
0129	30129	0080	P-pk1	H	Minimum power 1	(float, upper 2 bytes)	
0130	30130	0081		L		(float, lower 2 bytes)	
0131	30131	0082	Time1	H	Integration time 1	(float, upper 2 bytes)	
0132	30132	0083		L		(float, lower 2 bytes)	
0133	30133	0084	WP1	H	Sum of positive and negative watt hours 1	(float, upper 2 bytes)	
0134	30134	0085		L		(float, lower 2 bytes)	
0135	30135	0086	WP+1	H	Positive watt hours 1	(float, upper 2 bytes)	
0136	30136	0087		L		(float, lower 2 bytes)	
0137	30137	0088	WP-1	H	Negative watt hours 1	(float, upper 2 bytes)	
0138	30138	0089		L		(float, lower 2 bytes)	
0139	30139	008A	q1	H	Sum of positive and negative ampere hours 1	(float, upper 2 bytes)	
0140	30140	008B		L		(float, lower 2 bytes)	
0141	30141	008C	q+1	H	Positive ampere hour 1	(float, upper 2 bytes)	
0142	30142	008D		L		(float, lower 2 bytes)	
0143	30143	008E	q-1	H	Negative ampere hour 1	(float, upper 2 bytes)	
0144	30144	008F		L		(float, lower 2 bytes)	
0145	30145	0090	Urms1	H	True rms voltage 1	(float, upper 2 bytes)	
0146	30146	0091		L		(float, lower 2 bytes)	

Reg No.	Ref No.	H No.	Register Name		Register Description		Notes
0147	30147	0092	Umn1	H	Rectified mean voltage calibrated to the rms value 1	(float, upper 2 bytes)	
0148	30148	0093		L		(float, lower 2 bytes)	
0149	30149	0094	Udc1	H	DC voltage 1 (Simple average)	(float, upper 2 bytes)	
0150	30150	0095		L		(float, lower 2 bytes)	
0151	30151	0096	Urmn1	H	Rectified mean voltage 1	(float, upper 2 bytes)	
0152	30152	0097		L		(float, lower 2 bytes)	
0153	30153	0098	Uac1	H	AC voltage component 1	(float, upper 2 bytes)	
0154	30154	0099		L		(float, lower 2 bytes)	
0155	30155	009A	Irms1	H	True rms current 1	(float, upper 2 bytes)	
0156	30156	009B		L		(float, lower 2 bytes)	
0157	30157	009C	Imn1	H	Rectified mean current calibrated to the rms value 1	(float, upper 2 bytes)	
0158	30158	009D		L		(float, lower 2 bytes)	
0159	30159	009E	Idc1	H	DC current 1 (Simple average)	(float, upper 2 bytes)	
0160	30160	009F		L		(float, lower 2 bytes)	
0161	30161	00A0	Irmn1	H	Rectified mean current 1	(float, upper 2 bytes)	
0162	30162	00A1		L		(float, lower 2 bytes)	
0163	30163	00A2	Iac1	H	AC current component 1	(float, upper 2 bytes)	
0164	30164	00A3		L		(float, lower 2 bytes)	
0165	30165	00A4	(CfU1)	H	Voltage 1 crest factor	(float, upper 2 bytes)	
0166	30166	00A5		L		(float, lower 2 bytes)	
0167	30167	00A6	(CfI1)	H	Current 1 crest factor	(float, upper 2 bytes)	
0168	30168	00A7		L		(float, lower 2 bytes)	
0169	30169	00A8		H		(float, upper 2 bytes)	
0170	30170	00A9		L		(float, lower 2 bytes)	
Element 1 Harmonic measurement data							
0171	30171	00AA	U1(Total)	H	Total value of all harmonic components of voltage 1	(float, upper 2 bytes)	
0172	30172	00AB		L		(float, lower 2 bytes)	
0173	30173	00AC	U1(1)	H	1st order harmonic value of voltage 1 (fundamental wave)	(float, upper 2 bytes)	
0174	30174	00AD		L		(float, lower 2 bytes)	
0175	30175	00AE	I1(Total)	H	Total value of all harmonic components of current 1	(float, upper 2 bytes)	
0176	30176	00AF		L		(float, lower 2 bytes)	
0177	30177	00B0	I1(1)	H	1st order harmonic value of current 1 (fundamental wave)	(float, upper 2 bytes)	
0178	30178	00B1		L		(float, lower 2 bytes)	
0179	30179	00B2	P1(Total)	H	Total value of all harmonic components of active power 1	(float, upper 2 bytes)	
0180	30180	00B3		L		(float, lower 2 bytes)	
0181	30181	00B4	P1(1)	H	1st order harmonic value of active power 1 (fundamental wave)	(float, upper 2 bytes)	
0182	30182	00B5		L		(float, lower 2 bytes)	
0183	30183	00B6	Lambda1(1)	H	Power factor (λ) 1 of the 1st order (fundamental wave)	(float, upper 2 bytes)	
0184	30184	00B7		L		(float, lower 2 bytes)	
0185	30185	00B8	Phi1(1)	H	Phase difference between the voltage and current of the 1st order (fundamental wave), φ(1)	(float, upper 2 bytes)	
0186	30186	00B9		L		(float, lower 2 bytes)	
0187	30187	00BA	PhiU1(3)	H	Phase difference betweenof the 1st order (fundamental) voltage and the 3rd order harmonic voltage φU(3)	(float, upper 2 bytes)	
0188	30188	00BB		L		(float, lower 2 bytes)	
0189	30189	00BC	PhiI1(3)	H	Phase difference betweenof the 1st order (fundamental) current and the 3rd order harmonic current φI(3)	(float, upper 2 bytes)	
0190	30190	00BD		L		(float, lower 2 bytes)	
0191	30191	00BE	Uthd1	H	Total harmonic distortion of voltage 1	(float, upper 2 bytes)	
0192	30192	00BF		L		(float, lower 2 bytes)	
0193	30193	00C0	Ithd1	H	Total harmonic distortion of current 1	(float, upper 2 bytes)	
0194	30194	00C1		L		(float, lower 2 bytes)	

9.3 Register Functions and Applications

Reg No.	Ref No.	H No.	Register Name		Register Description		Notes
Element 2 normal measurement data							
0201	30201	00C8	U2	H	Voltage 2	(float, upper 2 bytes)	
0202	30202	00C9		L		(float, lower 2 bytes)	
to 0270							
Element 2 Harmonic measurement data							
0271	30271	010E	U2(Total)	H	Total value of all harmonic components of voltage 2	(float, upper 2 bytes)	
0272	30272	010F		L		(float, lower 2 bytes)	
to 0294							
Element 3 normal measurement data							
0301	30301	012C	U3	H	Voltage 3	(float, upper 2 bytes)	
0302	30302	012D		L		(float, lower 2 bytes)	
to 0370							
Element 2 Harmonic measurement data							
0371	30371	0172	U3(Total)	H	Total value of all harmonic components of voltage 3	(float, upper 2 bytes)	
0372	30372	0173		L		(float, lower 2 bytes)	
to 0394							
Wiring unit Σ normal measurement data							
0401	30401	0190	UΣ	H	Voltage of Σ	(float, upper 2 bytes)	
0402	30402	0191		L		(float, lower 2 bytes)	
0403	30403	0192	IΣ	H	Current of Σ	(float, upper 2 bytes)	
0404	30404	0193		L		(float, lower 2 bytes)	
0405	30405	0194	PΣ	H	Active power of Σ	(float, upper 2 bytes)	
0406	30406	0195		L		(float, lower 2 bytes)	
0407	30407	0196	SΣ	H	Apparent power of Σ	(float, upper 2 bytes)	
0408	30408	0197		L		(float, lower 2 bytes)	
0409	30409	0198	QΣ	H	Reactive power of Σ	(float, upper 2 bytes)	
0410	30410	0199		L		(float, lower 2 bytes)	
0411	30411	019A	LambdaΣ	H	Power factor of Σ (λ)	(float, upper 2 bytes)	
0412	30412	019B		L		(float, lower 2 bytes)	
0413	30413	019C	PhiΣ	H	Phase difference of Σ (φ)	(float, upper 2 bytes)	
0414	30414	019D		L		(float, lower 2 bytes)	
0415	30415	019E	WPΣ	H	Sum of positive and negative watt hours of Σ	(float, upper 2 bytes)	
0416	30416	019F		L		(float, lower 2 bytes)	
0417	30417	01A0	WP+Σ	H	Positive watt hours of Σ	(float, upper 2 bytes)	
0418	30418	01A1		L		(float, lower 2 bytes)	
0419	30419	01A2	WP-Σ	H	Negative watt hours of Σ	(float, upper 2 bytes)	
0420	30420	01A3		L		(float, lower 2 bytes)	
0421	30421	01A4	qΣ	H	Sum of positive and negative ampere hours of Σ	(float, upper 2 bytes)	
0422	30422	01A5		L		(float, lower 2 bytes)	
0423	30423	01A6	q+Σ	H	Positive ampere hour of Σ	(float, upper 2 bytes)	
0424	30424	01A7		L		(float, lower 2 bytes)	
0425	30425	01A8	q-Σ	H	Negative ampere hour of Σ	(float, upper 2 bytes)	
0426	30426	01A9		L		(float, lower 2 bytes)	
0427	30427	01AA	UrmsΣ	H	True rms voltage of Σ	(float, upper 2 bytes)	
0428	30428	01AB		L		(float, lower 2 bytes)	
0429	30429	01AC	UmnΣ	H	Rectified mean voltage calibrated to the rms value of Σ	(float, upper 2 bytes)	
0430	30430	01AD		L		(float, lower 2 bytes)	
0431	30431	01AE	UdcΣ	H	DC voltage of Σ (Simple average)	(float, upper 2 bytes)	
0432	30432	01AF		L		(float, lower 2 bytes)	
0433	30433	01B0	UrmnΣ	H	Rectified mean voltage of Σ	(float, upper 2 bytes)	
0434	30434	01B1		L		(float, lower 2 bytes)	
0435	30435	01B2	UacΣ	H	AC voltage component of Σ	(float, upper 2 bytes)	
0436	30436	01B3		L		(float, lower 2 bytes)	
0437	30437	01B4	IrmsΣ	H	True rms current of Σ	(float, upper 2 bytes)	
0438	30438	01B5		L		(float, lower 2 bytes)	
0439	30439	01B6	ImnΣ	H	Rectified mean current calibrated to the rms value of Σ	(float, upper 2 bytes)	
0440	30440	01B7		L		(float, lower 2 bytes)	
0441	30441	01B8	IdcΣ	H	DC current of Σ (Simple average)	(float, upper 2 bytes)	
0442	30442	01B9		L		(float, lower 2 bytes)	
0443	30443	01BA	IrmnΣ	H	Rectified mean current of Σ	(float, upper 2 bytes)	
0444	30444	01BB		L		(float, lower 2 bytes)	
0445	30445	01BC	IacΣ	H	AC current component of Σ	(float, upper 2 bytes)	
0446	30446	01BD		L		(float, lower 2 bytes)	

Reg No.	Ref No.	H No.	Register Name		Register Description		Notes
Measured data mapped to communication output items (:NUMeric[:NORMal]:ITEM<X> command)							
0001 + (X - 1) * 2			ItemX	H	Measured data mapped to ItemX	(float, upper 2 bytes)	Default value
0001 + (X - 1) * 2 + 1				L		(float, lower 2 bytes)	
2001	32001	07D0	Item1	H	Measured data mapped to Item 1	(float, upper 2 bytes)	U1
2002	32002	07D1		L		(float, lower 2 bytes)	
2003	32003	07D2	Item2	H	Measured data mapped to Item 2	(float, upper 2 bytes)	I1
2004	32004	07D3		L		(float, lower 2 bytes)	
2005	32005	07D4	Item3	H	Measured data mapped to Item 3	(float, upper 2 bytes)	P1
2006	32006	07D5		L		(float, lower 2 bytes)	
2007	32007	07D6	Item4	H	Measured data mapped to Item 4	(float, upper 2 bytes)	S1
2008	32008	07D7		L		(float, lower 2 bytes)	
2009	32009	07D8	Item5	H	Measured data mapped to Item 5	(float, upper 2 bytes)	Q1
2010	32010	07D9		L		(float, lower 2 bytes)	
2011	32011	07DA	Item6	H	Measured data mapped to Item 6	(float, upper 2 bytes)	λ1
2012	32012	07DB		L		(float, lower 2 bytes)	
2013	32013	07DC	Item7	H	Measured data mapped to Item 7	(float, upper 2 bytes)	φ1
2014	32014	07DD		L		(float, lower 2 bytes)	
2015	32015	07DE	Item8	H	Measured data mapped to Item 8	(float, upper 2 bytes)	fU1
2016	32016	07DF		L		(float, lower 2 bytes)	
2017	32017	07E0	Item9	H	Measured data mapped to Item 9	(float, upper 2 bytes)	fI1
2018	32018	07E1		L		(float, lower 2 bytes)	
2019	32019	07E2	Item10	H	Measured data mapped to Item 10	(float, upper 2 bytes)	None
2020	32020	07E3		L		(float, lower 2 bytes)	
to							
2509	32509	09CC	Item255	H	Measured data mapped to Item 255	(float, upper 2 bytes)	None
2510	32510	09CD		L		(float, lower 2 bytes)	
Measured data corresponding to the instrument display items of normal measurement (DISPlay[:NORMal]:ITEM command)							
3001	33001	0BB8	DisplayA	H	Measured data of the item shown in Display A	(float, upper 2 bytes)	U1
3002	33002	0BB9		L		(float, lower 2 bytes)	
3003	33003	0BBA	DisplayB	H	Measured data of the item shown in Display B	(float, upper 2 bytes)	I1
3004	33004	0BBB		L		(float, lower 2 bytes)	
3005	33005	0BBC	DisplayC	H	Measured data of the item shown in Display C	(float, upper 2 bytes)	P1
3006	33006	0BBD		L		(float, lower 2 bytes)	
3007	33007	0BBE	DisplayD	H	Measured data of the item shown in Display D	(float, upper 2 bytes)	λ1
3008	33008	0BBF		L		(float, lower 2 bytes)	

Peak over-range status (input register: 0003)

The peak over-range information of each element is mapped to the bits in the following manner.
The bit corresponding to the input in which a peak over-range occurs is set to 1.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
										I3	U3	I2	U2	I1	U1

Check range status (input register: 0004)

The status of the CHECK RANGE LED on the instrument's front panel is mapped to the bits in the following manner.
For details, see the explanation of the :INPut:CRANge? command in section 6.7.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
								AP	AO	AH	AL	VP	VO	VH	VL

Float Type Data

IEEE single-precision floating-point type data. Data during an error is as follows.

- When the data does not exist (the display shows "------")
  NAN 0x7FC00000
- Over-range (the display shows "--OL-"), computation over-range (the display shows "--OF-"), error (the display shows "Error")
  INF 0x7F800000

Register Map (Hold Register)

Reg No.	Ref No.	H No.	Register Name	Register Description		Effective Range	Default value	BackUp	R/W
Control Data									
0001	40001	0000	NUMeric:HOLD	Holds and releases register values	(uint 16)	0:release, 1:Hold	0	×	R/W
0002	40002	0001							
0003	40003	0002	INTEG:START/ STOP	Starts and stops integration	(uint 16)	0:Stop, 1:Start	0	×	R/W
0004	40004	0003	INTEG:RESET	Resets the integrated value	(uint 16)	1:Reset, Not 1: Invalid	-	×	W
0005	40005	0004							
0006	40006	0005							
0007	40007	0006							
0008	40008	0007							
0009	40009	0008							
0010	40010	0009							

Appendix 1 Error Messages

This section explains communication error messages.

- Error messages that are read from a PC such as through the :STATus:ERRor? command are output in English.
- If servicing is necessary to solve the problem indicated by a message, contact your nearest YOKOGAWA dealer.
- Only communication error messages are listed here. For details on other error messages, see the Getting Started Guide, IM WT310E-02EN.

• Communication syntax errors	100 to 199	Listed below
• Communication execution errors	200 to 299	
• Device-specific and other errors	300 to 399	
• Communication query errors	400 to 499	
• System errors (communication)	300, 399	
• Information (1 to 99)	1 to 99	Listed in section 6.2 of the Getting Started Guide, IM WT310E-02EN
• Execution Errors (600 to 899)	600 to 899	
• System Errors	900 to 999	

Communication Syntax Errors (100 to 199)
Error in communication command

Code	Message	Corrective Action	Page
102	Syntax error.	A syntax error not covered by error codes 100 to 199.	Chapters 5 and 6
103	Invalid separator.	Separate data values with a comma.	5-1
104	Data type error.	See page 5-6 and 5-7 and use the correct data type for each parameter.	5-6 and 5-7
108	Parameter not allowed.	Check the number of data values.	5-6 and chapter 6
109	Missing parameter.	Be sure to include all necessary data values.	5-6 and chapter 6
111	Header separator error.	Use a comma to separate each header from its data.	5-1
112	Program mnemonic too long.	Check the command length.	Chapter 6
113	Undefined header.	Check the header.	Chapter 6
114	Header suffix out of range.	Check the header.	Chapter 6
120	Numeric data error.	A value must be specified where the syntax contains <NRf>.	5-6
123	Exponent too large.	Where the syntax contains <NR3>, make the exponent that follows E smaller.	5-6 and Chapter 6
124	Too many digits.	Limit numeric values to 255 digits or less.	5-6 and Chapter 6
128	Numeric data not allowed.	Use a data type other than <NRf>.	5-6 and Chapter 6
131	Invalid suffix.	Check the unit of <Voltage>, <Current>, <Time>, or <Frequency>.	5-6
134	Suffix too long.	Check the unit of <Voltage>, <Current>, <Time>, or <Frequency>.	5-6
138	Suffix not allowed.	Only the following units can be used: <Voltage>, <Current>, <Time>, <Frequency>.	5-6
141	Invalid character data.	Be sure to select one of the listed choices when the syntax contains {...|...|...}.	Chapters 5 and 6
144	Character data too long.	Check the spelling of the strings when the syntax contains {...|...|...}.	Chapter 6
148	Character data not allowed.	Use a data type other than {...|...|...}.	Chapter 6
150	String data error.	Enclose parameters with single or double quotation marks where the syntax contains <String>.	5-7

Code	Message	Corrective Action	Page
151	Invalid string data.	The parameter is either too long, or it contains an unusable character.	Chapter 6
158	String data not allowed.	Use a data type other than <String>.	Chapter 6
161	Invalid block data.	<Block data> cannot be used.	5-7 and chapter 6
168	Block data not allowed.	<Block data> cannot be used.	5-7 and Chapter 6
171	Missing Right	Mathematical operations cannot be used.	—
172	Invalid expression.	Mathematical operations cannot be used.	Chapter 6
178	Expression data not allowed.	Mathematical operations cannot be used.	Chapter 6
181	Invalid outside macro definition.	This instrument does not support the IEEE 488.2 macro specifications.	—

Communication Execution Errors (200 to 299)
Error in communication execution

Code	Message	Corrective Action	Page
221	Setting conflict.	Check settings that are related to each other.	Chapter 6
222	Data out of range.	Check the ranges of the settings.	Chapter 6
223	Too much data.	Check data byte lengths.	Chapter 6
224	Illegal parameter value.	Check the ranges of the settings.	Chapter 6
225	OverFlow.	Keep program messages to 1024 bytes or less in length, including <PMT>.	5-2
226	Out Of Memory.	Keep program messages to 1024 bytes or less in length, including <PMT>.	5-2
241	Hardware missing.	Check that the specified options are all installed.	—
260	Expression error.	Mathematical operations cannot be used.	—
270	Macro error.	This instrument does not support the IEEE 488.2 macro specifications.	—
272	Macro execution error.	This instrument does not support the IEEE 488.2 macro specifications.	—
273	Illegal macro label.	This instrument does not support the IEEE 488.2 macro specifications.	—
275	Macro definition too long.	This instrument does not support the IEEE 488.2 macro specifications.	—
276	Macro recursion error.	This instrument does not support the IEEE 488.2 macro specifications.	—
277	Macro redefinition not allowed.	This instrument does not support the IEEE 488.2 macro specifications.	—
278	Macro header not found.	This instrument does not support the IEEE 488.2 macro specifications.	—

Communication Query Errors (400 to 499)
Error in communication Query

Code	Message	Corrective Action	Page
410	Query INTERRUPTED.	Check the transmission and reception order.	5-2
420	Query UNTERMINATED.	Check the transmission and reception order.	5-2
430	Query DEADLOCKED.	Keep program messages to 1024 bytes or less in length, including <PMT>.	5-2
440	Query UNTERMINATED after indefinite response.	Do not write a query after *IDN? or *OPT?.	—

System Communication Errors (300 and 399)
Error in System Operation

Code	Message	Corrective Action	Page
300	Communication device-specific error.	Servicing is required.	—
399	Fatal error in the communication driver.	Servicing is required.	—

Communication Warning (50)
Warning

Code	Message	Corrective Action	Page
50	*OPC/? exists in message.	Write *OPC or *OPC? at the end of program messages.	—

Other Errors (350, 390)

Code	Message	Corrective Action	Page
350	Queue overflow.	Read the error queue.	5-6
390	Overrun error (RS-232 only)	Decrease the baud rate.	3-8

Note

Code 350 occurs when the error queue overflows. This error is only returned in response to a :STATus:ERRor? query; it is never displayed on the screen.

Information (1 to 99)

Code	Message	Corrective Action	Page
3,80,87	The system has been initialized	For descriptions of errors and their corrective actions, see section 6.2 in the Getting Started Guide, IM WT310E-02EN.	—

Execution Errors (600 to 899)

Code	Message	Corrective Action	Page
759	Failed to initialize network.	Check the network settings.	Chapter 4
832	Internal memory access error.	For descriptions of errors and their corrective actions, see section 6.2 in the Getting Started Guide, IM WT310E-02EN.	—
841 to 847	Integrator execute error.		
Other than those above. (812,813,823 ,840,865,886)	Invalid operation.		

System Errors (900 to 999)

Code	Message	Corrective Action	Page
901,915,919	System error.	For descriptions of errors and their corrective actions, see section 6.2 in the Getting Started Guide, IM WT310E-02EN.	—

Appendix 2 About the IEEE 488.2-1992 Standard

The GP-IB interface of this instrument conforms to the IEEE 488.2-1992 standard. This standard specifies that the following 23 items be stated in the document. This section describes these items.

(1) Of the IEEE 488.1 interface functions, the subsets that are supported
See section 2.2, "GP-IB Interface Features and Specifications."

(2) The operation of the device when it is assigned an address outside the 0 to 30 range.
The address of this instrument cannot be set to an address outside the 0 to 30 range.

(3) Reaction of the device when the user changes the address
The address change is detected when the user presses INTERFACE and changes the address on the GPib menu. The new address is valid until the next time it is changed.

(4) Device settings at power-up. The commands that can be used at power-up.
As a basic rule, the previous settings (the settings that were in use when this instrument was turned off) are used.
There are no limitations on the commands that can be used at power-up.

(5) Message exchange options
(a) Input buffer size
1024 bytes.
(b) Queries that return multiple response messages
See the example of the commands given in chapter 6.
(c) Queries that create response data when the command syntax is being analyzed
All queries create response data when the command syntax is analyzed.
(d) Queries that create response data during reception
There are no queries of which the response data are created upon receiving a send request from the controller.
(e) Commands that have parameters that restrict one another
See the example of the commands given in chapter 6.

(6) Items that are included in the functional or composite header elements constituting a command
See chapters 5 and 6.

(7) Buffer sizes that affect block data transmission
When block data is being transmitted, the output queue is expanded to match the size of the data that is being transmitted.

(8) A list of program data elements that can be used in equations and their nesting limitations
Equations cannot be used.

(9) Syntax of the responses to queries
See the example of the commands given in chapter 6.

(10) Communication between devices that do not follow the response syntax
Not supported.

(11) Size of the response data block
0 to 24576 bytes

(12) A list of supported common commands
See section 6.17, "Common Command Group."

(13) Device condition after a successful calibration
The device will be performing measurements.

(14) The maximum length of block data that can be used for the *DDT trigger macro definition
Not supported.

(15) The maximum length of the macro label for defining macros, the maximum length of block data that can be used for the macro definition, and the process when recursion is used in macro definitions
Macro functions are not supported.

(16) Reply to the *IDN? query
See section 6.17, "Common Command Group."

(17) Size of storage area for protected user data for PUD and *PUD?
*PUD and *PUD? are not supported.

(18) The length of the *RDT and *RDT? resource names
*RDT and *RDT? are not supported.

(19) The change in the status due to *RST, *LRN?, *RCL, *SAV, and *RST
See section 6.17, "Common Command Group."
***LRN?, *RCL, and *SAV**
These common commands are not supported.

(20) The extent of the self-test using the *TST? command
See section 6.17, "Common Command Group."

(21) The structure of the extended return status
See chapter 7.

(22) Whether each command is processed in an overlapped manner or sequentially
See section 5.5, "Synchronization with the Controller" and chapter 6.

(23) The description of the execution of each command
See the explanations of each command's function in chapter 6 and the User's Manual, IM WT310E-01EN.

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