7555
Digital Multimeter

= For Reference =

Safety precausions are subject to change due to amandements made in laws and ordinaces.
Please operate the device at your own risk.
If you have any inquiries regarding the safety operation, please do not hesitate to contact your local Yokogawa sales office.

YOKOGAWA
Yokogawa Electric Corporation

IM 755501-01E
2nd Edition

Foreword

Thank you for purchasing the YOKOGAWA 7555 Digital Multimeter. This User's Manual contains useful information regarding the instrument's functions and operating procedures as well as precautions that should be observed during use. To ensure proper use of the instrument, please read this manual thoroughly before operating it. Keep the manual in a safe place for quick reference whenever a question arises.

Notes

- The contents of this manual are subject to change without prior notice as a result of improvements in the instrument's performance and functions. Display contents illustrated in this manual may differ slightly from what actually appears 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 representative listed on the back cover of this manual.
- Copying or reproduction of all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.
- A guarantee card is attached to the instrument. The card will not be reissued, so please read it carefully and keep it in a safe place.

Trademarks

Company names and product names which appear in this manual are their trademarks or registered trademarks.

Revisions

1st Edition: October 1996
2nd Edition: July 1998

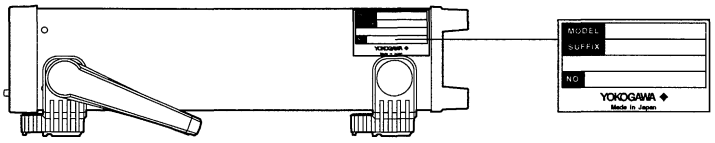
Disk No. BA19
2nd Edition:July 1998 (YG)

Checking the Contents of the Package

Unpack the box and check the contents. If the product is not the one you ordered, any item is missing or damage to any item is found, contact the dealer from whom you purchased the instrument.

Main Body

Check that the model name and suffix code given on the name plate at the right-side panel of the instrument match those on your order.



Model Name (MODEL) and Suffix Code (SUFFIX)

MODEL	SUFFIX	Specifications
755501		5 1/2-digit, DCV, DCA, OHM, ACV, ACA
Power supply voltage	-1	100VAC, 50/60Hz
	-4	120VAC, 50/60Hz
	-7	230VAC, 50/60Hz
Power cord	-D	UL/CSA standard power cord (A1006WD) Maximum rated voltage: 125 V, maximum rated current: 7 A
	-F	VDE standard power cord (A1009WD) Maximum rated voltage: 250 V, maximum rated current: 10 A
	-Q	BS standard power cord (A1054WD) Maximum rated voltage: 250 V, maximum rated current: 10 A
	-R	SAA standard power cord (A1024WD) Maximum rated voltage: 240 V, maximum rated current: 10 A
Options		
	/C1	GP-IB interface
	/K1	Simple scanner
	/D2	D/A output + BCD output

It is not possible to install both /K1 and /D2 options on the instrument.

Example: The model name and suffix code for a model with a GP-IB interface, UL/CSA standard power cord and simple scanner will be 755501-1-D/C1/K1.

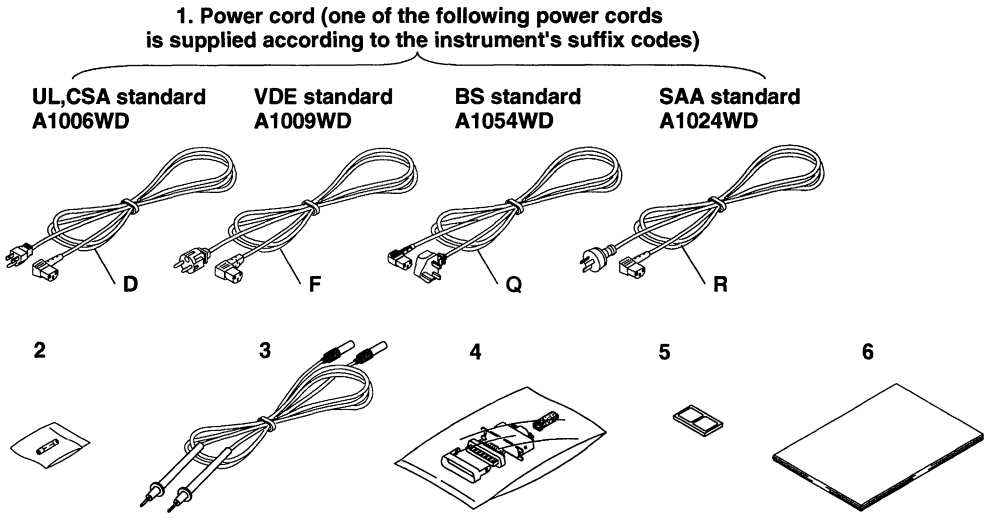
Serial No.

When you contact the dealer from whom you purchased the instrument, give him your unit's serial No.

Standard Accessories

The following standard accessories are supplied with the instrument. Make sure that all items are present and undamaged.

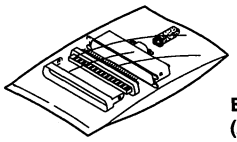
Name	Part No.	Quantity	Remarks
1. Power cord	Refer to the previous page.	1	—
2. Fuse	A1092EF	1	2A, Fast
3. Measuring lead wire	B9280TZ	1	
4. Remote connector	A1003JD	1	For remote control, D/A output
5. Rubber feet	A9088ZM	1	2 pieces/pair
6. User's Manual	IM755501-01E	1	This manual



When equipped with /1K1

Screws for fixing the scanner
The scanner (A1460JT) needs to be mounted on the instrument.

When equipped with /D2



BCD connector (A1006JD)

Accessories (Optional)

The following optional accessories are available. On receiving these optional accessories, make sure that all the items you ordered have been supplied, and that they are undamaged.

If you have any questions regarding optional accessories, or if you wish to place an order, contact the dealer from whom you purchased the instrument.

Name	Part No./Type	Remarks
Current clamp	751106	
Rack mounting kit	751533-E2	EIA (single mounting)
Rack mounting kit	751534-E2	EIA (double mounting)
Rack mounting kit	751533-J2	JIS (single mounting)
Rack mounting kit	751534-J2	JIS (double mounting)
4-wire resistance measuring lead wire	751510	0.6 m
Measuring lead wire set	758917	0.75 m, 2 cables/kit
Banana plug set	758919	
Banana conversion adapter	758920	
Fork terminal adapter set	758921	
Alligator clip adapter set	758922	
Clamp adapter set	758923	
BCD conversion adapter	758924	
Safety adapter	758925	Conductor part plated with gold

Note

It is recommended that the packing box be kept in a safe place. The box can be used when you need to transport the instrument to another location.

Safety Precautions

This instrument is an IEC safety class I instrument (provided with terminal for protective grounding). The following general safety precautions must be observed during all phases of operation, service and repair of this instrument. If this instrument is used in a manner not sepecified in this manual, the protection provided by this instrument may be impaired. Also, YOKOGAWA Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.


To avoid injury, death of personnel or damage to the instrument, the operator must refer to an explanation in the User's Manual or Service Manual.


Protective grounding terminal.


Function grounding terminal. This terminal should not be used as a "Protective grounding terminal".


Alternating current.

ON(power).


OFF(power).terminal".

Make sure to comply with the following safety precautions. Not complying might result in injury, death of personnel or damage to the instrument.

WARNING

Power Supply
Ensure the source voltage matches the voltage of the power supply before turning ON the power.

Power Cable and Plug
To prevent an electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged in an outlet with protective grounding terminal. Do not invalidate protection by using an extension cord without protective grounding.

Protective Grounding
Make sure to connect the protective grounding to prevent an electric shock before turning ON the power.

Necessity of Protective Grounding
Never cut off the internal or external protective grounding wire or disconnect the wiring of protective grounding terminal. Doing so poses a potential shock hazard.

Defect of Protective Grounding and Fuse
Do not operate the instrument when protective grounding or fuse might be defective.

Fuse
To prevent a fire, make sure to use fuses with specified standard(voltage, current, type). Before replacing the fuses, turn off the power and disconnect the power source. Do not use a different fuse or short-circuit the fuse holder.

Do not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable liquids or vapors. Operation of any electrical instrument in such an environment constitutes a safety hazard.

Do not Remove any Covers
There are some areas with high voltages. Do not remove any cover if the power supply is connected. The cover should be removed by qualified personnel only.

External Connection
To ground securely, connect the protective grounding before connecting to measurement or control unit.

Structure of the Manual

This User's Manual consists of 11 chapters, an Appendix and an Index as described below.

Chapter 1	**Overview and Functions** Describes flow of input signals and functions of this instrument.
Chapter 2	**Part Descriptions and Over-range Display** Describes each part of the instrument and functions of each front panel key.
Chapter 3	**Before Operating this Instrument** Describes general precautions for use, installation method, how to connect the power cord and how to turn the power on and off.
Chapter 4	**Starting Measurement** Describes how to measure, DC voltage/current, resistance, AC voltage/current and large current.
Chapter 5	**Carrying Out Computation** Describes each computing function (averaging, scaling, dB display and percentage display).
Chapter 6	**Other Functions** Describes the sampling rate, trigger functions, how to save measured data/set-up information and how to initialize the instrument.
Chapter 7	**Using External Input/Output Functions** Describes the EXT TRIG & OUTPUT Connector, comparator function, simple scanner (optional), D/A output function (optional) and BCD output function (optional).
Chapter 8	**Using the RS-232-C Interface** Describes how to control the instrument using a controller such as a personal computer and send measured/computed data from the instrument to the controller via a RS-232-C interface.
Chapter 9	**Using the GP-IB Interface** Describes how to control the instrument using a controller such as a personal computer and send measured/computed data from the instrument to a personal computer via a GP-IB interface.
Chapter 10	**Troubleshooting** Describes how to calibrate the instrument, how, in case of a problem, to ascertain the cause, error codes and their actions, and how to replace the fuse.
Chapter 11	**Specifications** Describes the main specifications of the instrument.
Appendix	Describes each communication command and sample programs.
Index	Describes important terms.

Conventions Used in this Manual

Symbols Used

The following symbols are used in this User's Manual.

⚠	Affixed on the instrument indicating that for safety's sake, the operator should refer to the User's Manual.
WARNING	Describes precautions that should be observed to prevent the danger of serious injury or death to the user.
CAUTION	Describes precautions that should be observed to prevent the danger of minor injury to the user and damage to the instrument.
Note	Provides information that is important for proper operation of the instrument.

Characters Displayed on 7-Segment LED

Numbers and alphabets are displayed using 7-segment LEDs. For a detailed description, refer to Section 1.3 "Numbers/Characters Displayed by LEDs" (page 1-4).

Symbols used on pages where description of operation is given

The following symbols are used to classify descriptions.

Relevant Keys

Indicates keys and indicators used to make settings.

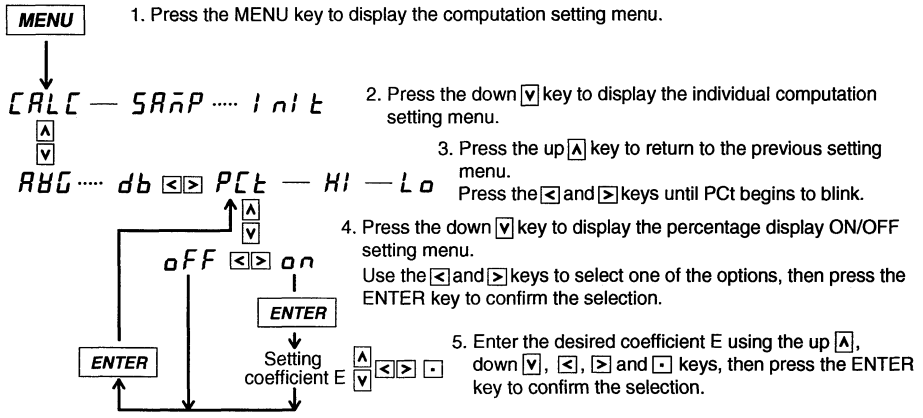
Operating Procedure

Describes operations using a flow diagram. For the meaning of each operation, refer to the example given below. The example is given on the assumption that you are going to operate this instrument for the first time. Thus, it may not be necessary to carry out all the operations when making a change to settings.

Explanation

Gives a detailed description of settings and restrictions regarding operations.

Example of *Operating Procedure*



Contents

Chapter 7 Using External Input/Output Functions

Chapter 8 Using the RS-232-C Interface

Chapter 9 Using the GP-IB Interface (Optional)

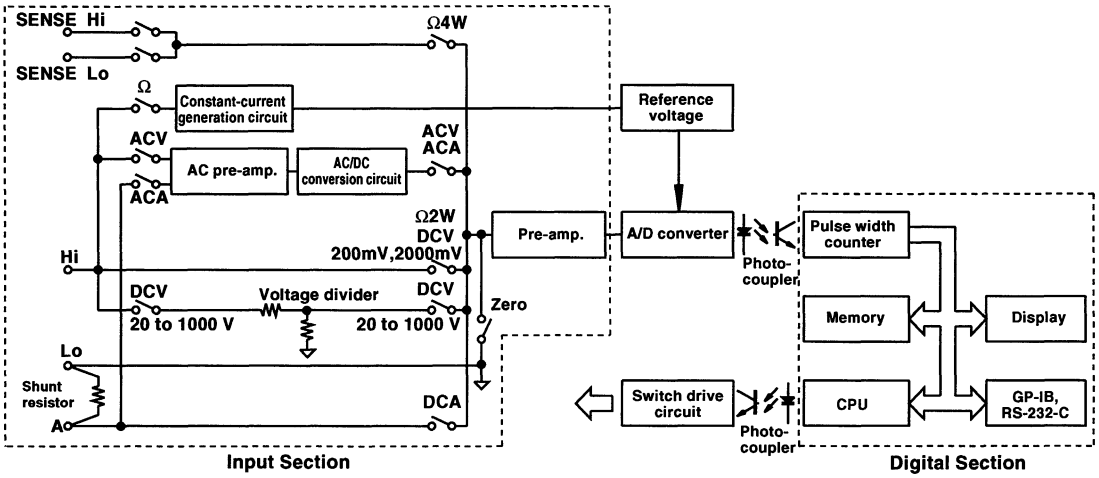
Chapter 10 Maintenance and Troubleshooting

Chapter 11 Specifications

(The contents for appendices are given on the next page.)

1.1 Block Diagram

Block Diagram



Principle of Operation

With the 200 mV or 2000 mV range for measurement of DC voltage, the input voltage is received by a pre-amp., then measured using high input impedance. With the 20-1000 V range, the input voltage is divided by the voltage divider before it is measured.

For measurement of AC voltage, the input AC voltage is normalized by an AC pre-amp., then converted to obtain DC voltage equivalent to the normalized AC voltage.

For measurement of resistance, a known current is applied to the resistor to be measured, then the resistance value is obtained using the voltage generated at the resistor.

For measurement of DC current, the current to be measured is applied to a known resistor (shunt resistor), then the current is obtained using the voltage generated at the resistor.

For measurement of AC current, the shunt resistor is used to convert the input current to an AC voltage, which is then converted to a DC voltage, like measurement of AC voltage described earlier.

Switching of functions and ranges is carried out by relays and FET switches controlled by the CPU.

The instrument employs a pre-amp. with low fluctuation of offset voltage and bias current. It also uses a zero-point adjusting switch in the input side of the pre-amp. to adjust the zero-point automatically.

The A/D converter employs the feedback pulse width modulation method, developed by YOKOGAWA, and features excellent linearity and stability.

The input section is isolated from the digital section. The digital section carries out various functions such as measurement, calculation and display of pulse width and control of communications.

1.2 Functions

Measurement Functions

Voltage Measurement

DC voltage: Can be measured using 5 ranges (200 mV, 2000 mV, 20 V, 200 V and 1000 V).
AC voltage: Can be measured using 5 ranges (200 mV, 2000 mV, 20 V, 200 V and 700 V).

Current Measurement

DC current: Can be measured using 4 ranges (2000 μA, 20 mA, 200 mA and 2000 mA).
Use of the optional current clamp (751106) enables measurement of large currents up to 200 A.

AC current: Can be measured using 4 ranges (2000 μA, 20 mA, 200 mA and 2000 mA).
Use of the optional current clamp (751106) enables measurement of large currents up to 150 A.

Resistance Measurement

Resistance can be measured using 7 ranges (200Ω, 2000Ω, 20kΩ, 200kΩ, 2000kΩ, 20MΩ and 200MΩ). Two measurement methods are available: 2-wire and 4-wire method. To reduce influences of the measuring lead wires, use the 4-wire method.

Computing Functions

NULL Function

Registers the data which is measured immediately after the NULL key is pressed as the NULL value, and displays the result obtained after the NULL value is subtracted from the measured data.

Averaging

Displays the result after moving averaging is performed on the measured data. This function is useful in cases where the measured data is unstable or a lot of noise exists.

Scaling

Displays the computation result of "(X-A)/B" (X indicates the measured data, A and B indicate the scaling factor).
This function is used in cases where measurement is carried out with the voltage (current) divider or when you want to change the unit of measurement.

dB Display

Displays the ratio of the measured data to the reference value in common logarithm.

Percentage Display

Displays the ratio of the measured data to the reference value in percentage.

Comparator Function

Displays comparison of the measured data and the reference value. Also outputs the comparison result (TTL level) to an external device.

Data Storage/Recall Function

Stores the measured data/computed data or set-up information in the internal memory. Also recalls the stored data, and then displays it or transfers it using the communications interface.

D/A Output Function (optional)

Outputs measured/computed data as an analog signal with full scale of ±1 V.

BCD Output Function (optional)

Outputs measured/computed data as a BCD parallel code.

Scanning Function (optional)

Enables measurement of DC voltage (max. 30 V) for the maximum of 8 channels. Use of this function allows a single unit (7555) to carry out multiple point measurement.

Communications Function

A RS-232-C interface is provided as standard, whiles a GP-IB interface is available as optional. Measured/computed data can be sent to a personal computer through the interface. It is also possible to set each function of this instrument from a personal computer.

Other Functions

Set-up Information Initialization Function

Resets the set-up information to the default settings.

1.3 Numbers/Characters Displayed by LEDs

Digital Numbers and Characters

The instrument uses 7-segment LEDs to display various data (numbers, alphabets, codes for arithmetical operations). Thus, the following special codes are actually displayed to indicate those data (some codes are not used with this instrument).

0 → 0	A → A	K → K	U → U
1 → 1	B → b	L → L	V → V
2 → 2	C → C Lower caseC → 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 Lower caseh → h	R → r	− → -
8 → 8	I → I	S → S	× → =
9 → 9	J → J	T → t	÷ → _

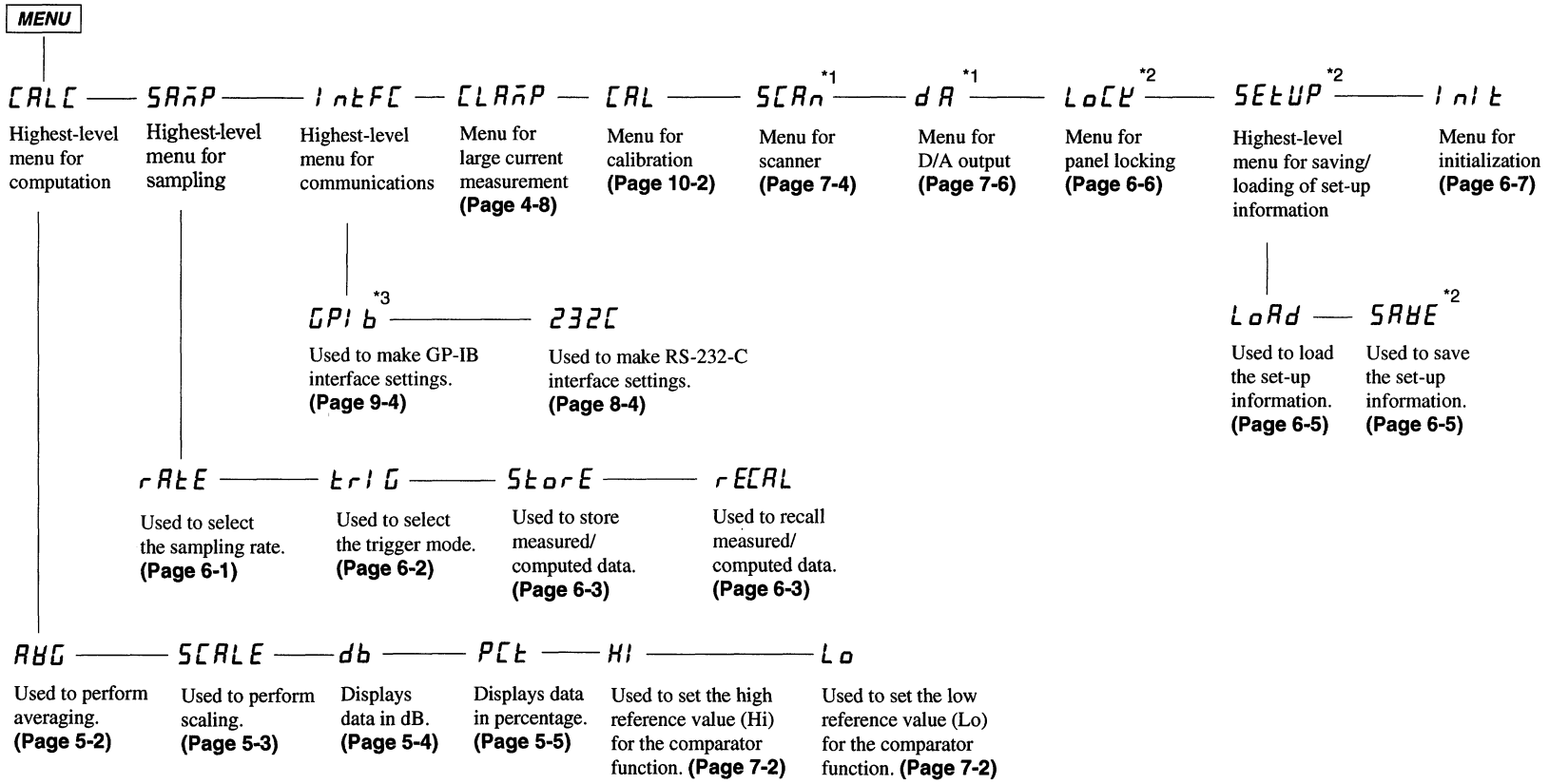
Operating Keys

The function of each key is described below.

DC V	Used to measure DC voltage.
AC V	Used to measure AC voltage.
Ω 2W	Used to measure resistance using the 2-wire method.
Ω 4W	Used to measure resistance using the 4-wire method.
DC A	Used to measure DC current.
AC A	Used to measure AC current.
AUTO	Used to select an appropriate measuring range automatically.
DOWN	Used to select the desired measuring range manually.
UP	Used to select the desired measuring range manually.
NULL	Used to activate the NULL function to display measured/computed data.
TRIG	Used to generate a trigger manually.
STORE	Used to store measured/computed data.
RECALL	Used to recall measured/computed data.
NEXT CH	Used to select the desired scan channel for the simple scanner.

Menu List

Each function can be set using a menu displayed on the instrument. Press the MENU key and a menu will be displayed on the instrument.



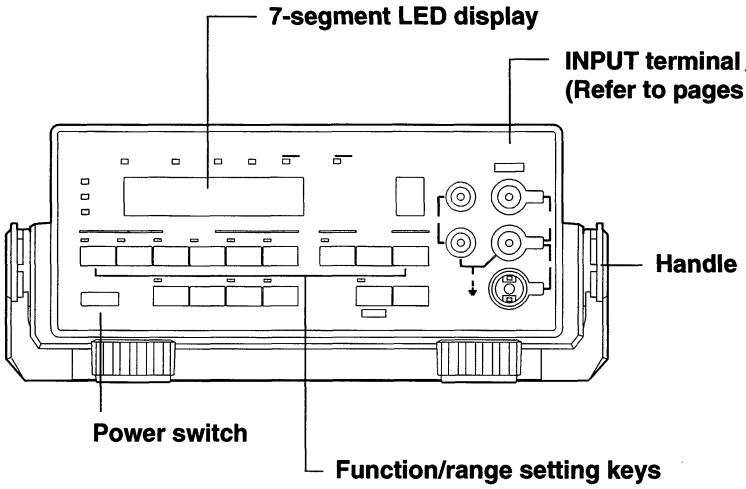
*1: Either the scanner or D/A output function can be selected as an option.

*2: Only these menus are available if the key lock is turned ON.

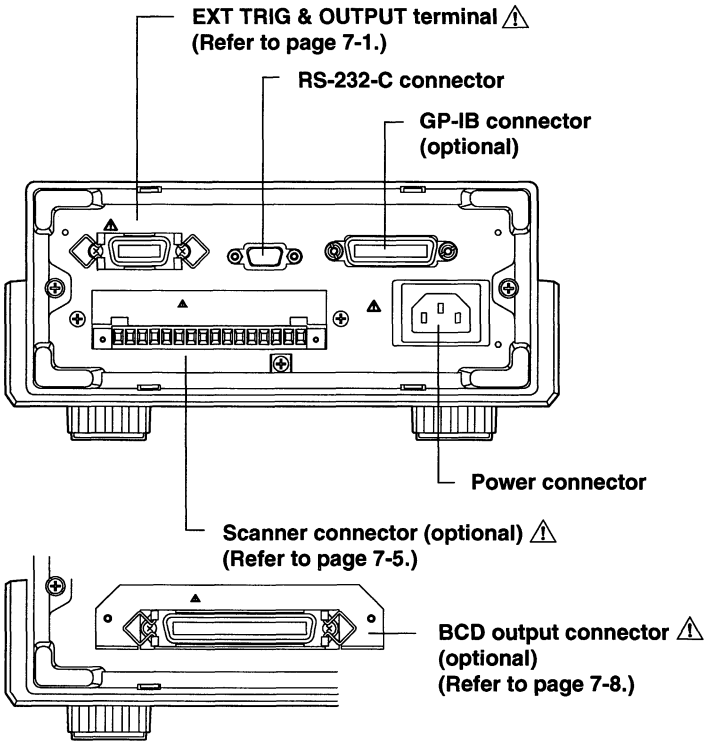
*3: It is an option.

2.1 Front and Rear Panels

Front Panel

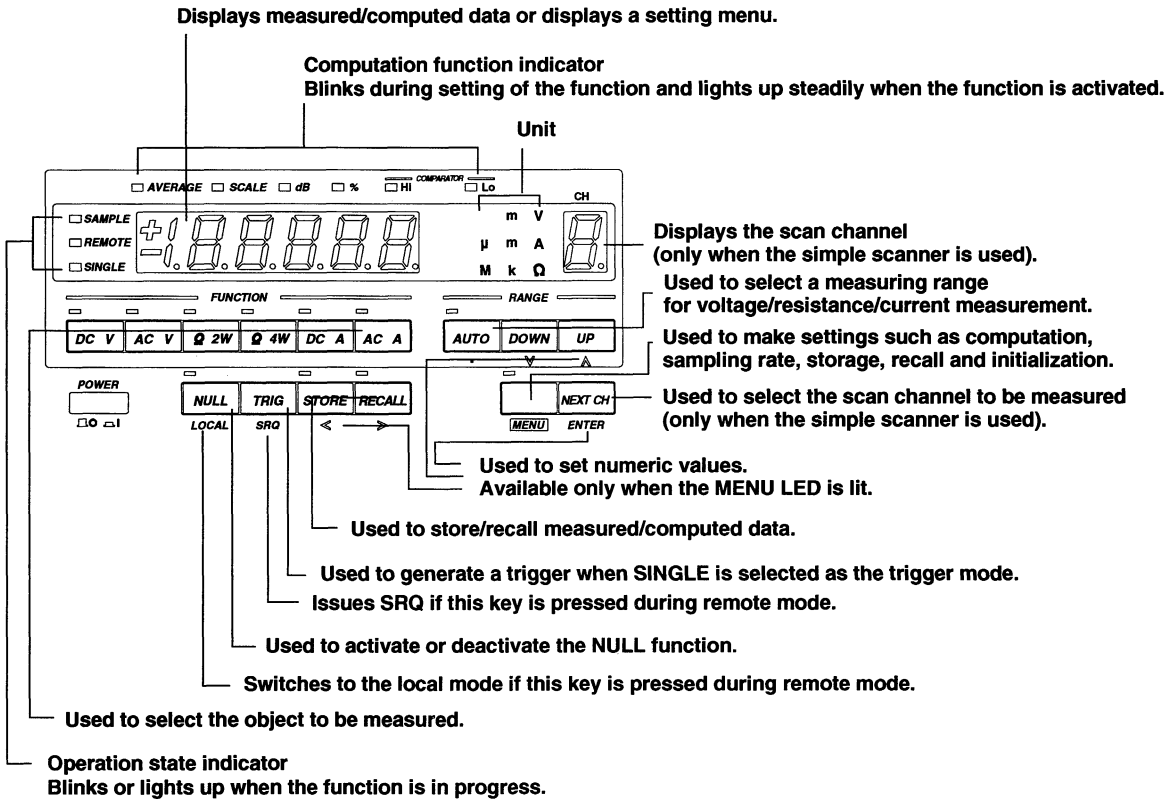


Rear Panel



2.2 Panel Keys and Over-range during Measurement

Operating Keys



Over-range

An over-range occurs if the measured or computed data exceeds the measuring range.
In auto range mode, the measuring range switches to an appropriate range automatically, though an over-range error occurs if the maximum range is exceeded. The following code will appear on the display if an over-range occurs.

Interruption during Measurement (bar display)

The following will appear on the display for a moment, from the time when data is acquired until the data is displayed. Normally, this cannot be seen, but it may be seen if the sampling rate is low in the SINGLE trigger mode.

Display during Range Switching in Auto Range Mode

In auto range mode, the instrument selects a measuring range suitable for the input data automatically. Only the decimal point is displayed until the measuring range is determined.

3.1 Usage Precautions

Safety Precautions

When you are using this instrument, read the "Safety Precautions" given on pages 4 and 5 thoroughly.

Do not remove the cover from the instrument.
Some parts of the instrument use high voltages, which are extremely dangerous. When the instrument needs internal inspection or adjustment, contact your dealer or nearest YOKOGAWA representative, as listed on the back cover of this manual.

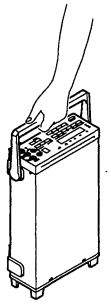
In case of irregularity
If you notice smoke or unusual odors coming from the instrument, immediately turn OFF the power and unplug the power cord. Also turn OFF the power to the object connected to the input terminal of the instrument. If such an irregularity occurs, contact your dealer or the nearest YOKOGAWA representative, as listed on the back cover of this manual.

Power cord
Nothing should be placed on the power cord; also, it should be kept away from any heat sources. When unplugging the power cord from the AC outlet, never pull the cord itself. Always hold the plug and pull it. If the power cord is damaged, contact your dealer. Refer to page 2 for the part number to use when placing an order.

General Handling Precautions When handling the instrument.

Never place anything on top of the instrument
Never place other equipment or objects containing water on top of the instrument, otherwise a breakdown may occur.

When moving the instrument.
Turn OFF the power to the object connected to the instrument, and disconnect the measuring lead wires and communication cables etc. Turn OFF the power to this instrument and disconnect the power cord from the AC outlet. When carrying the instrument, always carry it by the handle as shown below.



Keep input terminals away from electrically charged articles as they may damage internal circuits.

Do not allow volatile chemicals to come into contact with the case or operation panel. Also do not leave any rubber or vinyl products in contact with them for prolonged periods. The operation panel is made of thermoplastic resin, so take care not to allow any heated articles such as a soldering iron to come into contact with it.

Before cleaning the case and operation panel, make sure that the power cord is disconnected from the AC outlet. Wet a clean cloth with water, squeeze out excess water, then wipe the surface of the case and operation panel. Entry of water into the instrument will result in breakdown.

If the instrument will not be used for a long period, unplug the power cord from the AC outlet.

3.2 Installing the Instrument

Installation Conditions

The instrument must be installed in a place where the following conditions are met.

Ambient temperature and humidity

- Ambient temperature: 5 to 40°C
- Ambient humidity: 20 to 80% RH (no condensation)

Flat horizontal location

Set the instrument in a level, stable place. If placed on an uneven surface or in an unstable place, inaccurate measurement may be result.

Never install the instrument in the following places.

- In direct sunlight or near heat sources
- Where the level of mechanical vibration is high
- Near noise sources such as high voltage equipment or power lines
- Near strong magnetic field sources
- Where an excessive amount of soot, steam, dust or corrosive gases are present.
- In an unstable place

Note

- To ensure high measurement accuracy, the instrument should only be used under the following conditions.
  Ambient temperature: 23 ±5°C
  Ambient humidity: 30 to 75% RH (no condensation)
  When using the instrument in the temperature ranges of 5 to 18 or 28 to 40°C, add the temperature coefficient specified in Chapter 11, "Specifications" to the accuracy.
- If the ambient humidity of the installation site is 30% or below, use an anti-static mat to prevent generation of static electricity.
- Internal condensation may occur if the instrument is moved to another area where both ambient temperature and humidity are higher, or if the room temperature changes rapidly. In such cases acclimatize the instrument to the new environment for at least one hour before starting operation.

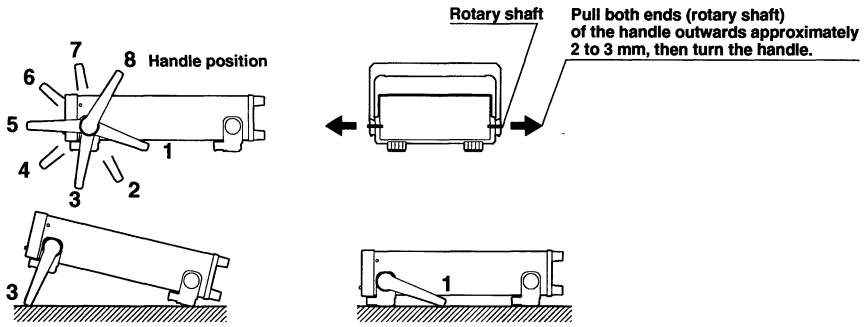
Installation Position

Desktop Installation

Place the instrument in a horizontal position or tilted using the stand as shown below.

When you use the handle to tilt the instrument, make sure that the handle is attached to the instrument securely. Pull both ends (rotary shaft) of the handle outwards approximately 2 to 3 mm, then turn the handle slowly until it is locked in the desired position.

Handle position (positions 1, 3, 5 and 8 are recommended. If the instrument is placed with handle position 4, make sure that no load is exerted on the instrument.)



Rack Mount

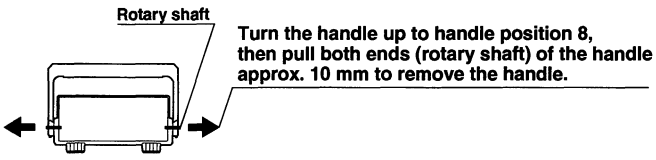
To install the instrument in a rack, use one of the following optional rack mounting kits.

Rack mounting kit (optional)

SUFFIX	Part No./Type
EIA (single mounting)	751533-E2
JIS (single mounting)	751533-J2
EIA (double mounting)	751534-E2
JIS (double mounting)	751534-J2

Mounting Procedure

1. Remove the handle by turning it up to handle position 8 (refer to the figure on the previous page) and pulling both ends of the handle approx. 10 mm.



For a detailed description of the mounting procedure, refer to the manual supplied with the rack mounting kit.

2. Remove the legs from the bottom of the instrument.
3. Remove the blank panel from each side of the instrument.
4. Attach the rack mount fixtures to the instrument.
5. Mount the instrument on the rack.

3.3 Connecting the Power Cord

Before Connecting the Power

Make sure that you observe the following points before connecting the power. Failure to do so may cause electric shock or damage to the instrument.

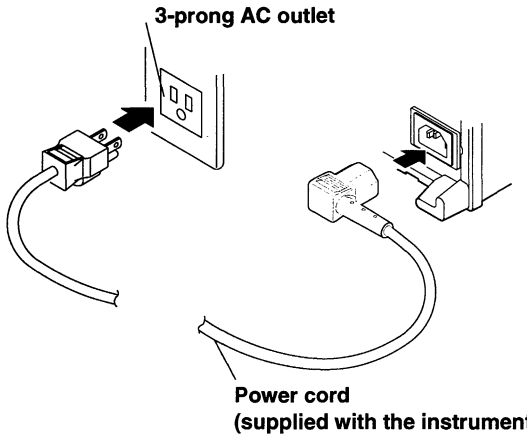
WARNING

- Always use protective ground to prevent electric shock.
- Since the power cord supplied with the instrument has a 3-prong plug with a grounding wire, the AC outlet to which the power cord is to be connected must be a 3-prong type with a grounding terminal.
- Before connecting the power cord, make sure that the power supply voltage complies with the rated electric power voltage for the instrument.
- Before connecting the power cord, make sure that the instrument's power switch is turned OFF.
- Never use an extension cord that does not have a protective grounding, otherwise the protection feature will be invalidated.

Connecting the Power Cord

1. Make sure that the instrument's power switch is turned OFF.
2. Plug the power cord into the power connector socket on the rear panel of the instrument.
3. Plug the other end of the power cord into an AC outlet that meets the following conditions. The AC outlet must be a 3-prong type with a grounding terminal.

Rated supply voltage : 100 VAC/120 VAC/230 VAC
Permitted supply voltage range : 90 to 110 VAC/108 to 132 VAC/207 to 253 VAC
Rated supply voltage frequency : 50/60 Hz
Maximum power consumption : 20 VA



3.4 Turning the Power ON or OFF

Items to be Checked Before Turning ON the Power

Check that the instrument is installed correctly. Refer to Section 3.2 "Installing the Instrument" (page 3-2).
Check that the power cord is connected correctly. Refer to Section 3.3 " Connecting the Power Cord" (page 3-4).

Location of the Power Switch

The power switch is located in the lower left corner of the front panel.

Response and Display at Power ON

The test program starts when the power switch is turned ON. The test program checks each memory. If the check results are satisfactory, the instrument will be ready for measurement.
If error code appears at the end of the test program, the instrument is not functioning properly. In this case, turn OFF the power immediately, and contact your dealer or the nearest YOKOGAWA representative. Inform them of the model name, suffix code and serial no. specified on the name plate on the rear panel, as well as the error code that was displayed.

Note

- In the case of an error code, refer to Section 10.3 "Error Codes and Corrective Actions" (page 10-9), and carry out the specified corrective actions.
- The instrument must be allowed to warm up for approx. 60 minutes before it satisfies all the specifications.

Response at Power OFF

Some items of the set-up information (such as measurement function settings) made prior to turning OFF the power are retained. This allows the instrument to start up in the retained function mode when the power is turned ON again. For a detailed description of set-up information items which can be retained when the power is turned OFF, refer to Section 3.5 "Default Settings".

Note

- The set-up information is backed up by a lithium battery. The battery lasts for approximately 10 years if it is used at an ambient temperature of 23°C. When the battery life comes to end, an error code will be displayed when the power is turned ON (refer to Section 10.3 "Error Codes and Corrective Actions"). In this case, the battery needs to be replaced immediately. The battery cannot be replaced by the user, so contact the nearest YOKOGAWA representative listed on the back cover of this manual.

3.5 Default Settings

Item		Default setting	Default at Power ON	When Initialized	Possible to Save
Measurement function		DCV		DCV	○
Measuring range		AUTO		AUTO	○
Sampling rate		SLOW		SLOW	○
Trigger mode		AUTO		AUTO	○
Large current measurement		OFF		OFF	○
Storage	Operation state	Clear	Clear	Clear	×
	Mode	1 SHOT		1 SHOT	○
	No. of data sets	2000		2000	○
	Stored data	Clear	Clear	Clear	×
Recall	Operation state	STOP	STOP	STOP	×
	Start data No.	1		1	○
NULL function	Operation state	OFF	OFF	OFF	○
	NULL value	0.00000	0.00000	0.00000	○
Averaging	Operation state	OFF	OFF	OFF	○
	No. of times averaging is performed	10	10	10	○
Scaling	Operation state	OFF	OFF	OFF	○
	Constant KA	0.00(V/A/Ω)	0.00(V/A/Ω)	0.00(V/A/Ω)	○
	Constant KB	1.00	1.00	1.00	○
dB display	Operation state	OFF	OFF	OFF	○
	Constant KC	20.0	20.0	20.0	○
	Constant KD	1.00(V/A/Ω)	1.00(V/A/Ω)	1.00(V/A/Ω)	○
Percentage display	Operation state	OFF	OFF	OFF	○
	Constant KE	1.00(V/A/Ω)	1.00(V/A/Ω)	1.00(V/A/Ω)	○
Comparator (Hi)	Operation state	OFF	OFF	OFF	○
	Constant KH	0.00(V/A/Ω)	0.00(V/A/Ω)	0.00(V/A/Ω)	○
Comparator (Lo)	Operation state	OFF	OFF	OFF	○
	Constant KL	0.00(V/A/Ω)	0.00(V/A/Ω)	0.00(V/A/Ω)	○
Key lock		OFF		OFF	○
Scanner	Operation state	OFF	OFF	OFF	○
	Mode	ONLY	ONLY	ONLY	○
	Channel	1 CH	1 CH	1 CH	○
D/A output	Output digit	1999		1999	○
RS-232-C/GP-IB	Switching	RS-232-C			×
	Command type	0			×
	Header	Available	Available		×
	Status byte	Clear	Clear		×
	Status byte mask	0	0		×
RS-232-C	Mode	Normal			×
	Baud rate	9600			×
	Data format	Mode 0			×
	Handshake mode	Mode 1			×
	Terminator	CRLF			×
GP-IB	Mode	Addressable			×
	Address	1			×

* Only the header, status byte and status byte mask (RS-232-C/GP-IB) are initialized when the power is turned ON if key lock is set to ON.
* Items marked with "○" can be saved.
* Items for which both "At Power ON" and "When Initialized" fields are empty will not be initialized but stored.
* If any of the communication related items are changed, the status byte will be cleared and the status byte mask is set to "0".

4.1 Wiring Precautions

WARNING

To prevent hazards, a protective grounding connection must be made.
Always turn OFF the power to the object being measured, before connecting it to the instrument. Never connect or disconnect the measuring lead wires from the object while power is supplied to it, otherwise a serious accident may result.
Make sure that you do not connect a current circuit to the voltage input terminal or vice versa. Incorrect connection may cause damage not only to the circuit or equipment under test and to this instrument, but may also endanger the operator.
Never apply a voltage or current exceeding the level specified in the table below to the voltage input terminal or current input terminal, when the power switch is ON. If the power switch is OFF, the power to the object must also be turned OFF.
For a description of external input terminal etc., refer to Chapter 11 "Specifications".

- **Between Hi and Lo**

DCV (200 mV, 2000 mV range)	Ω2W, Ω4W	ACV, DCV (20 V, 200 V, 1000 V range)
±500 Vpeak (continuous) ±1000 Vpeak (for 10 s)	±300 Vpeak (continuous)	1000 Vpeak or 700 Vrms, whichever is lower (continuous)

- **Between SENSE Hi and SENSE Lo**
  ±300 Vpeak (continuous)
- **Between A and Lo**
  2 Arms or 6 Apeak, whichever is lower (continuous)

If the instrument is used in a rack, provide a power switch so that power to the object can be shut off from the front of the rack in an emergency.
Never use a plug terminal (e.g. banana plug connector) which has an exposed conductor part as a measuring lead wire. If the plug terminal is disconnected, a serious problem may result.

CAUTION

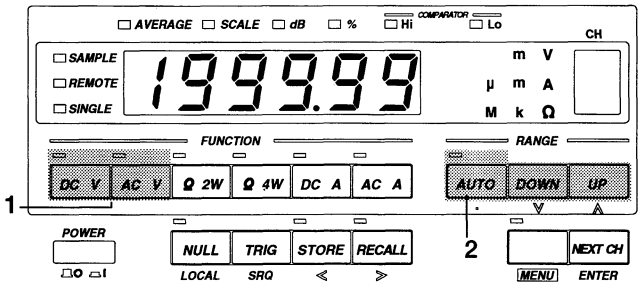
The measuring lead wires must have a sufficient margin in both breakdown voltage and current against those to be measured.

Note

- When measuring high currents, or currents or voltages that contain high-frequency components, wiring should be made with special attention paid to possible mutual interference and noise problems.
- To minimize stray capacitance to ground, route both lead wires and grounding wires so that they are as far away from the instrument's case as possible.

4.2 Measuring DC Voltage and AC Voltage

Relevant Keys

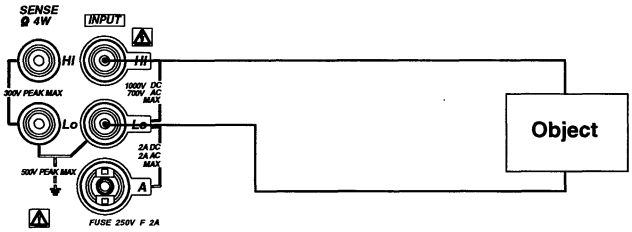


Operating Procedure

1. Press the DC V or AC V key. The LED of the selected key will light up.
2. Press the AUTO, DOWN or UP key to select an appropriate measuring range.

Explanation

Wiring (For wiring precautions, refer to page 4-1.)



WARNING

- When measuring high voltages, take special care to avoid electric shocks.
- Maximum permitted input voltage between Hi and Lo:

DCV (200 mV, 2000 mV range)	±500 Vpeak (continuous) ±1000 Vpeak (for 10 s)
DCV (20 V, 200 V, 1000 V range)	±1000 Vpeak (continuous)
AC V	1000 Vpeak or 700 Vrms, whichever is lower (continuous)

- The maximum withstanding voltage for the ground is ±500 Vpeak. Exceeding this limit may cause damage to the instrument.

Setting the Measuring Range

AUTO : Automatically switches the measuring range to a range suitable for the input. During measurement in auto range mode, the AUTO LED will be lit. To cancel the auto range mode, press the AUTO key again.

DOWN/UP : Allows you to select any measuring ranges given in the table below.

	DOWN	←		→	UP
DC	200mV	2000mV	20V	200V	1000V
AC	200mV	2000mV	20V	200V	700V

Points to Note during Measurement of DC Voltages

- If an over-range occurs during measurement with 200 mV or 2000 mV range, the internal protective circuit may be activated causing the input impedance to drop to approximately 100kΩ.
- During measurement of low voltages, thermal electromotive force generated at connections between the measuring lead wires, instrument and object may cause some problems. Make sure that the temperature is the same at the tip of all the measuring lead wires.
- For measurement of low voltages, short-circuit the measuring lead wire (Hi) with the lead wire (Lo) near the object, then use the NULL function to eliminate the residual voltage.
- If measurement is affected by noise such as power supplier's hum, set the sampling rate to an option other than FAST. Noise of power voltage frequency components cannot be eliminated if the sampling rate is set to FAST.

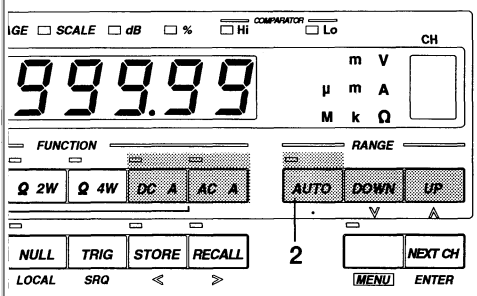
Points to Note during Measurement of AC Voltages

- Measurement is carried out by rms conversion method. With this method, DC components are eliminated, and only the AC components are measured and displayed.
- Measurement cannot be carried out with FAST selected as the sampling rate. If FAST selected, "CAUtl" will be displayed and the sampling rate is switched to MID1 automatically.

Note

- Selection of any functions during measurement of high currents or during use of the simple scanner is not allowed. In this case, turn OFF both large current measurement and scanner functions, then press the DC V or AC V key.
- For repeated measurement of a voltage which is within the same measuring range, it is recommended that that measuring range be fixed using the DOWN or UP.
- If the input voltage is below 5% of the measuring range (out of the specified accuracy range) in the case of measurement of AC voltage, the measured data may be unstable due to internal noise. Make sure that the input voltage is within 5 to 100% of the measuring range. The permitted frequency range is 20 Hz to 100 kHz.
- In the case of measurement of DC voltage with 200 mV or 2000 mV range, a meaningless value will be displayed if no input is connected to the instrument, since the input is sent directly to the pre-amplifier. However, this will not affect measurement.
- If the input is disconnected from the instrument during measurement of DC voltage in auto range mode, search for an appropriate measuring range may continue all the time.

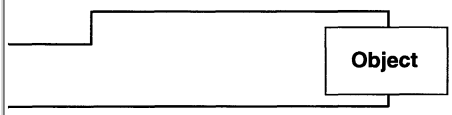
ırrent and AC Current



or [AC A] key. The LED of the selected key will light up.

[DOWN] or [UP] key to select an appropriate measuring range.

ı precautions, refer to page 4-1.)



WARNING

suring high voltages, take special care to avoid electric shock.
ıum permitted input current between A and Lo is 2 Arms or 6 Apeak,
is lower. If this is exceeded, the fuse for the current input circuit will
The fuse used must be of the specified rating. For replacement of the
to Section 10.4 "Replacing the Fuse".
ıum withstanding voltage for the ground is ±500 Vpeak. Exceeding
nay cause damage to the instrument.

ıring Range

ıatically switches the measuring range to a range suitable for the input.
ı measurement in auto range mode, the AUTO LED will be lit. To cancel the
ınge mode, press the AUTO key again.
s you to select any measuring ranges given in the table below.

	←	→	UP
	20mA	20mA	2000mA
	20mA	20mA	2000mA

Points to Note during Measurement of AC Voltages

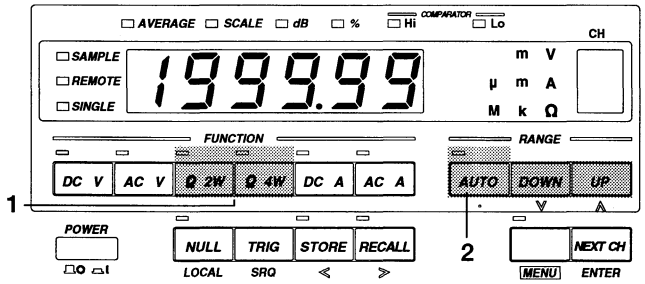
- Measurement is carried out by rms conversion method. With this method, DC components are eliminated, and only the AC components are measured and displayed.
- Measurement cannot be carried out with FAST selected as the sampling rate. If FAST selected, "CAUtl" will be displayed and the sampling rate is switched to MID1 automatically.

Note

- Selection of any functions during measurement of high currents or during use of the simple scanner is not allowed. In this case, turn OFF both large current measurement and scanner functions, then press the DC V or AC V key.
- For repeated measurement of a current which is within the same measuring range, it is recommended that that measuring range be fixed using the DOWN or UP.
- If the input current is below 5% of the measuring range (out of the specified accuracy range) in the case of measurement of AC current, the measured data may be unstable due to internal noise. Make sure that the input current is within 5 to 100% of the measuring range. The permitted frequency range is 20 Hz to 5 kHz.
- During measurement of AC current, a value other than zero may be displayed due to internal noise even if no input is connected to the instrument.

4.4 Measuring Resistance in 2-Wire/4-Wire Method

Relevant Keys



Operating Procedure

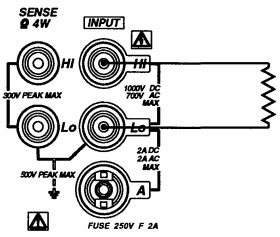
1. Press the [Ω 2W] or [Ω 4W] key to select the desired wiring system. The LED of the selected key will light up.

2. Press the [AUTO], [DOWN] or [UP] key to select an appropriate measuring range.

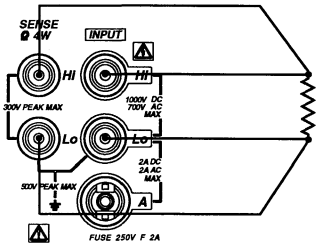
Explanation

Wiring (For wiring precautions, refer to page 4-1.)

2-wire method



4-wire method



WARNING

- When measuring high voltages, take special care to avoid electric shock.
- The maximum permitted input voltage between SENSE Hi and SENSE Lo is ±300 Vpeak. Never leave the instrument to stand still with an input voltage connected
- The maximum withstanding voltage for the ground is ±500 Vpeak. Exceeding this limit may cause damage to the instrument.

Setting the Measuring Range

AUTO : Automatically switches the measuring range to a range suitable for the input. During measurement in auto range mode, the AUTO LED will be lit. To cancel the auto range mode, press the AUTO key again.

DOWN/UP : Allows you to select any measuring ranges given in the table below.

DOWN	←				→	UP
200Ω	2000Ω	20kΩ	200kΩ	2000kΩ	20MΩ	200MΩ

Points to Note during Measurement

- In the case of measurement of high resistance with 2000 kΩ, 20 MΩ or 200 MΩ range, the displayed value fluctuates or the auto range function becomes unstable if large noise is input to the Hi terminal side. In this case, use shielded lead wires or connect the Lo to the case (to prevent common mode voltage) to eliminate the noise.
- In the case of 2-wire method, the resistance of the lead wires and that of internal wiring will be included. To exclude them, short-circuit the measuring lead wire (Hi) with the lead wire (Lo) and use the NULL function.
- With the 200 MΩ range selected, measured data will be displayed in 4 and half digits.
- With the 20 MΩ or 200 MΩ range selected, FAST or MID1 cannot be selected as the sampling rate. If FAST or MID1 is selected, "CAUt2" will be displayed and the sampling rate is switched to MID2 automatically.
- The maximum open-circuit voltage is 12.5 V.
- The following current flows through the resistor under measurement.

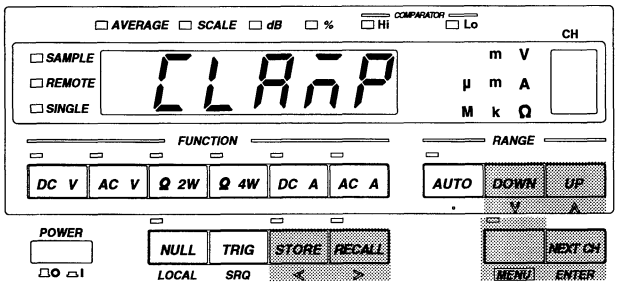
Range	200Ω	2000Ω	20kΩ	200kΩ	2000kΩ	20MΩ	200MΩ
Current	1mA	1mA	0.1mA	25μA	2.5μA	0.25μA	25nA

Note

- Selection of any functions during measurement of high currents or during use of the simple scanner is not allowed. In this case, turn OFF both large current measurement and scanner functions, then press the DC V or AC V key.
- With the 4-wire method, an optional 4-wire resistance measuring lead wire (part No.: 751510) is recommended.
- With the 4-wire method, a meaningless value will be displayed if no input is connected to the instrument, since the input is sent directly to the pre-amplifier. However, this will not affect measurement. Furthermore, zero may be displayed if the wiring is incorrect.
- With the 4-wire method, if the input is disconnected from the instrument during measurement in auto range mode, search for an appropriate measuring range may continue all the time.

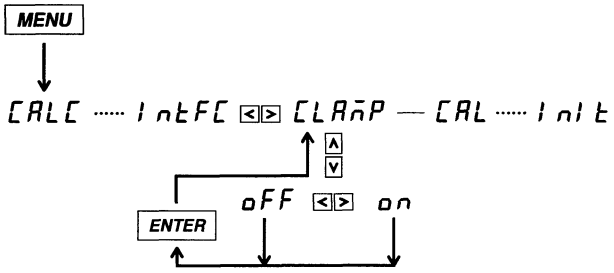
4.5 Measuring Large Currents

Relevant Keys



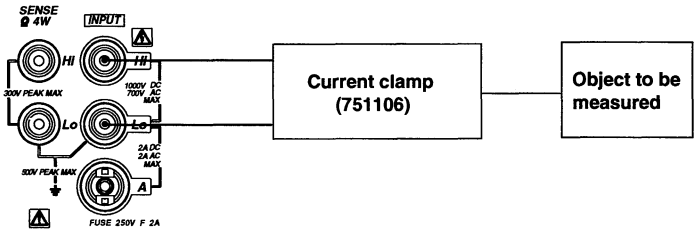
Operating Procedure

- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Wiring



Setting the Measuring Range

Only the following ranges are available. To select DC or AC, use the selector switch of the optional current clamp (type: 751106), and select CLAMP and turn it ON as described in Operating Procedure on this page.

DC current	200A
AC current	150A

Points to Note during Measurement

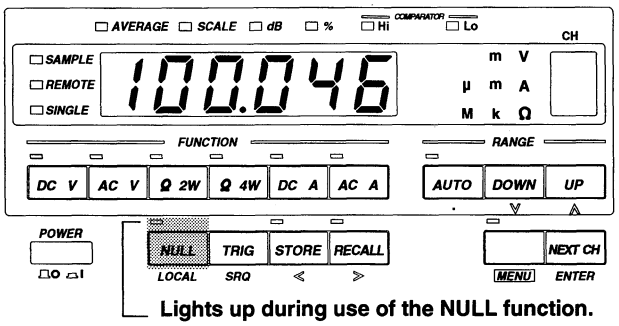
- Set the RANGE of the current clamp (751106) to "x0.1".
- When CLAMP is turned ON, all the FUNCTION key LEDs will go out, indicating that those keys are no longer operable. Values are displayed in 3 1/2 digits. (Only "1999" can be designated for the D/A output function.)

WARNING

- Before using a current clamp, thoroughly read the Instruction Manual supplied with it and adhere to the precautions given there.
- Before using a current clamp, make sure you understand the voltages used for the measurement circuit as well as the specifications and handling methods of the current clamp, to prevent danger such as electric shock.

5.1 Using the NULL Function

Relevant Keys



Operating Procedure

1. Press the NULL key.

Explanation

NULL Function

Registers the data measured immediately after the NULL key is pressed as the NULL value. Subsequently, while the NULL key's LED is lit, the NULL value will be subtracted from each measured data, and the result is displayed. To cancel the NULL function, press the NULL key again.

This allows cancellation of the lead wire resistance during measurement of resistance in the 2-wire method or the residual voltage during measurement of small voltages.

NULL Value

The NULL value can be set for each of the following measurement items.

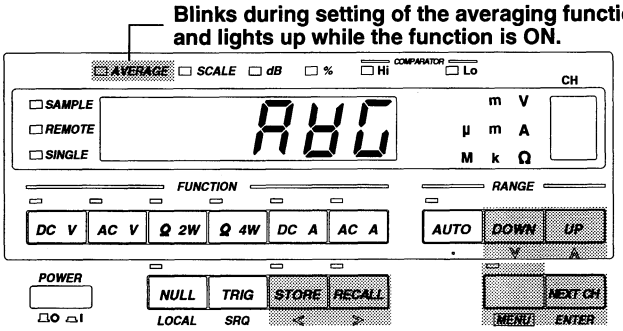
- DCV, ACV, Ω2W, Ω4W, DCA and ACA
- Large current measurement (clamp measurement)
- Simple scanner measurement (for each channel)

Note

- If the NULL key is pressed before the signal is input when Single is selected as trigger mode, the NULL value will not be fixed. In this case, the NULL key's LED will blink until the signal is input.
- If the NULL key is pressed while the measuring range is exceeded, the NULL value will not be fixed. In this case, the NULL key's LED will blink until the signal is input.
- In auto range mode, the measuring range is switched automatically to a range suitable for the input . Thus, if the input is within the 200 mV range and "input value - NULL value" is within the 2000 mV range, the measuring range will be switched to the 200 mV range. As a result, "-OL-" will be displayed.
- "-OL-" will be displayed if the input value or "input value - NULL value" is equal or above the measuring range.

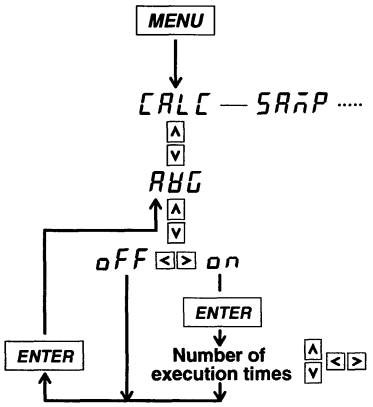
5.2 Carrying Out Averaging

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Averaging Function

Performs moving averaging on the measured data. This function is useful in cases where the displayed measured data fluctuates due to certain reasons such as noise in the input signal.

ON/OFF and number of execution times of the averaging function can be set for each of the following measurement items.

DCV, ACV, Ω2W, Ω4W, DCA, ACA and large current measurement

Number of Execution Times

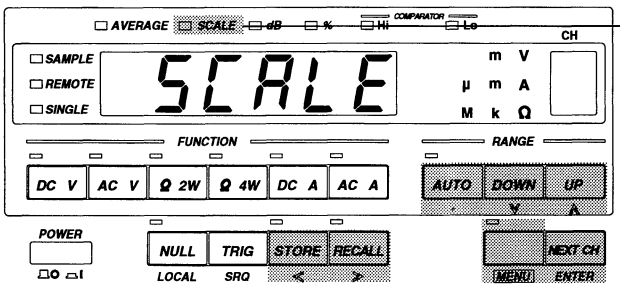
The number of execution times of the averaging function can be set to any value from 2 to 100.

Note

- The larger the number of execution times of the averaging function, the lower the fluctuation of measured data. However, the measured data may fail to respond in time.
- The averaging function cannot be used while the simple scanner is used.
- "-OL-" will be displayed if the input value is equal or above the measuring range. In this case, however, moving averaging will not be performed.
- Moving averaging will be re-started from the beginning if the function is turned ON/OFF or if the measuring range is switched (also in auto range mode).

5.3 Carrying Out Scaling

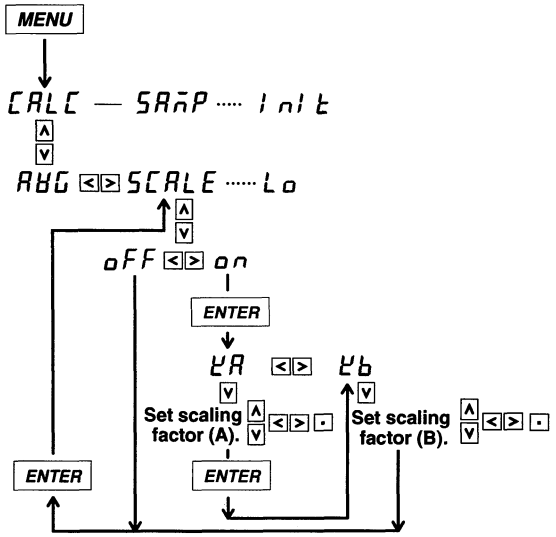
Relevant Keys



Blinks during setting of the scaling function and lights up while the function is ON.

Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively. To move the decimal point position, press the [·] key.
- To specify the unit of scaling factor, keep pressing the [>] key until any of the LEDs for the unit lights up. Then, press the up [∧] or down [∨] key to select the desired unit.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Scaling Function

Displays the computation result of "(X-A)/B". This function enables calculation of multiplying factor and deviation in relation to the reference value. X indicates the measured data, A and B indicate the scaling factor.

Scaling factors A and B can be set for each of the following measurement items.

DCV, ACV,Ω2W, Ω4W, DCA, ACA and large current measurement

Setting Range

- **Scale factor A, scale factor B ($B \neq 0$)**

  DCV, ACV : –199999 to 199999 (Unit: selectable from mV and V)

  Ω2W, Ω4W : –199999 to 199999 (Unit: selectable from Ω, kΩ and MΩ)

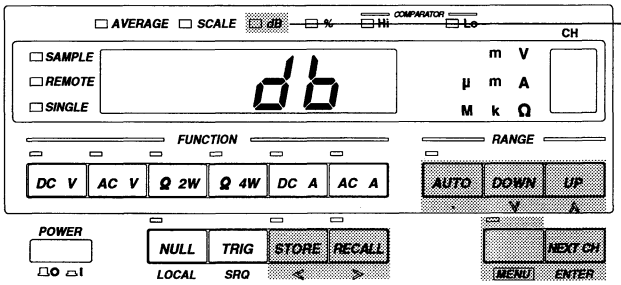
  DCA, ACA, large current measurement : –199999 to 199999 (Unit: selectable from μA, mA and A)

Note

- The scaling function cannot be used while the simple scanner is used.
- The scaling function cannot be set if FAST is selected as the sampling rate.
- It is not possible to select both dB and percentage (%). The dB/percentage display mode will be turned OFF when the scaling function is turned ON.
- If the scaling function is turned ON/OFF while the comparator function is in use, the comparator function will be turned OFF.
- After the scaling function is turned ON, if another function is used to carry out measurement with the sampling rate set to FAST then the function is switched to the previous function, the scaling function will be turned OFF.
- "-OL-" will be displayed if the input value is equal or above the measuring range or if the computed result is out of the range (–199999 to 199999).
- Scaling is performed on the input signal's internal data, not on the displayed data. Thus, the scaling result may differ from the computation result of the displayed data.

5.4 Displaying the Measured Data in dB

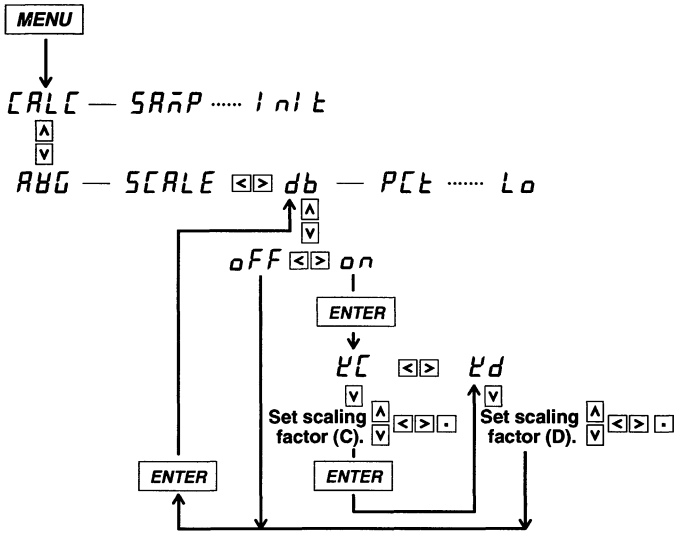
Relevant Keys



Blinks during setting of the dB display function and lights up while the function is ON.

Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively. To move the decimal point position, press the [·] key.
- To specify the unit of scaling factor, keep pressing the [>] key until any of the LEDs for the unit lights up. Then, press the up [∧] or down [∨] key to select the desired unit.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

dB Display

Displays the computation result of "$C\log_{10}|X/D|$". X indicates the measured data, and C and D indicate the factor.
Factors C and D can be set for each of the following measurement items.
DCV, ACV, Ω2W, Ω4W, DCA, ACA and large current measurement

Setting Range

Factor C : –199999 to 199999

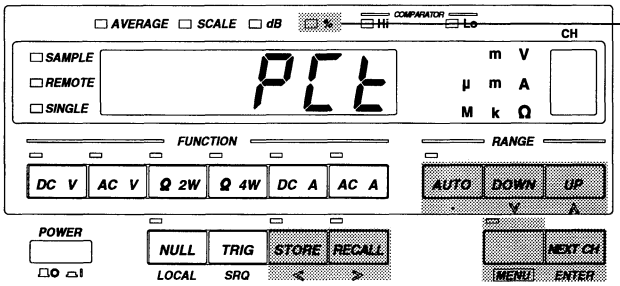
- **Factor D (D ≠ 0)**
  DCV, ACV : –199999 to 199999 (Unit: selectable from mV and V)
  Ω2W, Ω4W : –199999 to 199999 (Unit: selectable from Ω, kΩ and MΩ)
  DCA, ACA, large current measurement : –199999 to 199999 (Unit: selectable from μA, mA and A)

Note

- The dB display function cannot be used while the simple scanner is used.
- The dB display function cannot be set if FAST is selected as the sampling rate.
- "-OL-" will be displayed if the measured data is zero.
- It is not possible to select both scaling and percentage (%). The scaling/percentage display mode will be turned OFF when the dB function is turned ON.
- If the dB display function is turned ON/OFF while the comparator function is in use, the comparator function will be turned OFF.
- After the dB display function is turned ON, if another function is used to carry out measurement with the sampling rate set to FAST then the function is switched to the previous function, the dB display function will be turned OFF.
- "-OL-" will be displayed if the input value is equal or above the measuring range or if the computed result is out of the range (–199999 to 199999).
- dB computation is performed on the input signal's internal data, not on the displayed data. Thus, the result may differ from the computation result of the displayed data.

5.5 Displaying the Measured Data in Percentage

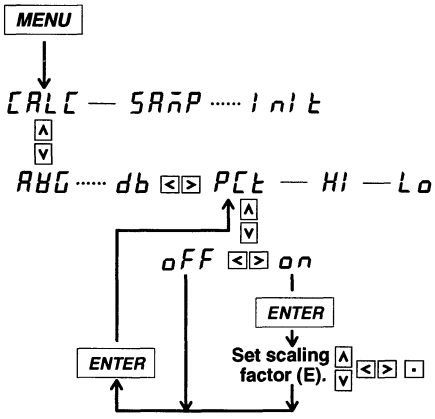
Relevant Keys



Blinks during setting of the percentage display function and lights up while the function is ON.

Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively. To move the decimal point position, press the [·] key.
- To specify the unit of scaling factor, keep pressing the [>] key until any of the LEDs for the unit lights up. Then, press the up [∧] or down [∨] key to select the desired unit.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Percentage (%) Display

Displays the computation result of "(X/E) x 100".
X indicates the measured data, and E indicates the factor (E ≠ 0).
Factor E can be set for each of the following measurement items.
DCV, ACV, Ω2W, Ω4W, DCA, ACA and large current measurement

Setting Range

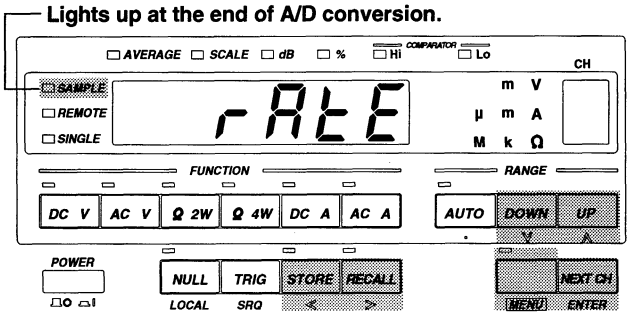
- **Factor E (E ≠ 0)**
  DCV, ACV : –199999 to 199999 (Unit: selectable from mV and V)
  Ω2W, Ω4W : –199999 to 199999 (Unit: selectable from Ω, kΩ and MΩ)
  DCA, ACA, large current measurement : –199999 to 199999 (Unit: selectable from μA, mA and A)

Note

- The percentage display function cannot be used while the simple scanner is used.
- The percentage display function cannot be set if FAST is selected as the sampling rate.
- It is not possible to select both scaling and dB display functions. The scaling/dB display mode will be turned OFF when the percentage function is turned ON.
- If the percentage display function is turned ON/OFF while the comparator function is in use, the comparator function will be turned OFF.
- After the percentage display function is turned ON, if another function is used to carry out measurement with the sampling rate set to FAST then the function is switched to the previous function, the percentage display function will be turned OFF.
- "-OL-" will be displayed if the input value is equal or above the measuring range or if the computed result is out of the range (–199999 to 199999).
- Percentage computation is performed on the input signal's internal data, not on the displayed data. Thus, the result may differ from the computation result of the displayed data.

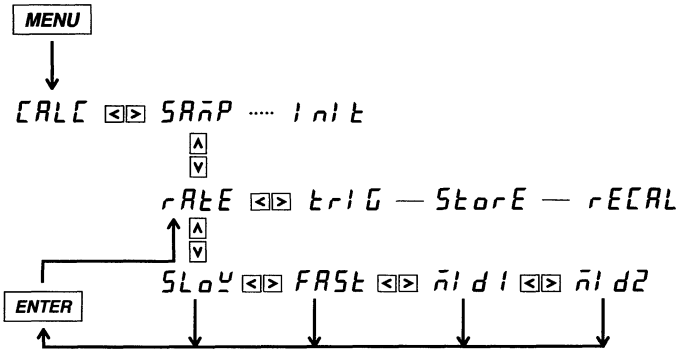
6.1 Changing the Sampling Rate

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Setting the Sampling Rate

The following sample rates are available.

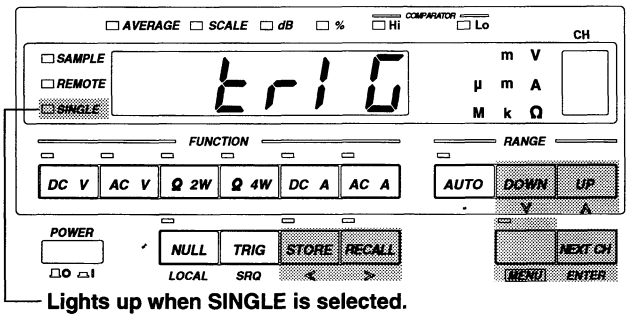
Menu	Sampling Rate
SLOW	2/sec
MID2	4/sec
MID1	20/sec
FAST	50/sec (125/sec for storage)

Note

- Data is displayed in 4 and half digits if FAST is selected.
- It is not possible to select FAST if any of following computation functions has been selected (an error code will be displayed).
  Scaling, dB display or percentage display
- It is not possible to select FAST if D/A output digit is set to 999 (an error code will be displayed).
- It is not possible to select FAST for measurement of AC voltage or current. If FAST is selected, "CAUt1" will be displayed and the sampling rate is switched to MID1 automatically.
- With the 20 MΩ or 200 MΩ range selected, FAST or MID1 cannot be selected as the sampling rate. If FAST or MID1 is selected, "CAUt2" will be displayed and the sampling rate is switched to MID2 automatically.

6.2 Using the Trigger Function

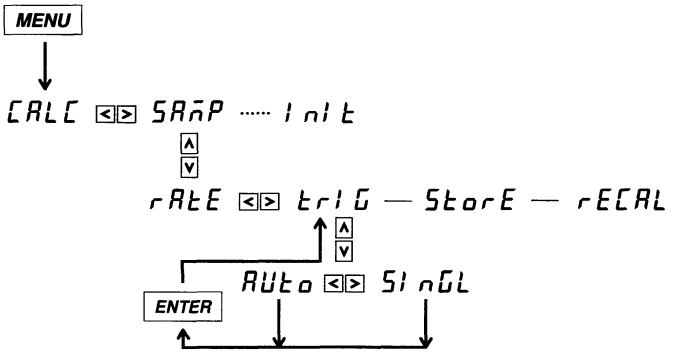
Relevant Keys



Lights up when SINGLE is selected.

Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Trigger Mode

The following two trigger modes are available.

- **AUTO**

Carries out sampling at the speed specified as the sampling rate.

- **SINGLE**

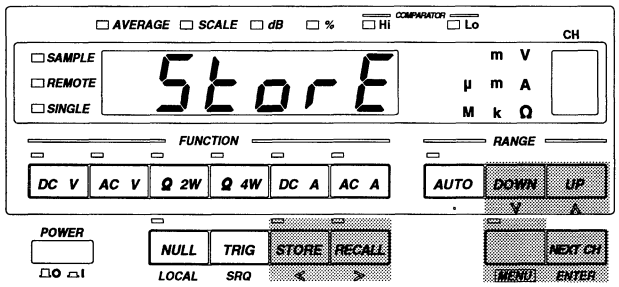
Carries out sampling each time a trigger is generated. A trigger can be generated in the following three methods.

- TRIG key located on the front panel
- Communications command (Refer to Appendix 1 and 2.)
- EXT TRIG (TTL level) (Refer to page 7-1.)

Menu	Time Required between Generation of a Trigger and Display (with no over-range, SINGLE mode selected and measuring range fixed)
SLOW	Approx. 700 ms
MID2	Approx. 350 ms
MID1	Approx. 100 ms
FAST	Approx. 40 ms

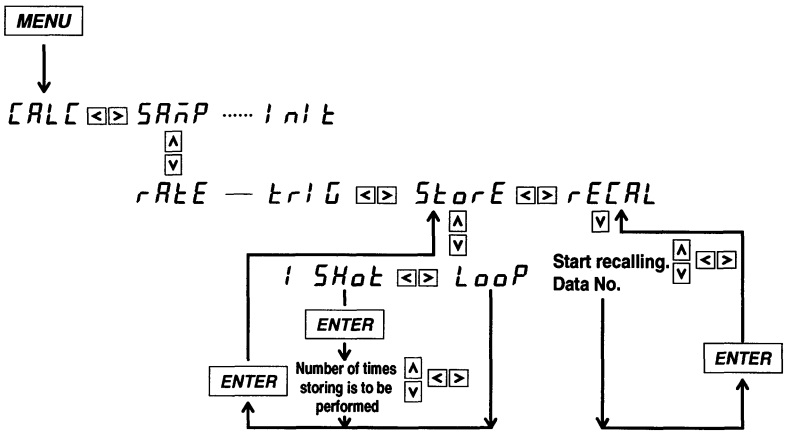
6.3 Storing/Recalling the Measured/Computed Data

Relevant Keys



Operating Procedure

1. Operate the instrument as shown in the flow chart given below.
   - Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
   - To confirm the selection or setting, press the ENTER key.
   - The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively.
   - To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.
2. Press the [STORE] key to start storing of the measured/computed data.
3. Storing will end when the [STORE] key is pressed again or storing has been completed the specified number of times.
4. Press the [RECALL] to recall the measured/computed data.



Explanation

Storage Function

Data can be stored in the internal memory 2000 times. If data exists in the internal memory, the STORE key's LED lights up. The stored data will be lost if the instrument is turned OFF, since it is not backed up by a battery. Two methods of storage are available.

1SHOT : Stores data in the internal memory the specified (storage) number of times. The number of times can be set from 1 to 2000.

LOOP : Replaces old data with new data, commencing with the oldest data, after storage has been performed 2000 times.

Data which can be stored

Measured or computed data can be stored. Computed data includes the following.

- Averaging data, scaling data, dB display data, percentage display data, input value – NULL value, comparison result

Storage Timing

Data is stored at the following timing depending on the trigger mode.

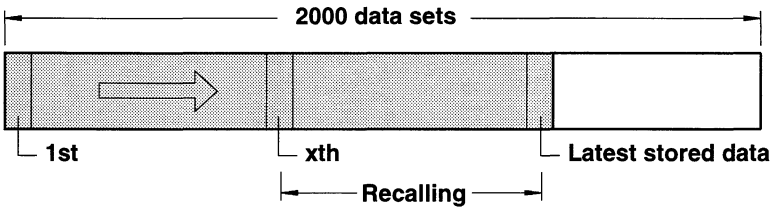
AUTO : Stores data one by one at the specified sampling rate.

SINGLE : Stores data when a trigger is generated in the case of external trigger mode, and stores data each time the TRIG key is pressed.

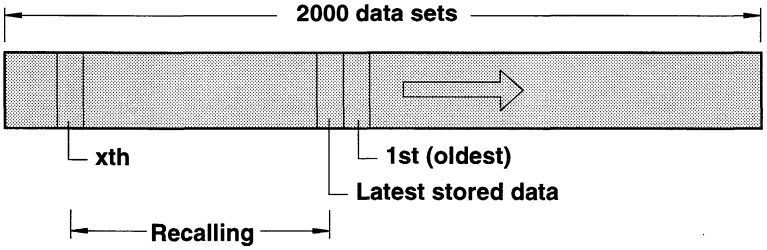
Recall Function

Recalls data, commencing with the data having the specified recall start data No. up to the latest data. The RECALL key's LED blinks during recalling. Note that the first data to be recalled varies as follows depending on the storage method (X indicates the recall start data No.).

Stored in 1SHOT or LOOP (no overwriting) method



Stored in LOOP (with overwriting) method



Recall Timing

Data is recalled at the following timing depending on the trigger mode.

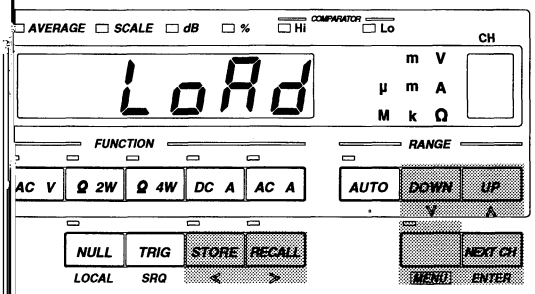
AUTO : Recalls data one by one at the specified sampling rate.

SINGLE : Recalls data when a trigger is generated in the case of external trigger mode, and recalls data each time the TRIG key is pressed.

Note

- The storage timing and recalling timing can be set individually. (e.g. Data can be stored at FAST sampling rate and recalled at SLOW sampling rate.)
- If the current function is switched to another after data is stored, the data will be deleted.
- Stored data will be lost if the instrument is turned OFF, since it is not backed up.
- If the recall start data No. is greater than the number of stored data sets, an error will appear.
- No measured/computed data will be displayed during storage if FAST has been selected as the sample rate.
- Recalling will be canceled if the current measurement function or range is changed or the NULL or NEXT CH key is pressed during recalling.
- Pressing the RECALL key recalls one data before a trigger is input.

ing the Set-up Information



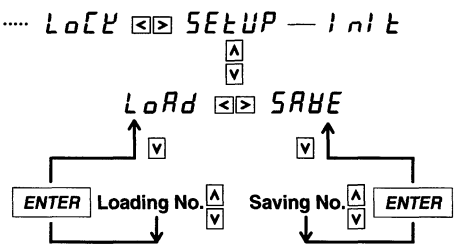
ıte the instrument as shown in the flow chart given below.

the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will abled.

nfirm the selection or setting, press the ENTER key.

linking value can be altered by pressing the up [∧] and down [∨] keys.

it from the menu during operation, press the MENU key. The screen will switch to the measurement n.



ıction

set-up information under the specified file name (FILE0 to FILE9) into the internal The set-up information will not be lost even if the instrument is turned OFF, since it is by a battery.

formation which can be saved

ving items in effect just before the MENU key is pressed will be saved. For a detailed ı, refer to Section 3.5 "Default Settings".

range, sampling method, ON/OFF state and parameters (factor etc.) of each function

ıction

specified file among files FILE0 to FILE9.

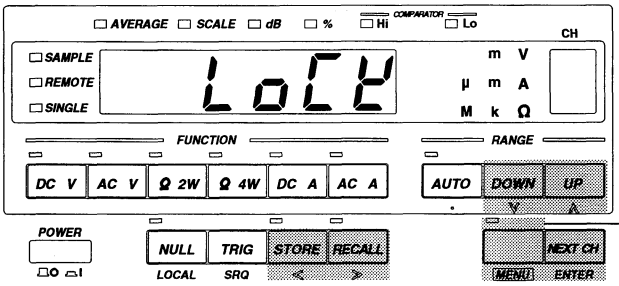
---

l information will not be deleted even if initialization is performed.

attempt is made to save set-up information in a file in which set-up information already exists, the ng information will be deleted (i.e. overwritten).

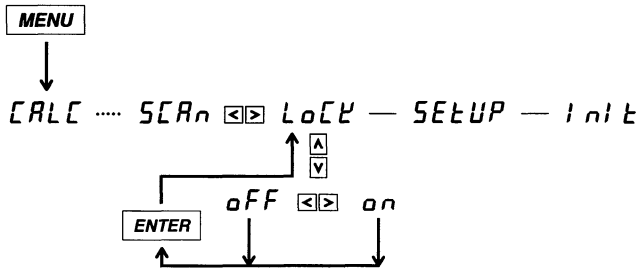
6.5 Locking Panel Keys

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- Press the MENU key. Functions (indicated by purple characters or symbols) marked below operation keys will be enabled.
- To confirm the selection or setting, press the ENTER key.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Key Lock

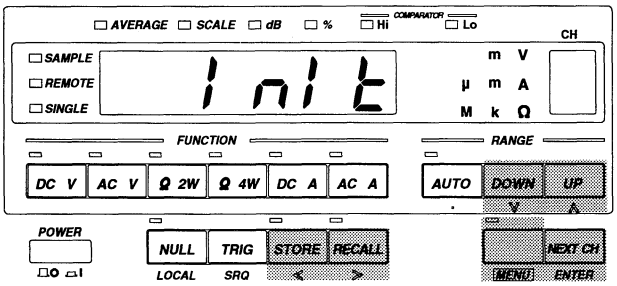
If the key lock function is turned ON, all the keys except for the power ON and MENU keys will become inoperable. The MENU key's LED blinks while this function is active. However, only the saving function for the set-up information can be used so that the key lock related set-up information is saved.

Note

- The key lock function will not be canceled even if the instrument is turned ON/OFF. To cancel, press the MENU key and select OFF from the key lock menu.
- If the instrument is turned OFF, then ON with the key lock function ON, none of the set-up information, except for the communications related information, will be initialized. For a detailed description, refer to Section 3.5 "Default Settings".

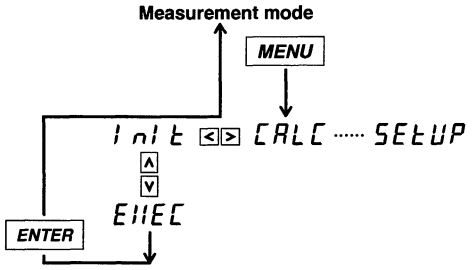
6.6 Initialization

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- To confirm the selection or setting, press the ENTER key.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



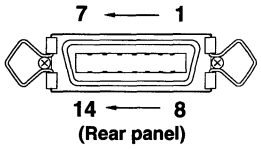
Explanation

Initialization

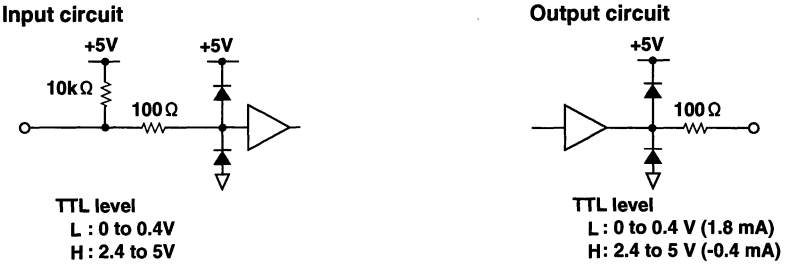
Initialization of the set-up information starts when the ENTER key is pressed as described in the above flow chart. For a detailed description of the set-up information which will be initialized, refer to Section 3.5 "Default Settings".

7.1 Pin Location of EXT TRIG & OUTPUT Connector

Pin Location



Input/Output Circuit



Signal Assignment

Pin No.	Signal Name	Input/Output	Specifications
1	EXT TRIG	Input	Trigger (trailing edge, pulse width: 2 µs or longer)
2	A/D END	Output	Sampling end pulse (pulse width: approx. 10 µs, active low)
3			
4	HIGH	Output	Output Comparator output (level output, active low)
5	PASS	Output	Output Comparator output (level output, active low)
6	LOW	Output	Output Comparator output (level output, active low)
7	GND		Ground
8	D/A OUT	Output	D/A output
9	D/A GND		D/A ground (internally connected to the ground)
10	NC		
11 to 13	CH No. data	Output	Scan CH No. is output.
14	GND		Ground

* The signal level is TTL.
* "NC" stands for "No Connection".
* The comparator judgment result obtained when an over-range occurs with the measured/computed data varies as follows depending on the selected measurement function.
  • ACV, Ω2W, Ω4W, ACA measurement: Active high
  • DCV, DCA, large current, simple scanner measurement: Active high and low

* CH No. data

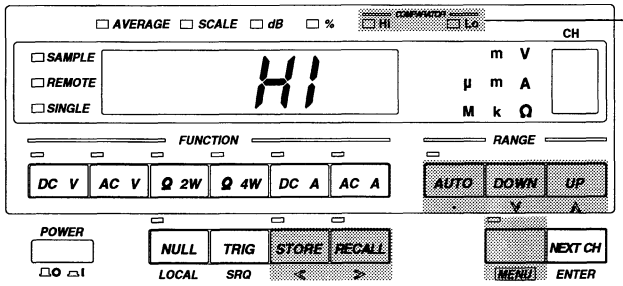
Pin No.			Scan CH No.
11	12	13	
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

CAUTION

Never allow a voltage exceeding the TTL level to be applied to any input pin of the EXT TRIG & OUTPUT connector. In addition, do not short-circuit any output pins or apply an external voltage to them. Failure to comply with the above precautions will result in damage to the instrument.

7.2 Using the Comparator Function

Relevant Keys

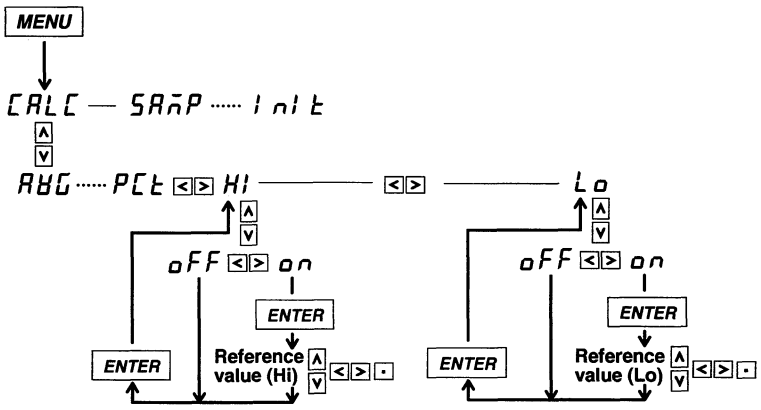


Blinks during setting of the comparator function and lights up while the function is ON.

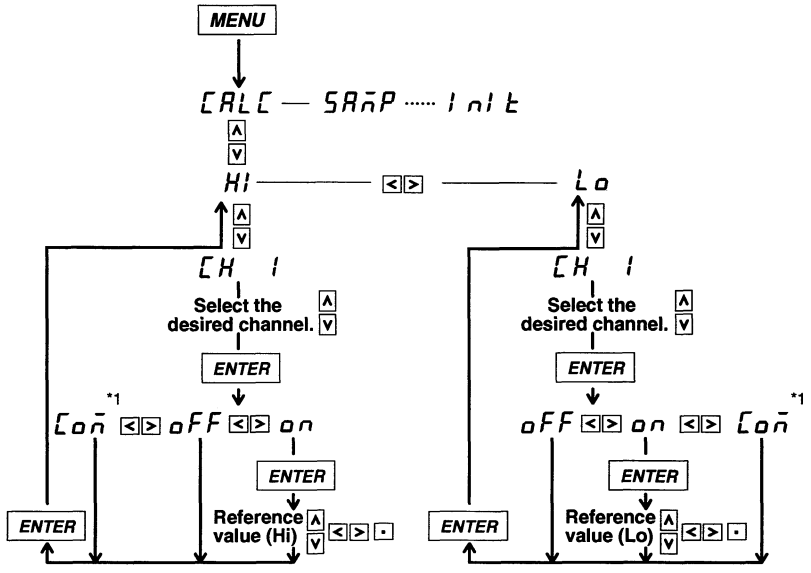
Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- To confirm the selection or setting, press the ENTER key.
- If you are using the simple scanner, select the desired channel for the comparator function before setting the reference value.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively. To move the decimal point position, press the [·] key.
- To specify the unit of scaling factor, keep pressing the [>] key until any of the LEDs for the unit lights up. Then, press the up [∧] or down [∨] key to select the desired unit.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.

When the Scanner is Not Used:



When the Scanner is Used:



*1: Possible to set if CH1 is not selected.

Explanation

Comparator Function

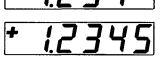
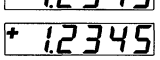
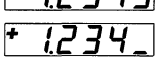
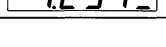
Compares the measured data or computed data with the reference values (Hi, Lo), and displays the result. If both reference values (Hi and Lo) are combined, judgment "Hi > X > Lo" can be performed. The judgment results are output as a TTL level signal from the EXT TRIG & OUTPUT connector. For a detailed description of the output signals, refer to Section 7.1 "Pin Location of EXT TRIG & OUTPUT Connector".

State	X ≥ Hi	Hi > X > Lo	X ≤ Lo
Judgment	HIGH	PASS	LOW

X = Measured data Hi, Lo = Reference values

Displaying the Judgment Result

The judgment result is displayed at the lowest digit of the displayed data. An example is given below.

X	Hi	Lo	Judgment	Display
1.2345V	1.000	-	HIGH	
1.2345V	1.3	-	PASS	
1.2345V	1.3	1.2	PASS	
1.2345V	-	1.3	LOW	

Setting the Reference Values

The reference values (Hi, Lo) can be set for each of the following measurement items.
DCV, ACV, Ω2W, Ω4W, DCA, ACA, measurement of large currents, each CH of the simple scanner

- **Setting range (varies depending on the data type)**
  DCV, ACV, measurement using the simple scanner
  : –199999 to 199999 (Unit: selectable from mV and V)
  Ω2W, Ω4W : –199999 to 199999 (Unit: selectable from Ω, kΩ and MΩ)
  DCA, ACA, large current measurement
  : –199999 to 199999 (Unit: selectable from μA, mA and A)
  Scaling, dB, percentage computation
  : –199999 to 199999

- **Operations when the scanner is not used:**
  OFF : Performs no comparison and judgment.
  ON : Compares the measured data with the specified reference values and makes judgment.

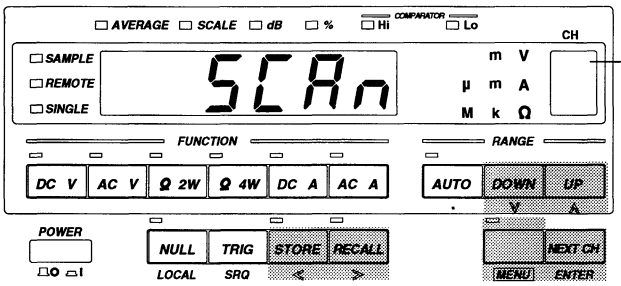
- **Operations when the scanner is used:**
  OFF : Performs no comparison and judgment.
  ON : Compares the measured data of each channel with the reference values specified for that channel, and makes judgment.
  COM : Compares the measured data of each channel with the reference values specified for channel CH1, and makes judgment. This eliminates the need for setting the reference values if the same reference values as those for CH1 are used. However, if either Hi or Lo is set to COM, both Hi and Lo will be set to COM . In the same manner, if one of Hi and Lo is set to ON or OFF, the other will be set to OFF.

Note

- An error code will be displayed if Lo is greater than Hi.
- If scaling, dB or percentage display functions are switched from ON to OFF or vice versa, both Hi and Lo will be set to OFF.

7.3 Using the Simple Scanner (Optional)

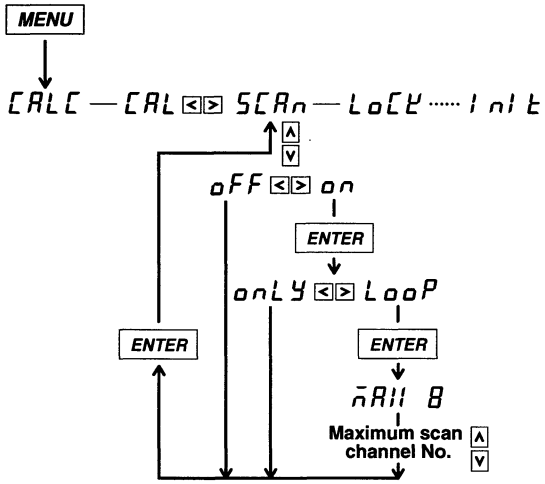
Relevant Keys



Scan CH is displayed when the scanner is used.

Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- To confirm the selection or setting, press the ENTER key.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

Functions of the Simple Scanner

This 8-channel 2-wire scanner is capable of measuring DC voltage (up to 30 V) only.

ONLY : Measures DC voltage of the channel which is selected using the [NEXT CH] .

LOOP : Measures DC voltage of the channels one by one sequentially, commencing with CH1 up to the specified channel. When measurement has been completed for the specified channel, measurement will start from CH1 again.

Setting the Maximum Scan Channel No. (MAX)

If LOOP mode is selected, the maximum scan channel No. must be specified. Channel Nos. 2 to 8 can be specified.

Sampling Time for Scanner (with no over-range, AUTO trigger mode and the same range selected for all channels)

Sampling Rate	Sampling Time for Scanner
FAST	Approx. 65 ms/CH
MID1	Approx. 150 ms/CH
MID2	Approx. 300 ms/CH
SLOW	Approx. 550 ms/CH

Setting the Measuring Range

AUTO Automatically switches the measuring range to a range suitable for the input. During measurement in auto range mode, the AUTO LED will be lit. To cancel the auto range mode, press the AUTO key again.

DOWN/UP Allows you to select any measuring ranges given in the table below.

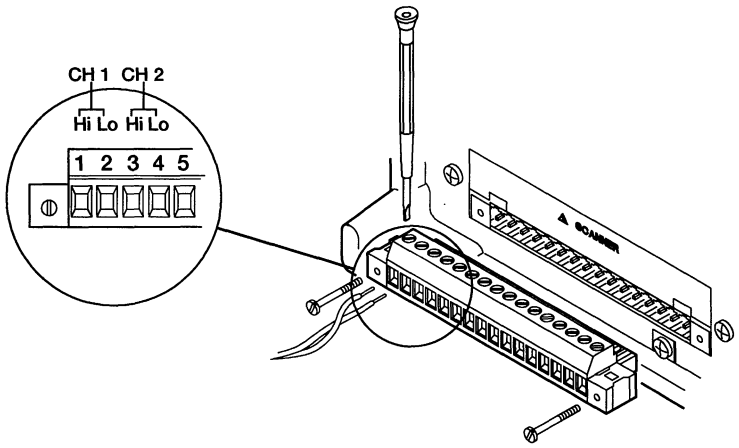
DOWN	←	→	UP
200mV	2000mV	20V	30V

It is recommended that the measuring range be selected with the scanner mode set to ONLY.

Connecting to the Simple Scanner

Remove the connector from the instrument, loosen the screws, connect the signal wires then tighten the screws. After all the signal wires are connected, reinstall the connector. If you want to fix the connector to the instrument, fix it with the two screws supplied with the instrument. The signal wires must meet the following requirements.

- Applicable electrical wires: Single wires of 1.0 mm in diameter (AWG18) or twisted wires of cross-sectional area of 0.75 sq. meters.
  (Electrical wires which can be used: Single wires of 0.4 to 1.0 mm in dia. (AWG26 to 18) or twisted wires of and cross-sectional area of 0.3 to 0.75 sq. meters (AWG22 to 20) and 0.18 mm or higher in dia.)
- Standard length of bare part: 8 mm



WARNING

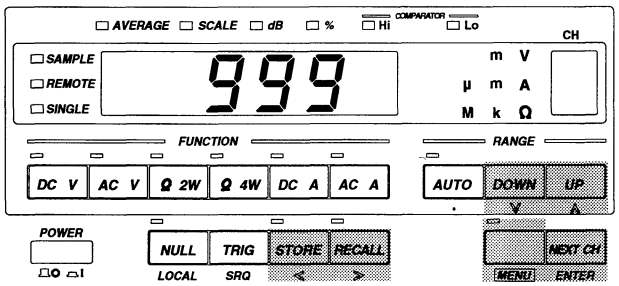
- Maximum permitted input voltage between terminals is 30 Vpeak.
- The maximum withstanding voltage for the ground is ±250 Vpeak. Exceeding this limit may cause damage to the instrument.

Note

- It is not possible to use the averaging (AVG), scaling (SCALE), dB and percentage (%) of the computing functions (CALC) if the scanner is used.
- If measurement is affected by noise such as power supplier's hum, set the sampling rate to an option other than FAST. Noise of power voltage frequency components cannot be eliminated if the sampling rate is set to FAST.
- Never apply a voltage exceeding 30 V between the Hi and Lo terminals on the front panel while the scanner is in use. If a voltage exceeding 30 V is being applied between the Hi and Lo terminals, do not apply any voltage to the scanner's terminal.

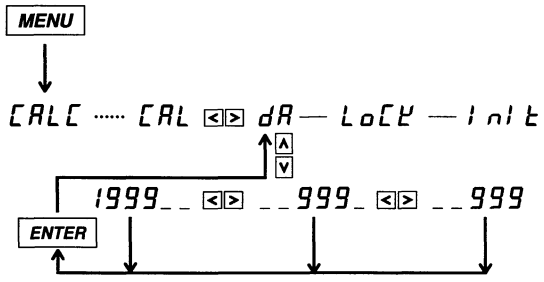
7.4 D/A Output (Optional)

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- To confirm the selection or setting, press the ENTER key.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.



Explanation

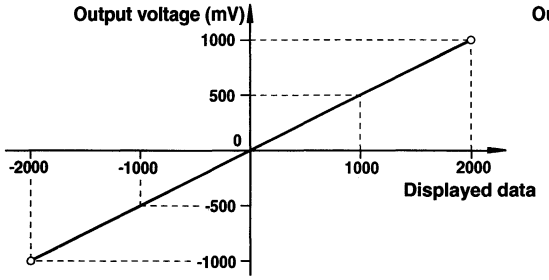
D/A Output Function

Of the displayed measured/computed data, the specified 3 digits or 3 1/2 digits are converted to a voltage signal (±999 mV), then output. The following digits can be specified.

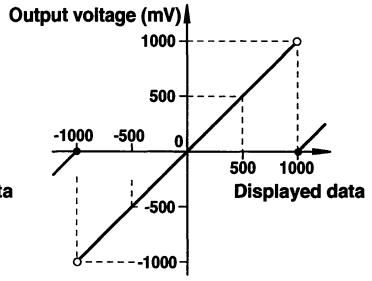
1999 999 999

Relationship between Displayed Data and Output Voltage

In the case of 1999



In the case of 999 and 999

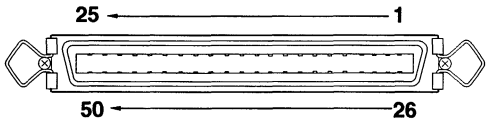


Note

- It is not possible to select 999 if FAST is selected as the sampling rate.
- Only 1999 can be selected during large current measurement.

7.5 BCD Output (Optional)

Pin Location



(Rear panel)

Input/Output Circuit Diagram

Refer to Section "Pin Location of EXT TRIG & OUTPUT Connector".

Signal Assignment

Pin No.	Signal Name	Pin No.	Signal Name
1	GND	33	A/D END
2 - 5	Data(10^0)	34 - 35	Polarity
6 - 9	Data(10^1)	36	Over-range
10 - 13	Data(10^2)	37 - 39	NC
14 - 17	Data(10^3)	40 - 43	Unit
18 - 21	Data(10^4)	44 - 46	Decimal point
22	Data(10^5)	47	PRINT
23 - 28	NC	48	EXT TRIG
29 - 31	Comparator output	49	NC
32	NC	50	GND

* The signal level is TTL.
* "NC" stands for "No Connection".

Data

Pin No.				Data
			22	10^5
21	20	19	18	10^4
17	16	15	14	10^3
13	12	11	10	10^2
9	8	7	6	10^1
5	4	3	2	10^0
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	1	1	1	Space

Comparator output A/D END

Refer to the signal assignment given on page 7-1.

Polarity

Pin No.		Polarity
35	34	
0	0	-oL-
0	1	Space
1	0	–
1	1	+

Over-range

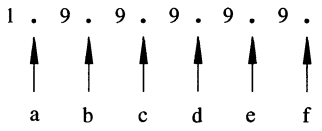
"1" is output when "-OL-" is displayed, otherwise "0" is output.

Unit

Pin No.				Unit
43	42	41	40	
0	0	0	0	mV
0	0	1	0	V
0	1	0	0	Ω
0	1	0	1	kΩ
1	0	1	1	MΩ
1	0	0	1	μA
1	0	1	0	mA
1	1	0	0	A
1	1	0	1	dB
1	1	1	0	%
1	1	1	1	Space

Decimal Point

Pin No.			Position
46	45	44	
0	0	0	a
0	0	1	b
0	1	0	c
0	1	1	d
1	0	0	e
1	0	1	f



PRINT

Start signal for the BCD printer. (Pulse width: approx. 1 ms, active low)

EXT TRIG

Refer to the signal assignment given on page 7-1.

CAUTION

Never allow a voltage exceeding the TTL level to be applied to any input pin of the BCD connector. In addition, do not short-circuit any output pins or apply an external voltage to them. Failure to comply with the above precautions will result in damage to the instrument.

Note

- The input and output circuits are the same as those for the EXT & OUTPUT connector.
- The BCD output function cannot be used if FAST is selected as the sampling rate.
- "0" will be output if "-OL-" is displayed.

8.1 RS-232-C Interface Functions and Specifications

Reception Function

Allows you to make the same settings as those which can be made using keys on the front panel. This function allows the instrument to receive a request for outputting of measured/computed data, panel set-up information and error codes.

Transmission Function

Allows the instrument to output measured/computed data. The panel set-up information and status byte can also be output. In addition, error codes which occurred can be output.

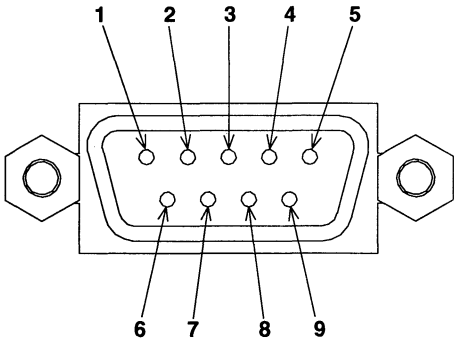
Specifications

Electrical characteristics	: Conforms to EIA RS-232-C.
Connection	: Point-to-point
Communications	: Full-duplex
Synchronization	: Start-stop system
Baud Rate	: 75, 150, 300, 600, 1200, 2400, 4800 and 9600
Start Bit	: 1 bit (fixed)
Data Length	: 7 or 8 bits
Parity	: Even, odd or no parity
Stop Bit	: 1 or 2 bits
Connector	: DELC-J9PAF-13L6 (JAE or equivalent)
Hardware Handshaking	: User can select whether CA or CB signals will always be True, or be used for control.
Software Handshaking	: User can select whether to control only transmission or both transmission and reception using X-on and X-off signals. X-on (ASCII 11H) X-off (ASCII 13H)
Receive Buffer Size	: 256 bytes

8.2 Connecting the RS-232-C Interface Cable

When connecting this instrument to a personal computer, make sure that the handshaking method, data transmission rate and data format selected for the instrument match those selected for the computer. For details, refer to the following pages. Also make sure that the correct interface cable is used.

Connector and Signal Names



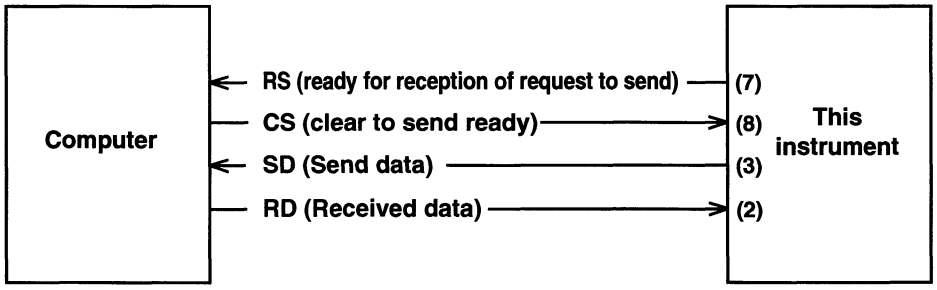
RS-232-C connector: DELC-J9PAF-13L6 (JAE or equivalent)

2. RD (Received Data) : Data received from personal computer
   Signal direction..... Input
3. SD (Send Data) : Data transmitted to personal computer
   Signal direction..... Output
5. SG (Signal Ground) : Ground for signals
7. RS (Request to Send) : Signal used to handshake when receiving data from personal computer
   Signal direction..... Output
8. CS (Clear to Send) : Signal used to handshake when transmitting data to personal computer
   Signal direction..... Input

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

Signal Direction

The figure below shows the direction of the signals used by the RS-232-C interface.



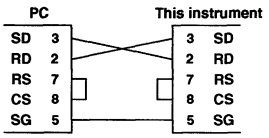
RS-232-C Standard Signals and their JIS and CCITT Abbreviations

RS-232-C Standard Signals

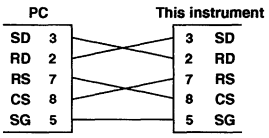
Pin No. (9-pin connector)	Abbreviations			Name
	RS-232-C	CCITT	JIS	
5	AB (GND)	102	SG	Ground for signals
3	BA (TXD)	103	SD	Send data
2	BB (RXD)	104	RD	Received data
8	CB (CTS)	105	CS	Request to send
7	CA (RTS)	107	RS	Date set ready

Signal Wiring Example (PC-9801 series personal computer from NEC is used as a controller)

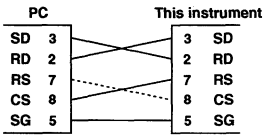
1. OFF-OFF/XON-XON



3. CTS-RTS(CS-RS)

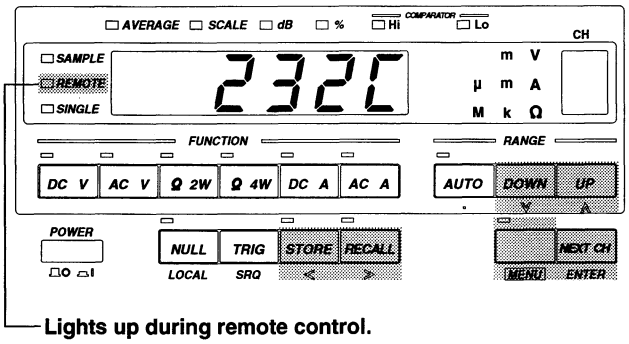


2. XON-RTS(XON-RS)



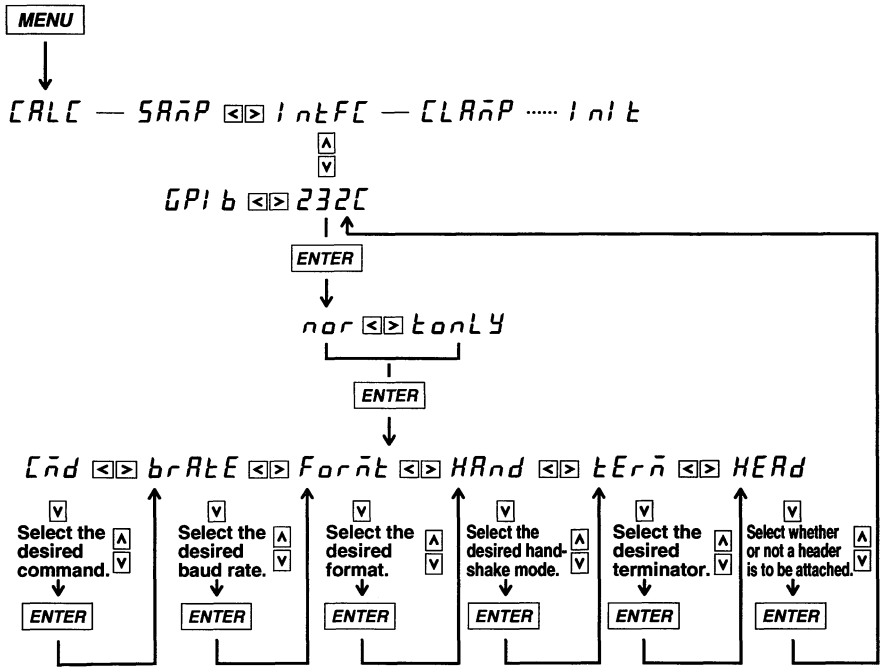
8.3 Setting Interface Mode, Handshake Mode, Data Format and Baud Rate

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.
- The selection or settings will be confirmed when the screen has returned to the measurement screen after the MENU key is pressed.



Explanation

Handshaking

To use an RS-232-C interface to transfer data between this instrument and a computer, it is necessary to use certain procedures by mutual agreement to ensure the proper transfer of data. These procedures are called "handshaking." Various handshaking systems are available depending on the computer to be used; the same handshaking system must be used for both computer and this instrument.

This instrument allows you to choose any handshaking mode from the following four using the panel keys.

Handshaking System Combinations (A circle indicates that the function is available.)

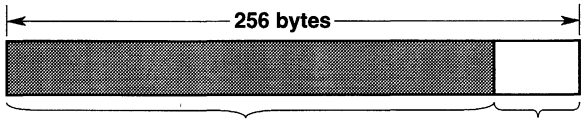
Handshake mode selection No.	Data sending control (Control method when sending data to computer)			Data receiving control (Control method when receiving data from computer)		
	Software handshake	Hardware handshake	No handshake	Software handshake	Hardware handshake	No handshake
	Sending stops when X-off is received, and sending is resumed when X-on is received.	Sending stops when CB (CTS) is False, and sending is resumed when CB is True.		X-off is sent when received data buffer becomes 3/4-full, and X-on is sent when received data buffer becomes 1/4-full.	CA (RTS) is set to False when received data buffer becomes 3/4-full, and is set to True when received data buffer becomes 1/4-full.	
0			○			○
1	○			○		
2	○				○	
3		○			○	

Note

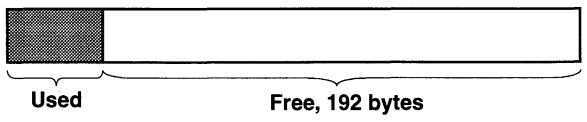
- The program for the personal computer must be designed in such a way that the receive buffer of both this instrument and the personal computer never become full.

Precautions Regarding Data Receiving Control

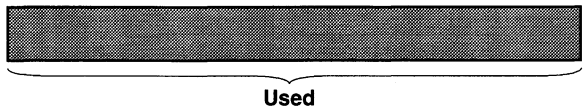
When handshaking is used to control received data, data may still be sent from the computer even if the free space in the receive buffer drops below 64 bytes. In this case, after the receive buffer is full, the excess data will be lost, whether handshaking is in use or not. Data storage to the buffer will begin again when there is free space in the buffer.



When handshaking is in use, reception of data will stop when the free space in the buffer drops to 64 bytes since data cannot be passed to the main program fast enough to keep up with the transmission.



After reception of data stops, data continues to be passed to the internal program. Reception of data starts again when the free space in the buffer increases to 192 bytes.

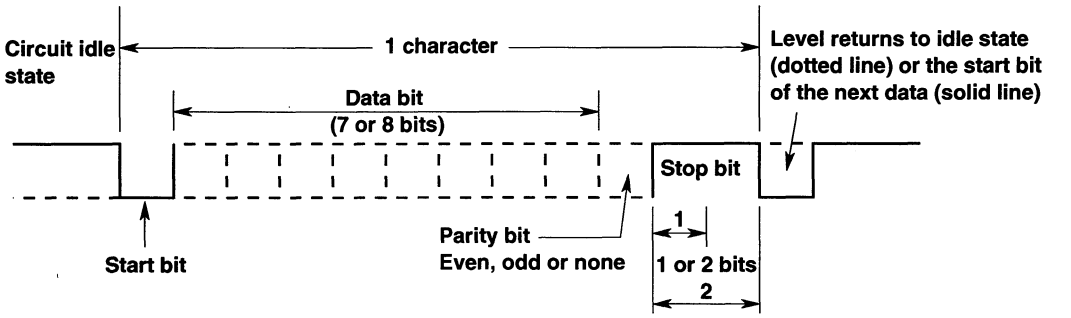


Whether handshaking is in use or not, if the buffer becomes full, any additional data received is no longer stored and is lost.

Data Receiving Control in Handshake Mode

Setting Data Format

The RS-232-C interface of this instrument performs communications using start-stop synchronization. In start-stop synchronization, one character is transmitted at a time. Each character consists of a start bit, data bits, a parity bit, and a stop bit. (Refer to the figure below.)



The table below shows the data format combinations supported by this instrument.

Setting	Start Bit	Data Length	Parity	Stop Bit
0	1	8	No	1
1	1	7	Odd	1
2	1	7	Even	1
3	1	7	No	2

Setting the Baud Rate

The following baud rates can be selected.

Baud Rate	75	150	300	600	1200	2400	4800	9600
Setting	0	1	2	3	4	5	6	7

Selecting the Command

As described in Appendix 1.1 "Command List", a total of five command types (0 to 4) are available. Select the command type to be used. If you are going to create a program using IEEE 488.2-1987 command type, set CMD to "4".

Selecting the Terminator

The following terminators can be selected.

Terminator	LF	CR	CR + LF
Setting	0	1	2

Selecting Whether or Not a Header is to be Attached

It is possible to select whether or not a header is to be attached.

	Header	No Header
Setting	1	0

Selecting the Mode

Normal and talk-only modes are available. The talk-only mode is not supported by command type 4 (IEEE 488.2-1987).

9.1 GP-IB Interface Functions and Specifications

Overview of the GP-IB Interface

Listener Function

- Allows you to make the settings which you can make using the panel keys on the instrument, except for the power ON/OFF and GP-IB communications settings.
- Receives commands from a controller requesting output of set-up and measured/computed data.
- Also receives status report commands.

Talker Function

Outputs set-up information and measured/computed data.

Talk-only Function

Outputs measured/computed data without using a controller. This mode is useful when you want to output such data to a printer which conforms to the GP-IB requirements. However, this function is not supported by command type 4 (IEEE 488.2-1987).

Note

- The listen-only and controller functions are not available on this instrument.

Switching between Remote and Local Mode

When switched from Local to Remote Mode

Remote mode is activated if this instrument is selected as a listener after a REN (Remote Enable) message is received from a controller while local mode is active.

- The REMOTE indicator LED lights up
- None of the front panel keys except the LOCAL key can be operated any more.
- Settings entered in local mode are retained.

When switched from Remote to Local Mode

Local mode is activated when the LOCAL key is pressed, REN is canceled or the GTL command is issued while remote mode is active.

- The REMOTE indicator LED goes out.
- All front panel keys are operative.
- Settings entered in remote mode are retained.

GP-IB Interface Specifications

Electrical and mechanical specifications : Conforms to IEEE St'd 488-1978
Functional specifications : Refer to the table blow.
Code : ISO (ASCII) code
Mode : Addressable mode/Talk-only mode
Address setting : Addresses 0 to 30 can be selected.
Remote mode clear : Remote mode can be cleared by pressing the LOCAL key on the front panel.

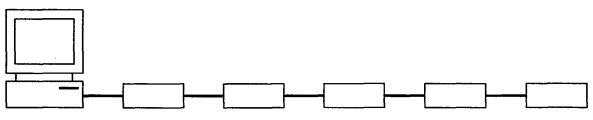
Function	Subset Name	Description
Source handshaking	SH1	Full source handshake capability
Acceptor handshaking	AH1	Full acceptor handshake capability
Talker		T5 Basic talker capability, serial polling, untalk on MLA (My Listen Address), talk-only capability
Listener		L4 Basic listener capability, unlisten on MTA (My Talk Address), no listen-only capability
Service request	SR1	Full service request capability
Remote local	RL1	Full remote/local capability
Parallel poll	PP0	No parallel polling capability
Device clear	DC1	Full device clear capability
Device trigger	DT1	No device trigger function
Controller	C0	No controller function
Electrical characteristic	E1	Open collector

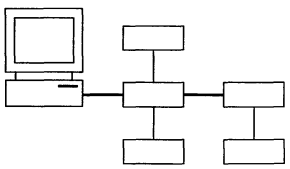
GP-IB Cable

The GP-IB connector on the rear panel of the instrument is a 24-pin connector that conforms to IEEE St'd 488-1978. Use a GP-IB cable that also conforms to IEEE St'd 488-1978.

Points to Note when Connecting the Cable

- Be sure to tighten the screws on the GP-IB cable connector firmly.
- More than one item of equipment can be connected through a GP-IB interface. However, it is not possible to connect more than 15 items of equipment (including the controller).
- If more than one item of equipment is to be connected, make sure that a different address is used for each item.
- Each connecting cable must be 2 m or less in length.
- The total length of all the cables must not exceed 20 m.
- While communications are in progress, more than two-thirds of the connected equipment items must be turned ON.
- When connecting more than one item of equipment, connect them as shown below so that the connection route forms a star or linear configuration. Loop or parallel wiring is not allowed.





9.2 Response to Interface Messages

What is an Interface Message?

An interface message is also called an interface command or bus command, and is issued by the controller. Interface messages are classified as follows.

Uni-line messages

These messages are transferred through a single control line. The following three types of uni-line message are available.

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

Multi-line message

Eight data lines are used to transmit a message. Multi-line messages are classified as follows.

- Address command
  Valid when the equipment is designated as a listener or a talker. The following five address commands are available.
  - Commands valid for equipment designated as a listener
    GTL (Go To Local), SDC (Selected Device Clear), PPC (Parallel Poll Configure), GET (Group Execute Trigger)
  - Command valid for equipment designated as a talker
    TCT (Take Control)
- Universal commands
  Valid for any item of equipment, irrespective of whether the item is designated as a listener or a talker. The following five universal commands are available.
  LLO (Local Lockout), DCL (Device Clear), PPU(Parallel Poll Unconfigure), SPE (Serial Poll Enable), SPD (Serial Poll Disable)
- In addition to the above commands, a listener address, talker address on secondary command can be sent in an interface message.
- Differences between SDC and DCL
  The SDC command is an address command and requires that both the talker and listener be designated; however DCL is a universal command and does not require that the talker and listener be designated. Therefore, SDC is used for particular items of equipment, while DCL can be used for any equipment connected to the communications bus.

Response to Interface Messages

Response to a uni-line message

- IFC : Clears the talker and listener. Stops output if data is being output.
- REN : Switches between remote and local modes.
- IDY : Not supported.

Response to a multi-line message (address command)

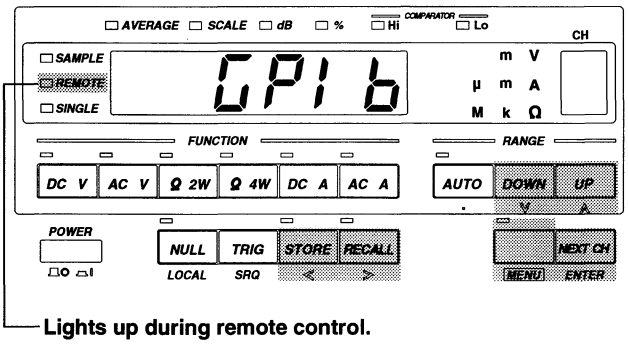
- GTL : Switches to local mode.
- SDC : Clears the program message (command) which is currently being output. Also clears the output queue.
- GET : Same as the TRIG key
- PPC, TCT : Not supported.

Response to a multi-line message (universal command)

- LLO : Not supported.
- DCL : Same as SDC
- SPE : Sets the talker function to serial poll mode for all equipment connected to the communications bus. The controller performs polling on equipment sequentially.
- SPD : Clears serial poll mode as the talker function for all equipment connected to the communications bus.
- PPU : Not supported.

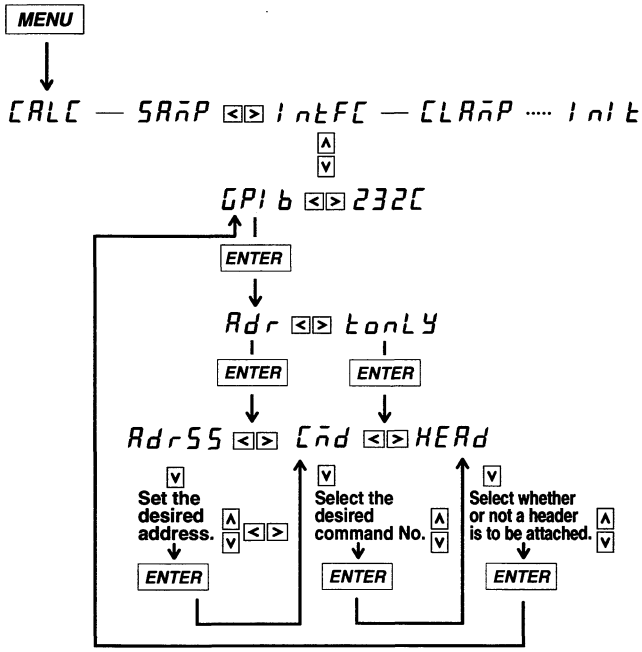
9.3 Setting the Address/Addressable Mode

Relevant Keys



Operating Procedure

- Operate the instrument as shown in the flow chart given below.
- The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively.
- To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.
- The selection or settings will be confirmed when the screen has returned to the measurement screen after the MENU key is pressed.



Explanation

Setting the Mode

Addressable mode or talk-only mode can be selected.

Setting the Address

Each item of equipment connected via a GP-IB interface has its own address, by which it can be identified. Therefore, this instrument's address must be set when the instrument is to be connected to other items of equipment such as a personal computer and used in addressable mode.

- Setting range: 0 to 30.
  The default setting is "1". Once the address is set, it will remain unchanged even if the set-up information is initialized.

Selecting the Command

As described in Appendix 1.1 "Command List", a total of five command types (0 to 4) are available. Select the command type to be used. If you are going to create a program using IEEE 488.2-1987 command type, set CMD to "4".

Selecting Whether or Not a Header is to be Attached

It is possible to select whether or not a header is to be attached.

	Header	No Header
Setting	1	0

Note

- If talk-only mode is selected when the instrument is not connected to a device such as personal computer and printer, incorrect measurement may result.

10.1 Calibrating the Instrument

To maintain high measurement accuracy, the instrument should be calibrated every 90 days.

Selecting the Standards

Items to be calibrated	Name of Standard	Calibration Range	Accuracy	Remarks
DCV	Standard DC voltage generator	190 mV to 1.9 V 19 V, 1000 V	±10 ppm ±20 ppm	4808 (Darton YOKOGAWA)
ACV	Standard AC voltage generator	190 Vrms to 700 Vrms	±0.02%	or equivalent
Ω	Standard resistor	100Ω to 1000kΩ 10MΩ 100MΩ	±20 ppm 0.02% 0.02%	4808 (Darton YOKOGAWA), 2781 (MCC) or equivalent
DCA	Standard DC current generator	1.9 mA to 1.9 A	±100 ppm	4808 (Darton YOKOGAWA)
ACA	Standard AC current generator	1.9 mA to 1.9 A	±0.1%	or equivalent

* MCC: Yokogawa M&C Corporation

Required Environment during Calibration

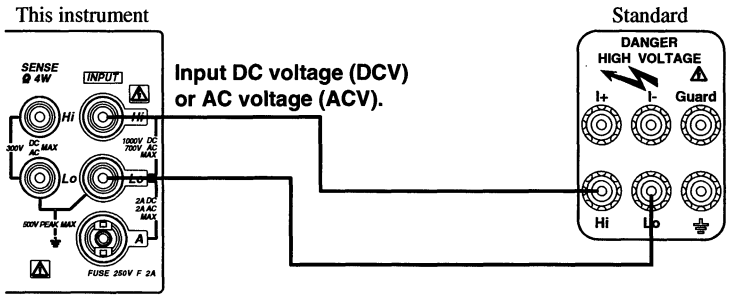
Ambient temperature : 23 ±1°C
Relative humidity : 45 to 75% RH
Power supply voltage : 100 V ±5% (suffix code –1)
120 V ±5% (suffix code –4)
230 V ±5% (suffix code –7)
Power supply frequency : (50/60 Hz) ±1 Hz
Warm-up time : 2 hours or more for the standards and 60 minutes or more for this instrument prior to calibration

Points to Note during Calibration

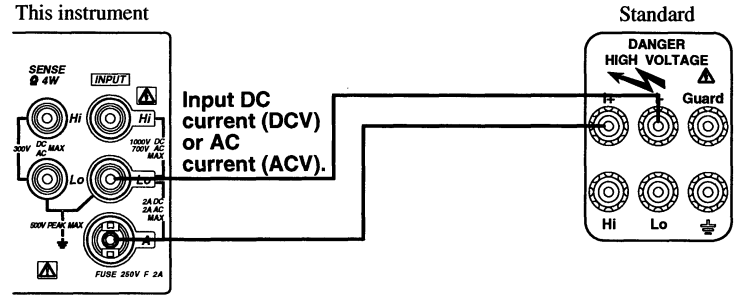
Make sure that the AC outlet to which this instrument is to be connected is a 3-prong type with a grounding terminal.

Wiring Method

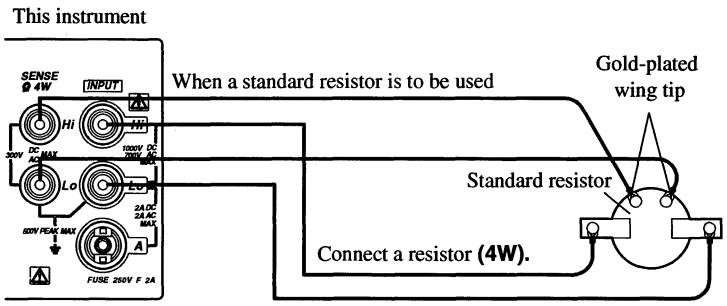
DCV, ACV



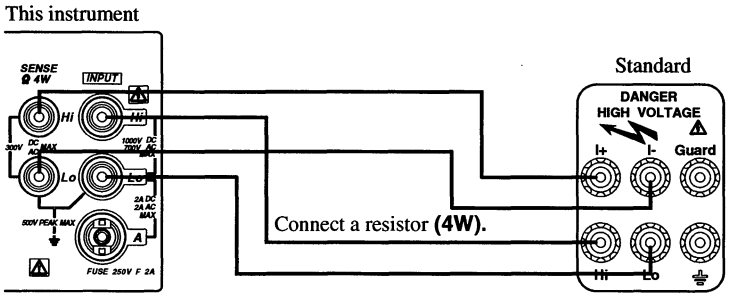
DCA, ACA



Ω4W (when 2781 is used)



Ω4W (when 4808 is used)



Operating Procedure

1. Warm-up the standard.
2. Connect the instrument to the standard.
3. Operate the instrument as shown in the flow chart given on the next page.
   - The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively. To move the decimal point position, press the [·] key.
   - To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.
4. Enter the password (7555).

Calibrating DCV, ACV, DCA, ACA and Ω4W

5. Select FUnC .
6. Press the function key corresponding to the function to be calibrated.
7. Select the measuring range to be calibrated. (Refer to table on page 10-4.)
8. To carry out calibration, two values (CAL_1, CAL_2) must be input to the instrument via the standard.

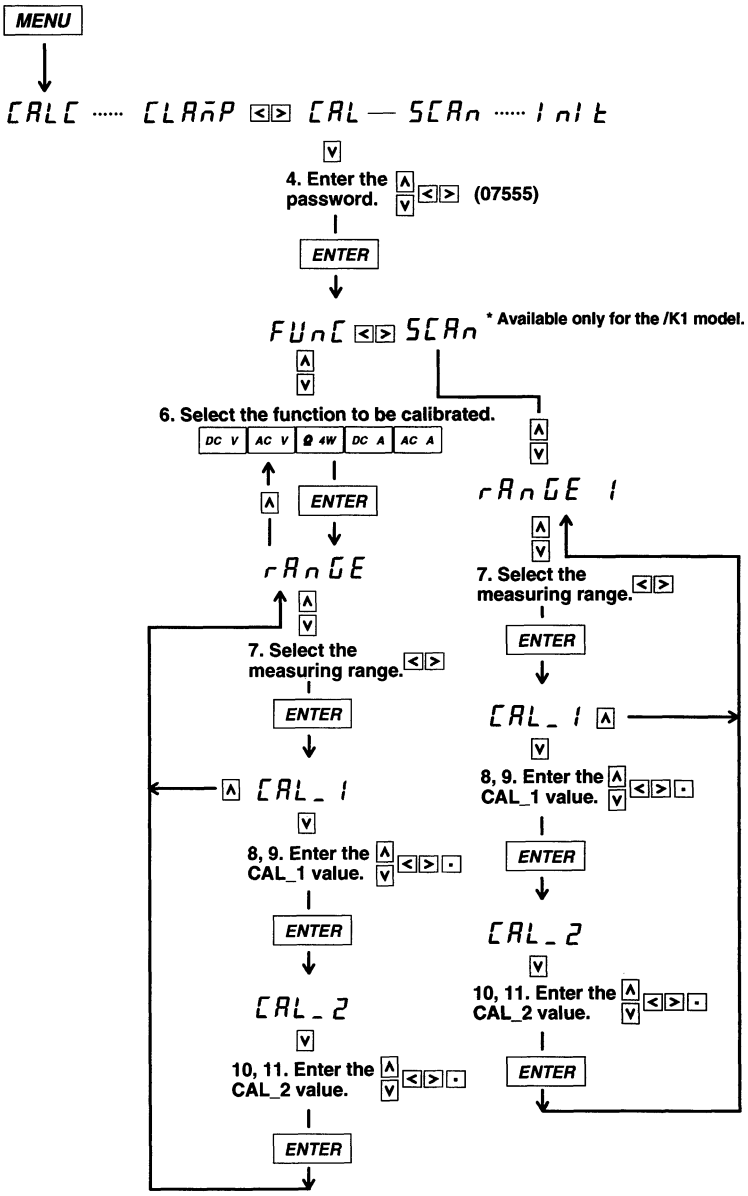
   The recommended CAL_1 value will be displayed at the end of step 7, so input this value to the instrument via the standard. (Refer to table on page 10-4.)
9. If necessary, change the CAL_1 value, then press the ENTER key.
10. The recommended CAL_2 value will be displayed, so input this value to the instrument via the standard. (Refer to the table on page 10-4.)
11. If necessary, change the CAL_2 value, then press the ENTER key.
12. Press the MENU key to return to the measurement screen. (The selection or settings will be confirmed when the screen has returned to the measurement screen.)

Calibrating the Simple Scanner (Optioal)

13. Select SCAn .
14. Carry out steps 7 to 12.

Note

- The selection or settings will not be confirmed if the instrument is turned OFF in the middle of the above procedure.



Points to Note during Calibration of the Scanner

Carry out calibration of the scanner only for CH1. Connect CH1 to the standard. For a description of the connecting method, refer to Section 7.3 "Using the Simple Scanner (Optional)".

Note

- For calibration of 20MΩ and 200MΩ ranges, it is recommended that shielded lead wires be used to eliminate influence of noise.
- Auto range mode cannot be selected.
- Only Ω4W is used for calibration of measurement of resistance.

Recommended Values for CAL_1 and CAL_2

CAL_1 and CAL_2 values required for calibration vary depending on the function to be calibrated. Find out appropriate values from the table shown below, and input them to the instrument via the standard .

If values exceeding those given in the table by ±10% are selected, an error will occur. However, for DCV, Ω4W and DCA, if a value (CAL_1) exceeding the one given in the table by ±100 digits is selected, an error will occur.

An error will also occur if the values selected as CAL_1 and CAL_2 differ considerably from those input to the instrument via the standard.

Recommended Values for Calibration of DCV, ACV, DCA, ACA and Ω4W

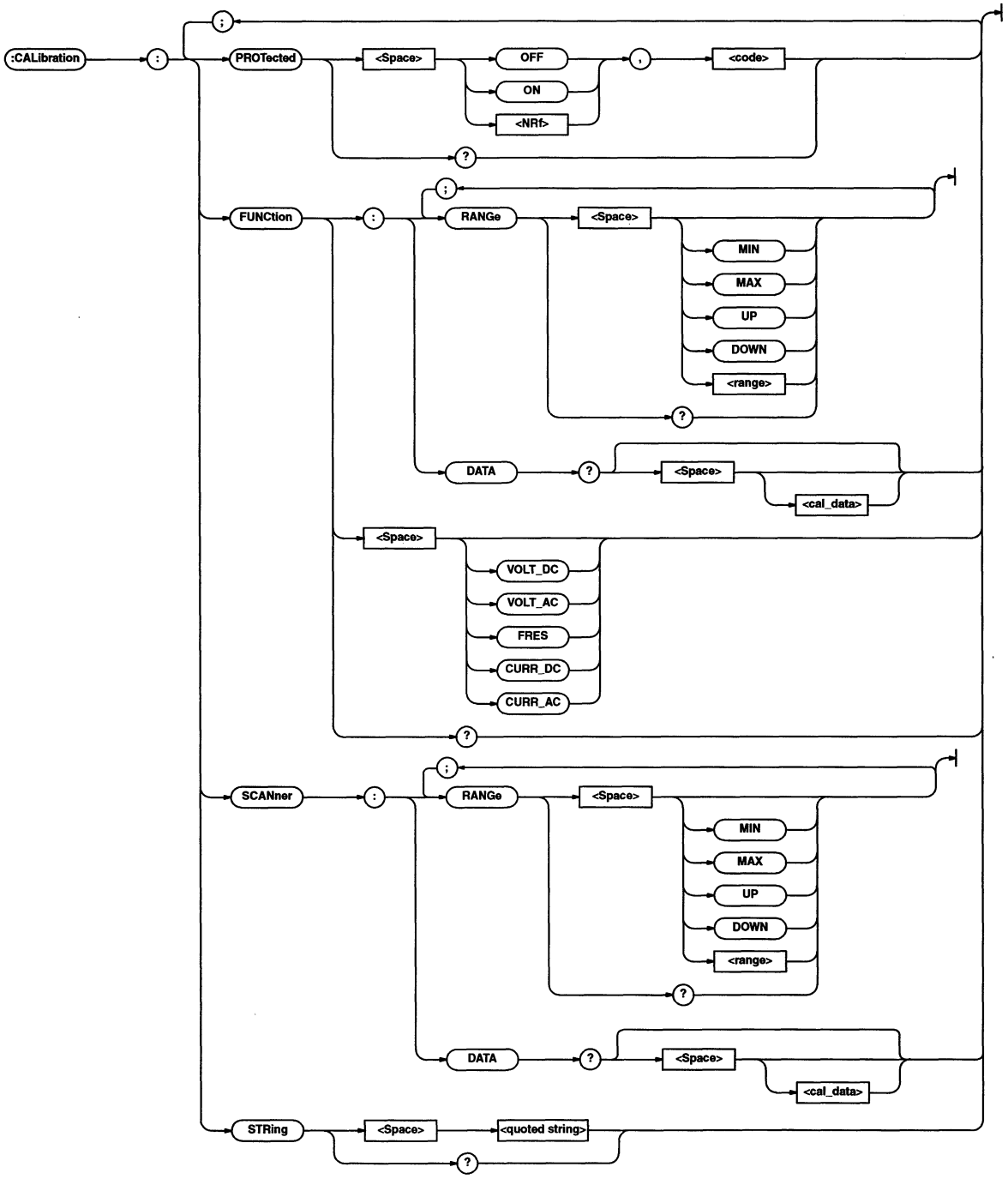
Function	Range	CAL_1	CAL_2	Remarks
DC Voltage	200 mV	0.000 mV	190.000 mV	
	2000 mV	0.00 mV	1900.00 mV	
	20 V	0.0000 V	19.0000 V	
DCV	200 V	0.000 V	190.000 V	
	1000 V	0.00 V	1000.00 V	
AC Voltage	200 mV	19.000 mV	190.000 mV	
	2000 mV	190.00 mV	1900.00 mV	Frequency: 400 Hz
	20 V	1.9000 V	19.0000 V	
ACV	200 V	19.000 V	190.000 V	
	700 V	69.00 V	690.00 V	
4-wire Resistance	200 Ω	0.000 Ω	100.000 Ω	
	2000 Ω	0.00 Ω	1000.00 Ω	Input the 4808's output value to the instrument.
	20 kΩ	0.0000 kΩ	10.0000 kΩ	
	200 kΩ	0.000 kΩ	100.000 kΩ	e.g.) 100.012 MΩ
	2000 kΩ	0.00 kΩ	1000.00 kΩ	Use the 4-wire method when 4808 is used.
	20 MΩ	0.0000 MΩ	10.0000 MΩ	
Ω4W	200 MΩ	0.000 MΩ	100.000 MΩ	
DC Current	2000 µA	0.00 µA	1900.00 µA	
	20 mA	0.0000 mA	19.0000 mA	
DCA	200 mA	0.000 mA	190.000 mA	
	2000 mA	0.00 mA	1900.00 mA	
AC Current	2000 µA	190.00 µA	1900.00 µA	
	20 mA	1.9000 mA	19.0000 mA	Frequency: 400 Hz
	200 mA	19.000 mA	190.000 mA	
ACA	2000 mA	190.00 mA	1900.00 mA	

Recommended Values for Calibration of the Scanner

Function	Range	CAL_1	CAL_2	Remarks
DC Voltage	20 V	0.0000 V	19.0000 V	Use CH1 for calibration.
DCV	30 V	0.000 V	29.000 V	

Communications Commands used for Calibration

Commands used for calibration of measured data are supported by IEEE 488.2-1987 only. Before executing any of these commands, read pages 10-1 to 10-4.



CALibration:PROTected

Function Sets the calibration mode/queries the current setting.

Syntax CALibration:PROTected {<Boolean>,<code>}
CALibration:PROTected?
<Boolean> = Calibration mode
<code> = 7555 (Password required to activate the calibration mode)

Example CALibration:PROTected ON,7555
CALibration:PROTected?→:CAL:PROT 1

Description It is not possible to make other settings if no mode is selected by this command.
Correction values are written in the non-volatile memory when the calibration mode is set to OFF or the MENU key is pressed. In the case of RS-232-C interface, do not send this command for approx. 1 second during writing of correction values to the non-volatile memory.

CALibration:FUNCtion

Function Sets the function to be calibrated/queries the current setting.

Syntax CALibration:FUNCtion{|VOLT_DC|VOLT_AC|FRES|CURR_DC|CURR_AC}
CALibration:FUNCtion?

Example CALibration:FUNCtion CURR_AC
CALibration:FUNCtion?→:CAL:FUNC CURR_AC

CALibration:FUNCtion:RANGe

Function Sets the range to be calibrated/queries the current setting.

Syntax CALibration:FUNCtion:RANGe {|MIN|MAX|UP|DOWN|<range>}
CALibration:FUNCtion:RANGe?
MAX = Maximum measuring range
MIN = Minimum measuring range
UP = Switches to the next upper measuring range.
DOWN = Switches to the next lower measuring range.
<range> = 1mV to 1KV(VOLT_DC/VOLT_AC)
= 1Ω to 200MΩ(FRES)
= 1μA to 2A(CURR_DC / CURR_AC)

Example CALibration:FUNCtion:RANGe 100mA
CALibration:FUNCtion:RANGe?→:CAL:FUNC:RANG +0.2E+00

CALibration:FUNCtion:DATA

Function Sets CAL_1 or CAL_2/queries the current setting.

Syntax CALibration:FUNCtion:DATA? {|<cal_data>}
CALibration:FUNCtion:DATA?
<cal_data> = (Value set for calibration)

Example CALibration:FUNCtion:DATA?→:CAL:FUNC:RANG +0.000E-03
CALibration:FUNCtion:DATA? 0.00000→:CAL:FUNC:RANG 0
CALibration:FUNCtion:DATA?→:CAL:FUNC:RANG +190.000E-03
CALibration:FUNCtion:DATA? +189.997E-03→:CAL:FUNC:RANG 0
CALibration:FUNCtion:DATA?→:CAL:FUNC:RANG -1.0

Description For calibration of each measuring range, two values must be input to the instrument via the standard. Thus, repeat this command twice.
CAL_1 and CAL_2 vary depending on the selected function and measuring range. A query for the values requested by the instrument can be made by executing "CALibration:FUNCtion:DATA?" with no parameters. Input the values obtained by the query to the instrument via the standard, and set them as <cal_data> by executing "CALibration:FUNCtion:DATA".
When calibration is completed successfully, "0" will be returned. If not, "1" will be returned. In this case, select the measuring range and set the CAL_1 and CAL_2 again. Once two values have been set, "-1.0" will be returned when a query "CALibration:FUNCtion:DATA?" is made, so proceed to calibrate the next function/range.

CALibration:SCANner:RANGe

Function Selects calibration of the simple scanner and sets the measuring range/queries the current setting.

Syntax CALibration:SCANner:RANGe {|MIN|MAX|UP|DOWN|<range>}CALibration:SCANner:RANGe?
MAX = Maximum measuring range (30 V range)
MIN = Minimum measuring range (20 V range)
UP = Switches to the 30 V range.
DOWN = Switches to the 20 V range.
<range> = 1 mV to 30 V

Example CALibration:SCANner:RANGe MAX
CALibration:SCANner:RANGe?→:CAL:FUNC:RANG +0.0
3E+03

Description Only 20 V and 30 V ranges are used for calibration of the simple scanner. An error will occur when this command is executed if the simple scanner is not installed on the instrument.

CALibration:Scanner:DATA

Function Sets CAL_1 or CAL_2/queries the current setting for the simple scanner.

Syntax
```
CALibration:SCANner:DATA? {|<cal_data>}
CALibration:SCANner:DATA?
<cal_data> = (Value set for calibration)
```

Example
```
CALibration:SCANner:DATA?→:CAL:SCAN:RANG
+0.000E-03
CALibration:SCANner:DATA? 0.00000→:CAL:
SCAN:RANG 0
CALibration:SCANner:DATA?→:CAL:SCAN:RANG
+19.0000E+00
CALibration:SCANner:DATA? +19.0001E+00→:
CAL:SCAN:RANG 0
CALibration:SCANner:DATA?→:CAL:SCAN:RANG -
1.0
```

Description Calibration procedure for the simple scanner is the same as that for "CALibration:FUNCtion:DATA?". An error will occur when this command is executed if the simple scanner is not installed on the instrument.

CALibration:STRing

Function Registers the specified character string data in the non-volatile memory/queries the current setting.

Syntax
```
CALibration:STRing {<quoted string>}
<quoted string> = Character string to be
registered (up to 15 characters)
```

Example
```
CALibration:STRing "95.12.25"
CALibration:STRing?→:CAL:STR "95.12.25"
```

Description This command enables you to record the date on which calibration is performed.
A query for the registered character string data can be made even if the instrument is not in calibration mode.

10.2 Actions in case of Problems

Items to be Checked In Case of Problems

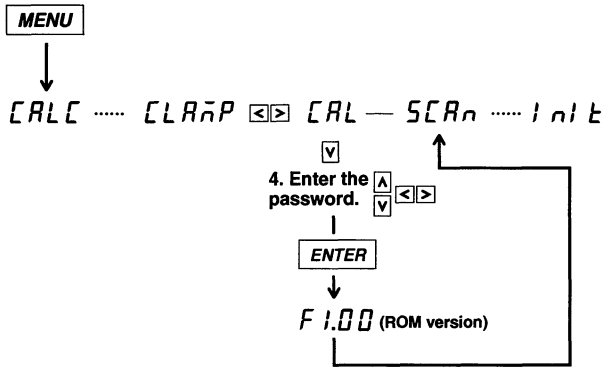
If the instrument does not operate properly even when the actions given in the table below are performed, contact YOKOGAWA or your YOKOGAWA sales representative. When contacting them, give them the ROM version No.

Symptom	What to Check	Reference Pages
Nothing is displayed when the power is turned ON.	• Is the power cord securely connected to the power connector of the instrument and the AC outlet?	3-4,3-5
Displayed data is odd.	• Is there any noise? • Are measurement leads connected correctly? • Are the ambient temperature and humidity within the allowed range?	3-2,3-3,4-1
Keys do not function.	• Is the REMOTE indicator LED off? • Is the MENU indicator off? (in key lock mode)	9-1 6-6
Instrument cannot be controlled via GP-IB interface.	• Does the GP-IB address specified in the program match the address set up in the instrument? • Does the interface meet IEEE Standard 488-1978 electrical and mechanical requirements?	9-2,9-4
Instrument cannot be controlled via RS-232-C interface.	• Are the instrument and controller using the same communications settings?	8-1 to 8-3

Checking the ROM Version

Operating Procedure

1. Operate the instrument as shown in the flow chart given on the next page.
   - The blinking value can be altered by pressing the up [∧] and down [∨] keys. To shift the blinking position to the right or left, press the [<] or [>] key, respectively.
   - To exit from the menu during operation, press the MENU key. The screen will switch to the measurement screen.
2. Enter the password (02049).
3. ROM version will be displayed.



10.3 Error Codes and Corrective Actions

Error Code	Description	Corrective Action	Reference Pages
40	FAST selected as sample rate	Select an option other than FAST, then turn the power ON.	5-3,5-4,5-5
41	MID1 selected as sample rate	Select an option other than MID1, then turn the power ON.	
50	Too large data	Set the data which is within the allowable setting range.	
51	Too small data	Set the data which is within the allowable setting range.	
52	Data set to 0	Set a value other than "0".	Chapter 5
60	Scaling, dB or percentage is ON.	Turn OFF scaling, dB and percentage display functions, then make necessary settings.	6-1
61	D/A output digit is set to "___999".	Set D/A output digit to an option other than "__999", then make necessary settings.	6-1,7-6
62	D/A output digit is set to an option other than "1999__".	Set D/A output digit to an option other than "1999__", then make necessary settings.	4-8,7-6
70	Attempted to set a value smaller than the recall start data No.	Set a value which is larger than the recall start data No.	6-4
71	Attempted to set a value larger than the number of stored data sets.	Set a value which is smaller than the number of stored data sets.	6-4
72	The number of stored data sets has not reached the recall start data No.	Set the recall start data No. smaller than the number of stored data sets.	6-4
80	An error has occurred during calibration.	Check the output from the standard. Also check the wiring between the standard and instrument.	10-1 to 4
81	CAL_1/CAL_2 is exceeding the allowable range.	Set them within the recommended range.	10-4
95	Abnormality was found with the set-up information during storage.	The set-up information contains incorrect information, so initialize the instrument.	6-7
96	Abnormality was found with the backed-up information.	If this error still occurs after initialization is carried out and the power is turned ON again, the lithium battery voltage may be too low, so service is required.	6-7
97	EEPROM failure	Service required.	
98	ROM failure	Service required.	
99	Abnormality was found with internal components.	Service required.	
CAUt1*	Sample rate was switched to MID1.		4-3,4-5
CAUt2*	Sample rate was switched to MID2.		4-7

* Codes marked with "*" are not displayed if the instrument is in remote control.

10.4 Replacing the Fuse

WARNING

- The fuse used must be of the specified ratings (current, voltage, type) in order to prevent a fire hazard.
- Before replacing the fuse, always turn OFF the power switch and disconnect the power cord from the AC outlet.
- Never short-circuit the fuse holder to bypass the fuse.

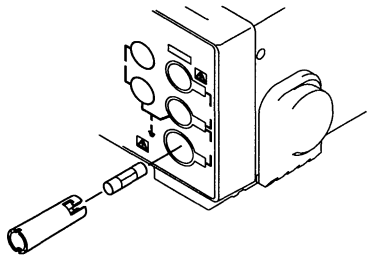
Required Ratings

The fuse must satisfy the following requirements.

- Maximum rated voltage : 250 V
- Maximum rated current : 2 A
- Type : FAST
- Parts No. : A1092EF

Replacing Method

A fuse holder is built into each current terminal as shown in the figure below. Turn the holder counter-clockwise by hand to remove it. Place a new fuse in the holder, then replace the holder in its original place.



11 Specifications

11.1 DC Voltage (DCV)

Ranges

Range	Sampling SLOW/MID2/MID1		Sampling FAST		Input Resistance	Max. Input (Hi-Lo)
	Max. Reading	Resolution	Max. Reading	Resolution		
200mV	199.999	1 μV	199.99	10 μV	>1GΩ	±1000Vpeak(10 sec) ±500Vpeak(Continuously)
2000mV	1999.99	10 μV	1999.9	100 μV		
20V	19.9999	100 μV	19.999	1mV	10MΩ±1%	±1000Vpeak (Continuously)
200V	199.999	1mV	199.99	10mV		
1000V	1100.00	10mV	1100.0	100mV		

- The 24 h, 23 ±1°C accuracy is the value with respect to the calibration standard.
- The NULL function is used.
- When sampling MID2 is used, 1 is added to the value of digits of SLOW.
- When sampling MID1 is used, 3 is added to the value of digits of SLOW.
- The number in parenthesis is the value of digits in the case of sampling FAST.
- Common mode rejection ratio: 120 dB or better
  (Value at sampling SLOW/MID2/MID1, 50/60 Hz ±0.1%, Rs = 1 kΩ)
- Normal mode rejection ratio: 60 dB or better
  (Value at sampling SLOW/MID2/MID1, 50/60 Hz ±0.1%)
- Maximum allowable voltage between Lo and the case: ±500 Vpeak

Accuracy (Sampling SLOW) : ±(% of reading + digits)

Range	24h, 23±1℃	90 days, 23±5℃	1 year, 23±5℃	Temperature Coefficient (5~18, 28~40℃)/℃
200mV	0.0055+6(6)	0.009+8(6)	0.012+8(6)	0.0011+1 (0.4)
2000mV	0.0045+3(5)	0.006+3(5)	0.009+3(5)	0.0009+0.5(0.3)
20V	0.007+4(6)	0.012+4(6)	0.02 +4(6)	0.0012+0.5(0.3)
200V	0.006+3(5)	0.011+3(5)	0.019+3(5)	0.0012+0.5(0.3)
1000V	0.008+3(5)	0.013+3(5)	0.021+3(5)	0.0015+0.5(0.3)

11.2 DC Current (DCA)

Ranges

Range	Sampling SLOW/MID2/MID1		Sampling FAST		Input Resistance
	Max. Reading	Resolution	Max. Reading	Resolution	
2000 μA	1999.99	10nA	1999.9	100nA	<11Ω
20 mA	19.9999	100nA	19.999	1 μA	<11Ω
200 mA	199.999	1 μA	199.99	10 μA	<0.3Ω
2000 mA	1999.99	10 μA	1999.9	100 μA	<0.3Ω

Accuracy (Sampling SLOW) : ±(% of reading + digits)

Range	1 year, 23±5℃
2000 μA	0.06+100(100)
20mA	0.06+ 20(20)
200mA	0.12+ 80(20)
2000mA	0.12+ 40(40)

- When sampling MID2 is used, 10 is added to the value of digits of SLOW.
- When sampling MID1 is used, 20 is added to the value of digits of SLOW.
- The number in parenthesis is the value of digits in the case of sampling FAST.
- Temperature coefficient: ±(1/10 of measurement accuracy)/°C
- Allowable current: 2 A (built-in 2 A fuse)

When Current Clamp (751106) is Used

Range	Max. Reading	Resolution	Accuracy : ± (% of reading + digits)
200 A	199.9	100 mA	2 + 10 (≦150A)
			2.5 + 10 (>150A)

- The accuracy is the value over one year, at 23 ±5°C, after zero adjustment.
- Temperature coefficient: ±(1/10 of measurement accuracy)/°C

11.3 Resistance Measurement (Ω2W/Ω4W)

Ranges

Range	Sampling SLOW/MID2/MID1		Sampling FAST		Current
	Max. Reading	Resolution	Max. Reading	Resolution	
200Ω	199.999	1mΩ	199.99	10mΩ	1mA
2000Ω	1999.99	10mΩ	1999.9	100mΩ	1mA
20kΩ	19.9999	100mΩ	19.999	1Ω	100 μA
200kΩ	199.999	1Ω	199.99	10Ω	25 μA
2000kΩ	1999.99	10Ω	1999.9	100Ω	2.5 μA
20MΩ	19.9999	100Ω	—	—	250nA
200MΩ	199.99	10kΩ	—	—	25nA

Accuracy (4-Wire System, Sampling SLOW): ± (% of reading + digits)

Range	24h, 23±1℃	90 days, 23±5℃	1 year, 23±5℃	Temperature Coefficient (5 to 18, 28 to 40℃)/℃
200Ω	0.008+6 (6)	0.015+7 (6)	0.019+7 (6)	0.0021+1 (1.5)
2000Ω	0.007+4 (5)	0.012+6 (5)	0.016+6 (5)	0.0016+1 (0.4)
20kΩ	0.007+3 (5)	0.012+5 (5)	0.016+5 (5)	0.0016+1 (0.4)
200kΩ	0.008+3 (5)	0.013+5 (5)	0.017+5 (5)	0.0016+1 (0.4)
2000kΩ	0.03+15 (20)	0.05+20 (30)	0.05+20 (30)	0.005+1 (0.4)
20MΩ	0.25+30	0.25+30	0.25+30	0.02+3
200MΩ	2+20	2+20	2+20	0.05+5

- The 24 h, 23 ±1°C accuracy is the value with respect to the calibration standard.
- The NULL function is used.
- When sampling MID2 is used, 1 is added to the value of digits of SLOW.
- When sampling MID1 is used, 3 is added to the value of digits of SLOW.
- The number in parenthesis is the value of digits in the case of sampling FAST.
- The accuracy in the case of the 2-wire method is the same as that of the 4-wire method. However, 4 mΩ/°C is added to the temperature coefficient.
- Excludes the affect of the lead wires.
- Open terminal voltage: Max. 12.5 V
- Max. input voltage: ±300 Vpeak (between Hi and Lo, between SENSE Hi and SENSE Lo)
- Response time: Until the reading falls within the specified accuracy.
  2000 kΩ/20 MΩ range: Within 0.4 seconds
  200 MΩ range: Within 5 seconds

11.4 AC Voltage (ACV)

Ranges

Range	Sampling SLOW/MID2/MID1		Input Resistance	Max. Input (Hi-Lo)
	Max. Reading	Resolution		
200mV	199.999	1 μV	1MΩ ±2% Approx. 150 pF	700 Vrms or ±1000 Vpeak 10^7V·Hz or less
2000mV	1999.99	10 μV		
20V	19.9999	100 μV		
200V	199.999	1mV		
700V	700.00	10mV		

- When sampling MID2 is used, 10 is added to the value of digits of SLOW.
- When sampling MID1 is used, 20 is added to the value of digits of SLOW.
- AC coupling: True RMS value measurement method
- Input range: Sinusoidal waveform of between 5 and 100% of the range
- Response time: Until the reading falls within ±0.2% of the final value
  Within 400 ms
- Crest factor: 3 at full scale (For 700 V range: 2 at full scale)
- Temperature coefficient: ±(1/10 of measurement accuracy)/°C
- Maximum allowable voltage between Lo and the case: ±500 Vpeak

Accuracy (Sampling SLOW) : ± (% of reading + digits), 1 year, 23 ± 5°C

Range	20Hz to 30Hz	30Hz to 45Hz	45Hz to 10kHz	10kHz to 20kHz	20kHz to 50kHz	50kHz to 100kHz
200mV	0.9+250	0.5+250	0.4+250	0.5+300	0.8+500	2+500
2000mV	0.8+100	0.4+100	0.2+100	0.4+200	0.6+500	2+500
20V	0.8+100	0.4+100	0.2+100	0.4+200	0.6+500	2+500
200V	1+100	0.4+100	0.3+100	0.4+200	0.8+500	3+500
700V	1+100	0.4+100	0.4+100	0.6+300		

11.5 AC Current (ACA)

Ranges

Range	Sampling SLOW/MID2/MID1		Input Resistance (50 Hz)
	Max. Reading	Resolution	
2000 μA	1999.99	10nA	<11Ω
20mA	19.9999	100nA	<11Ω
200mA	199.999	1 μA	<0.3Ω
2000mA	1999.99	10 μA	<0.3Ω

- When sampling MID2 is used, 10 is added to the value of digits of SLOW.
- When sampling MID1 is used, 20 is added to the value of digits of SLOW.
- AC coupling: True RMS value measurement method
- Input range: Sinusoidal waveform of between 5 and 100% of the range
- Response time: Until the reading falls within ±0.2% of the final value
  Within 400 ms
- Crest factor: 3 at full scale
- Temperature coefficient: ±(1/10 of measurement accuracy)/°C
- Allowable current: 2 A (built-in 2 A fuse)

Accuracy (Sampling SLOW) : ± (% of reading + digits), 1 year, 23 ± 5°C

Range	20Hz to 30Hz	30Hz to 45Hz	45Hz to 2kHz	2kHz to 5kHz
2000 μA	1.5+350	0.8+300	0.5+300	0.8+300
20mA	1.3+300	0.8+200	0.5+200	0.8+200
200mA	1.3+300	0.8+300	0.5+300	0.8+300
2000mA	1.5+300	1.5+200	1+200	1.5+200

When Current Clamp (751106) is Used

Range	Max. Reading	Resolution	Accuracy : ± (% of reading + digits)
150 A	150.0	100 mA	2 + 10

- The accuracy is the value over one year, at 23 ±5°C, after zero adjustment.
- 40 to 500Hz
- Temperature coefficient: ±(1/10 of measurement accuracy)/°C

11.6 Sampling

	Sampling Rate	Integrating Time
SLOW	2/s	200 ms
MID2	4/s	100 ms
MID1	20/s	20 ms or 16.67 ms
FAST	50/s (125/s)	2 ms

- When MID1 is used, 20 ms (50 Hz) or 16.67 ms (60 Hz) is automatically selected according to the supply voltage frequency.
- When FAST is used, the sampling rate is set to 125 times/sec during storage only.
- In the case of AC voltage and AC current measurement, MID1 is activated when FAST is selected.
- In the 20 MΩ and 200 MΩ ranges, MID2 is activated when FAST or MID1 is selected.

11.7 Communication Functions

RS-232-C interface (standard accessory)

Transmission method : Start-stop synchronization

Transmission speed : 75, 150, 300, 600, 1200, 2400, 4800 and 9600 bits/s

Handshake mode, baud rate, number of bits, and header can be set to ON or OFF.

GP-IB interface (optional)

Electrical and mechanical specifications : Conforms to IEEE St'd 488-1978 (Conforms to IEEE Std 488.2-1978)

Functional specifications : SH1, AH1, T5, L4, SR1, PP0, DC1, DT1, C0

Address mode, address and header can be set to ON or OFF.

11.8 General Specifications

Operating principle : Feedback pulse width modulation method

Sample mode : Auto/Single

Sampling rate : Four modes (SLOW, MID2, MID1 and FAST) are available.

Maximum reading : 199999

Over-range information : -OL- sign display

Data memory : Up to 2000 items of measurement data and also 10 kinds of set-up information can be saved.

Operating temperature : 5 to 40°C

Operating humidity : 20 to 80% RH

Supply voltage range : 100 VAC (operating voltage: 90 to 110 VAC).....suffix code –1

120 VAC (operating voltage: 108 to 132 VAC).....suffix code –4

230 VAC (operating voltage: 207 to 253 VAC).....suffix code –7

Supply voltage frequency : 50/60 Hz

Storage temperature : –5 to 50°C

Power consumption : 20 VA max.

Warm-up time : Approx. 60 minutes (until all specifications are satisfied)

Dimensions : Approx. 213 (W) x 88 (H) x 350 (D) mm

Weight : Approx. 3.5 kg (main body only)

Accessories : Power cord (1), measurement lead wire (1), fuse 2 A (FAST) (1), rubber feet (1 set), remote connector (1), user's manual (1)

11.9 Options

GP-IB : See the Communications Functions on this page.

Simple scanner : 8 ch./2-wire

Channel Nos. are indicated on the front panel.

Available for DC voltage measurement only

Maximum tolerable voltage : 30 Vpeak between Hi and Lo terminals, 30 Vpeak between channels, 250 Vpeak between Lo and the case

Accuracy : Add 20 to the digits value given as the accuracy for the DC voltage measurement when the range is 2000 mV or less.

Add (0.02% of reading + 20 digits) to the value given as the accuracy for the DV voltage measurement when the range is 20 V or higher.

BCD output : Data output: BCD parallel output

Output items: Measurement data, decimal point, unit, polarity, over-range

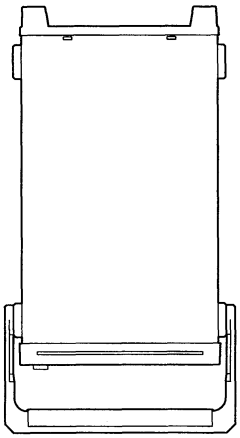
Connector: 50-pin (equivalent to Amphenol 57-40500)

D/A output : Output voltage range: –1 V to +1 V / F.S

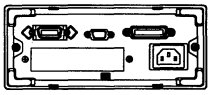
Any three contiguous digits (or 3 1/2-digits in the case of "1999") of the displayed area

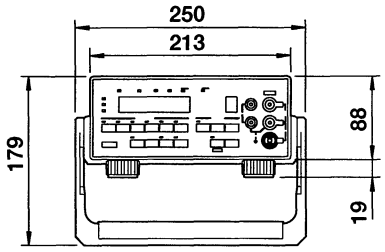
11.10 External Dimensions

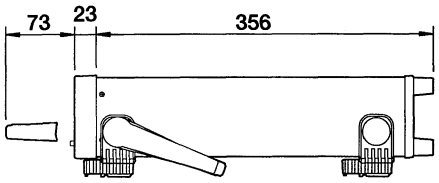
Unit: mm



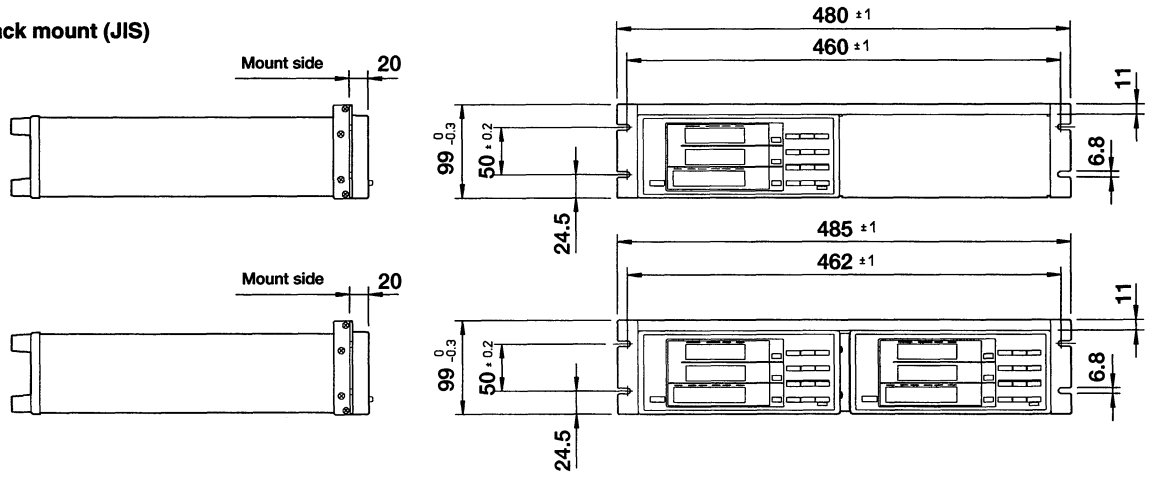
Rear View



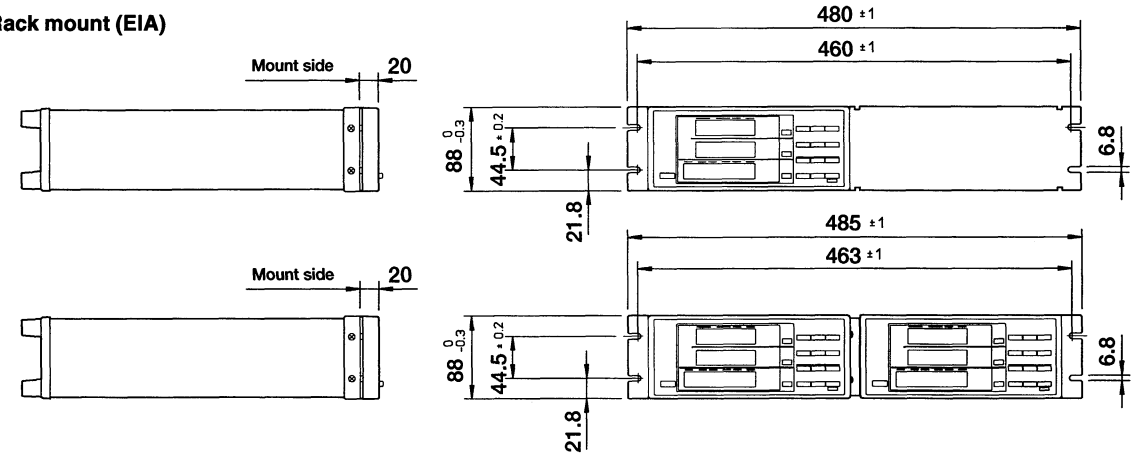




- Rack mount (JIS)



- Rack mount (EIA)



Unless otherwise specified, tolerance is ±3%. (However, tolerance is ±0.3 mm when below 10 mm.)

App 1.1 Command List

The following table shows all the commands which can be used with this instrument. Care has been taken so that the instrument can support programs which have been created by another model (e.g. 7552). Command types and instruments which support those command types are described below.

Command type 0 : This instrument (before introduction of the IEEE 488.2-1987) or 7551/7552 (YOKOGAWA)

Command types 1 to 3 : DMM by other manufacturers

Command type 4 : This instrument (IEEE 488.2-1987)

For a detailed description of command types 0 and 4, refer to Appendix 1.2 and 2.2. For other command types, refer to the User's Manual of the corresponding instrument.

Type 0	Type 1	Type 2	Type 3	Type 4	Remarks
F1	F1	F1	F1	SENS:FUNC "VOLTage:DC"	Selects DCV.
(F1)R0	(F1)R0	(F1)R0	(F1)RA	SENS:FUNC:VOLT:DC:AUTO ON	Selects AUTO range mode.
(F1)R3	(F1)R3	(F1)R1	(F1)R-1	SENS:FUNC:VOLT:DC:RANG 2E-1V	Selects 200 mV range.
(F1)R4	(F1)R4	(F1)R2	(F1)R0	SENS:FUNC:VOLT:DC:RANG 2E-0V	Selects 2000 mV range.
(F1)R5	(F1)R5	(F1)R3	(F1)R1	SENS:FUNC:VOLT:DC:RANG 2E+1V	Selects 20 V range.
(F1)R6	(F1)R6	(F1)R4	(F1)R2	SENS:FUNC:VOLT:DC:RANG 2E+2V	Selects 200 V range.
(F1)R7	(F1)R7	(F1)R5	(F1)[R3]	SENS:FUNC:VOLT:DC:RANG 1E+3V	Selects 1000 V range.
F2	F2	F2	F2	SENS:FUNC "VOLTage:AC"	Selects ACV.
(F2)R0	(F2)R0	(F2)R0	(F2)RA	SENS:FUNC:VOLT:AC:AUTO ON	Selects AUTO range mode.
(F2)R3	(F2)R3	(F2)R1	(F2)R-1	SENS:FUNC:VOLT:AC:RANG 2E-1V	Selects 200 mV range.
(F2)R4	(F2)R4	(F2)R2	(F2)R0	SENS:FUNC:VOLT:AC:RANG 2E-0V	Selects 2000 mV range.
(F2)R5	(F2)R5	(F2)R3	(F2)R1	SENS:FUNC:VOLT:AC:RANG 2E+1V	Selects 20 V range.
(F2)R6	(F2)R6	(F2)R4	(F2)R2	SENS:FUNC:VOLT:AC:RANG 2E+2V	Selects 200 V range.
(F2)R7	(F2)R7	(F2)R5	(F2)[R3]	SENS:FUNC:VOLT:AC:RANG 7E+2V	Selects 700 V range.
F3	F3	F3	F3	SENS:FUNC "RESistance"	Selects Ω2W.
(F3)R0	(F3)R0	(F3)R0	(F3)RA	SENS:FUNC:RES:AUTO ON	Selects AUTO range mode.
(F3)R3	(F3)R3	(F3)R1	(F3)R2	SENS:FUNC:RES:RANG 2E+2OHM	Selects 200 Ω range.
(F3)R4	(F3)R4	(F3)R2	(F3)R3	SENS:FUNC:RES:RANG 2E+3OHM	Selects 2000 Ω range.
(F3)R5	(F3)R5	(F3)R3	(F3)R4	SENS:FUNC:RES:RANG 2E+4OHM	Selects 20 kΩ range.
(F3)R6	(F3)R6	(F3)R4	(F3)R5	SENS:FUNC:RES:RANG 2E+5OHM	Selects 200 kΩ range.
(F3)R7	(F3)R7	(F3)R5	(F3)R6	SENS:FUNC:RES:RANG 2E+6OHM	Selects 2000 kΩ range.
(F3)R8	(F3)R8	(F3)R6	(F3)R7	SENS:FUNC:RES:RANG 2E+7OHM	Selects 20 MΩ range.
(F3)R9	(F3)R9	(F3)R7	(F3)[R8]	SENS:FUNC:RES:RANG 2E+8OHM	Selects 200 MΩ range.
F4	F4	F4	F4	SENS:FUNC "FRESistance"	Selects Ω4W.
(F4)R0	(F4)R0	(F4)R0	(F4)RA	SENS:FUNC:FRES:AUTO ON	Selects AUTO range mode.
(F4)R3	(F4)R3	(F4)R1	(F4)R2	SENS:FUNC:FRES:RANG 2E+2OHM	Selects 200 Ω range.
(F4)R4	(F4)R4	(F4)R2	(F4)R3	SENS:FUNC:FRES:RANG 2E+3OHM	Selects 2000 Ω range.
(F4)R5	(F4)R5	(F4)R3	(F4)R4	SENS:FUNC:FRES:RANG 2E+4OHM	Selects 20 kΩ range.
(F4)R6	(F4)R6	(F4)R4	(F4)R5	SENS:FUNC:FRES:RANG 2E+5OHM	Selects 200 kΩ range.
(F4)R7	(F4)R7	(F4)R5	(F4)R6	SENS:FUNC:FRES:RANG 2E+6OHM	Selects 2000 kΩ range.
(F4)R8	(F4)R8	(F4)R6	(F4)R7	SENS:FUNC:FRES:RANG 2E+7OHM	Selects 20 MΩ range.
(F4)R9	(F4)R9	(F4)R7	(F4)[R8]	SENS:FUNC:FRES:RANG 2E+8OHM	Selects 200 MΩ range.
F5	F5	F5	F5	SENS:FUNC "CURRent:DC"	Selects ACV.
(F5)R0	(F5)R0	(F5)R0	(F5)RA	SENS:FUNC:CURR:DC:AUTO ON	Selects AUTO range mode.
(F5)R4	(F5)[R4]	(F5)[R3]	(F5)[R-3]	SENS:FUNC:CURR:DC:RANG 2E-3A	Selects 2000 μA range.
(F5)R5	(F5)[R5]	(F5)[R4]	(F5)[R-2]	SENS:FUNC:CURR:DC:RANG 2E-2A	Selects 20 mA range.
(F5)R6	(F5)R6	(F5)R1	(F5)R-1	SENS:FUNC:CURR:DC:RANG 2E-1A	Selects 200 mA range.
(F5)R7	(F5)R7	(F5)R2	(F5)R0	SENS:FUNC:CURR:DC:RANG 2E+0A	Selects 2000 mA range.
F6	F6	F6	F6	SENS:FUNC "CURRent:AC"	Selects ACA.
(F6)R0	(F6)R0	(F6)R0	(F6)RA	SENS:FUNC:CURR:AC:AUTO ON	Selects AUTO range mode.
(F6)R4	(F6)[R4]	(F6)[R3]	(F6)[R-3]	SENS:FUNC:CURR:AC:RANG 2E-3A	Selects 2000 μA range.
(F6)R5	(F6)[R5]	(F6)[R4]	(F6)[R-2]	SENS:FUNC:CURR:AC:RANG 2E-2A	Selects 20 mA range.
(F6)R6	(F6)R6	(F6)R1	(F6)R-1	SENS:FUNC:CURR:AC:RANG 2E-1A	Selects 200 mA range.
(F6)R7	(F6)R7	(F6)R2	(F6)R0	SENS:FUNC:CURR:AC:RANG 2E+0A	Selects 2000 mA range.
F7*1	[F7]	[F7]	[F7]	SENS:FUNC "CLAMp"	Selects CLAMP.
F8*1	[F8]	[F8]	[F8]	SENS:FUNC "SCANner"	Selects SCANNER.
(F8)R0	(F8)R0	(F8)R0	(F8)RA	SENS:FUNC:SCAN:AUTO ON	Selects AUTO range mode.
(F8)R3	(F8)R3	(F8)R1	(F8)R-1	SENS:FUNC:SCAN:RANG 2E-1V	Selects 200 mV range.
(F8)R4	(F8)R4	(F8)R2	(F8)R0	SENS:FUNC:SCAN:RANG 2E-0V	Selects 2000 mV range.
(F8)R5	(F8)R5	(F8)R3	(F8)R1	SENS:FUNC:SCAN:RANG 2E+1V	Selects 20 V range.
(F8)R6	(F8)R6	(F8)R4	(F8)R2	SENS:FUNC:SCAN:RANG 3E+1V	Selects 200 V range.

Type 0	Type 1	Type 2	Type 3	Type 4	Remarks
RX*1	RX	[RX]	[RX]	SENS:FUNC:VOLT:DC:AUTO OFF SENS:FUNC:VOLT:AC:AUTO OFF SENS:FUNC:RES:AUTO OFF SENS:FUNC:FRES:AUTO OFF SENS:FUNC:CURR:DC:AUTO OFF SENS:FUNC:CURR:AC:AUTO OFF	Cancels AUTO range mode.
SO0*1	[SO0]	[SO0]	[SO0]	SENS:FUNC:SCAN:STAT LOOP	Selects scanner LOOP mode.
SO1*1	[SO1]	[SO1]	[SO1]	SENS:FUNC:SCAN:STAT SHOT	Selects scanner ONLY mode.
CH1～8*1	[CH1～8]	[CH1～8]	[CH1～8]	SENS:FUNC:SCAN:CH <channel>	Selects scanner channel.
SH2～8*1	[SH2～8]	[SH2～8]	[SH2～8]	SENS:FUNC:SCAN:MAX <max>	Selects the maximum channel No..
					Trigger mode
M0	M0	T0	T1	SENS:SAMP:TRIG AUTO	AUTO
M1	M1	T3	T2	SENS:SAMP:TRIG SINGLE	SINGLE
M2*2					N reading*2
E	E	?	T3	Use the GET command.	Trigger input
					Sample rate
SI0～25	PR1	S2	[PR1]	SENS:SAMP:RATE FAST	FAST mode (20 ms;8 ms (store only))
SI26～75	PR2	S1	[PR2]	SENS:SAMP:RATE MID1	MID1 mode (50 ms)
SI76～300	PR3	[S3]	[PR3]	SENS:SAMP:RATE MID2	MID2 mode (250 ms)
SI300～	[PR4]	S0	[PR4]	SENS:SAMP:RATE SLOW	SLOW mode (500 ms)
					Integral time*1
IT1					2 ms (equivalent to FAST mode)
IT2					16.66 ms (equivalent to MID1 mode)
IT3					20.00 ms (equivalent to MID1 mode)
IT4					100 ms (equivalent to MID2 mode)
IT5*1					200 ms (equivalent to SLOW mode)
IT6*1					16.66/20.00 ms (equivalent to MID1 mode)
					NULL function
NL0	NL0	B0	[NL0]	SENS:CALC:NULL OFF	NULL OFF
NL1	NL1	B1	[NL1]	SENS:CALC:NULL ON	NULL ON
NL2*2				SENS:CALC:NULL:OFFSET <offset>	Sets the NULL value.
					Scaling function
CF1C00*3 /SC0	SC0	[SC0]	[SC0]	SENS:CALC:SCAL OFF	SCALE OFF
CF1C01*3 /SC1	SC1	[SC1]	[SC1]	SENS:CALC:SCAL ON	SCALE ON
					dB display function
CF2C00*3 /DB0	[DB0]	[DB0]	[DB0]	SENS:CALC:DB OFF	dB OFF
CF2C01*3 /DB1	[DB1]	[DB1]	[DB1]	SENS:CALC:DB ON	dB ON
					Comparator OFF
CF3C00				SENS:CALC:LIM:HI OFF SENS:CALC:LIM:LOW OFF	Sets Hi/Lo to OFF.
					Comparator ON
CF3C01				SENS:CALC:LIM:HI ON SENS:CALC:LIM:LOW ON	Sets Hi/Lo to ON.
					Percentage (%) display function
CF4C00*3 /PC0	[PC0]	[PC0]	[PC0]	SENS:CALC:PERC OFF	% OFF
CF4C01*3 /PC1	[PC1]	[PC1]	[PC1]	SENS:CALC:PERC ON	% ON
					Comparator Hi
CF5C00*3 /PH0	[PH0]	[PH0]	[PH0]	SENS:CALC:LIM:HI OFF	COMP HI OFF
CF5C01*3 /PH1	[PH1]	[PH1]	[PH1]	SENS:CALC:LIM:HI ON	COMP HI ON
CF5C02*3 /PH2	[PH2]	[PH2]	[PH2]	SENS:CALC:LIM:HI COM	COMP HI COM
					Comparator Lo
CF6C00*3 /PL0	[PL0]	[PL0]	[PL0]	SENS:CALC:LIM:LO OFF	COMP LO OFF
CF6C01*3 /PL1	[PL1]	[PL1]	[PL1]	SENS:CALC:LIM:LO ON	COMP LO ON
CF6C02*3 /PL2	[PL2]	[PL2]	[PL2]	SENS:CALC:LIM:LO COM	COMP LO COM

Type 0	Type 1	Type 2	Type 3	Type 4	Remarks
					Setting the coefficient (factor) for each computing function
KAm1Em2	[KAm1Em2]	[KAm1Em2]	[KAm1Em2]	SENS:CALC:SCAL:KA m1Em2	Sets KA.
KBm1Em2	[KBm1Em2]	[KBm1Em2]	[KBm1Em2]	SENS:CALC:SCAL:KB m1Em2	Sets KB.
KCm1Em2	[KCm1Em2]	[KCm1Em2]	[KCm1Em2]	SENS:CALC:DB:KC m1Em2	Sets KC.
KDm1Em2	[KDm1Em2]	[KDm1Em2]	[KDm1Em2]	SENS:CALC:DB:KD m1Em2	Sets KD.
KEm1Em2	[KEm1Em2]	[KEm1Em2]	[KEm1Em2]	SENS:CALC:PERC:KE m1Em2	Sets KE.
Hlm1Em2	[Hlm1Em2]	[Hlm1Em2]	[Hlm1Em2]	SENS:CALC:LIM:HI:KH m1Em2	Sets KH.
LOm1Em2	[LOm1Em2]	[LOm1Em2]	[LOm1Em2]	SENS:CALC:LIM:LOW:KL m1Em2	Sets KL.
					Turning the averaging function ON/OFF.
SM0	[SM0]	[SM0]	[SM0]	SENS:CALC:AVER OFF	Average OFF
SM1	[SM1]	[SM1]	[SM1]	SENS:CALC:AVER ON	Average ON
AT2～100	[AT2～100]	[AT2～100]	[AT2～100]	SENS:CALC:AVER:COU 2～100	Setting the number of averaging times.
					Turning the filter ON/OFF. *2
FL0*2	FL0*2				Turns the filter OFF.
FL1*2	FL1*2				Turns the filter OFF.
					Turning auto zero ON/OFF*2
AZ0*2	AZ0*2		Z0*2		OFF
AZ1*2	AZ1*2		Z1*2		ON
AZ2*2	AZ2*2				Turns auto zero OFF after executed once.
					Selecting whether or not the header is added
H0	H0	Y0		COMM:HEAD OFF	Header = OFF
H1	H1	Y1		COMM:HEAD ON	= ON
H2*2	H2*2				= Binary*2
DL0	DL0	W0	[DL0]		Delimiter = CR/LF, EOF
DL1	DL1	W5	[DL1]		Delimiter = LF
DL2	DL2	W6	[DL2]		Delimiter = EOI
					SRQ send mode
MS1	[MS1]	N16P1	M01	Transit filter bit 6	At the end of A/D output
MS2	[MS2]	N4P1	M20	Transit filter bit 7	When SRQ key is pressed.
MS4	[MS4]	N32P1	M04	Standard event register bit 5	When a syntax error occurs
MS8	[MS8]	N1P1	[M10]	Transit filter bit 10	When an over-range occurs
TD*2					Trigger delay*2
NS*2					Sampling number*2
CI*2					Initializes the IC card.*2
RC	C	[RC]	[RC]	*RST	Initializes the set-up information.
Z	Z	[Z]	[HZ]	*RST	Initializes parameters.
SS0～9	[SS0～9]	[SS0～9]	[SS0～9]	SENS:PANEL:SAVE <file_No>	Saves the set-up information.
SL0～9	[SL0～9]	[SL0～9]	[SL0～9]	SENS:PANEL:LOAD <file_No>	Loads the set-up information.
ST0	[ST0]	[ST0]	[ST0]	SENS:STOR:STAT STOP	Stops storing.
ST1	[ST1]	[ST1]	[ST1]	SENS:STOR:STAT START	Start storing.
ST2	[ST2]	[ST2]	[ST2]	SENS:STOR:STAT CLEAR	Clears the store buffer.
SY0*1	[SY0]	[SY0]	[SY0]	SENS:STOR:MOD LOOP	Executes storage LOOP.
SY1*1	[SY1]	[SY1]	[SY1]	SENS:STOR:MOD SHOT	Executes storage SHOT.
SB1 ～2000*1	[SB1～2000]	[SB1～2000]	[SB1～2000]	SENS:STOR:MOD SHOT,1～2000	Sets the store buffer size (must be greater than the recall start data No.)
R00	[R00]	[R00]	[R00]	SENS:REC:STAT STOP	Stops recalling.
R01	[R01]	[R01]	[R01]	SENS:REC:STAT START	Starts recalling.
RD1～2000	[RD1～2000]	[RD1～2000]	[RD1～2000]	SENS:REC:STAR 1～2000	Sets the recall start data No. (converted to "0" If set to a negative value)
				SENS:REC:SIZ?	Reads all the recall data.
				SENS:REC:RDATA:DATA?	Reads recalled data.
				SENS:REC:RDATA?	Reads all the information regarding recalled data.
LK0*1	[LK0]	[LK0]	[LK0]	SENS:PANEL:LOCK OFF	Turns key lock OFF.
LK1*1	[LK1]	[LK1]	[LK1]	SENS:PANEL:LOCK ON	Turns key lock ON.
DA0*	[DA0]	[DA0]	[DA0]	SENS:DA "1999**"	DA mode ="1999 "
DA1*	[DA1]	[DA1]	[DA1]	SENS:DA "**999*"	DA mode =" 999 "
DA2*	[DA2]	[DA2]	[DA2]	SENS:DA "***999"	DA mode =" 999"

Type 0	Type 1	Type 2	Type 3	Type 4	Remarks
					Number of display digits
	RE3*2		N3*2		3 1/2 digits
	RE4*2		N4*2		4 1/2 digits
	RE5*2		N5*2		5 1/2 digits
					Display
	DS0*2	D0*2	D2,3*2		OFF
	DS1*2	D1*2	D1*2		ON
OS	○○?	G0,1,3,5			Outputs the set-up information.
ESC D	[ESC D]	[ESC D]	[ESC D]	READ:DATA?	Outputs the measured data. (RS-232-C)
ESC R	[ESC R]	[ESC R]	[ESC R]		Switches to remote control mode. (RS-232-C) REN (Remote Enable)
ESC L	[ESC L]	[ESC L]	[ESC L]		Switches to local control mode. (RS-232-C) GTL (Go To Local)
ESC S	[ESC S]	[ESC S]	[ESC S]		Outputs the status byte. (RS-232-C) bit1:End of A/D output bit2:Fixed at 0 bit3:Syntax error bit4:Over-range bit5:Fixed at 0 bit6:Error bit7:Fixed at 1 bit8:Fixed at 0

*1 Not supported by 7551/7552 (YOKOGAWA).
These commands have been added specially for this instrument.

*2 Functional commands not supported by this instrument. No error will occur even if any of these commands are received (no effect on operation).

*3 Same as commands given after "/".

* Command given in [ ] are commands created by YOKOGAWA for this instrument. Thus, they cannot be used with instruments manufactured by other companies.

* An error will occur if PC, FC and AC commands of 7551/7552 are used with this instrument.

* With command type 2, it is possible to combine N and P0.

* LF/ EOI is always used as the terminator if a GP-IB interface is used.

APP 1.2 Commands

AT — **Sets the number of times averaging is to be performed.**

Syntax: ATM<terminator>
m to 100 (the number of times averaging is to be performed)

Description: This command is used to set the number of times moving averaging is to be performed.

CF — **Selects the computing function.**

Syntax: CFm<terminator>
m = 1: Scaling
2: dB display
3: Comparator function (Hi and Lo)
4: Percentage (%) display
5: Comparator function (Hi)
6: Comparator function (Lo)

Description:
• This command is used to select the desired computing function. Use this command to select the desired computing function, then use the CO command to turn the selected function ON/OFF.

CH — **Selects the channel to be used for the scanner.**

Syntax: CHm<terminator>
m = 1 to 8 (Channel No.)

Description:
• It is not possible to select any channel if the scanner measurement is not selected.
• If LOOP mode has been selected, it is not possible to select a channel No. greater than the maximum scan channel No.

CO — **Turns the function selected by the CF command ON/OFF.**

Syntax: COm<terminator>
m = 0: OFF 1: ON
2: COM (effective when a channel No. other than CH1 is selected for scanner measurement)

Description:
• This command is used to select a function to be carried out for the measured data. Before using this command, select the desired function using the CF command. If FAST is selected as the sample rate or if the scanner is used, it will not be possible to turn ON the scaling, dB and % display functions.
• If DA2/DA3 (D/A output) is selected, it is not possible to select large current measurement.

DAm — **Sets the display digits for D/A output.**

Syntax: DAm<terminator>
m = 0: "1999__" is set as display mode.
1: "__999 " is set as the output digits.
2: "___999" is set as the output digits.
3: "___999" is set as the output digits.

Description:
• If FAST is selected as the sample rate, it is not possible to use the DA2/DA3 command.
• Only DA0 can be selected for large current measurement.

DB — **Turns the dB display function ON/OFF.**

Syntax: DBm<terminator>
m = 0: OFF 1: ON

Description:
• If FAST is selected as the sample rate, it is not possible to turn the dB display function ON.

DL — **Selects the terminator. (This command is available with RS-232-C interface only)**

Syntax: DLm<terminator>
m = 0: CR + LF 1: LF 2: CR

Description:
• This command is used to select the terminator for the output data.

E — **Sets a trigger.**

Syntax: E<terminator>

Description:
• This command is used to set a trigger if SINGLE is selected as the trigger mode.

ESC D — **Outputs the measured/computed data.**

Syntax: ESC D<terminator>

Description:
• This command can be used with a RS-232-C interface only.

ESC L — **Activates local control mode.**

Syntax: ESC L<terminator>

Description:
• This command is used to switch from remote control mode to local control mode. This command can be used with a RS-232-C interface only.

ESC R — **Activates remote control mode.**

Syntax: ESC R<terminator>

Description:
• This command is used to activate remote control mode so that the instrument can be controlled remotely. This command can be used with a RS-232-C interface only.

ESC S — **Outputs the status byte.**

Syntax: ESC S<terminator>

Description:
• This command is used to output the status byte. This command can be used with a RS-232-C interface only.

For command types 0 and 1

bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1
0	SRQ	ERR	0	OL	SYN ERR	0	A/D END

bit 8: Fixed at 0
bit 7: Fixed at 1
bit 6: Set in case of an error (i.e. when both or either of bits 4 and 3 are set to 1).
bit 5: Fixed at 0
bit 4: Set in case of a range-over.
bit 3: Set in case of a syntax error
bit 2: Fixed at 0
bit 1: Set at the end of measurement

For command type 2

bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1
0	SRQ	ERR	A/D END	0	SRQ	0	OL

For command type 3

bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1
0	SRQ	SRQ	OL	0	SYN ERR	0	A/D END

F — **Select the measurement function.**

Syntax: Fm1RM2<terminator>
"m1" indicates the type of function measurement.
m1= 1 (DC voltage measurement: DCV)
2 (AC voltage measurement: ACV)
3 (Resistance measurement: ?2W)
4 (Resistance measurement: ?4W)
5 (DC current measurement: DCA)
6 (AC current measurement: ACA)
7 (Large current measurement)
8 (Scanner measurement: 1 SHOT, CH1 selected)
"m2" indicates the measuring range.

Description:
• F7 can be set for DA0 only.
• F8 is optional. This cannot be set if no scanner is installed.
• For selection of the measuring range, refer to Section 1.1 "Command List" (page App 1-1).

H — **Selects whether or not a header is to be attached.**

Syntax: Hm<terminator>
m = 0: No header added
1: Header added

Kn/HI/LO **Sets the coefficient (factor) for each computation.**

Syntax **Knm1Em2<terminator>**

n = A: KA for scaling
B: KB for scaling
C: KC for dB computation
D: KD for dB computation
E: KE for percentage computation

m1=(–199999 to +199999)..(Decimal point can be included)
m2=(–9 to +9)..(Exponent)

For KA and KB:Kam1Em2 ("m1" and "m2" must satisfy the following conditions. "m1" must not be equal to 1 for KB.)
(m1 x 10^{m2}) = ±199999V(DCV/ACV measurement)
= ±199999MΩ(Ω2W/Ω4W measurement)
= ±199999A(DCA/ACA, large current measurement)

For KC: KCm1Em2 ("m1" and "m2" must satisfy the following conditions.)
(m1 x 10^{m2}) = ±199999V(DCV/ACV measurement)
= ±199999MΩ(Ω2W/Ω4W measurement)
= ±199999A(DCA/ACA, large current measurement)

For KD: KDm1Em2 ("m1" and "m2" must satisfy the following conditions. "m1" must not be equal to 1.)
(m1 x 10^{m2}) = ±199999

For KE:KEm1Em2 ("m1" and "m2" must satisfy the following conditions. "m1" must not be equal to 1.)
(m1 x 10^{m2}) = ±199999V(DCV/ACV measurement)
= ±199999MΩ(Ω2W/Ω4W measurement)
= ±199999A(DCA/ACA, large current measurement)

HImEm2<terminator>

m1=(–199999 to +199999)..(Decimal point can be included)
m2=(–9 to +9)
"m1" and "m2" must satisfy the following conditions.
(m1 x 10^{m2}) = ±199999V(DCV/ACV measurement)
= ±199999MΩ(Ω2W/Ω4W measurement)
= ±199999A(DCA/ACA, large current measurement)
= ±199999(Scaling/dB/% computation)
(Must not be smaller than KL)

LOm1Em2<terminator>

m1=(–199999 to +199999)..(Decimal point can be included)
m2=(–9 to +9)
"m1" and "m2" must satisfy the following conditions.
(m1 x 10^{m2}) = ±199999V(DCV/ACV measurement)
= ±199999MΩ(Ω2W/Ω4W measurement)
= ±199999A(DCA/ACA, large current measurement)
= ±199999(Scaling/dB/% computation)
(Must not be smaller than KH)

Description • This command is used to set coefficients KA, KB, KC, KD, KE, KH and KL. The settable range (maximum and minimum) varies depending on the selected function.

LK **Turns the panel lock key ON/OFF.**

Syntax LKm<terminator>
m = 0: OFF 1: ON

M **Selects trigger mode.**

Syntax Mn<terminator>
m = 0: AUTO 1: SINGLE

MS **Sets the status byte.**

Syntax MSm<terminator>
m = 0 to 15 (depends on combination of four interruption causes)

Interruption Cause	Mask Value	Program Data (MSm)
A/D conversion end	1	MS1
Panel SRQ key ON	2	MS2
Syntax error	4	MS4
Over-range	8	MS8

Description

bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1
0	SRQ	ERROR	0	OL	Syntax error	SRQ keyON	A/D conversion end

NL **Turns the NULL function ON/OFF.**

Syntax NLm<terminator>
m = 0: OFF 1: ON

Description • This command is used to register the data measured immediately after the NULL key is pressed as the NULL value.

OS **Outputs the set-up information.**

Syntax OS<terminator>

Description • Set-up information relating to the currently selected measurement function is output separately a total of 11 times. The following items are output; model, measurement function type, measuring range, trigger mode, sampling rate, delay time, NULL function ON/OFF, auto zero, averaging function ON/OFF, D/A mode, number of averaging times, computation type and their coefficients. The delay time and auto zero are always "0".
• Before executing the next command, make sure that the set-up information is output 11 times.

PC **Turns the percentage (%) display function ON/OFF.**

Syntax PCm<terminator>
m = 0: OFF 1: ON

Description • If FAST is selected as the sample rate, it is not possible to turn the percentage display function ON.

PH **Turns the comparator function (Hi) ON/OFF.**

Syntax PHm<terminator>
m = 0: OFF 1: ON
2: COM (effective when a channel No. other than CH1 is selected for scanner measurement)

PL **Turns the comparator function (Lo) ON/OFF.**

Syntax PLm<terminator>
m = 0: OFF 1: ON
3: COM (effective when a channel No. other than CH1 is selected for scanner measurement)

R **Selects the measuring range.**

Syntax Fm1Rm2<terminator>
"m1" indicates the type of function measurement.
m1=0 (DC voltage measurement: DCV)
1 (AC voltage measurement: ACV)
2 (Resistance measurement: Ω2W)
3 (Resistance measurement: Ω4W)
4 (DC current measurement: DCA)
5 (AC current measurement: ACA)
6 (Large current measurement)
7 (Scanner measurement: 1 SHOT, CH1 selected)
"m2" indicates the measuring range.

Description • F7 is optional. This cannot be set if no scanner is installed.
• For selection of the measuring range, refer to Section 1.1 "Command List" (page App 1-1).

RC **Initializes the set-up information and computation coefficients.**

Syntax RC<terminator>

Description • The set-up information and computation coefficients will be initialized forcibly, irrespective of the current settings.
(However, communication related information will not

be initialized.)

RD **Sets the recall start data No.**

Syntax RDm<terminator>
m = 0 to 2000

Description • If the recall start data No. is greater than the number of data sets to be stored, an error will appear.

RO **Turns the measured data recall function ON/OFF.**

Syntax ROm<terminator>
m = 0: OFF 1: ON

Description • If the recall function is turned ON during storage operation of the measured data, storage operation will be canceled.
• If RO1 is set when SINGLE is selected as the trigger mode, read recalled data each time a trigger is caused. However, if RO1 is set, one data will be recalled before a trigger is caused.

RX **Cancels the auto range mode.**

Syntax RX<terminator>

Description • If the auto range mode has been selected, it will be canceled.
• This command will have no effect if the auto range mode has not been selected.

SB **Sets the number of data sets to be stored.**

Syntax SBm<terminator>
m = 1 to 2000

Description • If the number of data sets to be stored is not greater than the recall start data No., an error will appear.

SC **Turns the scaling function ON/OFF**

Syntax SCm<terminator>
m = 0: OFF 1: ON

Description • If FAST is selected as the sample rate, it is not possible to turn the scaling function ON.

SH **Sets the maximum channel No. for scanner LOOP mode.**

Syntax SHm<terminator>
m to 8: Maximum channel No.

SI **Sets the sampling rate.**

Syntax SIm<terminator>
m = 0 to 25: Sampling rate FAST
m = 6 to 75: Sampling rate MID1
m = 76 to 300: Sampling rate MID2
m = 301 to 3600000: Sampling rate SLOW

Description • It is not possible to select FAST if the DA2/DA3 command is set or if the scaling, dB or percentage display function is ON.

SL **Makes settings relating to loading of the set-up information.**

Syntax SLm<terminator>
m = 1 to 9 (0 is set if omitted)

Description • This command is used to recall the set-up information saved in the internal memory of the instrument. The following items are recalled; sampling rate, trigger mode, selected function type, measuring range for each function, presence/absence of the functions (auto range, NULL, averaging, scaling, dB display, percentage display and comparator) and their computation coefficients, scanner operation mode and maximum channel No.

SM **Turns the averaging function ON/OFF.**

Syntax SMm<terminator>
m = 0: OFF 1: ON (executed)

Description • It is not possible to turn the averaging function ON if the scanner is used.

SO **Selects the scanner operation mode.**

Syntax Syntax SOm<terminator>
m = 0: LOOP 1: ONLY

Description • This command cannot be used if the simple scanner is not installed.

ST **Turns the measured data storage function ON/OFF.**

Syntax STm<terminator>
m = 0: OFF 1: ON
2: Deletes the stored contents.

Description • If the storage function is turned ON during recalling operation of the measured data, recalling operation will be canceled.

SY **Sets the storage method of the measured data.**

Syntax SYm<terminator>
m = 1: 1SHOT 0: LOOP

Description • If this command is used while the storage function is ON, the storage function will be turned OFF.

SS **Makes settings relating to saving of the set-up information.**

Syntax SSm<terminator>
m = 0 to 9 (0 is set if omitted)

Description • This command is used to save the current set-up information into the internal memory of the instrument. The following items are saved; sampling rate, trigger mode, selected function type, measuring range for each function, presence/absence of the functions (auto range, NULL, averaging, scaling, dB display, percentage display and comparator) and their computation coefficients, scanner operation mode and maximum channel No.

Z **Initializes the set-up information.**

Syntax Z<terminator>

Description • The set-up information will be initialized forcibly, irrespective of the current settings.
(However, communication related information will not be initialized.)

Note

- If another communication command is executed while storage operation is in progress at the sample rate FAST, data may not be stored at a rate of 125 times per second.
- If FAST is selected, it is not possible to recall the data directly. In this case, carry out storage operation, switch the sampling rate to an option other than FAST, then execute the RO command to recall the data.

Adhere to the following points when using programs created for the 7551/7552 (YOKOGAWA).

- This instrument does not support functions to be used with the following commands. However, the instrument will not malfunction even such commands are executed.
  M2, TDm (m = 0 to 3600000), NSm (m = 0 to 1000), NL2, CI, AZm (m = 0 to 2), DAm (m = 10, 11, 12, 13)
- COm (m = 0 to 2) and CFm (m = 1 to 6) can be executed correctly with this instrument. Equivalent commands which are supported by this instrument are given below.

7551/7552	7555
CF1CO0/CF1CO1	SC
CF2CO0/CF2CO1	DB
CF3CO0/CF3CO1	PH/PL
CF4CO0/CF4CO1	PC
CF5CO0/CF5CO1	PH
CF6CO0/CF6CO1	PL

- This instrument differs from the 7551/7552 (YOKOGAWA) in measurement timing etc.
- This instrument does not support binary output. No error will occur even if H2 command is executed, however, the previous header setting (i.e. whether or not the header is to be added) will be effective.

APP 1.3 Data Output Format

Data Format

- **Measured/computed data**

Header	Data	Terminator

- **Recall data**

Data No.	,	Header	Data	Terminator

Data No.

Added only when stored data is recalled. Data Nos. 1 to 2000 are used.

Header Section

The header section consists of 4 bytes (h1 to h4).

h1	h2	h3	h4

h1: Computation settings

N: Computation OFF	S: Scaling
D: dB display	H: Comparator Hi
L: Comparator Lo	P: Comparator PASS
O: Over-range	V: Computation error
E: Illegal data	* Percentage display

h2 to h3: Measurement settings

DC: DC	
AC: AC	
R2: 2-wire resistor	R4: 4-wire resistor
CL: Large current	
S1: Simple scanner CH1	S2: Simple scanner CH2
S3: Simple scanner CH3	S4: Simple scanner CH4
S5: Simple scanner CH5	S6: Simple scanner CH6
S7: Simple scanner CH7	S8: Simple scanner CH8

h4: Unit of measured data

V: Voltage
A: Ampere
O: Ohm?

Data Section

The data section consists of 11 or 12 bytes (d1 to d11 or d12).

d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12

d1 : Polarity ; _ (space) or - (minus)
d2 to d8 : Maximum 6 digits + Decimal point
d9 to d12 : Exponent (e.g. E+10, E-6)
2 digits will be used for the exponent part in the case of the computed data (scaling, dB display, percentage display) only.

- **Data state in the case of an over-range**

d1 : +
d2 to d8 : "9" in 6 digits + Decimal point (positioned according to the measuring range)
d9 to d11 : Displayed as follows according to the multiplier code.
E + 6 = M
E + 3 = k
E + 0 = o code
E - 3 = m
E - 6 = μ

APP 1.4 Sample Program

Before Programming

Required Environment

Hardware

PC	:	IBM PC-AT and compatible system
Interface	:	GPIB-PCII/IIA National Instruments

Software

PC	:	MS-DOS V5.00 (or higher)
Interface	:	Config. Program IBCONF.EXE Rev C.4.1
Basic	:	Quick Basic Ver 4.0/4.5
Command type	:	Command 0 type

Note

- A space or tab between a command and parameter can be omitted.
- Up to 50 characters can be used. Characters exceeding this limit will be ignored.

Sample Program 1

```
'   ************************************************************
'   *                                                          *
'   *     MODEL 7555 Sample Program(Recall Data) for GP-IB     *
'   *                                                          *
'   ************************************************************
'
    REM $INCLUDE: 'qbdecl4.bas'
'
' Error exception
'
    DECLARE SUB GPIBERR (MSG$)
'
' Identify
'
    DEVNAME$ = "GPIB0"          'It's me
    CALL IBFIND(DEVNAME$, BOARD%)
    IF (BOARD% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
    DEVNAME$ = "M7555"          'Model 7555
    CALL IBFIND(DEVNAME$, DEV%)
    IF (DEV% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
'
' Interface Clear
'
    V% = 1                      'Set
    CALL IBRSC(BOARD%, V%)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBRSC Error")
'
' Setup
'
    CMD$ = "M0IT2"              'Set Trigger Auto mode and MID1 mode
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "SB2000SM0DB0"       'Set Buffer size and No average and No dB
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
```

```
' Store Data
'
    CMD$ = "ST1"                'Start Data Storage
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    FOR I% = 1 TO 30000: FOR J% = 1 TO 1000: NEXT J%: NEXT I% 'Wait
    CMD$ = "ST0"                'Stop Data Storage
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
' Read Data
'
    CMD$ = "M1"                 'Set Trigger Single mode
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "RD1R01"             'Set Recall No
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")

RLOOP:
    CMD$ = "E"                  'Set Read Trigger
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    D$ = SPACE$(40)
    CALL IBRD(DEV%, D$)         'Read Recall Data
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBRD Error")
    I% = INSTR(D$, CHR$(10))
    IF I% > 0 THEN D$ = LEFT$(D$, I% - 1)
    IF LEFT$(D$, 2) = "NO" THEN PRINT D$: GOTO RLOOP
    END

'=============================================================
'                    Subroutine GPIBERR
'  This subroutine will notify you that a NI-488 function failed by printing
'  an error message.  The status variable IBSTA% will also be printed
'  in hexadecimal along with the mnemonic meaning of the bit position.
'  The status variable IBERR% will be printed in decimal along with the
'  mnemonic meaning of the decimal value.  The status variable IBCNT% will
'  be printed in decimal.
'
'  The NI-488 function IBONL is called to disable the hardware and software.
'
'  The STOP command will terminate this program.
'=============================================================
'
SUB GPIBERR (MSG$) STATIC

    PRINT MSG$
```

```
    PRINT "ibsta = &H"; HEX$(IBSTA%); " <";
    IF IBSTA% AND EERR THEN PRINT " ERR";
    IF IBSTA% AND TIMO THEN PRINT " TIMO";
    IF IBSTA% AND EEND THEN PRINT " END";
    IF IBSTA% AND SRQI THEN PRINT " SRQI";
    IF IBSTA% AND RQS THEN PRINT " RQS";
    IF IBSTA% AND SPOLL THEN PRINT " SPOLL";
    IF IBSTA% AND EEVENT THEN PRINT " EVENT";
    IF IBSTA% AND CMPL THEN PRINT " CMPL";
    IF IBSTA% AND LOK THEN PRINT " LOK";
    IF IBSTA% AND RREM THEN PRINT " REM";
    IF IBSTA% AND CIC THEN PRINT " CIC";
    IF IBSTA% AND AATN THEN PRINT " ATN";
    IF IBSTA% AND TACS THEN PRINT " TACS";
    IF IBSTA% AND LACS THEN PRINT " LACS";
    IF IBSTA% AND DTAS THEN PRINT " DTAS";
    IF IBSTA% AND DCAS THEN PRINT " DCAS";
    PRINT " >"

    PRINT "iberr = "; IBERR%;
    IF IBERR% = EDVR THEN PRINT " EDVR <DOS Error>"
    IF IBERR% = ECIC THEN PRINT " ECIC <Not CIC>"
    IF IBERR% = ENOL THEN PRINT " ENOL <No Listener>"
    IF IBERR% = EADR THEN PRINT " EADR <Address error>"
    IF IBERR% = EARG THEN PRINT " EARG <Invalid argument>"
    IF IBERR% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
    IF IBERR% = EABO THEN PRINT " EABO <Op. aborted>"
    IF IBERR% = ENEB THEN PRINT " ENEB <No GPIB board>"
    IF IBERR% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
    IF IBERR% = ECAP THEN PRINT " ECAP <No capability>"
    IF IBERR% = EFSO THEN PRINT " EFSO <File sys. error>"
    IF IBERR% = EBUS THEN PRINT " EBUS <Command error>"
    IF IBERR% = ESTB THEN PRINT " ESTB <Status byte lost>"
    IF IBERR% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
    IF IBERR% = ETAB THEN PRINT " ETAB <Table Overflow>"

    PRINT "ibcnt = "; IBCNT%

'       Call the IBONL function to disable the hardware and software.

    CALL IBONL(DEV%, 0)

    STOP

END SUB
```

Sample Program 2

```
'   ************************************************************
'   *                                                          *
'   *     MODEL 7555 Sample Program(Set Average) for GP-IB     *
'   *                                                          *
'   ************************************************************
'
    REM $INCLUDE: 'qbdecl4.bas'
'
' Error exception
'
    DECLARE SUB GPIBERR (MSG$)
'
' Identify
'
    DEVNAME$ = "GPIB0"          'It's me
    CALL IBFIND(DEVNAME$, BOARD%)
    IF (BOARD% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
    DEVNAME$ = "M7555"          'Model 7555
    CALL IBFIND(DEVNAME$, DEV%)
    IF (DEV% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
'
' Interface Clear
'
    V% = 1                      'Set
    CALL IBRSC(BOARD%, V%)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBRSC Error")
'
' Remote
'
    V% = 1                      'Set
    CALL IBSRE(BOARD%, V%)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBSRE Error")
'
' Setup
'
    CMD$ = "MOSI100"            'Set Trigger mode Auto and Sampling rate MID2
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "F1R5"               'Set Range 20V DC
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "AT20SM1"            'Set Average On and count is 20
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "ST1"                'Start Data Storage
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    FOR I% = 1 TO 30000: FOR J% = 1 TO 1000: NEXT J%: NEXT I% 'Wait
    CMD$ = "ST0"                'Stop Data Storage
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
' Local
'
    V% = 0                      'Reset
    CALL IBSRE(BOARD%, V%)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBSRE Error")
    END
```

```
'=============================================================
'                    Subroutine GPIBERR
'  This subroutine will notify you that a NI-488 function failed by printing
'  an error message.  The status variable IBSTA% will also be printed
'  in hexadecimal along with the mnemonic meaning of the bit position.
'  The status variable IBERR% will be printed in decimal along with the
'  mnemonic meaning of the decimal value.  The status variable IBCNT% will
'  be printed in decimal.
'
'  The NI-488 function IBONL is called to disable the hardware and software.
'
'  The STOP command will terminate this program.
'=============================================================
'
SUB GPIBERR (MSG$) STATIC

    PRINT MSG$

    PRINT "ibsta = &H"; HEX$(IBSTA%); " <";
    IF IBSTA% AND EERR THEN PRINT " ERR";
    IF IBSTA% AND TIMO THEN PRINT " TIMO";
    IF IBSTA% AND EEND THEN PRINT " END";
    IF IBSTA% AND SRQI THEN PRINT " SRQI";
    IF IBSTA% AND RQS THEN PRINT " RQS";
    IF IBSTA% AND SPOLL THEN PRINT " SPOLL";
    IF IBSTA% AND EEVENT THEN PRINT " EVENT";
    IF IBSTA% AND CMPL THEN PRINT " CMPL";
    IF IBSTA% AND LOK THEN PRINT " LOK";
    IF IBSTA% AND RREM THEN PRINT " REM";
    IF IBSTA% AND CIC THEN PRINT " CIC";
    IF IBSTA% AND AATN THEN PRINT " ATN";
    IF IBSTA% AND TACS THEN PRINT " TACS";
    IF IBSTA% AND LACS THEN PRINT " LACS";
    IF IBSTA% AND DTAS THEN PRINT " DTAS";
    IF IBSTA% AND DCAS THEN PRINT " DCAS";
    PRINT " >"

    PRINT "iberr = "; IBERR%;
    IF IBERR% = EDVR THEN PRINT " EDVR <DOS Error>"
    IF IBERR% = ECIC THEN PRINT " ECIC <Not CIC>"
    IF IBERR% = ENOL THEN PRINT " ENOL <No Listener>"
    IF IBERR% = EADR THEN PRINT " EADR <Address error>"
    IF IBERR% = EARG THEN PRINT " EARG <Invalid argument>"
    IF IBERR% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
    IF IBERR% = EABO THEN PRINT " EABO <Op. aborted>"
    IF IBERR% = ENEB THEN PRINT " ENEB <No GPIB board>"
    IF IBERR% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
    IF IBERR% = ECAP THEN PRINT " ECAP <No capability>"
    IF IBERR% = EFSO THEN PRINT " EFSO <File sys. error>"
    IF IBERR% = EBUS THEN PRINT " EBUS <Command error>"
    IF IBERR% = ESTB THEN PRINT " ESTB <Status byte lost>"
    IF IBERR% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
    IF IBERR% = ETAB THEN PRINT " ETAB <Table Overflow>"

    PRINT "ibcnt = "; IBCNT%
'       Call the IBONL function to disable the hardware and software.
    CALL IBONL(DEV%, 0)
    STOP
END SUB
```

2.1 Overview of IEEE 488.2-1987

The GP-IB interface provided with this instrument conforms to IEEE 488.2-1987. This standard requires the following 23 points be stated in this document. This Appendix describes these points.

(1) Subsets supported by IEEE 488.1 interface functions

Refer to page 9-2.

(2) Operation of device when the device is assigned to an address other than addresses 0 to 30

The instrument does not allow assignment to an address other than 0 to 30.

(3) Reaction when the user initializes the changes made to the address

The current address is changed when a new address is set using "IntFC" menu activated by depression of the MENU key. The newly set address will come into effect when the screen switches to the measurement screen after the MENU key is pressed again.

(4) Device set-up at power ON. Commands which can be used at power ON

Basically, the previous settings (i.e. the settings which were valid when power was turned OFF) are valid.
All commands are available at power ON.

(5) Message transmission options

(a) Input buffer size

1024 bytes

(b) Queries which return multiple response messages

Refer to Appendix 2.3 "Commands".

(c) Queries which generate response data during analysis of the syntax

Every query generates a response data when analysis of the syntax is completed.

(d) Queries which generate response data during reception

No query generates response data when the query is received by the controller.

(e) Commands consisting of parameters which restrict one other

Refer to Appendix 2.3 "Commands".

(6) Options included in command function elements and composite header elements

Refer to Appendix 2.2 and 2.3.

(7) Buffer size which affects transmission of block data

No block data is supported.

(8) List of program data elements which can be used in equations, and nesting limit

No equations can be used.

(9) Syntax of response to queries

Refer to Appendix 2.3 "Commands".

(10) Communications between devices which do not follow the response syntax

The response syntax is not followed in communication modes (see page 9-4) other than those specified in IEEE 488.2-1987.

(11) Size of data block of response data

No block data is supported.

(12) List of supported common commands

Refer to Appendix 2.3.8 "Common Command Group".

(13) Condition of device when calibration is successfully completed

*CAL? common command is not supported.

(14) Maximum length of block data which can be used for definition of *DDT trigger macro

Not supported

(15) Maximum length of macro label used in definition of macro, maximum length of block data which can be used for definition of macro, processing when recursion is used in definition of macro

Macro functions are not supported.

(16) Response to *IDN?

Refer to Appendix 2.3.8 "Common Command Group".

(17) Size of storage area for protected user data for *PUD and *PUD?

*PUD and *PUD? are not supported.

(18) Length of *RDT and *RDT? resource name

*RDT and *RDT? are not supported.

(19) Change in status due to *RST, *LRN?, RCL and *SAV

*RST, *LRN?

Refer to Appendix 2.3.8 "Common Command Group".

*RCL, *SAV

These commands are not supported.

(20) Execution range of self-test using the *TST?

Refer to Appendix 2.3.8 "Common Command Group".

(21) Structure of extended return status

Refer to Appendix 2.4.

(22) To find out whether each command is performed in parallel or sequentially

Every command is performed sequentially.

(23) Description of execution of each command

Refer to Appendix 2.3 "Commands" and their corresponding chapter.

2.2 Program Format

2.2.1 Syntax

Symbols used in commands are shown in the table below. They are called BNF (Backus-Nour Form). For a detailed description of data, refer to pages App 2-6 and 2-7.

Symbol	Meaning	Example	Input Example
{ }	Select one from { }.	STATus {START | STOP | CLEAR}	STAT STOP
|	Exclusive OR	STATus {START | STOP | CLEAR}	STAT STOP
[]	Can be omitted.	SAMPle[:RATE] SLOW	
•••		Can be repeated.	

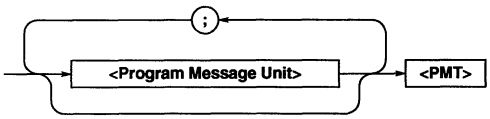
2.2.2 Messages

Messages

Blocks of message (data) are transferred between the controller and the instrument during communications. Messages sent from the controller to the instrument are called program messages, and messages returned from the instrument to the controller are called response messages.
If a program message contains a query command, i.e. a command which requests a response, the instrument returns a response message. A single response message is always returned in reply to a program message.

Program Messages

As explained above, the data (message) sent from the controller to the instrument is called a program message. The format of a program message is shown below.



<Program message unit>

A program message consists of zero or more program message units; each unit corresponds to one command. The instrument executes commands one by one according to the order in which they are received.
Program message units are delimited by a ";".
For the program message format, refer to the next page.

Example :SENSE:SAMPLE:RATE SLOW;TRIG AUTO<PMT>

unit unit

<PMT>

PMT is a terminator used to terminate each program message. The following three types of terminator are available.

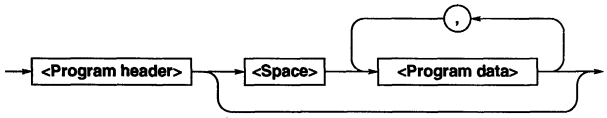
NL(New Line) : Same as LF (Line Field). ASCII code "0AH" is used.

^END : END message defined in IEEE488.1. (EOI signal)
(The data byte sent with an END message is positioned at the end of a program message unit.)

NL^END : NL with an END message attached
(NL is not included in the program message unit.)

Program message unit format

The format of a program message unit is shown below.



<Program header>

A program header is used to indicate the command type. For details, refer to page App 2-4.

<Program data>

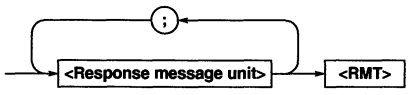
If certain conditions are required for the execution of a command, program data must be added. Program data must be separated from the header by a space (ASCII code "20H"). If multiple items of program data are included, they must be separated by a "," (comma).

Example :SENSE:SAMPLE:TRIG AUTO<PMT>

header data

Response Message

The data returned by the instrument to the controller is called a response message. The format of a response message is shown below.



<Response message unit>

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

Response message units are delimited by a ";".

For the response message format, refer to the next page

Exsample

:SENSE:SAMPLE:RATE +0.500E+00;TRIG AUTO<RMT>

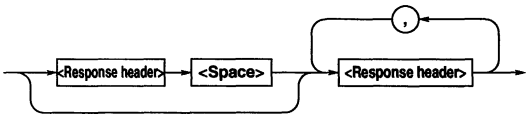
unit unit

<RMT>

RMT is the terminator used for every response message. Only one type of response message is available; NL^END .

Response message unit format

The format for a program message unit is shown below.



<Response header>

A response header is sometimes used to precede the response data. Response data must be separated from the header by a space. For details, refer to page App 2-6.

<Response data>

Response data is used to define a response. If multiple items of response data are used, they must be separated by a "," (comma).

Exsample :SENSE:STORE:MODE SHOT,1000<RMT>

header data data

If a program message contains more than one query, responses are made in the same order as the queries. Normally, each query returns only one response message unit, but there are some queries which return more than one response message unit. The first response message unit always responds to the first query, but it is not always true that the "n" th unit always responds to the "n" th query. Therefore, if you want to make sure that a response is made to each query, the program message must be divided up into individual messages.

Message Transmission Order

- It is always possible to send a program message if the previous message which was sent did not contain any queries.
- If the previous message contained a query, it is not possible to send another program message until a response message has been received. An error will occur if a program message is sent before a response message has been received in its entirety. A response message which has not been received will be discarded.
- If an attempt is made by the controller to receive a response message even if there it no response message, an error will occur. An error will also occur if the controller makes an attempt to receive a response message before transmission of a program message is completed.
- If a program message with more than one unit is sent, and if some of the units are incomplete, the instrument receives program message units which the instrument thinks complete, and makes an attempt to execute them. However, these attempts may not always be successful and a response may not always be returned, even if the program message contains queries.

Dead Lock

The instrument has a buffer memory in which both program and response messages of more than 1024 bytes can be stored. (The number of bytes available will vary depending on the operating state of the instrument.) If both buffer memories become full at the same time, the instrument becomes inoperative. This state is called dead lock. In this case, operation can be resumed by discarding the response message.

No dead lock will occur, if the size of the program message including the PMT is kept below 1024 bytes. Furthermore, no dead lock will occur if the program message does not contain a query.

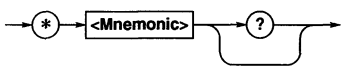
2.2.3 Commands

Commands

There are two types of command (program header) which can be sent from the controller to the instrument. They differ in the format of their program headers.

Common Command Header

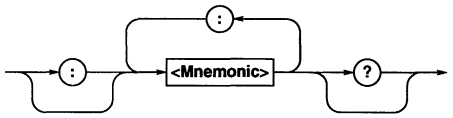
Commands defined as such in IEEE 488.2-1987 are called common commands. The header format of a common command is shown below. An asterisk (*) must always be attached to the beginning of a command.



An example of a common command: *CLS

Compound Header

Commands designed to be used only with the instrument are classified and arranged in a hierarchy according to their function. The format of a compound header is illustrated below. A colon (:) must be used when specifying a lower-level header.



An example of a compound header:

```
:SENSE:FUNCTION:TYPE "CLAMP"
```

Note

- A mnemonic is a character string made up of alphanumeric characters.

When Concatenating Commands

Command Group

A command group is a group of commands which have the same compound header. A command group may contain sub-groups.

Example: Command groups relating to the measurement results

```
:MEASURE?
:MEASURE:VOLTAGE
:MEASURE:RESISTANCE
:MEASURE:FRESISTANCE
:MEASURE:CURRENT
:MEASURE:CLAMP
:MEASURE:SCANNER
```

When Concatenating Commands of the Same Group

The instrument stores the hierarchical level of the command which is currently being executed, and performs analysis on the assumption that the next command to be sent will also belong to the same level. Therefore, it is possible to omit the header if the commands belong to the same group.

Example

```
:SENSE:VOLTAGE:DC:RANGE MAX;AUTO OFF<PMT>
```

When Concatenating Commands of Different Group

A colon (:) must be included before the header of a command, if the command does not belong to the same group as the preceding command.

Example

```
:SENSE:SAMPLE:RATE SLOW;:MEASURE?<PMT>
```

When Concatenating Common Commands

Common commands defined in IEEE 488.2-1987 are independent of hierarchical level. Thus, it is not necessary to add a colon (:) before a common command.

Example

```
:SENSE:VOLTAGE:DC:RANGE MAX;*CLS;AUTO
OFF<PMT>
```

When Separating Commands with <PMT>

If a terminator is used to separate two commands, each command is a separate message. Therefore, the common header must be typed in for each command even when commands of the same command group are concatenated.

Example

```
:SENSE:VOLTAGE:DC:RANGE MAX<PMT>:SENSE:
VOLTAGE:DC:AUTO OFF<PMT>
```

Upper-level Query

An upper-level query is the highest command of the first appearing group to which a question mark is appended. Execution of an upper-level query allows all a group's settings to be output at once. Some query groups comprising more than three hierarchical levels can output all their lower level settings.

Example

```
:SENSE:SAMPLE?<PMT>→:SENSE:SAMPLE:RATE
+0.500E+00;TRIG AUTO<PMT>
```

In reply to a query, a response can be returned as a program message to the instrument.

Header Interpretation Rules

The instrument interprets the header received according to the following rules.

- Mnemonics are not case sensitive.
  Example: FUNCtion, function and Function are acceptable.
- The lower-case part of a header can be omitted.
  Example: FUNCtion, FUNCT and FUNC are acceptable.
- If the header ends with a question mark, the command is a query. It is not possible to omit the question mark.
  Example: "FUNCtion?" can be abbreviated to "FUNC?".
- Any part enclosed by [ ] can be omitted.
  Example: [SENSe]:SAMPle[:RATE] SLOW can be abbreviated to "SAMP SLOW".
  However, a part enclosed by [ ] cannot be omitted if is located at the end of an upper-level query.
  Example: "SAMPle?" and "SAMPle:RATE?" are not the same query.

2.2.4 Response

On receiving a query from the controller, the instrument returns a response message to the controller. A response message is sent in either of the following two forms.

- Response consisting of a header and data
  If the query can be used as a program message without any change, a command header is attached to the query, which is then returned.

  Example:
  :SENSE:SAMPLE:TRIG?<PMT>→:SENSE:SAMPLE:TRIG SINGLE<RMT>

- Response consisting of data only
  If the query cannot be used as a program message unless changes are made to it (i.e. it is a query-only command), no header is attached and only the data is returned. Some query-only commands can be returned after a header is attached to them.

  Example:
  STATUS:ERROR?<PMT>→0,"NO ERROR"<RMT>

When returning a response without a header

It is possible to remove the header from a response consisting of a header and data. For this, the "COMMunicate:HEADer" command is used.

Abbreviated form

Normally, the lower-case part is removed from a response header before the response is returned to the controller. Naturally, the full form of the header can also be used. For this, the "COMMunicate:VERBose" command is used. The part enclosed by [ ] is also omitted in the abbreviated form.

2.2.5 Data

Data

A data section comes after the header. A space must be included between the header and the data. The data contains conditions and values. Data is classified as below.

Data	Description
<Decimal>	Value expressed as a decimal number
(Example: Setting the number of averaging→ :SENSE:CALCULATE:AVERAGE:COUNT 50)	
<Voltage><Time> <Resistance><Frequency>	Physical value
(Example: DC voltage range→ :SENSE:VOLTAGE:DC:RANGE 75V)	
<Register>	Register value expressed as either binary, octal, decimal or hexadecimal
(Example: Extended event register value→STATUS:EESE #HFE)	
<Character data>	Specified character string (mnemonic). Can be selected from { }
(Example: Selecting the sampling rate→ :SENSE:SAMPLE:RATE FAST)	
<Boolean>	Indicates ON/OFF. Set to ON, OFF or value
(Example: Turning the NULL function ON→ :SENSE:CALCULATE:NULL:STATE ON)	
<Character string data>	Arbitrary character string
(Exampe: Selecting the measurement function→ :SENSE:FUNCTION:TYPE "SCANner")	

<Decimal>

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

Symbol	Description	Example
<NR1>	Integer	125 -1 +1000
<NR2>	Decimal fraction	125.0 -.90 +001.
<NR3>	Decimal fraction with exponent 10	125.0E+0 -9E-1 +.1E4
<NRf>	Any of the forms <NR1> to <NR3> is allowed.	

- Decimal values which are sent from the controller to the instrument can be sent in any of the forms <NR1> to <NR3>. In this case, <NRf> appears.
- For response messages which are returned from the instrument to the controller, the form (<NR1> to <NR3>) to be used is determined by the query. The same form is used, irrespective of whether the value is large or small.
- In the case of <NR3>, the "+" after the "E" can be omitted, but the "–" cannot.
- If a value outside the setting range is entered, the value will be normalized so that it is just inside the range.
- If the value has more than the significant number of digits, the value will be rounded.

<Voltage>, <Current>, <Resistance>, <Time>

<Voltage>, <Current>, <Resistance> and <Time> indicate decimal values which have physical significance. <Multiplier> or <Unit> can be attached to <NRf>. They can be entered in any of the following forms.

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

<Multiplier>

Multipliers which can be used are shown below.

Symbol	Word	Description
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 which can be used are shown below.

Symbol	Word	Description
V	Volt	Voltage
A	Ampere	Current
S	Second	Time
OHM	Ohm	Resistance

- <Multiplier> and <Unit> are not case sensitive.
- "U" is used to indicate "μ".
- "MA" is used for Mega (M) to distinguish it from Milli. However, milliampere is also expressed by "MA".
- If both <Multiplier> and <Unit> are omitted, the default unit (V, A, S and OHM) will be used.
- Response messages are always expressed in <NR3> form. Neither <Multiplier> nor <Unit> is used.

<Register>

<Register> indicates an integer, but can also be expressed in hexadecimal, octal or binary instead of as a decimal number. <Register> is used when each bit of a value has a particular meaning. <Register> is expressed in one of the following forms.

Form	Example
<NRf>	1
#H<Hexadecimal value made up of the digits 0 to 9, and A to F>	#H0F
#Q<Octal value made up of the digits 0 to 7>	#q777
#B<Binary value made up of the digits 0 and 1>	#B001100

- <Register> is not case sensitive.
- Response messages are always expressed in <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 { }. For interpretation rules, refer to "Header Interpretation Rules" on page App 2-5.

Form	Example
{MIN | MAX | AUTO}	AUTO

- As with a header, the "COMMunicate:VERBose" command can be used to return a response message in its full form. Alternatively, the abbreviated from can be used.
- The "COMMunicate:HEADer" does not affect <character data>.

<Boolean>

<Boolean> is data which indicates ON or OFF, and is expressed in one of the following forms.

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

- When <Boolean> is expressed in <NRf>, OFF is selected if the rounded integer value is "0" and ON is selected if the rounded integer is not "0".
- A response message is always returned as "1" if the value is ON and as "0" if it is OFF.

<Character String Data>

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

Form	Example
<Character String data>	'ABC' "IEEE488.2-1987"

- If a character string contains a double quotation mark ("), the double quotation mark will be replaced by two concatenated double quotation marks (""). This rule also applies to a single quotation mark within a character string.
- Response messages are always enclosed in double quotation marks.
- <Character string data> is an arbitrary character string, therefore the instrument assumes that the remaining program message units are part of the character string if no single (') or double quotation mark (") is encountered. As a result, no error will be detected.

2.2.6 Synchronization with the Controller

There are two kinds of commands; overlap commands and sequential commands. This instrument does not support overlap commands which may start before execution of the previously sent command is completed. If sequential commands, which are supported by the instrument, are sent sequentially, the instrument does not start the next sequential command until execution of the previously sent command has been completed.
However, in some cases, synchronization is required to make a correct inquiry about the measured data even if a sequential command is used.
For instance, if the "MEASURE?" is sent to query the measured data only when the comparison result is Hi, the measured data will always be output, irrespective of the comparison result.

In this case, the following methods can be used to query the measured data only when the comparison result is Hi.

Using "STATus:CONDition?" query

A "STATus:CONDition?" query is used to make an inquiry about the contents of the conditioning register (page App 2-33). It is possible to judge whether the comparison result is Hi or not by reading bit 0 of the condition register. Bit 0 is "1" if the comparison result is Hi, and "0" if it is not.

Using the extended event register

Changes in the condition register are reflected in the extended event register (page App 2-33).

Example

```
STATus:FILTer1 FALL;:STATus:EESE 1;EESR?;*SRE
8;<PMT>
(Service request is awaited.)
MEASure?<PMT>
```

"STATus:FILTer1 FALL" indicates that the transit filter is set so that bit 0 (FILTer1) of the extended event register is set to "1" when bit 0 of the condition register is changed from "1" to "0".
"STATus:EESE 1" is a command used only to reflect the status of bit 0 of the extended event register in the status byte.
"STATus:EESR?" is used to clear the extended event register.
The "*SRE" command is used to generate a service request caused by the extended event register only.
"MEASure?" will not be executed until a service request is generated.

APP 2.3 Commands

2.3.1 Command List

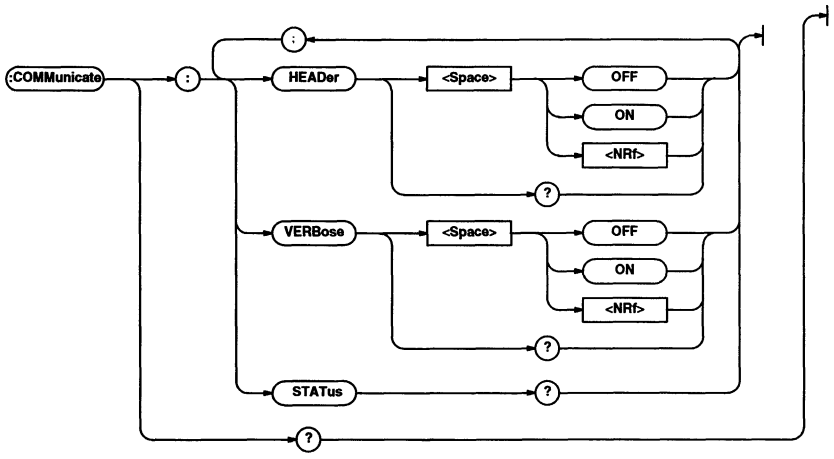
Command	Function	Page
CALibration Group (Used only for calibration of measured data)		
:CALibration:PROTected	Sets the calibration mode/queries the current setting.	10-6
:CALibration:FUNCtion	Sets the function to be calibrated/queries the current setting.	10-6
:CALibration:FUNCtion:RANGe	Sets the measuring range to be calibrated/queries the current setting.	10-6
:CALibration:FUNCtion:DATA	Sets CAL_1 and CAL_2/queries the current setting.	10-6
:CALibration:SCANner:RANGe	Selects calibration of the simple scanner and sets the measuring range/queries the current setting.	10-6
:CALibration:SCANner:DATA	Sets CAL_1 or CAL_2/queries the current setting for the simple scanner.	10-7
:CALibration:STRing	Registers the specified character string data in the memory/queries the current setting.	10-7
COMMunicate Group		
:COMMunicate?	Queries all the communication settings.	APP 2-12
:COMMunicate:HEADer	Determines whether a header is to be added or not/queries the current setting.	APP 2-12
:COMMunicate:STATus?	Queries the interface status.	APP 2-12
:COMMunicate:VERBose	Determines whether a response to a query is to be returned in full form or in abbreviated form/queries the current setting.	APP 2-12
MEASure Group		
:MEASure?	Queries the measured/computed data.	APP 2-14
:MEASure:CLAMp?	Switches to large current measurement mode and queries the measured/computed data.	APP 2-14
:MEASure:CURRent:AC?	Switches to AC current measurement mode and queries the measured/computed data.	APP 2-14
:MEASure:CURRent:DC?	Switches to DC current measurement mode and queries the measured/computed data.	APP 2-14
:MEASure:FRESistance?	Switches to 4-wire resistance measurement mode and queries the measured/computed data.	APP 2-14
:MEASure:RESistance?	Switches to 2-wire resistance measurement mode and queries the measured/computed data.	APP 2-14
:MEASure:SCANner?	Switches to simple scanner measurement mode and queries the measured/computed data.	APP 2-14
:MEASure:VOLTage:AC?	Switches to AC voltage measurement mode and queries the measured/computed data.	APP 2-15
:MEASure:VOLTage:DC?	Switches to DC voltage measurement mode and queries the measured/computed data.	APP 2-15
READ Group		
:READ?	Queries all the settings relating to measured/computed data.	APP 2-15
:REDA:DATA?	Queries the measured/computed data.	APP 2-15
:READ:INFormation[:STATus]?	Queries the state of the measured/computed data.	APP 2-15
SENSe Group		
[:SENSe]:CALCulate?	Queries all the computation settings.	APP 2-21
[:SENSe]:CALCulate:AVERage?	Queries all the averaging settings.	APP 2-21
[:SENSe]:CALCulate:AVERage:COUnt	Sets the number of times averaging is to be executed/queries the current setting.	APP 2-21
[:SENSe]:CALCulate:AVERage[:STATe]	Turns the averaging function ON/OFF/queries the current setting.	APP 2-21
[:SENSe]:CALCulate:DB?	Queries the dB display coefficients.	APP 2-21
[:SENSe]:CALCulate:DB:KCdata	Queries coefficient KC for the dB display function/queries the current setting.	APP 2-21
[:SENSe]:CALCulate:DB:KDdata	Queries coefficient KD for the dB display function/queries the current setting.	APP 2-21
[:SENSe]:CALCulate:DB[:STATe]	Turns the dB display function ON/OFF/queries the current setting.	APP 2-21
[:SENSe]:CALCulate:LIMit?	Queries all the comparator settings (Hi and Lo).	APP 2-21
[:SENSe]:CALCulate:LIMit:HI?	Queries all the comparator settings (Hi).	APP 2-21
[:SENSe]:CALCulate:LIMit:HI:KHdata	Queries coefficient KH for the comparator function (Hi)/queries the current setting.	APP 2-21
[:SENSe]:CALCulate:LIMit:HI[:STATe]	Turns the comparator function (Hi) ON/OFF and sets COM/queries the current setting.	APP 2-21

Command	Function	Page
[:SENSe]:CALCulate:LIMit:LOw?	Queries all the comparator settings (Lo).	APP 2-21
[:SENSe]:CALCulate:LIMit:LO:KLdata	Queries coefficient KH for the comparator function (Lo)/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:LIMit:LO[:STATe]	Turns the comparator function (Lo) ON/OFF and sets COM/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:NULL?	Queries all the NULL function settings.	APP 2-22
[:SENSe]:CALCulate:NULL:OFFSet	Queries the NULL value/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:NULL[:STATe]	Turns the NULL function ON/OFF/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:PERCent?	Queries all the percentage display function settings.	APP 2-22
[:SENSe]:CALCulate:PERCent:KEdata	Queries coefficient KE for the percentage display function/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:PERCent[:STATe]	Turns the percentage display function ON/OFF/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:SCALe?	Queries all the scaling function settings.	APP 2-22
[:SENSe]:CALCulate:SCALe:KAdata	Queries coefficient KA for the scaling function/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:SCALe:KBdata	Queries coefficient KB for the scaling function/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:SCALe[:STATe]	Turns the scaling function ON/OFF/queries the current setting.	APP 2-22
[:SENSe]:CALCulate:DA	Sets the D/A output digits/queries the current setting.	APP 2-22
[:SENSe]:FUNCtion?	Queries the currently selected function and range.	APP 2-23
[:SENSe]:FUNCtion:CLAMp	Sets the large current measurement mode/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:CURRent:AC:AUTO	Sets the auto range mode for AC current measurement/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:CURRent:AC[:RANGe]	Sets the measuring range for AC current measurement.	APP 2-23
[:SENSe]:FUNCtion:CURRent:DC:AUTO	Sets the auto range mode for DC current measurement/queries.	APP 2-23
[:SENSe]:FUNCtion:CURRent:DC[:RANGe]	Sets the measuring range for DC current measurement.	APP 2-23
[:SENSe]:FUNCtion:FRESistance:AUTO	Sets the auto range mode for 4-wire resistance measurement/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:FRESistance[:RANGe]	Sets the measuring range for 4-wire resistance measurement.	APP 2-23
[:SENSe]:FUNCtion:RESistance:AUTO	Sets the auto range mode for 2-wire resistance measurement/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:RESistance[:RANGe]	Sets the measuring range for 2-wire resistance measurement.	APP 2-23
[:SENSe]:FUNCtion:SCANner?	Queries all the scanner settings.	APP 2-23
[:SENSe]:FUNCtion:SCANner:AUTO	Sets the auto range mode for the scanner/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:SCANner:CHannel	Sets the scanner measurement channel/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:SCANner:MAX	Sets the maximum channel No. for LOOP scanner mode/queries the current setting.	APP 2-23
[:SENSe]:FUNCtion:SCANner:NEXT	Changes the scanner measurement channel.	APP 2-23
[:SENSe]:FUNCtion:SCANner:RANGe	Sets the measuring range for the scanner/queries the current setting.	APP 2-24
[:SENSe]:FUNCtion:SCANner[:STATus]	Sets the scanner mode/queries the current setting.	APP 2-24
[:SENSe]:FUNCtion:TYPE	Sets the measurement function/queries the current setting.	APP 2-24
[:SENSe]:FUNCtion:VOLTage:AC:AUTO	Sets the auto range mode for AC voltage measurement/queries the current setting.	APP 2-24
[:SENSe]:FUNCtion:VOLTage:AC[:RANGe]	Sets the measuring range for AC voltage measurement.	APP 2-24
[:SENSe]:FUNCtion:VOLTage:DC:AUTO	Sets the auto range mode for DC voltage measurement/queries the current setting.	APP 2-24
[:SENSe]:FUNCtion:VOLTage:DC[:RANGe]	Sets the measuring range for DC voltage measurement.	APP 2-24
[SENSe]:PANEl[:LOCK]	Sets/queries the panel's key lock setting.	APP 2-24
[SENSe]:PANEl:LOAD	Loads the set-up information.	APP 2-24
[SENSe]:PANEl:SAVE	Saves the set-up information.	APP 2-24
[:SENSe]:RECall:DATANo	Sets the store data No. to be queried/queries the current setting.	APP 2-25
[:SENSe]:RECall:RDATA?	Queries all the settings relating to the specified store data.	APP 2-25
[:SENSe]:RECall:RDATA:CALCulate?	Queries the computation function used for the specified store data.	APP 2-25
[:SENSe]:RECall:RDATA:DATA?	Queries the specified store data.	APP 2-25
[:SENSe]:RECall:RDATA:FUNCtion?	Queries the function and measuring range for the specified store data.	APP 2-25
[:SENSe]:RECall:RDATA:STATus?	Queries the status of the specified store data.	APP 2-25
[:SENSe]:RECall:SIZe?	Queries the number of stored data sets.	APP 2-25
[:SENSe]:RECall:STARt	Sets the recall start data No./queries the current setting.	APP 2-25
[:SENSe]:RECall[:STATus]	Sets the recall mode/queries the current setting.	APP 2-25
[:SENSe]:SAMPle?	Queries all the sampling settings.	APP 2-25
[:SENSe]:SAMPle[:RATE]	Sets the sampling rate/queries the current setting.	APP 2-25
[:SENSe]:SAMPle:TRIG	Sets the trigger mode/queries the current setting.	APP 2-25
[:SENSe]:STORe:MODe	Sets the storage mode/queries the current setting.	APP 2-26
[:SENSe]:STORe[:STATus]	Sets the storage state/queries the current setting.	APP 2-26

Command	Function	Page
STATus Group		
:STATus?	Queries all the communication status function settings.	APP 2-26
:STATus:CONDition?	Queries the contents of the condition register and clears the register.	APP 2-26
:STATus:EESE	Sets the extended event enable register/queries the current setting.	APP 2-26
:STATus:EESR?	Queries the contents of the extended event register and clears the register.	APP 2-26
:STATus:ERRor?	Queries the error cord and contents of the message (located at the beginning of the error queue).	APP 2-26
:STATus:FILTer<x>	Sets the transit filter/queries the current setting.	APP 2-27
:STATus:OMESsage	Sets whether or not to add a message in response to "STATus:ERRor?"/queries the current setting.	APP 2-27
:STATus:SPOLl?(Serial Poll)	Performs a serial polling.	APP 2-27
UNIT Group		
:UNIT?	Queries all the unit settings.	APP 2-27
:UNIT:CURRent	Sets the default units for <Current>/queries the current setting.	APP 2-27
:UNIT:RESistance	Sets the default units for <Resistance>/queries the current setting.	APP 2-27
:UNIT:TIME	Sets the default units for <Time>/queries the current setting.	APP 2-27
:UNIT:VOLTage	Sets the default units for <Voltage>/queries the current setting.	APP 2-27
Common Command Group		
*CLS	Clears the standard event register, extended event register and error queue.	APP 2-28
*ESE	Sets the standard event enable register value/queries the current setting.	APP 2-28
*ESR?	Sets the standard event register value/queries the current setting.	APP 2-28
*IDN?	Queries the instrument model.	APP 2-28
*LRN?	Performs various queries at once.	APP 2-28
*OPC	(Not supported by this instrument.)	APP 2-29
*OPC?	("1" is always returned since this command is supported by this instrument.)	APP 2-29
*OPT?	Queries installed options.	APP 2-29
*PSC	Selects whether or not to clear the registers when power is turned ON/queries the current setting.	APP 2-29
*RST	Initializes the set-up information.	APP 2-29
*SRE	Sets the service request enable register value/queries the current setting.	APP 2-29
*STB?	Queries the status byte register value.	APP 2-29
*TRG?	Carries out the same operations as when the TRIG key is pressed.	APP 2-29
*TST?	Executes a self-test and queries the test result.	APP 2-29

2.3.2 COMMunicate Group

The commands in the COMMunicate group are used to make settings and inquiries about communications. There is no front panel key with this function.



COMMunicate?

Function Queries all the communication settings.

Syntax COMMunicate?

Example COMMUNICATE?
→:COMMUNICATE:HEADER 1;VERBOSE 1

COMMunicate:HEADer

Function Determines whether a header is to be added for (e.g. CONFIGURE:VOLTAGE:RANGE 150.0E+00) or not (e.g. 150.0E+00) when sending a response to a query/queries the current setting.

Syntax COMMunicate:HEADer {<Boolean>}
COMMunicate:HEADer?

Example COMMUNICATE:HEADER ON
COMMUNICATE:HEADER?→:COMMUNICATE:HEADER 1

COMMunicate:STATus?

Function Queries the interface status.

Syntax COMMunicate:STATus?

Example COMMUNICATE:STATUS?→:COMMUNICATE:STATUS 0

Description Meaning of each status bit is given below.

Bit	GP-IB	RS-232-C
0	Unrecovery transmission error for 7210	Parity error
1	Always "0"	Framing error
2	Always "0"	Break character detected
3	Always "0"	Always "0"

The corresponding bit is set when a status cause occurs, and is cleared when the status is read.

COMMunicate:VERBose

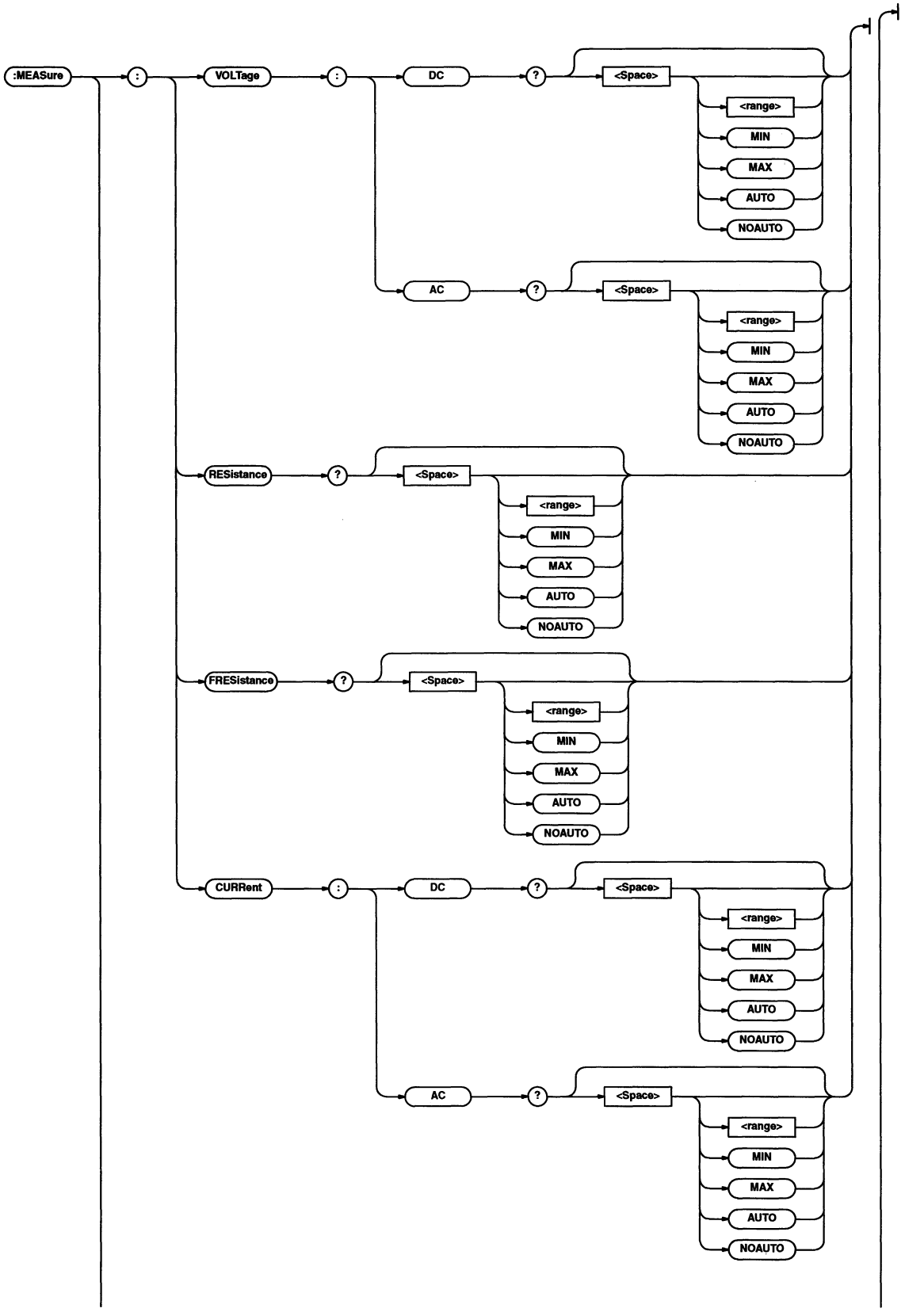
Function Determines whether a response to a query is to be returned in full form (e.g. CONFIGURE:VOLTAGE:RANGE 150.0E+00) or in abbreviated form (e.g. VOLT:RANG 150.0E+00)/queries the current setting.

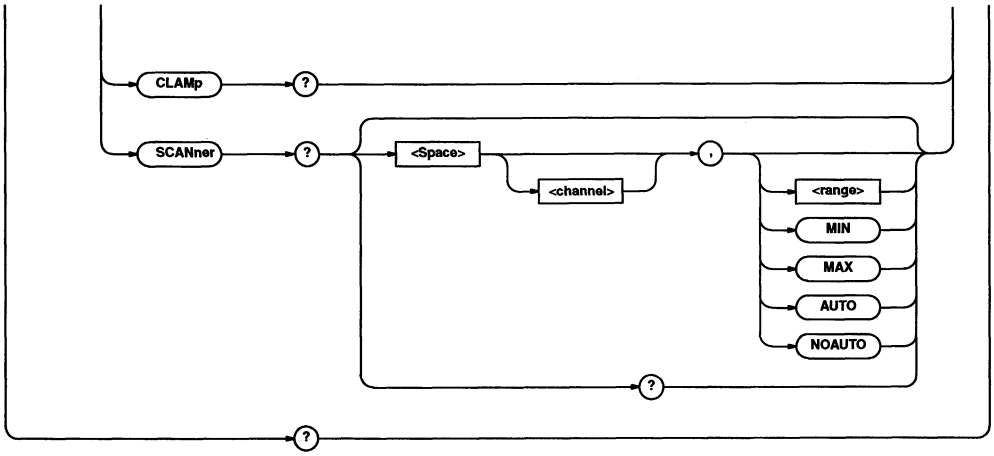
Syntax COMMunicate:VERBose {<Boolean>}
COMMunicate:VERBose?

Example COMMUNICATE:VERBOSE ON
COMMUNICATE:VERBOSE?→:COMMUNICATE:VERBOSE 1

2.3.3 MEASure Group

The commands in the MEASure group are used to change the measurement function, select the measuring range then query the measured/computed data.





MEASure?

Function Queries the measured/computed data for the currently selected measurement function.

Syntax MEASure?

Example MEASure?→:MEAS:FRES +27.150E+00

Description This query is used only to query the settings regarding the currently selected function.

MEASure:CLAMp?

Function Switches to large current measurement mode and queries the measured/computed data.

Syntax MEASure:CLAMp?

Example MEASure:CLAMp?→:MEAS:CLAM +118.9E+00

Description While the D/A output function is in use, large current measurement can be carried out only by SENSe:DA "1999**".

MEASure:CURRent:AC?

Function Switches to AC current measurement mode and queries the measured/computed data.

Syntax MEASure:CURRent:AC?{|<range>|MIN|MAX|AUTO|NOAUTO}
<range>=1 μA to 2A (Auto range mode is canceled)
MIN=2000 μA range (Auto range mode is canceled)
MAX=2000 mA range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:CURRent:AC? AUTO→:MEAS:CURR:AC+115.1E-06

Description The currently selected measuring range will remain unchanged if no measuring range setting is made.

MEASure:CURRent:DC?

Function Switches to DC current measurement mode and queries the measured/computed data.

Syntax MEASure:CURRent:DC?{|<range>|MIN|MAX|AUTO|NOAUTO}
<range>=1 μA to 2A (Auto range mode is canceled)
MIN=2000 μA range (Auto range mode is canceled)
MAX=2000 mA range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:CURRent:DC? MIN→:MEAS:CURR:DC -3.41E-06

Description The currently selected measuring range will remain unchanged if no measuring range setting is made.

MEASure:FRESistance?

Function Switches to 4-wire resistance measurement mode and queries the measured/computed data.

Syntax MEASure:FRESistance?
{|<range>|MIN|MAX|AUTO|NOAUTO}
<range>=1 Ω to 200MΩ (Auto range mode is canceled)
MIN=1 Ω range (Auto range mode is canceled)
MAX=200MΩ range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:FRESistance? 100→:MEAS:FRES+65.298E+00

Description The currently selected measuring range will remain unchanged if no measuring range setting is made.

MEASure:RESistance?

Function Switches to 2-wire resistance measurement mode and queries the measured/computed data.

Syntax MEASure:RESistance?
{|<range>|MIN|MAX|AUTO|NOAUTO}
<range>=1 Ω to 200MΩ (Auto range mode is canceled)
MIN=1 Ω range (Auto range mode is canceled)
MAX=200MΩ range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:RESistance? MAX→:MEAS:RES +35.35E+06

Description The currently selected measuring range will remain unchanged if no measuring range setting is made.

MEASure:SCANner?

Function Switches to simple scanner measurement mode and queries the measured/computed data.

Syntax MEASure:SCANner {(|<channel>),(|(<range>)|MIN|MAX|AUTO|NOAUTO)}
<channel>=1 to 8 (Measurement channel)
<range>=1mV to 30V (Auto range mode is canceled)
MIN=200mV range (Auto range mode is canceled)
MAX=30V range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:SCANner? 3,NOAUTO→:MEAS:SCAN3,+319.33E-03

Description The current channel/measuring range will remain unchanged if no channel/measuring range setting is made. This query must be used for each channel.

MEASure:VOLTage:AC?

Function Switches to AC voltage measurement mode and queries the measured/computed data.

Syntax MEASure:VOLTage:AC? {|<range>|MIN|MAX|AUTO|NOAUTO}
<range>=1mV to 700V (Auto range mode is canceled)
MIN=200mV range (Auto range mode is canceled)
MAX=700V range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:VOLTage:AC?→:MEAS:VOLT:AC +45.273E-03

Description The currently selected measuring range will remain unchanged if no measuring range setting is made.

MEASure:VOLTage:DC?

Function Switches to DC voltage measurement mode and queries the measured/computed data.

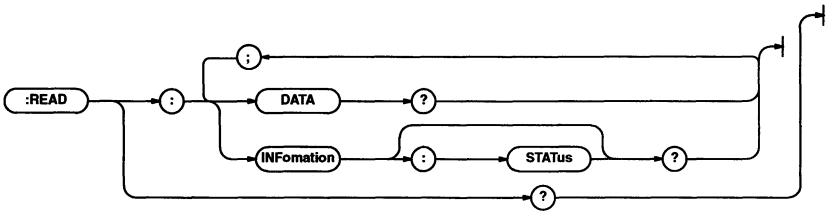
Syntax MEASure:VOLTage:DC? {|<range>|MIN|MAX|AUTO|NOAUTO}
<range>=1mV to 1KV (Auto range mode is canceled)
MIN=200mV range (Auto range mode is canceled)
MAX=1000 V range (Auto range mode is canceled)
AUTO=AUTO range mode is set.
NOAUTO=AUTO range mode is canceled.

Example MEASure:VOLTage:DC? AUTO→:MEAS:VOLT:DC +1.87271E+00

Description The currently selected measuring range will remain unchanged if no measuring range setting is made.

2.3.4 READ Group

The commands in the READ group are used to query the measured/computed data.



READ?

Function Queries all the settings relating to measured/computed data.

Syntax READ?

Example READ?→:READ:DATA -3.49E-06;INF:STAT NULL

READ:DATA?

Function Queries the measured/computed data.

Syntax READ:DATA?

Example READ:DATA?→:READ:DATA +1.87271E+00

Description Measured/computed data is stored in the internal buffer when a trigger signal is input. Once an inquiry is made, the buffer will be emptied.
If SINGLE has been selected as the trigger mode and there is no data to be recalled, "+9.99999E+9" will be returned.
This query cannot be used if FAST is selected as the sampling rate. In this case, store the data, switch the sampling rate to an option other than FAST, use "SENSe:RECall:START" to recall the data and then use this query.

READ:INFomation[:STATus]?

Function Queries the state of the measured/computed data.

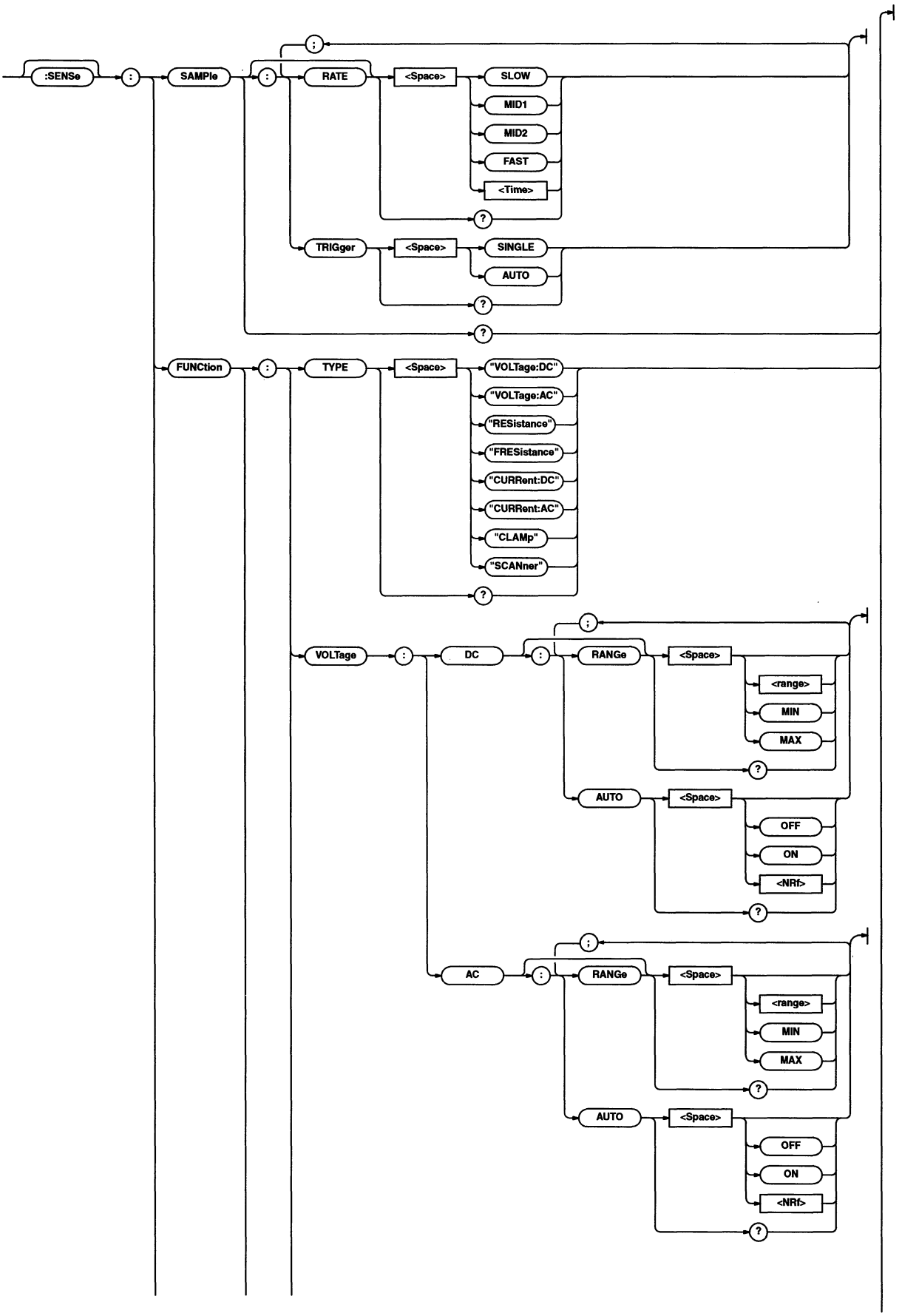
Syntax READ:INFomation[:STATus]?

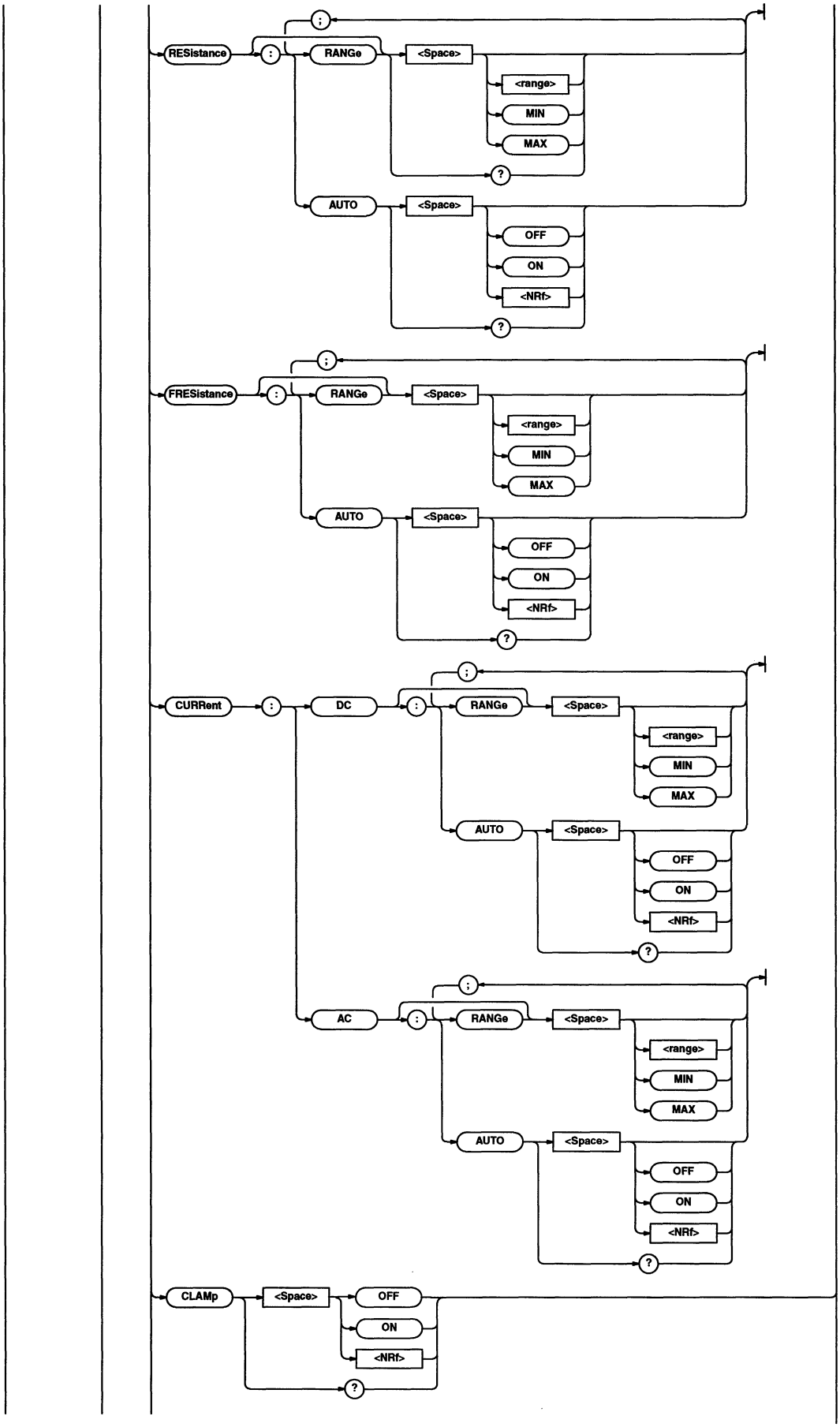
Example READ:INFomation:STATus?→:READ:INF:STAT OVER

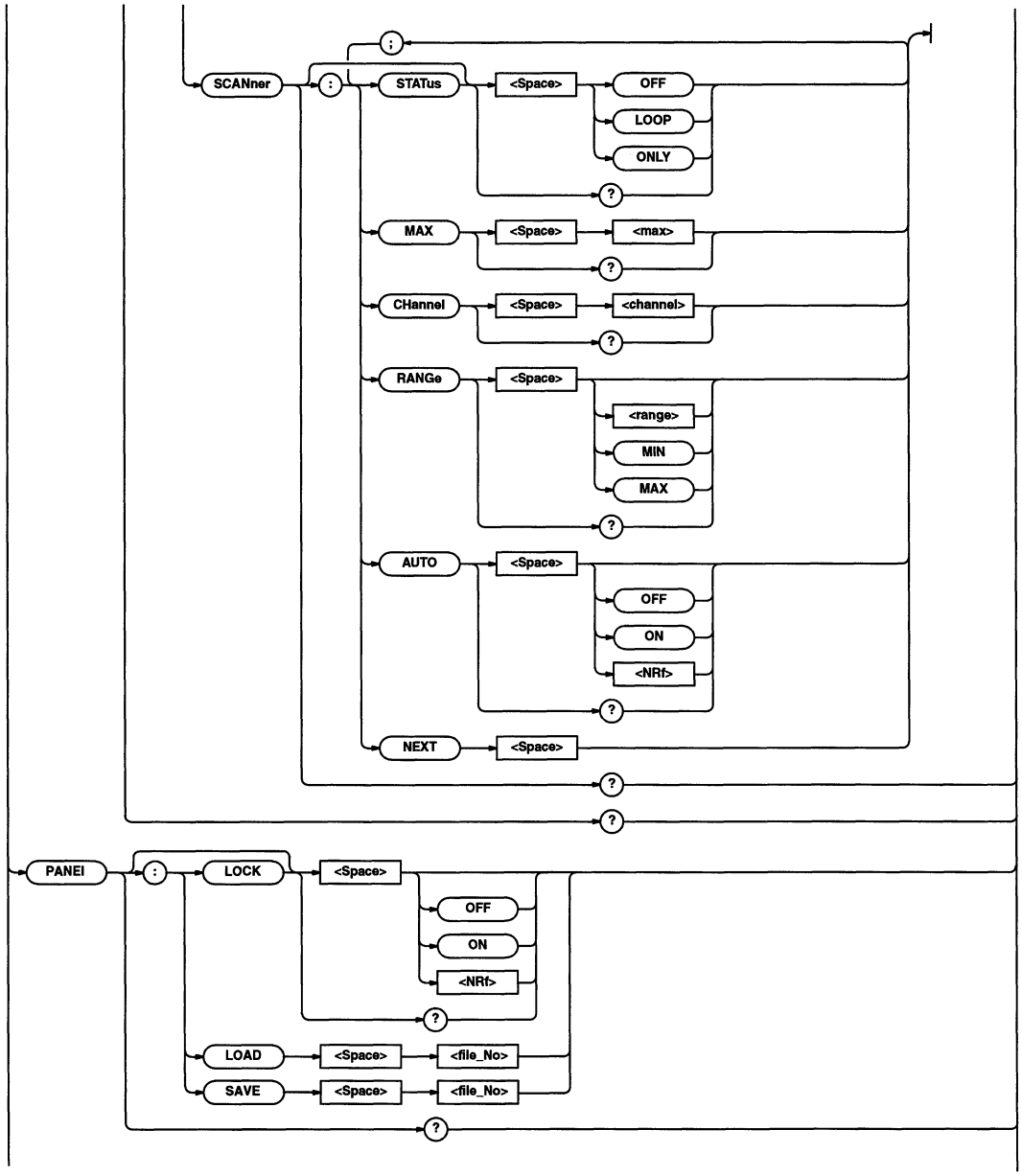
Description The state of the measured/computed data can also be queried by "SENSe:RECall:RDATA:STATUs".
This query can be made to the data which has been queried by "READ:DATA?". To query the state of new data, "READ:DATA?" must be executed first.
This query cannot be used if FAST is selected as the sampling rate. In this case, store the data, switch the sampling rate to an option other than FAST, use "SENSe:RECall:START" to recall the data and then use this query.

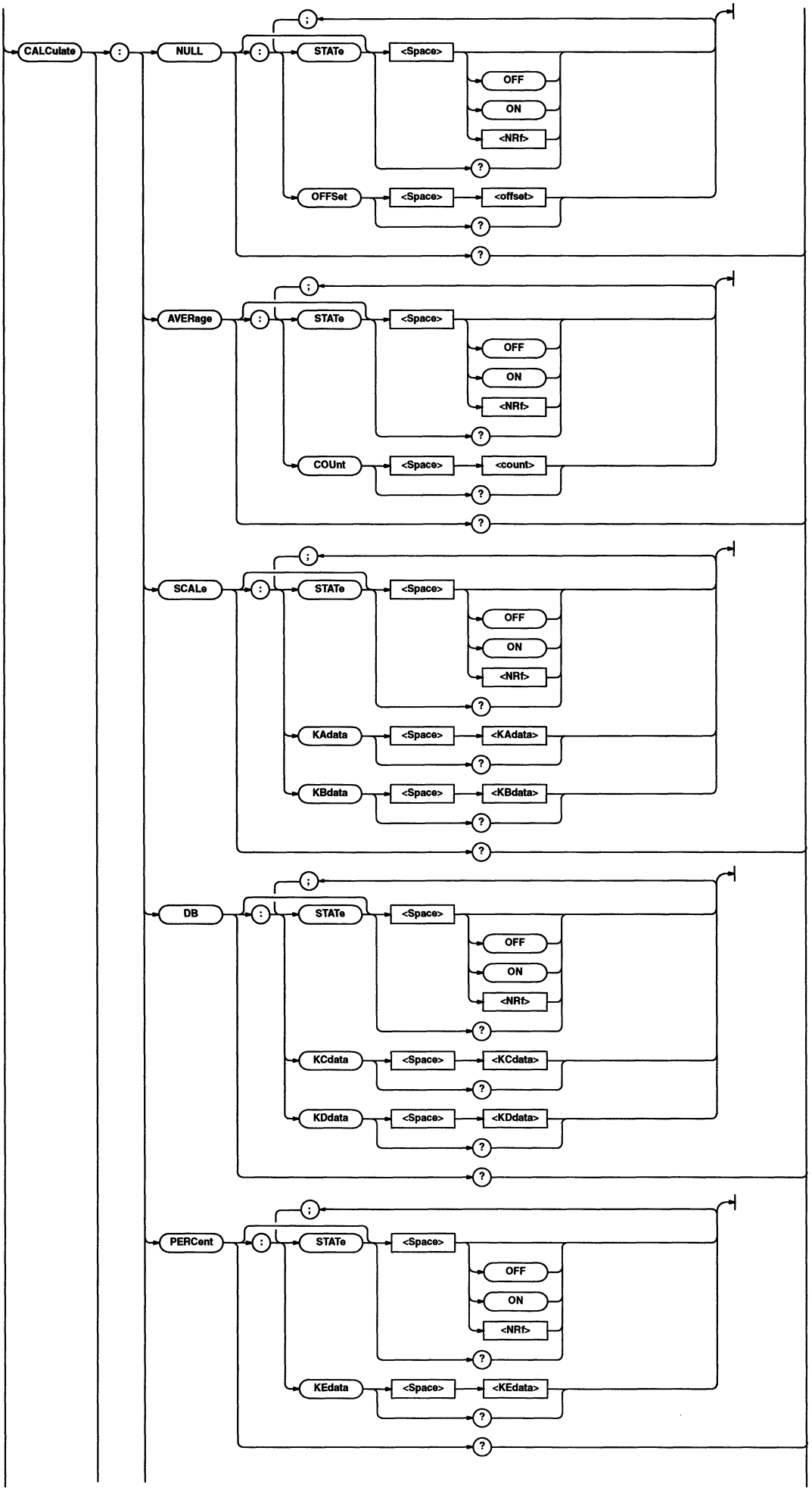
2.3.5 SENSe Group

The commands in the SENSe group are used to make various settings of the instrument. This allows you to make the same settings and queries which you can make using the menu. SENSe can be defined in an abbreviated form.




RESistance
:
RANGe
<Space>
<range>
MIN
MAX
?
AUTO
<Space>
OFF
ON
<NRf>
?
;
FRESistance
:
RANGe
<Space>
<range>
MIN
MAX
AUTO
<Space>
OFF
ON
<NRf>
?
;
CURRent
:
DC
:
RANGe
<Space>
<range>
MIN
MAX
AUTO
<Space>
OFF
ON
<NRf>
?
;
AC
:
RANGe
<Space>
<range>
MIN
MAX
AUTO
<Space>
OFF
ON
<NRf>
?
CLAMp
<Space>
OFF
ON
<NRf>
?


SCANner
:
STATus
<Space>
OFF
LOOP
ONLY
?
MAX
<Space>
<max>
?
CHannel
<Space>
<channel>
?
RANGe
<Space>
<range>
MIN
MAX
?
AUTO
<Space>
OFF
ON
<NRf>
?
NEXT
<Space>
;
?
?
PANEl
:
LOCK
<Space>
OFF
ON
<NRf>
?
LOAD
<Space>
<file_No>
SAVE
<Space>
<file_No>
?


CALCulate
:
NULL
;
:
STATe
<Space>
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ON
<NRf>
?
OFFSet
<Space>
<offset>
?
?
AVERage
;
:
STATe
<Space>
OFF
ON
<NRf>
?
COUnt
<Space>
<count>
?
?
SCALe
;
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STATe
<Space>
OFF
ON
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?
KAdata
<Space>
<KAdata>
?
KBdata
<Space>
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DB
;
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STATe
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OFF
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KCdata
<Space>
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KDdata
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PERCent
;
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STATe
<Space>
OFF
ON
<NRf>
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KEdata
<Space>
<KEdata>
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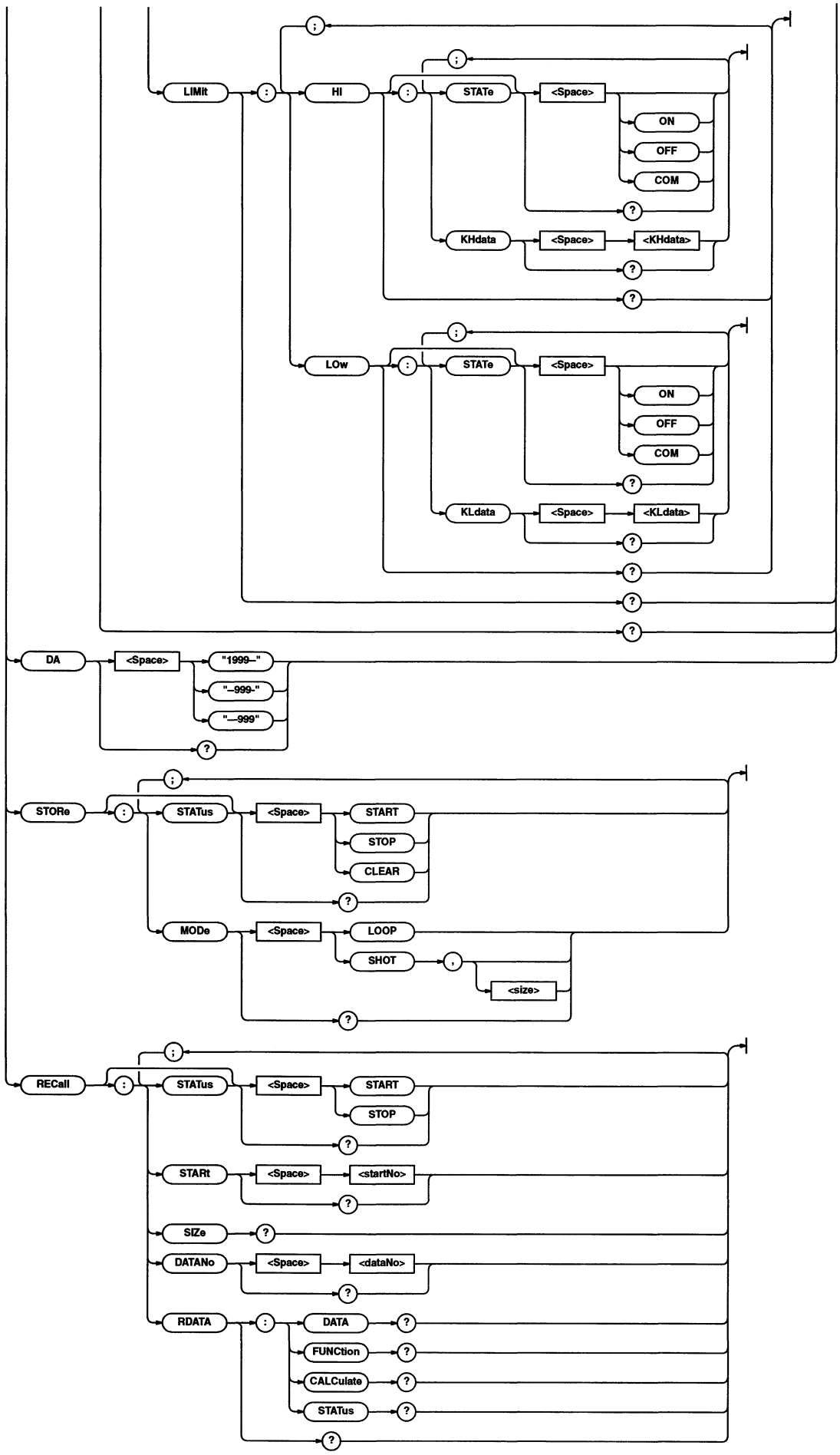
?


LIMit
HI
STATe
<Space>
ON
OFF
COM
?
KHdata
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<KHdata>
LOw
STATe
<Space>
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"—999"
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STOP
CLEAR
MODe
<Space>
LOOP
SHOT
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RECall
STATus
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START
STOP
STARt
<Space>
<startNo>
SIZe
DATANo
<Space>
<dataNo>
RDATA
DATA
FUNCtion
CALCulate
STATus

[SENSe]:CALCulate?

Function Queries all the computation settings.
Syntax [SENSe]:CALCulate?
Example SENSe:CALCulate?→:CALC:NULL 1;NULL:OFFS+1.73955E+00;:CALC:AVER 1;AVER:COU 100;CALC:SCAL 0;SCAL:KA 0.00E-03;KB 1.00000E+00;CALC:DB 1;DB:KC+20.000E+00;KD +1.00000E+00;CALC:PERC 0;PERC:KE1.00000E+00;CALC:LIM:HI ON;HI:KH 1.00000E+00;CALC:LIM:LO OFF;LO:KL 1.00000E+00

[SENSe]:CALCulate:AVERage?

Function Queries whether or not the averaging function is selected and the number of times averaging is to be executed.
Syntax [SENSe]:CALCulate:AVERage?
Example SENSe:CALCulate:AVERage?→:CALC:AVER 0;AVER:COU 10

[SENSe]:CALCulate:AVERage:COUnt

Function Sets the number of times averaging is to be executed/queries the current setting.
Syntax [SENSe]:CALCulate:AVERage:COUnt {<count>}
[SENSe]:CALCulate:AVERage:COUnt?
<count>=2 to 100
Example SENSe:CALCulate:AVERage:COUnt 100
SENSe:CALCulate:AVERage:COUnt?→:CALC:AVER:COU 100

[SENSe]:CALCulate:AVERage[:STATe]

Function Turns the averaging function ON/OFF/queries the current setting.
Syntax [SENSe]:CALCulate:AVERage[:STATe] {|<Boolean>}
[SENSe]:CALCulate:AVERage:STATe?
Example SENSe:CALCulate:AVERage:STATe OFF
SENSe:CALCulate:AVERage:STATe?→:CALC:AVER 0

[SENSe]:CALCulate:DB?

Function Queries the dB display coefficients.
Syntax [SENSe]:CALCulate:DB?
Example SENSe:CALCulate:DB?→:CALC:DB 0;DB:KC +20.000E+00;KD +4.8765E+00

[SENSe]:CALCulate:DB:KCdata

Function Queries the dB display coefficients.
Syntax [SENSe]:CALCulate:DB:KCdata {<KCdata>}
[SENSe]:CALCulate:DB:KCdata?
<KCdata>=±199999
Example SENSe:CALCulate:SCALe:KCdata 20.000
SENSe:CALCulate:SCALe:KCdata?→:CALC:DB:KC 20.000E+00

[SENSe]:CALCulate:DB:KDdata

Function Queries coefficient KC for the dB display function/queries the current setting.
Syntax [SENSe]:CALCulate:DB:KDdata {<KDdata>}
[SENSe]:CALCulate:DB:KDdata?
<KDdata> =±199999V (DC/AC voltage measurement)
=±199999MΩ (2-/4-wire resistance measurement)
=±199999A (DC/AC current measurement, large current measurement)
<KDdata> must not be "0".
Example SENSe:CALCulate:DB:KDdata 1.234MOHM
SENSe:CALCulate:DB:KDdata?→:CALC:DB:KD 1.23000E+6

[SENSe]:CALCulate:DB[:STATe]

Function Turns the dB display function ON/OFF/queries the current setting.
Syntax [SENSe]:CALCulate:DB[:STATe] {|<Boolean>}
[SENSe]:CALCulate:DB:STATe?
Example SENSe:CALCulate:DB:STATe OFF
SENSe:CALCulate:DB:STATe?→:CALC:DB 0
Description The dB display function cannot be turned ON if FAST has been selected as the sampling rate using "SENSe:SAMPle:RATE FAST".

[SENSe]:CALCulate:LIMit?

Function Queries all the comparator settings (Hi and Lo).
Syntax [SENSe]:CALCulate:LIMit?
Example SENSe:CALCulate:LIMit?→:CALC:LIM:HI ON;HI:KH +10.0000E+00;CALC:LIM:LO OFF;LO:KL -10.0000E+00

[SENSe]:CALCulate:LIMit:HI?

Function Queries all the comparator settings (Hi).
Syntax [SENSe]:CALCulate:LIMit:HI?
Example SENSe:CALCulate:LIMit:HI?→:CALC:LIM:HI ON;HI:KH +10.0000E+00

[SENSe]:CALCulate:LIMit:HI:KHdata

Function Queries coefficient KH for the comparator function (Hi)/queries the current setting.
Syntax [SENSe]:CALCulate:LIMit:HI:KHdata {<KHdata>}
[SENSe]:CALCulate:LIMit:HI:KHdata?
<KHdata> =±199999V (DC/AC voltage measurement)
=±199999MΩ (2-/4-wire resistance measurement)
=±199999A (DC/AC current measurement, large current measurement)
=±199999 (Scaling/dB display/percentage display)
(KH must be greater than KL.)
Example SENSe:CALCulate:LIMit:HI:KHdata 2500
SENSe:CALCulate:LIMit:HI:KHdata?→:CALC:LIM:HI:KH 2.5000E+03
Description An error will occur if this command/query is used when COM is selected.

[SENSe]:CALCulate:LIMit:HI[:STATe]

Function Turns the comparator function (Hi) ON/OFF and sets COM/queries the current setting.
Syntax [SENSe]:CALCulate:LIMit:HI[:STATe] {|ON|OFF|COM}
[SENSe]:CALCulate:LIMit:HI:STATe?
Example SENSe:CALCulate:LIMit:HI:STATe COM
SENSe:CALCulate:LIMit:HI:STATe?→:CALC:LIM:HICOM
Description COM is effective if a channel other than channel 1 is selected for the scanner. Otherwise, this command will be ignored even if this command is executed.

[SENSe]:CALCulate:LIMit:LOw?

Function Queries all the comparator settings (Lo).
Syntax [SENSe]:CALCulate:LIMit:LOw?
Example SENSe:CALCulate:LIMit:LOw?→:CALC:LIM:LO ON;LO:KL -10.0000E+00

[SENSe]:CALCulate:LIMit:LOw:KLdata

Function Queries coefficient KL for the comparator function (Lo)/ queries the current setting.

Syntax [SENSe]:CALCulate:LIMit:LOw:KLdata {<KLdata>}
[SENSe]:CALCulate:LIMit:LOw:KLdata?
<KLdata> =±199999V (DC/AC voltage measurement)
=±199999MΩ (2-/4-wire resistance measurement)
=±199999A (DC/AC current measurement, large current measurement)
=±199999 (Scaling/dB display/percentage display)
(KL must be greater than KH.)

Example SENSe:CALCulate:LIMit:LOw:KLdata -2500V
SENSe:CALCulate:LIMit:LOw:KLdata?→:CALC:LIM:LO:KL -2.5000E+03

Description An error will occur if this command/query is used when COM is selected.

[SENSe]:CALCulate:LIMit:LOw[:STATe]

Function Turns the comparator function (Lo) ON/OFF and sets COM/queries the current setting.

Syntax [SENSe]:CALCulate:LIMit:LOw[:STATe] {|ON|OFF|COM}
[SENSe]:CALCulate:LIMit:LOw:STATe?

Example SENSe:CALCulate:LIMit:LOw:STATe ON
SENSe:CALCulate:LIMit:LOw:STATe?→:CALC:LIM:LO ON

Description COM is effective if a channel other than channel 1 is selected for the scanner. Otherwise, this command will be ignored even if this command is executed.

[SENSe]:CALCulate:NULL?

Function Queries all the NULL function settings.

Syntax [SENSe]:CALCulate:NULL?

Example SENSe:CALCulate:NULL?→:CALC:NULL 0;NULL:OFFS +0.00E-03

[SENSe]:CALCulate:NULL:OFFSet

Function Queries the NULL value/queries the current setting.

Syntax [SENSe]:CALCulate:NULL:OFFSet {<offset>}
[SENSe]:CALCulate:NULL:OFFSet?

Example SENSe:CALCulate:NULL:OFFSet 1.0V
SENSe:CALCulate:NULL:OFFSet?→:CALC:NULL:OFFS +1.02237E+00

[SENSe]:CALCulate:NULL[:STATe]

Function Turns the NULL function ON/OFF/queries the current setting.

Syntax [SENSe]:CALCulate:NULL[:STATe] {|<Boolean>}
[SENSe]:CALCulate:NULL:STATe?

Example SENSe:CALCulate:NULL:STATe OFF
SENSe:CALCulate:NULL:STATe?→:CALC:NULL 0

[SENSe]:CALCulate:PERCent?

Function Queries all the percentage display function settings.

Syntax [SENSe]:CALCulate:PERCent?

Example SENSe:CALCulate:PERCent?→:CALC:PERC 0;PERC:KE +10.000E+00

[SENSe]:CALCulate:PERcent:KEdata

Function Queries coefficient KE for the percentage display function/ queries the current setting.

Syntax [SENSe]:CALCulate:PERCent:KEdata {<KEdata>}
[SENSe]:CALCulate:PERCent:KEdata?
<KEdata> =±199999V (DC/AC voltage measurement)
=±199999MΩ (2-/4-wire resistance measurement)
=±199999A (DC/AC current measurement, large current measurement)
<KEdata> must not be "0".

Example SENSe:CALCulate:PERCent:KEdata 1.234V
SENSe:CALCulate:PERCent:KEdata?→:CALC:PERC:KE 1.23000E+00

[SENSe]:CALCulate:PERCent[:STATe]

Function Turns the percentage display function ON/OFF/queries the current setting.

Syntax [SENSe]:CALCulate:PERCent[:STATe] {|<Boolean>}
[SENSe]:CALCulate:PERCent:STATe?

Example SENSe:CALCulate:PERCent:STATe OFF
SENSe:CALCulate:PERCent:STATe?→:CALC:PERC 0

Description The percentage display function cannot be turned ON if FAST has been selected as the sampling rate using "SENSe:SAMPle:RATE FAST".

[SENSe]:CALCulate:SCALe?

Function Queries all the scaling function settings.

Syntax [SENSe]:CALCulate:SCALe?

Example SENSe:CALCulate:SCALe?→:CALC:SCAL 1;SCAL:KA +120.234E+03;KB -1.23456E+00

[SENSe]:CALCulate:SCALe:KAdata

Function Queries coefficient KA for the scaling function/queries the current setting.

Syntax [SENSe]:CALCulate:SCALe:KAdata {<KAdata>}
[SENSe]:CALCulate:SCALe:KAdata?
<KAdata> =±199999V (DC/AC voltage measurement)
=±199999MΩ (2-/4-wire resistance measurement)
=±199999A (DC/AC current measurement, large current measurement)

Example SENSe:CALCulate:SCALe:KAdata 1.234uA
SENSe:CALCulate:SCALe:KAdata?→:CALC:SCAL:KA 1.23400E-6

[SENSe]:CALCulate:SCALe:KBdata

Function Queries coefficient KB for the scaling function/queries the current setting.

Syntax [SENSe]:CALCulate:SCALe:KBdata {<KBdata>}
[SENSe]:CALCulate:SCALe:KBdata?
<KBdata> =±199999V (DC/AC voltage measurement)
=±199999MΩ (2-/4-wire resistance measurement)
=±199999A (DC/AC current measurement, large current measurement)
<KBdata> must not be "0".

Example SENSe:CALCulate:SCALe:KBdata 250.01
SENSe:CALCulate:SCALe:KBdata?→:CALC:SCAL:KB 250.01E+00

[SENSe]:CALCulate:SCALe[:STATe]

Function Turns the scaling function ON/OFF/queries the current setting.

Syntax [SENSe]:CALCulate:SCALe[:STATe] {|<Boolean>}
[SENSe]:CALCulate:SCALe:STATe?

Example SENSe:CALCulate:SCALe:STATe ON
SENSe:CALCulate:SCALe:STATe?→:CALC:SCAL 1

Description The scaling function cannot be turned ON if FAST has been selected as the sampling rate using "SENSe:SAMPle:RATE FAST".

[SENSe]:DA

Function Sets the D/A output mode/queries the current setting.

Syntax [SENSe]:DA {"1999**"|"**999*"|"***999"}
[SENSe]:DA?

Example SENSe:DA "1999**"
SENSe:DA?→:DA "1999**"

Description An error will occur if this command/query is executed when the D/A output function is not installed.
It is not possible to set "***999" if FAST has been selected as the sampling rate using "SENSe:SAMPle:RATE FAST".
Only SENSe:DA "1999**" can be set for large current measurement.

[SENSe]:FUNCtion?

Function Queries the currently selected function and range.

Syntax [SENSe]:FUNCtion?

Example SENSe:FUNCtion?→:FUNC:CURR:AC +0.2E+00;AC:AUT 0 1

[SENSe]:FUNCtion:CLAMp

Function Sets the large current measurement mode/queries the current setting.

Syntax [SENSe]:FUNCtion:CLAMp {<Boolean>}
[SENSe]:FUNCtion:CLAMp?

Example SENSe:FUNCtion:CLAMp ON
SENSe:FUNCtion:CLAMp?→:FUNC:CLAM 1

Description The large current measurement mode cannot be turned ON while the D/A output function is in use, unless SENSe:DA "1999**" is set.

[SENSe]:FUNCtion:CURRent:AC:AUTO

Function Sets the auto range mode for AC current measurement/ queries the current setting.

Syntax [SENSe]:FUNCtion:CURRent:AC:AUTO {|<Boolean>}
[SENSe]:FUNCtion:CURRent:AC:AUTO?

Example SENSe:FUNCtion:CURRent:AC:AUTO ON
SENSe:FUNCtion:CURRent:AC:AUTO?→:FUNC:VOLT:AC :AUTO 1

[SENSe]:FUNCtion:CURRent:AC[:RANGe]

Function Sets the measuring range for AC current measurement.

Syntax [SENSe]:FUNCtion:CURRent:AC[:RANGe] {|<range>|MIN|MAX}
<range>=1 μA to 2A

Example SENSe:FUNCtion:CURRent:AC:RANGe 1000mA

Description If this command is sent during DC current measurement, the measurement function will switch to AC current measurement automatically.

[SENSe]:FUNCtion:CURRent:DC:AUTO

Function Sets the auto range mode for DC current measurement/ queries the current setting.

Syntax [SENSe]:FUNCtion:CURRent:DC:AUTO {|<Boolean>}
[SENSe]:FUNCtion:CURRent:DC:AUTO?

Example SENSe:FUNCtion:CURRent:DC:AUTO OFF
SENSe:FUNCtion:CURRent:DC:AUTO?→:FUNC:CURR:DC :AUTO 0

[SENSe]:FUNCtion:CURRent:DC[:RANGe]

Function Sets the measuring range for DC current measurement.

Syntax [SENSe]:FUNCtion:CURRent:DC[:RANGe] {|<range>|MIN|MAX}
<range>=1 μA to 2A

Example SENSe:FUNCtion:CURRent:DC:RANGe 1000uA

Description If this command is sent during AC current measurement, the measurement function will switch to DC current measurement automatically.

[SENSe]:FUNCtion:FRESistance:AUTO

Function Sets the auto range mode for 4-wire resistance measurement/queries the current setting.

Syntax [SENSe]:FUNCtion:RESistance:AUTO {|<Boolean>}
[SENSe]:FUNCtion:RESistance:AUTO?

Example SENSe:FUNCtion:RESistance:AUTO 1
SENSe:FUNCtion:RESistance:AUTO?→:FUNC:RES:AUTO 1

[SENSe]:FUNCtion:FRESistance[:RANGe]

Function Sets the measuring range for 4-wire resistance measurement.

Syntax [SENSe]:FUNCtion:FRESistance[:RANGe] {|<range>|MIN|MAX}
<range>=1 Ω to 200MΩ

Example SENSe:FUNCtion:FRESistance:RANGe 45000HM

Description If this command is sent during 2-wire resistance measurement, the measurement function will switch to 4-wire resistance measurement automatically.

[SENSe]:FUNCtion:RESistance:AUTO

Function Sets the auto range mode for 2-wire resistance measurement/queries the current setting.

Syntax [SENSe]:FUNCtion:RESistance:AUTO {|<Boolean>}
[SENSe]:FUNCtion:RESistance:AUTO?

Example SENSe:FUNCtion:RESistance:AUTO 0
SENSe:FUNCtion:RESistance:AUTO?→:FUNC:RES:AUT 0 0

[SENSe]:FUNCtion:RESistance[:RANGe]

Function Sets the measuring range for 2-wire resistance measurement.

Syntax [SENSe]:FUNCtion:RESistance[:RANGe] {|<range>|MIN|MAX}
<range>=1 Ω to 200MΩ

Example SENSe:FUNCtion:RESistance:RANGe 45000HM

Description If this command is sent during 4-wire resistance measurement, the measurement function will switch to 2-wire resistance measurement automatically.

[SENSe]:FUNCtion:SCANner?

Function Queries all the scanner settings.

Syntax [SENSe]:FUNCtion:SCANner?

Example SENSe:FUNCtion:SCANner?→:FUNC:SCAN LOOP;MAX8; CH 6;RANG +0.02E+03;AUTO 0

[SENSe]:FUNCtion:SCANner:AUTO

Function Sets the auto range mode for the scanner/queries the current setting.

Syntax [SENSe]:FUNCtion:SCANner:AUTO {|<Boolean>}
[SENSe]:FUNCtion:SCANner:AUTO?

Example SENSe:FUNCtion:SCANner:AUTO OFF
SENSe:FUNCtion:SCANner:AUTO?→:FUNC:SCAN:AUTO 0

Description An error will occur when this command/query is executed if LOOP or 1SINGLE scanner mode is not selected

[SENSe]:FUNCtion:SCANner:CHannel

Function Sets the scanner measurement channel/queries the current setting.

Syntax [SENSe]:FUNCtion:SCANner:CHannel {<channel>}
[SENSe]:FUNCtion:SCANner:CHannel?
<channel>=1 to 8 (channel No.)

Example SENSe:FUNCtion:SCANner:CHannel 5
SENSe:FUNCtion:SCANner:CHannel?→:FUNC:SCAN:CH 5

Description It is not possible to set a channel No. which is larger than the specified maximum channel No. if LOOP scanner mode is selected.
An error will occur when this command/query is executed if LOOP or 1SINGLE scanner mode is not selected.

[SENSe]:FUNCtion:SCANner:MAX

Function Sets the maximum channel No. for LOOP scanner mode/ queries the current setting.

Syntax [SENSe]:FUNCtion:SCANner:MAX {<max>}
[SENSe]:FUNCtion:SCANner:MAX?
<max>=2 to 8 (Maximum channel No. for LOOP scanner mode)

Example SENSe:FUNCtion:SCANner:MAX 7
SENSe:FUNCtion:SCANner:MAX?→:FUNC:SCAN:MAX 7

[SENSe]:FUNCtion:SCANner:NEXT

Function Changes the scanner measurement channel.

Syntax [SENSe]:FUNCtion:SCANner:NEXT

Example SENSe:FUNCtion:SCANner:NEXT

Description This command is used to change the currently selected channel No. to the next higher channel No..
The currently selected channel No. will change to the next lower channel No. if the maximum loop channel No. is exceeded in the case of LOOP scanner mode or if channel 8 is exceeded in the case of 1SHOT scanner mode.

[SENSe]:FUNCtion:SCANner:RANGe

Function Sets the measuring range for the scanner/queries the current setting.

Syntax [SENSe]:FUNCtion:SCANner:RANGe {|<range>|MIN|MAX}
[SENSe]:FUNCtion:SCANner:RANGe?
<range>=1mV to 30V

Example SENSe:FUNCtion:SCANner:RANGe 25V
SENSe:FUNCtion:SCANner:RANGe?→:FUNC:SCAN:RANG +0.02E+03

Description An error will occur when this command/query is executed if LOOP or 1SINGLE scanner mode is not selected.

[SENSe]:FUNCtion:SCANner[:STATus]

Function Sets the scanner mode/queries the current setting.

Syntax [SENSe]:FUNCtion:SCANner[:STATus] {OFF|LOOP|ONLY}
[SENSe]:FUNCtion:SCANner:STATus?

Example SENSe:FUNCtion:SCANner:STATus ONLY
SENSe:FUNCtion:SCANner:STATus?→:FUNC:SCAN ONLY

[SENSe]:FUNCtion:TYPE

Function Sets the measurement function/queries the current setting.

Syntax [SENSe]:FUNCtion:TYPE {"VOLTage:DC"|"VOLTage:AC"|"RESistance"|"FRESistance"|"CURRent:DC"|"CURRent:AC"|"CLAMp"|"SCANner"}
[SENSe]:FUNCtion:TYPE?

Example SENSe:FUNCtion:TYPE "CURRent:AC"
SENSe:FUNCtion:TYPE?→:FUNC:"CURRent:AC"

[SENSe]:FUNCtion:VOLTage:AC:AUTO

Function Sets the auto range mode for AC voltage measurement/ queries the current setting.

Syntax [SENSe]:FUNCtion:VOLTage:AC:AUTO {|<Boolean>}
[SENSe]:FUNCtion:VOLTage:AC:AUTO?

Example SENSe:FUNCtion:VOLTage:AC:AUTO ON
SENSe:FUNCtion:VOLTage:AC:AUTO?→:FUNC:VOLT:AC :AUTO 1

[SENSe]:FUNCtion:VOLTage:AC[:RANGe]

Function Sets the measuring range for AC voltage measurement.

Syntax [SENSe]:FUNCtion:VOLTage:AC[:RANGe] {|<range>|MIN|MAX}
<range>=1mV to 1KV

Example SENSe:FUNCtion:VOLTage:AC:RANGe 500V

Description If this command is sent during DC voltage measurement, the measurement function will switch to AC voltage measurement automatically.

[SENSe]:FUNCtion:VOLTage:DC:AUTO

Function Sets the auto range mode for DC voltage measurement/ queries the current setting.

Syntax [SENSe]:FUNCtion:VOLTage:DC:AUTO {|<Boolean>}
[SENSe]:FUNCtion:VOLTage:DC:AUTO?

Example SENSe:FUNCtion:VOLTage:DC:AUTO OFF
SENSe:FUNCtion:VOLTage:DC:AUTO?→:FUNC:VOLT:DC :AUTO 0

[SENSe]:FUNCtion:VOLTage:DC[:RANGe]

Function Sets the measuring range for DC voltage measurement.

Syntax [SENSe]:FUNCtion:VOLTage:DC[:RANGe] {|<range>|MIN|MAX}
<range>=1mV to 1KV

Example SENSe:FUNCtion:VOLTage:DC:RANGe 500V

Description If this command is sent during AC voltage measurement, the measurement function will switch to DC voltage measurement automatically.

[SENSe]:PANEl:[:LOCK]

Function Sets/queries the ON/OFF setting of the panel's key lock.

Syntax [SENSe]:PALEl[:LOCK] {<Boolean>}
[SENSe]:PANEl[:LOCK]?

Example SENSe:PANEl:LOCK ON
SENSe:PANEl:LOAD?→:PANEL 1

[SENSe]:PANEl:LOAD

Function Loads the set-up information.

Syntax [SENSe]:PALEl:LOAD {<file_No>}
file_No=0 to 9

Example SENSe:PANEl:LOAD 0

[SENSe]:PANEl:SAVE

Function Saves the set-up information.

Syntax [SENSe]:PALEl:SAVE {<file_No>}
file_No=0 to 9

Example SENSe:PANEl:SAVE 0

[SENSe]:RECall:DATANo

Function Sets the store data No. to be queried/queries the current setting.

Syntax [SENSe]:RECall:DATANo {<dataNo>}
[SENSe]:RECall:DATANo?
<dataNo>=1 up to the number of stored data sets

Example SENSe:RECall:DATANo 5
SENSe:RECall:DATANo?→:REC:DATAN 5

Description The store data No. specified in <dataNo> will be set to "1" when storage is started, stopped or cleared.

[SENSe]:RECall:RDATA?

Function Queries all the settings relating to the store data specified in <dataNo>.

Syntax [SENSe]:RECall:RDATA?

Example SENSe:RECall:RDATA?→:REC:RDATA:DATA +0.0E-03;FUNC "CURRent:DC",+0.002ER+00;CALC SCALE:STAT NULL

Description An error will occur if the specified stored data does not exist.

[SENSe]:RECall:RDATA:CALCulate?

Function Queries the computation function used for the store data specified in <dataNo>.

Syntax [SENSe]:RECall:RDATA:CALCulate?

Example SENSe:RECall:RDATA:CALCulate?→:REC:RDATA:CALC NULL

Description

NULL computation	=NULL
Averaging	=AVG
Scaling	=SCALE
dB display	=DB
Percentage display	=PCT
No computation	=THROUGH

[SENSe]:RECall:RDATA:DATA?

Function Queries the store data specified in <dataNo>.

Syntax [SENSe]:RECall:RDATA:DATA?

Example SENSe:RECall:RDATA:DATA?→:REC:RDATA:DATA+0.0E-03

Description An error will occur if the specified stored data does not exist.

[SENSe]:RECall:RDATA:FUNCtion?

Function Queries the function and measuring range for the store data specified in <dataNo>.

Syntax [SENSe]:RECall:RDATA:FUNCtion?

Example SENSe:RECall:RDATA:FUNCtion?→:REC:RDATA:FUNC "CURRent:DC"

Description

DC voltage measurement	="VOLTage:DC"
AC voltage measurement	="VOLTage:AC"
2-wire resistance measurement	="RESistance"
4-wire resistance measurement	="FRESistance"
DC current measurement	="CURRent:DC"
AC current measurement	="CURRent:AC"
Large current measurement	="CLAMp"
Scanner measurement	="SCANner"

A channel No. will also be returned in the case of scanner measurement.

[SENSe]:RECall:RDATA:STATus?

Function Queries the status of the store data specified in <dataNo>.

Syntax [SENSe]:RECall:RDATA:STATus?

Example SENSe:RECall:RDATA:STATus?→:REC:RDATA:STATOVER

Description The following will be returned depending on the status.

Over-range	=OVER
Pass ASS	=PASS (when the comparator function is used)
HI	=HI (when the comparator function is used)
LO	=LO (when the comparator function is used)
Normal measurement	=NULL (when the comparator function is used)
No data	=NO

[SENSe]:RECall:SIZe?

Function Queries the number of stored data sets.

Syntax [SENSe]:RECall:SIZe?

Example SENSe:RECall:SIZe?→:REC:SIZ 50

[SENSe]:RECall:STARt

Function Sets the recall start data No./queries the current setting.

Syntax [SENSe]:RECall:STARt {<startNo>}
[SENSe]:RECall:STARt?
<startNo>=1 up to the number of stored data sets

Example SENSe:RECall:STARt 10
SENSe:RECall:STARt?→:REC:STAR 10

[SENSe]:RECall[:STATus]

Function Sets the recall state/queries the current setting.

Syntax [SENSe]:RECall[:STATus] {START|STOP}
[SENSe]:RECall[:STATus]?

Example SENSe:RECall:STATus START"
SENSe:RECall:STATus?→:REC STOP

Description START indicates that recalling has started (or in progress), and STOP indicates recalling has stopped.

[SENSe]:SAMPle?

Function Queries all the sampling settings.

Syntax [SENSe]:SAMPle?

Example SENSe:SAMPle?→:SAMP +0.500E+00;SAMP:TRIG AUTO;

[SENSe]:SAMPle[:RATE]

Function Sets the sampling rate/queries the current setting.

Syntax [SENSe]:SAMPle[:RATE]
{SLOW|MID1|MID2|FAST|<Time>}
[SENSe]:SAMPle:RATE?
<Time>=1 ms to 1 s (sampling rate)

Example SENSe:SAMPle:RATE 8mS
SENSe:SAMPle:RATE?→:SAMP +0.008E+00

Description It is not possible to select FAST (or sampling rate equivalent to FAST) if SENSe:DA "***999" has been set or the scaling, dB display or percentage function is in progress.

[SENSe]:SAMPle:TRIG

Function Sets the trigger mode/queries the current setting.

Syntax [SENSe]:SAMPle:TRIG {SINGLE|AUTO}
[SENSe]:SAMPle:TRIG?

Example SENSe:SAMPle:TRIG AUTO
SENSe:SAMPle:TRIG?→:SAMP:TRIG AUTO

[SENSe]:STORe:MODe

Function Sets the storage mode/queries the current setting.

Syntax [SENSe]:STORe:MODe {LOOP|(SHOT,<size>)}
[SENSe]:STORe:MODe?
<size>=1 to 2000 (number of stored data sets)

Example SENSe:STORe:MODe SHOT,100"
SENSe:STORe:MODe?→:STOR:MOD SHOT,100

Description The number of stored data sets will be set to 2000 if LOOP has been selected.

[SENSe]:STORe[:STATus]

Function Sets the storage state/queries the current setting.

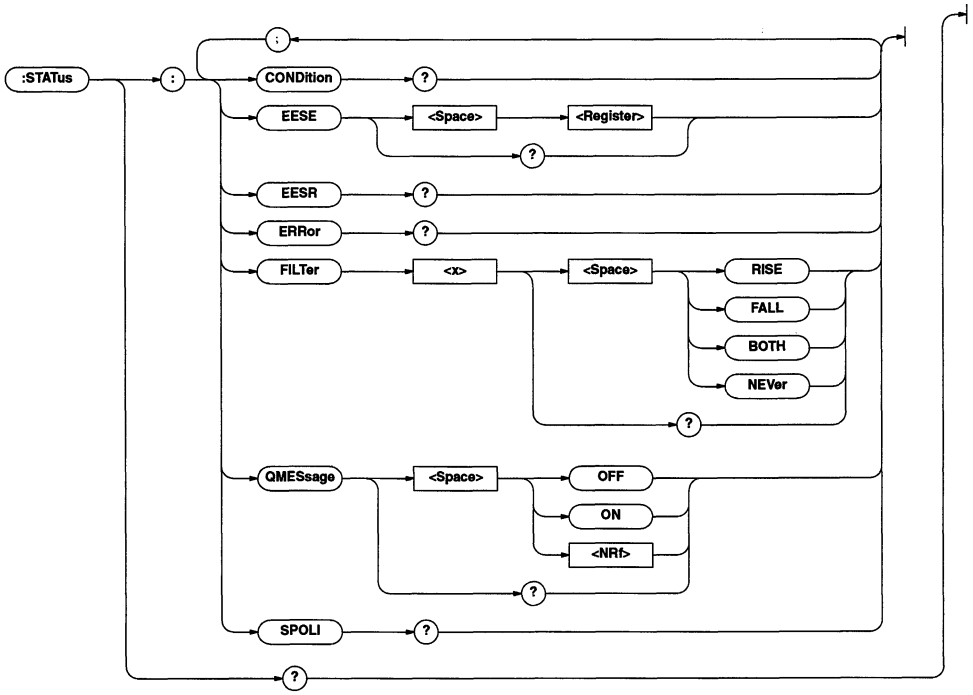
Syntax [SENSe]:STORe[:STATus] {START|STOP|CLEAR}
[SENSe]:STORe[:STATus]?

Example SENSe:STORe:STATus START"
SENSe:STORe:STATus?→:STOR STOP

Description START indicates that storage is started (or in progress), and STOP indicates storage is stopped.
If another communication command is executed while storage operation is in progress at the sampling rate FAST, data may not be stored at a rate of 125 times per second.

2.3.6 STATus Group

The commands in the STATus group are used to make settings and queries about the communication status function. There is no front panel key for this function. For the status report, refer to Appendix 2.4.



STATus?

Function Queries all the communication status function settings.

Syntax STATus?

Example STATUS?→:STATUS:EESE 0;FILTER1 NEVER;FILTER2 NEVER;FILTER3 NEVER;FILTER4 NEVER;FILTER5 NEVER;FILTER6 NEVER;FILTER7 NEVER;FILTER8 NEVER;FILTER9 NEVER;FILTER10 NEVER;FILTER11 NEVER;FILTER12 NEVER;FILTER13 NEVER;FILTER14 NEVER;FILTER15 NEVER;FILTER16 NEVER;QMESSAGE 1

STATus:CONDition?

Function Queries the contents of the condition register and clears the register.

Syntax STATus:CONDition?

Example STATUS:CONDITION→16

Description For the condition register, refer to Appendix. 2.4 "Status Report".

STATus:EESE

Function Sets the extended event enable register/queries the current setting.

Syntax STATus:EESE {<Register>}
STATus:EESE?
<Register>=0 to 65535

Example STATUS:EESE 257
STATUS:EESE?→:STATUS:EESE 257

Description For the , refer to Appendix. 2.4 "Status Report".

STATus:EESR?

Function Queries the contents of the extended event register and clears the register.

Syntax STATus:EESR?

Example STATUS:EESR?→1

Description For the extended event register, refer to Appendix. 2.4 "Status Report".

STATus:ERRor?

Function Queries the error cord and contents of the message (located at the beginning of the error queue).

Syntax STATus:ERRor?

Example STATUS:ERROR?→113,"Undefined header"

STATus:FILTer<x>

Function Sets the transit filter/queries the current setting.

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 For the condition register, refer to Appendix. 2.4 "Status Report".

STATus:QMESsage

Function Sets whether or not to add a message in response to "STAtus:ERRor?"/queries the current setting.

Syntax STATus:QMESsage {<Boolean>}
STATus:QMESsage?

Example STATUS:QMESSAGE OFF
STATUS:QMESSAGE?→:STATUS:QMESSAGE 0

STATus:SPOLI?(Serial Poll)

Function Performs a serial polling.

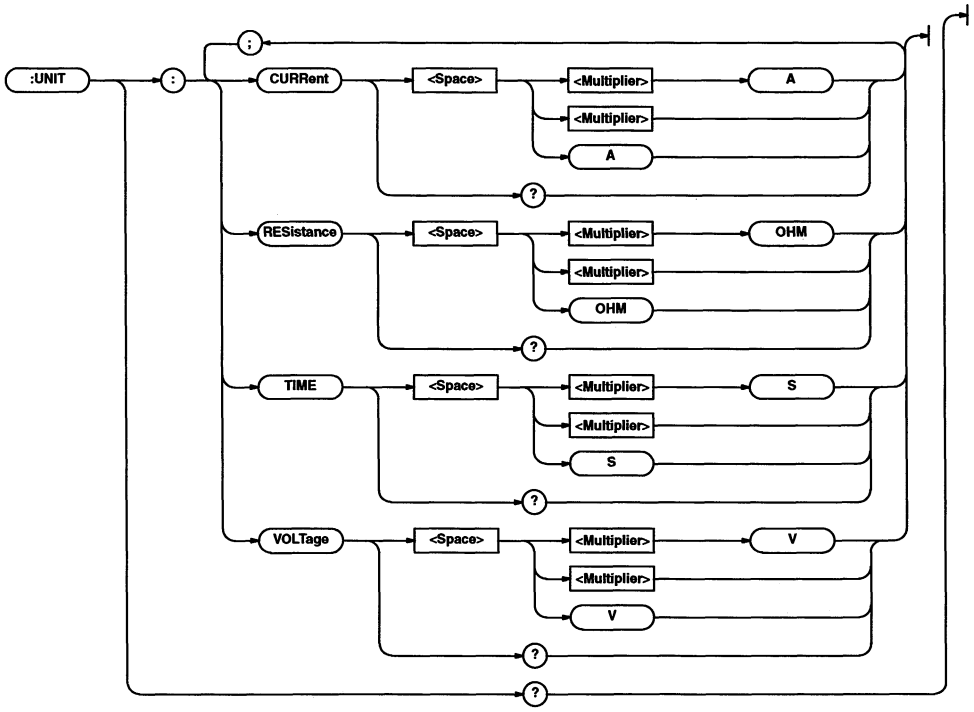
Syntax STATus:SPOLI?

Example STATUS:SPOLL?→STATUS:SPOLL 0

Description This command is available with RS-232-C interface only.

2.3.7 UNIT Group

The commands in the UNIT group are used to make settings and queries about the default units for <Current>, <Voltage>, <Resistance> and <Time>. There is no front panel key for this function.



UNIT?

Function Queries the default units for <Current>, <Resistance>, <Time> and <Voltage>.

Syntax UNIT?

Example UNIT?→:UNIT:CURR A;RES OHM;TIME S;VOLT V

UNIT:CURRent

Function Sets the default units for <Current>/queries the current setting.

Syntax UNIT:CURRent {<Multiplier>A|<Multiplier>|A}

Example UNIT:CURRent A
UNIT:CURRent→:UNIT:CURR A

UNIT:RESistance

Function Sets the default units for <Resistance>/queries the current setting.

Syntax UNIT:RESistance {<Multiplier>OHM|<Multiplier>|OHM}

Example UNIT:RESistance OHM
UNIT:RESistance→:UNIT:RES OHM

UNIT:TIME

Function Sets the default units for <Time>/queries the current setting.

Syntax UNIT:TIME {<Multiplier>S|<Multiplier>|S}

Example UNIT:TIME S
UNIT:TIME→:UNIT:RES S

UNIT:VOLTage

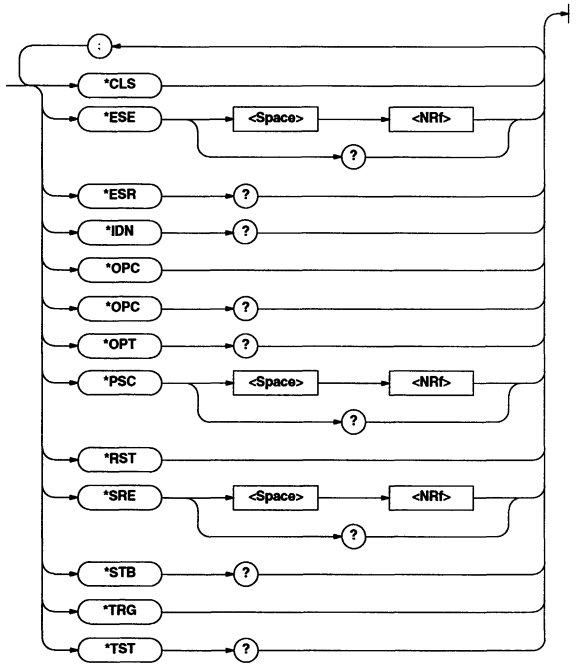
Function Sets the default units for <Voltage>/queries the current setting.

Syntax UNIT:VOLTage {<Multiplier>V|<Multiplier>|V}

Example UNIT:VOLTage V
UNIT:VOLTage→:UNIT:VOLT V

2.3.8 Common Command Group

The commands in the common command group are independent of the instrument's functions, and are specified in IEEE 488.2-1987. There is no front panel key that corresponds to this group.



*CLS

Function Clears the standard event register, extended event register and error queue.

Syntax *CLS

Example *CLS

Description The output queue will also be cleared if a *CLS command is appended after the program message terminator.
For details of the registers and queue, refer to Appendix 2.4.

*ESE

Function Sets the standard event enable register value /queries the current setting.

Syntax *ESE {<NRf>}
*ESE?
{<NRf>}=0 to 255

Example *ESE 253
*ESE?→253

Description <NRf> is the sum of the bits expressed as a decimal number.
For example, if "*ESE 253" is set, the standard event enable register will be set to "11111101". This means that bit 2 of the standard event register is disabled so that bit 5 (ESB) of the status byte register will not be set to "1", even if an inquiry error occurs.
Default is "*ESE 0", i.e. all bits are disabled.
The standard event enable register will not be cleared, even if an inquiry is made using "*ESE?".
For details of the standard event enable register, refer to page App 2-32.

*ESR?

Function Queries the standard event register value and clears it at the same time.

Syntax *ESR?

Example *ESR?→32

Description The sum of the bits is returned as a decimal value.
It is possible to ascertain the type of event which has occurred, while SRQ is occurring.
For example, if "*32" is returned, this means that the standard event register is "00100000", i.e. the SRQ has occurred due to a command syntax error.
If an inquiry is made using "*ESR?", the standard event register will be cleared.
For details of the standard event register, refer to page App 2-32.

*IDN?

Function Queries the instrument model.

Syntax *IDN?

Example *IDN? → YOKOGAWA,7555,0,F1.00

Description A reply consists of the following sequence: <Manufacturer>, <Model>, <Serial No.> and <Firmware version>. "0" is always returned as the <Serial No.>.

*LRN?

Function Queries all the current settings for the following commands.
UNIT? , MEASure? , SENSe:FUNCtion? , SENSe:DA? , SENSe:STORe:STATus? , SENSe:RECall:STATUs?

Syntax *LRN?

Example *LRN?→:UNIT:CURR A;RES OHM;TIME S;VOLT V;:MEAS:VOLT:DC +1.43612E+00;:SENS:FUNC:VOLT:DC +0.002E+03;DC:AUTO 1;:SENS:DA "1999**";STOR:STAT CLEAR;:SENS:REC:STAT STOP

*OPC

Function Sets bit 0 (OPC bit) of the standard event register to "1" when execution of an overlap command is completed. This command will be ignored even if it is sent, since it is not supported by this instrument.

Syntax *OPC

*OPC?

Function "1" will be returned if execution of the designated overlap command has been completed. "1" is always returned since no overlap command is supported by this instrument.

Syntax *OPC?

Example *OPC? → 1

*OPT?

Function Queries installed options.

Syntax *OPT?

Example *OPT? → SCANNER2,GPIB

Description "NONE" is returned for uninstalled options.

The following responses are available.

SCANNER imple scanner
DABCD /A and BCD output
GPIB P-IB interface

"*OPT?" must always be the last query in a program message. If there is another query after "*OPT" , an error will occur.

*PSC

Function Selects whether or not to clear the following registers when power is turned ON/queries the current setting. However, they cannot be cleared if the parameter is "0" when rounded.

Standard event enable register
Extended event enable register
Transit filter

Syntax *PSC {<NRf>}

*PSC?

{<NRf>}=0 (does not clear the registers), a value other than 0 (clears the registers)

Example *PSC 1

*PSC?→1

Description For details of each register, refer to Appendix 2.4.

*RST

Function Initializes the set-up information.

Syntax *RST

Example *RST

Description For the default settings, refer to Section 3.5 "Default Settings". All the items except for communications related items will be initialized.

*SRE

Function Sets the service request enable register value/queries the current setting.

Syntax *SRE {<NRf>}

*SRE?

{<NRf>}=0 to 255

Example *SRE 239

*SRE?→239

Description <NRf> is the sum of the bits expressed as a decimal number.

For example, if "*ESE 239" is set, the service request enable register will be set to "11101111". This means that bit 4 of the service request enable register is disabled, so that bit 5 (ESB) of the status byte register will not be set to "1", even if the output queue is not empty.

However, bit 6 (MSS) of the status byte register is the MSS bit, so it will be ignored.

Default is "*SRE 0", i.e. all bits are disabled.

The service request enable register will not be cleared, even if an inquiry is made using "*SRE?".

For details of the service request enable register, refer to page App 2-32.

*STB?

Function Queries the status byte register value.

Syntax *STB?

Example *STB?→4

Description The sum of the bits expressed as a decimal value is returned.

Bit 6 is MSS not RQS, since the register is read without serial polling.

For example, if "4" is returned, the status byte register is set to "00000100", i.e. the error queue is not empty (an error has occurred).

The status byte register will not be cleared, even if an inquiry is made using "*STB?".

For details of the status byte register, refer to page App 2-32.

*TRG

Function Carries out the same operations as when the TRIG key is pressed.

Syntax *TRG

Description The multi-line message GET (Group Execute Trigger) also has the same effect.

*TST?

Function Executes a self-test and queries the test result. All internal memories are tested.

Syntax *TST?

Example *TST?→0

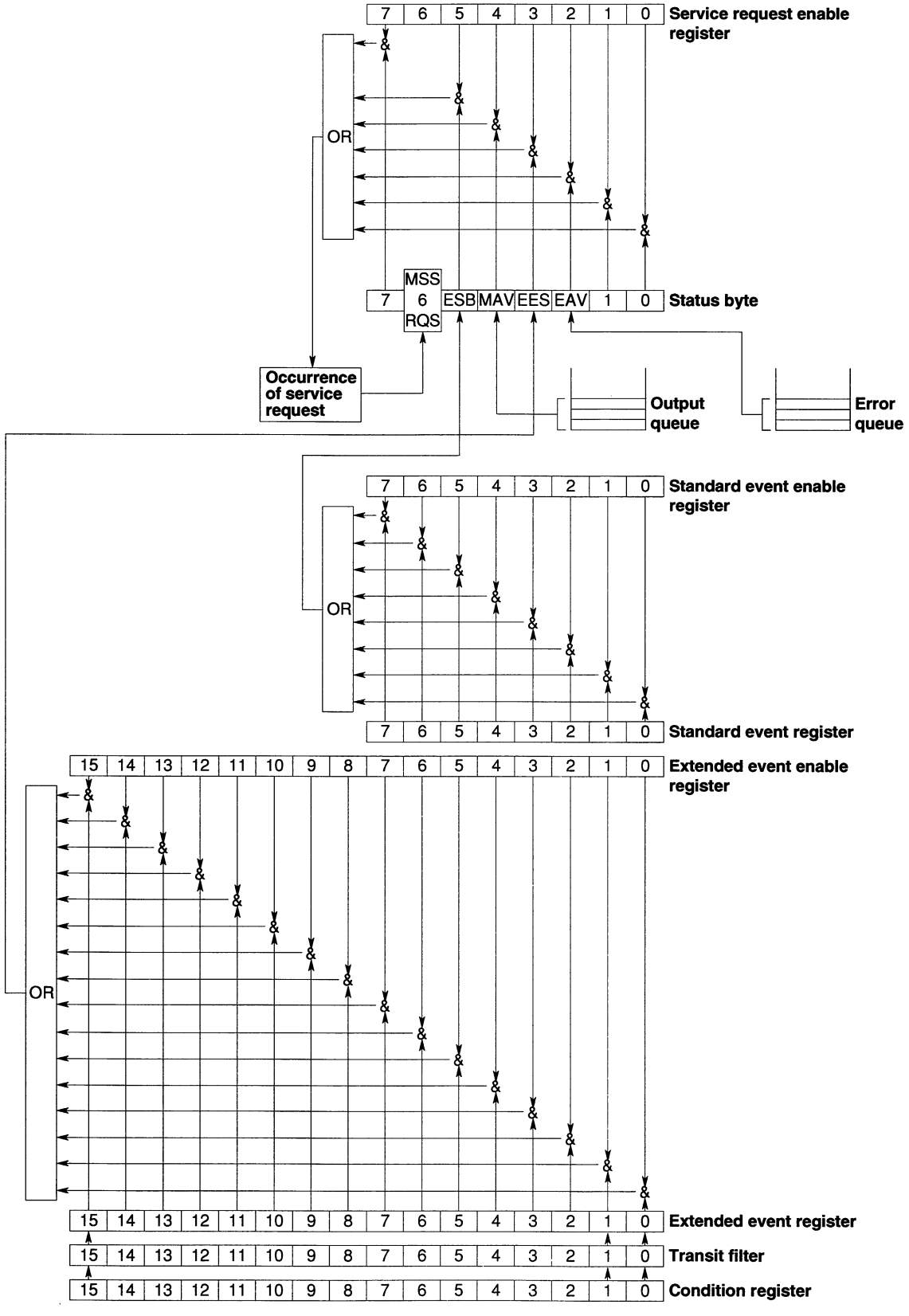
Description "0" will be returned if the self test result is satisfactory, and a value other than "0" will be returned if an abnormality is detected during the test.

2.4 Status Report

2.4.1 Overview of Status Report

Status Report

The figure below shows the status report which is read by a serial poll. This is an extended version of the one specified in IEEE 488.2-1987.



Overview of Registers and Queues

Name	Function	Writing	Reading
Status byte		—	Serial poll (RQS), *STB? (MSS)
Service request enable register	Masks status byte	*SRE	*SRE?
Standard event register	Event in the instrument	—	*ESR?
Standard event enable register	Masks standard event register.	*ESE	*ESE?
Extended event register	Event in the instrument	—	STATus:EESR?
Extended event enable register	Masks extended event register.	STATus:EESE	STATus:EESE?
Condition register	Current instrument status	—	STATus:CONDition?
Transit filter	Extended event occurrence conditions	STATus:FILTer <x>	STATus:FILTer<x>?
Output queue	Stores response message to an inquiry.	All executable queues	
Error queue	Stored error Nos. and messages.	—	STATus:ERRor?

Registers and Queues which Affect Status Byte

Registers which affect each bit of the status byte are shown below.

Standard event register : Sets bit 5 (ESB) of status byte to "1" or "0".

Output queue : Sets bit 4 (MAV) of status byte to "1" or "0".

Extended event register : Sets bit 3 (EES) of status byte to "1" or "0".

Error queue : Sets bit 2 (EAV) of status byte to "1" or "0".

Enable Registers

Registers which mask a bit so that the bit does not affect the status byte, even if that bit is "1", are shown below.

Status byte : Masks bits using the service request enable register.

Extended event register : Masks bits using the extended event enable register.

Writing/Reading from Registers

For example, the *ESE command is used to set bits in the standard event enable register to "1" or "0", and the *ESR? query is used to check whether bits in that register are set to "1" or "0". For details of these commands, refer to Appendix 2.3.

2.4.2 Status Byte

Overview of Status Byte

- **Bits 0, 1 and 7**

  Not used (always "0")

- **Bit 2 EAV (Error Available)**

  Set to "1" when the error queue is not empty, i.e. when an error occurs. For details, refer to page App 2-34.

- **Bit 3 EES (Extend Event Summary Bit)**

  Set to "1" when a logical AND of the extended event register and the corresponding enable register is not "0", i.e. when an event takes place in the instrument. Refer to page App 2-3.

- **Bit 4 MAV (Message Available)**

  Set to "1" when the output queue is not empty, i.e. when there is data which is to be output when an inquiry is made. Refer to page App 2-34.

- **Bit 5 ESB (Event Summary Bit)**

  Set to "1" when a logical AND of the standard event register and the corresponding enable register is not "0", i.e. when an event takes place in the instrument. Refer to page App 2-32.

- **Bit 6 RQS (Request Status)/MSS (Master Summary Status)**

  MSS is set to "1" when a logical AND of the status byte (except for bit 6) and the service request enable register is not "0", i.e. when the instrument is requesting a service from the controller.

  RQS is set to "1" when MSS changes from "0" to "1", and is cleared when a serial poll is performed or when MSS 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 no service will be requested, even if an error occurs, set bit 2 of the service request enable register to "0". This can be done using the *SRE command. To inquire whether each bit of the service request enable register is "1" or "0", use *SRE?. For details of the *SRE command, refer to Appendix 2.3.

Operation of the Status Byte

A service request is issued when bit 6 of the status byte becomes "1". Bit 6 becomes "1" when any of the other bits becomes "1" (or when the corresponding bit in the service request enable register becomes "1").

For example, if an event takes place and the logical OR of each bit of the standard event register and the corresponding bit in the enable register becomes "1", bit 5 (ESB) will be set to "1". In this case, if bit 5 of the service request enable register is "1", bit 6 (MSS) will be set to "1", thus requesting service from the controller.

It is also possible to check what type of event has occurred by reading the contents of the status byte.

Reading from the Status Byte

The following two methods are provided for reading the status byte.

- **Inquiry using the *STB? query**

  Making an inquiry using the *STB? query changes bit 6 to MSS. This causes the MSS to be read. After completion of the read-out, none of the bits in the status byte will be cleared.

- **Serial poll**

  Execution of a serial poll changes bit 6 to RQS. This causes RQS to be read. After completion of the read-out, only RQS is cleared. Using a serial poll, it is not possible to read MSS.

Clearing the Status Byte

No method is provided for forcibly clearing all the bits in the status byte. Bits which are cleared are shown below.

When an inquiry is made using the *STB? query

No bit is cleared.

When a serial poll is performed

Only the RQS bit is cleared.

When the *CLS command is received

When the *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 bits in the status byte are cleared, except bit 4 (MAV), since the output queue cannot be cleared by the *CLS command. However, the output queue will be also cleared if the *CLS command is received just after a program message terminator.

2.4.3 Standard Event Register

Overview of the Standard Event Register

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

- **Bit 7 PON (Power ON)**

  Set to "1" when power to the instrument is turned ON.

- **Bit 6 URQ (User Request)**

  Not used (always "0")

- **Bit 5 CME (Command Error)**

  Set to "1" when the command syntax is incorrect.

  Examples Incorrectly spelled command name

- **Bit 4 EXE (Execution Error)**

  Set to "1" when the command syntax is correct but the command cannot be executed in the current state.

  Examples Parameters are outside the setting range.

- **Bit 3 DDE (Device Dependent Error)**

  Set to "1" when execution of the command is not possible due to an internal problem in the instrument that is not a command syntax error or execution error.

- **Bit 2 QYE (Query Error)**

  Set to "1" if the output queue is empty or if the data is missing even if a query is sent.

  Examples No response data; data is lost since the output queue is full.

- **Bit 1 RQC (Request Control)**

  Not used (always "0")

- **Bit 0 OPC (Operation Complete)**

  Set to "1" when the operation designated by the *OPC command has been completed.

Bit Masking

To mask a bit in the standard event register so that it does not cause bit 5 (ESB) of the status byte, 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". This can be done using the *ESE command. To inquire whether each bit of the standard event enable register is "1" or "0", use the *ESE?. For details of the *ESE command, refer to Appendix 2.3.

Operation of the Standard Event Register

The standard event register is provided for eight kinds of event which can occur inside the instrument. Bit 5 (ESB) of the status byte is set to "1" when any of the bits in this register becomes "1" (or when the corresponding bit of the standard event enable register becomes "1").

Examples

1. A query error occurs.
2. Bit 2 (QYE) is set to "1".
3. Bit 5 (ESB) of the status byte is set to "1" if bit 2 of the standard event enable register is "1".

It is also possible to check which type of event has occurred inside the instrument by reading the contents of the standard event register.

Reading from the Standard Event Register

The contents of the standard event register can be read by the *ESR? command. After completion of the read-out, the register will be cleared.

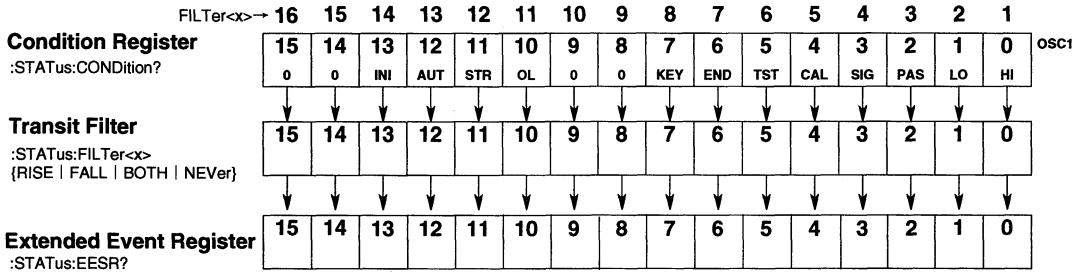
Clearing the Standard Event Register

The standard event register is cleared in the following three cases.

- When the contents of the standard event register are read using *ESR?
- When the *CLS command is received
- When power is turned ON again

2.4.4 Extended Event Register

The extended event register stores the results obtained when a change to the state in the condition register, which shows the internal state of the instrument, is detected by the transit filter edge.



Meaning of each bit of the condition register is given below.

Bit 0	HI(Hi)	Changes from "0" to "1" and back to "0" when the comparator result is Hi.
Bit 1	LO(Lo)	Changes from "0" to "1" and back to "0" when the comparator result is Lo.
Bit 2	PAS(Pass)	Changes from "0" to "1" and back to "0" when the comparator result is Pass.
Bit 3	SIG(Single)	Changes to "1" when the trigger mode switches to SINGLE, and changes to "0" when the trigger mode switches to AUTO.
Bit 4	CAL(Calibration)	Changes to "1" during calibration. Calibration is complete when this bit changes from "1" to "0".
Bit 5	TST(Self Test)	Changes to "1" when the self-test has been completed.
Bit 6	END(A/D END)	Changes from "0" to "1" and back to "0" when A/D conversion is completed.
Bit 7	KEY(SRQ Key)	Changes from "0" to "1" and back to "0" when the SRQ key is pressed.
Bit 8		Always "0"
Bit 9		Always "0"
Bit 10	OL(Over Range)	Changes from "0" to "1" and back to "0" when an over-range occurs.
Bit 11	STR(Data Store)	Changes to "1" when storage of measured/computed data is completed.
Bit 12	AUT(Auto)	Changes to "1" when the trigger mode switches to AUTO, and changes to "0" when the trigger mode switches to SINGLE.
Bit 13	INI(Init)	Changes to "1" when the set-up information is initialized.
Bit 14		Always "0"
Bit 15		Always "0"

Each transit filter parameter detects a change to the particular bit (1 to 16) of the condition register, and changes the corresponding bit of the extended event register accordingly as follows.

RISE	Sets the specified bit of the extended event register to "1" when changed from "0" to "1".
FALL	Sets the specified bit of the extended event register to "1" when changed from "1" to "0".
BOTH	Sets the specified bit of the extended event register to "1" when changed from "1" to "0" or from "0" to "1".
NEVer	Always "0"

2.4.5 Output Queue and Error Queue

Overview of the Output Queue

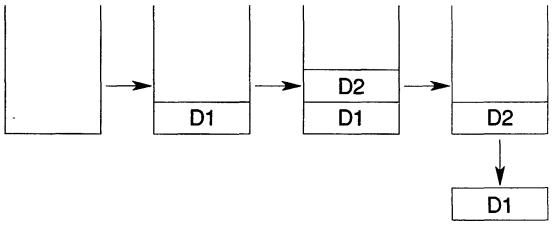
The output queue is provided to store response messages to queries. For example, when the READ:DATA? query is sent to request output of the measured data, the response data will be stored in the output queue until it is read out.

The example below shows that data is stored record by record in the output queue, and is read out oldest item first, newest item last.

The output queue is emptied in the following cases (in addition to when read-out is performed).

- When a new message is received from the controller
- When dead lock occurs (page App 2-4)
- When a device clear command (DCL or SDC) is received
- When power is turned ON again

The output queue cannot be emptied using the *CLS command. To see whether the output queue is empty or not, check bit 4 (MAV) of the status byte.



Overview of the Error Queue

The error queue stores the error No. and the message when an error occurs. For example, when the controller receives an incorrect program message, an error occurs and its error No. 113 and message "Undefined header" will be stored in the error queue.

The contents of the error queue can be read using the STATus:ERRor? query. Like the output queue, messages are read the oldest message first, newest message last.

If the error queue becomes full, the final message will be replaced by message 350, "Queue overflow".

The error queue is emptied in the following cases (in addition to when read-out is performed).

- When the *CLS command is received
- When power is turned ON again

To see whether the error queue is empty or not, check bit 2 (EAV) of the status byte.

2.5 Sample Program

Required Environment

Hardware

PC	: IBM PC-AT and compatible system
Interface	: GPIB-PCII/IIA National Instruments

Software

PC	: MS-DOS V5.00 (or higher)
Interface	: Config. Program IBCONF.EXE Rev C.4.1
Basic	: Quick Basic Ver 4.0/4.5
Command type	: Command 4 type

Sample Program 1

```
'   ************************************************************
'   *                                                          *
'   *     MODEL 7555 Sample Program(Recall Data) for GP-IB     *
'   *                                                          *
'   ************************************************************
'
    REM $INCLUDE: 'qbdecl4.bas'
'
' Error exception
'
    DECLARE SUB GPIBERR (MSG$)
'
' Identify
'
    DEVNAME$ = "GPIB0"          'It's me
    CALL IBFIND(DEVNAME$, BOARD%)
    IF (BOARD% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
    DEVNAME$ = "M7555"          'Model 7555
    CALL IBFIND(DEVNAME$, DEV%)
    IF (DEV% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
'
' Interface Clear
'
    V% = 1                      'Set
    CALL IBRSC(BOARD%, V%)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBRSC Error")
'
' Setup Communication
'
    CMD$ = "COMM:HEAD 0"      'Disable Response Header
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
```

```
' Setup Function
'
    CMD$ = "FUNC:TYPE " + CHR$(34) + "VOLT:DC" + CHR$(34) 'DC Voltage
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "FUNC:VOLT:DC:AUTO 1" 'Auto Range
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "SAMP:RATE MID2;TRIG AUTO" 'MID2 Rate and Auto Trigger
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
' Setup Calcurate
'
    CMD$ = "CALC:DB:STAT 1;KC 20;KD 0.1" 'dB Scale
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
' Setup Store
'
    CMD$ = "STOR:MODE SHOT,10;STAT CLEAR" 'Store Shot mode, 10 points and Clear
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "STOR:STAT START"    'Start Data Storage
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
' Wait Measure Stop
'
WLOOP:
    CMD$ = "STOR:STAT?"         'Query Status
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    D$ = SPACE$(200)
    CALL IBRD(DEV%, D$)         'Get Status
    IF LEFT$(D$, 4) = "STOP" THEN GOTO RECALL
    FOR I% = 1 TO 30000: NEXT I%
    GOTO WLOOP
'
' Get Data
'
RECALL:
    PRINT "RECALL"
    CMD$ = "REC:SIZE?"          'Query Stored Count
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    D$ = SPACE$(200)
    CALL IBRD(DEV%, D$)         'Get Stored Count
    SIZE% = VAL(D$)
    FOR I% = 1 TO SIZE%
        CMD$ = "REC:DATANO " + STR$(I%) + ";RDATA:DATA?" 'Query Stored Data
        CALL IBWRT(DEV%, CMD$)
        IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
        D$ = SPACE$(200)
        CALL IBRD(DEV%, D$)     'Get Stored Data
        J% = INSTR(D$, CHR$(10))
        IF J% > 0 THEN D$ = LEFT$(D$, J% - 1)
        PRINT D$
    NEXT I%
    END
```

```
'=============================================================
'                      Subroutine GPIBERR
'  This subroutine will notify you that a NI-488 function failed by printing
'  an error message.  The status variable IBSTA% will also be printed
'  in hexadecimal along with the mnemonic meaning of the bit position.
'  The status variable IBERR% will be printed in decimal along with the
'  mnemonic meaning of the decimal value.  The status variable IBCNT% will
'  be printed in decimal.
'
'  The NI-488 function IBONL is called to disable the hardware and software.
'
'  The STOP command will terminate this program.
'=============================================================
'
SUB GPIBERR (MSG$) STATIC

    PRINT MSG$

    PRINT "ibsta = &H"; HEX$(IBSTA%); " <";
    IF IBSTA% AND EERR THEN PRINT " ERR";
    IF IBSTA% AND TIMO THEN PRINT " TIMO";
    IF IBSTA% AND EEND THEN PRINT " END";
    IF IBSTA% AND SRQI THEN PRINT " SRQI";
    IF IBSTA% AND RQS THEN PRINT " RQS";
    IF IBSTA% AND SPOLL THEN PRINT " SPOLL";
    IF IBSTA% AND EEVENT THEN PRINT " EVENT";
    IF IBSTA% AND CMPL THEN PRINT " CMPL";
    IF IBSTA% AND LOK THEN PRINT " LOK";
    IF IBSTA% AND RREM THEN PRINT " REM";
    IF IBSTA% AND CIC THEN PRINT " CIC";
    IF IBSTA% AND AATN THEN PRINT " ATN";
    IF IBSTA% AND TACS THEN PRINT " TACS";
    IF IBSTA% AND LACS THEN PRINT " LACS";
    IF IBSTA% AND DTAS THEN PRINT " DTAS";
    IF IBSTA% AND DCAS THEN PRINT " DCAS";
    PRINT " >"

    PRINT "iberr = "; IBERR%;
    IF IBERR% = EDVR THEN PRINT " EDVR <DOS Error>"
    IF IBERR% = ECIC THEN PRINT " ECIC <Not CIC>"
    IF IBERR% = ENOL THEN PRINT " ENOL <No Listener>"
    IF IBERR% = EADR THEN PRINT " EADR <Address error>"
    IF IBERR% = EARG THEN PRINT " EARG <Invalid argument>"
    IF IBERR% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
    IF IBERR% = EABO THEN PRINT " EABO <Op. aborted>"
    IF IBERR% = ENEB THEN PRINT " ENEB <No GPIB board>"
    IF IBERR% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
    IF IBERR% = ECAP THEN PRINT " ECAP <No capability>"
    IF IBERR% = EFSO THEN PRINT " EFSO <File sys. error>"
    IF IBERR% = EBUS THEN PRINT " EBUS <Command error>"
    IF IBERR% = ESTB THEN PRINT " ESTB <Status byte lost>"
    IF IBERR% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
    IF IBERR% = ETAB THEN PRINT " ETAB <Table Overflow>"

    PRINT "ibcnt = "; IBCNT%

'       Call the IBONL function to disable the hardware and software.
    CALL IBONL(DEV%, 0)
    STOP
END SUB
```

Sample Program 2

```
'   ************************************************************
'   *                                                          *
'   *     MODEL 7555 Sample Program(Using Scanner) for GP-IB   *
'   *                                                          *
'   ************************************************************
'
    REM $INCLUDE: 'qbdecl4.bas'
'
' Error exception
'
    DECLARE SUB GPIBERR (MSG$)
'
' Identify
'
    DEVNAME$ = "GPIB0"          'It's me
    CALL IBFIND(DEVNAME$, BOARD%)
    IF (BOARD% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
    DEVNAME$ = "M7555"          'Model 7555
    CALL IBFIND(DEVNAME$, DEV%)
    IF (DEV% < 0) THEN CALL GPIBERR("IBFIND Error " + DEVNAME$)
'
' Interface Clear
'
    V% = 1                      'Set
    CALL IBRSC(BOARD%, V%)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBRSC Error")
'
' Setup
'
    CMD$ = "FUNC:SCAN ONLY"     'Scanner Only mode
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
    CMD$ = "SAMP:RATE SLOW;TRIG SINGLE" 'Slow Rate and Single Trigger
    CALL IBWRT(DEV%, CMD$)
    IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
'
' Scan
'
    FOR I% = 1 TO 5             'Scan from 1CH to 5CH
        CMD$ = "FUNC:SCAN:CH " + STR$(I%) 'Select CH
        CALL IBWRT(DEV%, CMD$)
        IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
        FOR J% = 1 TO 2         'Scan twice for each ch
            CALL IBTRG(DEV%)    'Trigger
            CMD$ = "READ:DATA?" 'Query Data
            CALL IBWRT(DEV%, CMD$)
            IF (IBSTA% AND EERR) THEN CALL GPIBERR("IBWRT Error")
            D$ = SPACE$(40)
            CALL IBRD(DEV%, D$) 'Get Data
            K% = INSTR(D$, CHR$(10))
            IF K% > 0 THEN D$ = LEFT$(D$, K% - 1)
            PRINT D$
        NEXT J%
    NEXT I%
    END
```

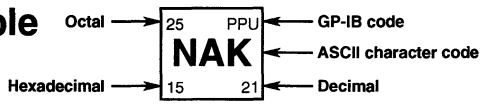
```
'=============================================================
'                      Subroutine GPIBERR
'  This subroutine will notify you that a NI-488 function failed by printing
'  an error message.  The status variable IBSTA% will also be printed
'  in hexadecimal along with the mnemonic meaning of the bit position.
'  The status variable IBERR% will be printed in decimal along with the
'  mnemonic meaning of the decimal value.  The status variable IBCNT% will
'  be printed in decimal.
'
'  The NI-488 function IBONL is called to disable the hardware and software.
'
'  The STOP command will terminate this program.
'=============================================================
'
SUB GPIBERR (MSG$) STATIC

    PRINT MSG$

    PRINT "ibsta = &H"; HEX$(IBSTA%); " <";
    IF IBSTA% AND EERR THEN PRINT " ERR";
    IF IBSTA% AND TIMO THEN PRINT " TIMO";
    IF IBSTA% AND EEND THEN PRINT " END";
    IF IBSTA% AND SRQI THEN PRINT " SRQI";
    IF IBSTA% AND RQS THEN PRINT " RQS";
    IF IBSTA% AND SPOLL THEN PRINT " SPOLL";
    IF IBSTA% AND EEVENT THEN PRINT " EVENT";
    IF IBSTA% AND CMPL THEN PRINT " CMPL";
    IF IBSTA% AND LOK THEN PRINT " LOK";
    IF IBSTA% AND RREM THEN PRINT " REM";
    IF IBSTA% AND CIC THEN PRINT " CIC";
    IF IBSTA% AND AATN THEN PRINT " ATN";
    IF IBSTA% AND TACS THEN PRINT " TACS";
    IF IBSTA% AND LACS THEN PRINT " LACS";
    IF IBSTA% AND DTAS THEN PRINT " DTAS";
    IF IBSTA% AND DCAS THEN PRINT " DCAS";
    PRINT " >"

    PRINT "iberr = "; IBERR%;
    IF IBERR% = EDVR THEN PRINT " EDVR <DOS Error>"
    IF IBERR% = ECIC THEN PRINT " ECIC <Not CIC>"
    IF IBERR% = ENOL THEN PRINT " ENOL <No Listener>"
    IF IBERR% = EADR THEN PRINT " EADR <Address error>"
    IF IBERR% = EARG THEN PRINT " EARG <Invalid argument>"
    IF IBERR% = ESAC THEN PRINT " ESAC <Not Sys Ctrlr>"
    IF IBERR% = EABO THEN PRINT " EABO <Op. aborted>"
    IF IBERR% = ENEB THEN PRINT " ENEB <No GPIB board>"
    IF IBERR% = EOIP THEN PRINT " EOIP <Async I/O in prg>"
    IF IBERR% = ECAP THEN PRINT " ECAP <No capability>"
    IF IBERR% = EFSO THEN PRINT " EFSO <File sys. error>"
    IF IBERR% = EBUS THEN PRINT " EBUS <Command error>"
    IF IBERR% = ESTB THEN PRINT " ESTB <Status byte lost>"
    IF IBERR% = ESRQ THEN PRINT " ESRQ <SRQ stuck on>"
    IF IBERR% = ETAB THEN PRINT " ETAB <Table Overflow>"

    PRINT "ibcnt = "; IBCNT%

'       Call the IBONL function to disable the hardware and software.
    CALL IBONL(DEV%, 0)
    STOP
END SUB
```

2.6 ASCII Character Code

ASCII character codes are given below.

	0	1	2	3	4	5	6	7
0	0 **NUL** 0 0	20 **DEL** 10 16	40 0 **SP** 20 32	60 16 **0** 30 48	100 0 **@** 40 64	120 16 **P** 50 80	140 0 **‘** 60 96	160 16 **p** 70 112
1	1 GTL **SOH** 1 1	21 LLO **DC1** 11 17	41 1 **!** 21 33	61 17 **1** 31 49	101 1 **A** 41 65	121 17 **Q** 51 81	141 1 **a** 61 97	161 17 **q** 71 113
2	2 **STX** 2 2	22 **DC2** 12 18	42 2 **”** 22 34	62 18 **2** 32 50	102 2 **B** 42 66	122 18 **R** 52 82	142 2 **b** 62 98	162 18 **r** 72 114
3	3 **ETX** 3 3	23 **DC3** 13 19	43 3 **#** 23 35	63 19 **3** 33 51	103 3 **C** 43 67	123 19 **S** 53 83	143 3 **c** 63 99	163 19 **s** 73 115
4	4 SDC **EOT** 4 4	24 DCL **DC4** 14 20	44 4 **$** 24 36	64 20 **4** 34 52	104 4 **D** 44 68	124 20 **T** 54 84	144 4 **d** 64 100	164 20 **t** 74 116
5	5 PPC **ENQ** 5 5	25 PPU **NAK** 15 21	45 5 **%** 25 37	65 21 **5** 35 53	105 5 **E** 45 69	125 21 **U** 55 85	145 5 **e** 65 101	165 21 **u** 75 117
6	6 **ACK** 6 6	26 **SYN** 16 22	46 6 **&** 26 38	66 22 **6** 36 54	106 6 **F** 46 70	126 22 **V** 56 86	146 6 **f** 66 102	166 22 **v** 76 118
7	7 **BEL** 7 7	27 **ETB** 17 23	47 7 **’** 27 39	67 23 **7** 37 55	107 7 **G** 47 71	127 23 **W** 57 87	147 7 **g** 67 103	167 23 **w** 77 119
8	10 GET **BS** 8 8	30 SPE **CAN** 18 24	50 8 **(** 28 40	70 24 **8** 38 56	110 8 **H** 48 72	130 24 **X** 58 88	150 8 **h** 68 104	170 24 **x** 78 120
9	11 TCT **HT** 9 9	31 SPD **EM** 19 25	51 9 **)** 29 41	71 25 **9** 39 57	111 9 **I** 49 73	131 25 **Y** 59 89	151 9 **i** 69 105	171 25 **y** 79 121
A	12 **LF** A 10	32 **SUB** 1A 26	52 10 ***** 2A 42	72 26 **:** 3A 58	112 10 **J** 4A 74	132 26 **Z** 5A 90	152 10 **j** 6A 106	172 26 **z** 7A 122
B	13 **VT** B 11	33 **ESC** 1B 27	53 11 **+** 2B 43	73 27 **;** 3B 59	113 11 **K** 4B 75	133 27 **[** 5B 91	153 11 **k** 6B 107	173 27 **{** 7B 123
C	14 **FF** C 12	34 **FS** 1C 28	54 12 **,** 2C 44	74 28 **<** 3C 60	114 12 **L** 4C 76	134 28 **** 5C 92	154 12 **l** 6C 108	174 28 **|** 7C 124
D	15 **CR** D 13	35 **GS** 1D 29	55 13 **-** 2D 45	75 29 **=** 3D 61	115 13 **M** 4D 77	135 29 **]** 5D 93	155 13 **m** 6D 109	175 29 **}** 7D 125
E	16 **SO** E 14	36 **RS** 1E 30	56 14 **.** 2E 46	76 30 **>** 3E 62	116 14 **N** 4E 78	136 30 **^** 5E 94	156 14 **n** 6E 110	176 30 **~** 7E 126
F	17 **SI** F 15	37 **US** 1F 31	57 15 **/** 2F 47	77 UNL **?** 3F 63	117 15 **O** 4F 79	137 UNT **_** 5F 95	157 15 **o** 6F 111	177 **DEL (RUBOUT)** 7F 127
	Address Command	**Universal Command**	**Listener Address**		**Talker Address**		**Secondary Command**	

Example



2.7 Error Messages

Error messages related to communications are given below.

- Error messages are shown in English when they are displayed on a personal computer.
- When servicing is required, contact your nearest YOKOGAWA representative, given on the back cover of this manual.
- Only error messages relating to communications are given. For other error messages, such as those which occur when an incorrect panel key operation is carried out, refer to Section 10.3 "Error Codes and Corrective Actions".

Errors in communication command (100 to 199)

Cord	Message	Action	Refference Page
102	Syntax error	Incorrect syntax	Appendix 2.2, 2.3
103	Invalid separator	Insert a comma between data items to separate them.	App 2-3
104	Data type error	Refer to pages App 2-6 to 2-7 and enter using the correct data format.	App 2-6, 2-7
105	GET not allowed	GET is not supported as a response to an interface message.	—
108	Parameter not allowed	Check the number of parameters.	App 2-6, Appendix 2.3
109	Missing parameter	Enter required parameters.	App 2-6, Appendix 2.3
111	Header separator error	Insert a space between the header the data to separate them.	App 2-3
112	Program mnemonic too long	Check the mnemonic (a character string consisting of letters and numbers).	Appendix 2.3
113	Undefined header	Check the header.	Appendix 2.3
114	Header suffix out of range	Check the header.	Appendix 2.3
120	Numeric data error	Mantissa must be entered before a numeric value for <NRf> format.	App 2-6
123	Exponent too large	Use a smaller exponent for <NR3> format.	App 2-6, Appendix 2.3
124	Too many digits	Limit the number of digits to 255 or less.	App 2-6, Appendix 2.3
128	Numeric data not allowed	Enter in a format other than <NRf> format.	App 2-6, Appendix 2.3
131	Invalid suffix	Check the unit for <Voltage>and <Current>.	App 2-7
134	Suffix too long	Check the unit for <Voltage>and <Current>.	App 2-7
138	Suffix not allowed	No units are allowed other than <Voltage> and <Current>.	App 2-7
141	Invalid character data	Enter one of the character strings in {...|...|...}.	Appendix 2.3
144	Character data too long	Check the character strings in {...|...|...}.	Appendix 2.3
148	Character data not allowed	Enter in a format other than in {...|...|...}.	Appendix 2.3
150	String data error	<Character string> must be enclosed by double quotation marks or single quotation marks.	App 2-7
151	Invalid string data	<Character string> is too long or contains characters which cannot be used.	Appendix 2.3

Cord	Message	Action	Refference Page
158	String data not allowed	Enter in a data format other than <Character string>.	Appendix 2.3
161	Invalid block data	<Block data> is not allowed.	—
168	Block data not allowed	<Block data> is not allowed.	—
171	Invalid expression	Equation is not allowed.	Appendix 2.3
178	Expression data not allowed	Equation is not allowed.	Appendix 2.3
181	Invalid outside macro definition	Does not conform to the macro function specified in IEEE488.2.	—

Error in communications execution (200 to 299)

Cord	Message	Action	Refference Page
221	Setting conflict	Check the relevant setting.	Appendix 2.3
222	Data out of range	Check the setting range.	Appendix 2.3
223	Too much data	Check the data byte length.	Appendix 2.3
224	Illegal parameter value	Check the setting range.	Appendix 2.3
241	Hardware missing	Check availability of options.	—
260	Expression error	Equation is not allowed.	—
270	Macro error	Does not conform to the macro function specified in IEEE488.2.	—
272	Macro execution error	Does not conform to the macro function specified in IEEE488.2.	—
273	Illegal macro label	Does not conform to the macro function specified in IEEE488.2.	—
275	Macro definition too long	Does not conform to the macro function specified in IEEE488.2.	—
276	Macro recursion error	Does not conform to the macro function specified in IEEE488.2.	—
277	Macro redefinition not allowed	Does not conform to the macro function specified in IEEE488.2.	—
278	Macro header not found	Does not conform to the macro function specified in IEEE488.2.	—

Error in communications query (400 to 499)

Cord	Message	Action	Refference Page
410	Query INTERRUPTED	Check transmission/reception order.	App 2-3
420	Query UNTERMINATED	Check transmission/reception order.	App 2-3
430	Query DEADLOCKED	Limit the length of the program message including <PMT> to 1024 bytes or less.	App 2-4
440	Query UNTERMINATED after indefinite response	Do not enter any query after *IDN? and *OPT?.	—

Error in System Operation (912)

Cord	Message	Action	Refference Page
912	Fatal error in Communication-driver	Servicing is required.	—

Other errors (350, 390)

Cord	Message	Action	Refference Page
350	Queue overflow	Read the error queue	App 2-34
390	Overrun error (RS-232-C only)	Decrease the baud rate.	Page 8-6
391	Connection error (RS-232-C only)	A parity error or a stop bit was detected.	Page 8-6

Note

- Code 350 occurs when the error queue is full up. This message is output only for the STATus:ERRor? query and is not displayed on the screen.

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