HIOKI

INSTRUCTION MANUAL

3188/3189

AC/DC POWER HiTESTER

HIOKI E. E. CORPORATION

Contents

Introduction

Thank you for purchasing this Hioki 3188•3189 AC/DC Power HiTester. To get the maximum performance from this unit, and to ensure trouble - free operation, handling this manual carefully and keep this at hand.

Chapter 1

Before Use

1-1. For Safety

For Safety

⚠ WARNING

This equipment was designed in according with IEC1010 and IEC348 Electric Measurement Equipment Safety Standards, and was tested for safety prior to shipment. For high voltage measurement, wrong measure way could be an accident resuiting in injury or death, or damage to the equipment. Please read and understand this manual carefully before operating. We take no responsibility for an accident except caused by our products.

Safety Symbols

This manual, when heeded carefully, provides the operator with all the information necessary to maintain safe and satisfactory performance. Please read items of particular importance to the safe operation before use.

⚠	• Before performing any operation involving a part of the equipment labelled with the ⚠ mark, the operator should first refer to the corresponding explanation in this Instruction Manual labelled with the ⚠ mark. • The ⚠ mark in this Instruction Manual indicates sections that the operator of this equipment must read.
⏚	This symbol denotes the protective grounding terminal.

The following symbols are used in this Instruction Manual to indicate the relative importance of cautions and warnings.

⚠ **DANGER.....** This indicates points where an error could pose serious danger to the operator.

⚠ **WARNING....** This indicates points where an error could damage the unit or pose a hazard to the operator.

CAUTION..... This indicates points that the information being described is important for the proper operation to the equipment, and failure to conform could cause damage to the equipment and render measurement impossible.

⚠ DANGER

To avoid any danger of electric shock or short circuiting, please pay particular attention to the following points:

- Only connect up the unit after checking that the power source of the line to be measured is isolated.
- When connecting up the unit, after completing all the connections, recheck to confirm that you have not made any wiring error.
- Before turning on the power, make quite sure that the source voltage corresponds to the voltage indicated on this unit.

⚠ WARNING

To avoid damage to the unit and danger of electric shock, please pay particular attention to the following points:

- Before performing measurement, always check the selected range.
- Do not exceed input voltage and the maximum input current.
- Do not apply external power to the output terminals.
- Avoid subjecting this unit to any shock or impact during use.

CAUTION

- The values for apparent power (VA), reactive power (var), power factor (PF) and phase angle (deg) produced by this unit are computed from the measured voltage (V), current (A), and active power (W), using the expressions given in the specifications. The values given may be different from those measured with an instrument of different operating principles or using different calculation expressions.
- If operated close to a transformer or line carrying a large current, the unit is susceptible to the effects of an external magnetic field, which may cause measurement errors. As far as possible operate the unit away from such influences.
- For accurate measurement, allow the unit to warm up for one hour before starting operation.
- Because of the design of the internal circuitry, when measuring a signal containing harmonics of certain frequencies, the power indication may be unstable, fluctuating periodically. (More specifically, the problem is likely to occur if the signal contains significant components of frequencies which are integral multiples of 2.930 kHz.)
- For voltage and current, when the input is less than 0.4% and for effective power, when it is less than 0.05% of the measurement range, the indication is forcibly set to zero. (This is termed the "offset clear" function.)
- This unit has a frequency measurement function, but this may produce unexpected results on a waveform which is severely distorted.
- When an in-phase voltage of high frequency is applied (as for example when measuring the secondary side of an inverter), errors may occur in the measured values.
- When the rectification method is set to AC + DC, it is not possible to distinguish the polarity of the DC component of voltage or current.
- Integration values produced by this unit are computed in software from the measured current and power values. Similar integration values produced by an instrument with a different response speed, sampling rate or method of calculation may differ from those of this unit.
- To ensure the accuracy of measurement be careful not to let the unit overheat. (Keep away from sources of heat, and provide sufficient ventilation space around the unit, or when rack-mounted provide a cooling fan.)

1-2. External Check and Accessories

When you receive delivery of this unit, first check that it has not been damaged in transit. In particular check the panel switches and connectors.

Next, check that all the standard accessories are present.

In the unlikely event of any damage, or if any of the standard accessories are missing, contact your nearest service representative without delay.

Accessory	Type	Number provided
Power cable	———————	1
Conversion plug	———————	1
Instruction manual	———————	1
Spare fuse	T0.4A/250V (for 100/120V) T0.2A/250V (for 220/240V)	1
Connector	ADS-B36LMR (Equivalent to Honda Tsushin Kogyo CO.,LTD)	1

* The spare fuse is stored inside the AC power supply inlet, and is of a rating appropriate to the actual operational voltage of the unit.

1-3. Shipment

If this unit is to be shipped or transported, the original packing should preferably be used. If this is not available, employ the following procedure.

(1) Procure a packing case somewhat larger than the unit, such as a cardboard box.
(2) Wrap the unit in plastic sheeting.
(3) Wrap cushioning material around the unit to a thickness of at least 100 mm.
(4) Pack the unit wrapped in this cushioning material into the box, pack in the accessories, add more cushioning to fill the box tightly, and then seal it with adhesive tape.

Chapter 2

Overview

2-1. Overview

The 3188•3189 AC/DC Power HiTester is a power tester suitable for measuring the electrical power consumption of low power equipment such as domestic electrical products and the three-phase equipments.

With this one unit, it is possible to measure voltage, current, effective power, apparent power, wattless power, the power factor, phase angle, frequency and integrated value.

2-2. Features

(1) Wide broad band from DC to 20kHz.

(2) In wattless power and the power factor indication. It is possible to recognize the phase is fast or slow.

(3) The voltage range and current range are wide. (from 15V to 600V, from 0.5A to 20A)

(4) For voltage, current and effective power, analog output is equipped. (simultaneous output)

(5) For voltage and current, monitor output (wave form output) is equipped. (simultaneous output)

(6) It is possible to get the plus, minus, total current or power integrations simultaneously.

(7) When you set the rectification method to DC, you can recognize the polarity of direct voltage and direct current.

(8) Between the terminal for voltage measurement and for current measurement is insulated.

(9) All measurement data has simultaneity.

(10) GP-IB interface is equipped. When connect GP-IB listen only printer, manual printing of measurement data, time interval printing which synchronize with integration measurement and help printing of setting items are possible.

(11) This equipment has input terminal for external shunt.

(12) It is possible to change such as the apparent power, wattless power, the power factor, phase angle, frequency and integration value to direct voltage from D/A output terminal in ±2Vf.s..

2-3. Specification

Items in [ ] corresponds to the 3189 only.

Measuring line:	Single-phase three-wire (1 ϕ3W) and three-phase three wire (3 ϕ3W) [three-phase three-wire (3V3A) and three-phase four-wire (3 ϕ4W)]
Measuring items:	Voltage, current, effective power, apparent power, wattless power, power factor, phase angle, frequency, current integration and power integration (V, A, W, VA, var, PF, deg, Hz, Ah, Wh)
Display type:	LED display
	display • a - Voltage, current, effective power, apparent power, wattless power, power factor and phase angle
	display • b - Voltage, current, effective power, apparent power, wattless power, power factor, phase angle and integration elapsed time
	display • c - Voltage, current, effective power, apparent power, wattless power, power factor, phase angle, frequency and integrate value
	Unit - m, k, M, V, A, W, VA, var, PF, deg, Hz, Ah, Wh
Sample rate:	5 times/sec.
Temperature and humidity ranges for operation:	0°C to 40°C, 80% R.H. with no condensation
Temperature and humidity ranges for storage:	-10°C to 50°C, 80% R.H. with no condensation

Voltage, current, effective power measurement

Measuring range :	Voltage - 15.00/30.00/60.00/150.0/300.0/600.0V Current - direct input 500.0mA/1.000/2.000/5.000/10.00/20.00A shunt input 50/100mV Effective power - according to combination of voltage and current Include auto and manual ranging
Maximum sustainable input:	Voltage - 650V effective value, 920V peak Current - Direct input - 30A effective value, 45A peak Shunt input - 1.0V effective value, 1.5V peak
Maximum crest factor:	Less than 3
Input resistance (DC):	Voltage - 1MΩ ±5% Current - Direct input - less than 10mΩ Shunt input - 100Ω ±5%
Influence on power factor:	Direct input - less than ±0.4% rdg. (In 45Hz to 66Hz, PF=0.5) Shunt input - less than ±0.4% rdg. (In 45Hz to 66Hz, PF=0.5)

Measurement accuracy (23°C ±3°C, PF=1, warm-up time=60min.) In 150V and 5A range. For external shunt, in 50mV range	
Frequency	Accuracy
DC	±0.25%rdg. ±0.3%f.s.
10Hz to 20Hz	±1.5%f.s.
20Hz to 45Hz	±0.4%rdg. ±0.4%f.s.
45Hz to 66Hz	±0.25%rdg. ±0.1%f.s. (Basic accuracy)
66Hz to 4kHz	±0.4%rdg. ±0.4%f.s.
4kHz to 10kHz	±1.4%f.s.
10kHz to 20kHz	±3.0%f.s.

Measurement accuracy (23°C ±3°C, PF=1, warm-up time=60min.) In 15, 30, 60, 300 and 600V range and 2, 10 and 20A range. For external shunt, in 100mV range	
Frequency	Accuracy
DC	±0.4%rdg. ±0.3%f.s.
10Hz to 20Hz	±1.5%f.s.
20Hz to 45Hz	±0.4%rdg. ±0.4%f.s.
45Hz to 66Hz	±0.4%rdg. ±0.1%f.s.
66Hz to 4kHz	±0.4%rdg. ±0.4%f.s.
4kHz to 10kHz	±1.4%f.s.
10kHz to 20kHz	±3.0%f.s.

Measurement accuracy (23°C ±3°C, PF=1, warm-up time=60min.) In 500mA and 1A range	
Frequency	Accuracy
DC	±0.4%rdg. ±0.4%f.s.
10Hz to 20Hz	±1.5%f.s.
20Hz to 45Hz	±0.4%rdg. ±0.4%f.s.
45Hz to 66Hz	±0.4%rdg. ±0.2%f.s.
66Hz to 4kHz	±0.4%rdg. ±0.4%f.s.
4kHz to 10kHz	±1.4%f.s.
10kHz to 20kHz	±3.0%f.s.

In combination of voltage and current range, effective power accuracy takes worse one in the above table.

(example: In 150V and 1A range, accuracy for effective power range will be as same as 1A range.)

Items in [ ] corresponds to the 3189 only.

Input type:	Voltage - resistive potential divided Current - shunt resistance
Insulation type:	Isolated amplifier
Measurement type:	Voltage - real effective value measurement by analog treatment, average rectifier effective value conversion measurement and DC measurement Current - real effective value measurement by analog treatment and DC measurement Effective power - real effective value measurement by analog treatment
Effective input limit:	10% to 110% for range
Temperature coefficient:	Less than ±0.05%f.s./°C
External magnetic field influence:	Less than ±1.5%f.s. (In 400A/m AC, 50/60Hz magnetic field)
Common mode voltage influence:	Less than ±0.2%f.s. (Provides 600V AC rms and 50/60Hz between voltage, current, shunt input terminal short, voltage, current, shunt input terminal and case.)
Maximum Common mode voltage:	600Vrms (DC, 50/60Hz) for voltage, current, and shunt input terminal
Analog output:	Output voltage - 2V DC f.s. Outputs voltage, current and power of each channels and W1+W2 [W1+W2+W3] simultaneously Output accuracy- measurement accuracy ±0.1%f.s. Response time - less than 1.6 sec. (suddenly change to 0% to 90% and 100% to 10% for range) Output resistance - 100Ω ±5%
Monitor output:	Output voltage - 2Vf.s. Outputs voltage and current of each channels simultaneously (wave form output)

Apparent power, wattless power and power factor measurement

Measurement type:	Computed from voltage, current and effective power (for computing equation refer to table 2-3-1)
Measurement range:	Apparent power - refer to table 2-3-2 Wattless power - refer to table 2-3-2 (with polarity lead or lag) Power factor (measuring range) - 0.000 to ±1.000 (with polarity lead or lag)
Effective input limit:	Same as the effective input limits of voltage, current and effective power

Phase angle measurement

Measurement type:	Computed from power factor (for compulating equation refer to table 2-3-1)
Measurement limit:	+(lag) 90.0deg. to –(lead) 90.0deg.
Effective input limit:	Same as the effective input range of voltage, current and effective power

Frequency measurement

Measurement type:	Reverse operation from input wave form cycle
Measurement range:	500Hz/50kHz (Includes auto and manual ranging)
Measurement limit:	0.8% to 100% for range (4Hz to 500Hz/400Hz to 50kHz)
Effective input limit:	10% to 110% for voltage and current range
Accuracy:	±0.1%rdg. ±1dgt. (0°C to 40°C, In sinewave input)
Measurement cycle:	2 times/sec. to 5 times/sec. (By measurement frequency, renewal cycle on display is 5 times/sec)
Functions:	Source changing (voltage of CH1 and current of CH1) Filter changng linked with range (cut off frequency is 100% for range)

Current integration and power integration

Measurement type:	Calculation with measurement value of voltage and effective power (Selects from voltage, effective power and W SUM of each channels.)
Measurement limit:	0 to ±999999MAh/MWh (Integrate time exists within 1000 hours)
Effective input limit:	10% to 110% for current and effective power range
Accuracy:	Measurement accuracy for current and effective power is ±1 dgt.
Accuracy of integration time:	±100 ppm ±1 sec. (in 0°C to 40°C)
Timer setting limit:	1 minutes to 1000 hours (sets the unit to 1 minute)
Functions:	Integration according to polarity (display, the integration value of plus, minus and total) Integration start, stop and reset (key operating and external control are possible) Stops integration with timer Display of integration elapsed time (1 minutes to 1000 hours) Add and integration by repeat of start and stop Back up of integrate value and integration elapsed time in power cut Integration restarting when the power cut is over

Functions

Rectifier type changing:	DC – DC measurement AC + DC RMS - AC + DC measurement (For both voltage and current, display real effective value) AC + DC V MEAN - AC + DC measurement (voltage is displayed as average rectifier effective value, current is displayed as real effective value)
Scaling:	Direct reading by setting of PT and CT ratio Setting range - PT 1.000 to 9999 CT 0.01 to 9999
Average:	Display by moving and averaging the sampling data Setting range - OFF, 8, 16, 32 and 64
Over input warning:	When the input wave form peak value is 3 times for range, warning lamp light

Items in [ ] corresponds to the 3189 only.

Battery backup:	Backup each settings and integrate data When the power is cut off during integration, it is restarted after power cut is over
Hold:	Stops renewaling displays of all measured values

D/A output

Constitution:	16 bits D/A converter, 1ch (polarity +15 bits)
Accuracy (23°C±3°C):	Measurement accuracy ±0.2%f.s.
Tempeature coefficient:	Less than ±0.05%f.s./°C
Sample rate:	5 times/sec.
Output voltage:	2V DC f.s.
Output contents:	Value of VA, var, PF and deg of each channel and SUM and V, A and W of SUM, frequency and integration.

GP-IB:	Based on IEEE-488.1 1987 and refer to IEEE-488.2 1987 Manual output using talk only mode, time interval output and help output function is contained (External control is possible for manual output) (It is possible to set the interval with unit in 10 seconds from 10 seconds to 1000 hours. Synchronized with integration starting)
Withstand voltage:	2.2kVAC, 50/60Hz, 1 minute (Between voltage, current, shunt input terminal and case, output terminal, external terminal Between voltage, current, shunt input terminal and power supply Between voltage input terminal and current, shunt input terminal) 1.5kVAC, 50/60Hz, 1 minute (Between power supply and case, output terminal, external control terminal)
Insulation resistance:	In 500VDC more than 100MΩ, (Between voltage, current, shunt input terminal and case, output terminal, external control terminal Between voltage, current, shunt input terminal and power supply Between voltage input terminal and current, shunt input terminal Between power supply and case, output terminal, external control terminal)
Power supply:	100V AC ±10%, 50/60H (120V, 220V, 240V (250V MAX) are specified at ordering)
Power consumption:	55VA MAX
External dimensions:	Approx. 88(H) × 430(W) × 410(Dmm±5mm) (without projections such as buttons and supporting leg)
Weight:	6.8kg ±10% [7.5kg ±10%]
Accessories:	Instruction manual, power code, conversion plug and connector

Table 2-3-1. Calculation expressions

Note 1. V, A and W means internal calculated data (without ±1 dgt. rounding error for display) of voltage, current and effective power. Therefore, sometimes they would differ from apparent power, wattless power and power factor which is calculated with displayed value of them.

Note 2. si means the polarity which become -1 when the current phase for voltage is LEAD and +1 when it is LAG.

Note 3. su means the polarity which become -1 when SUM shows the negative value and ± when it shows the positive value.

Note 4. SUM, calculated with V and A means averaging value.

Note 5. When such an inequality as |VA| < |W| is performed under the influence of such as measurement error or unbalanced load, this unit works to be |VA|=|W|, var = 0 and PF =1.

Note 6. ΣW, ΣVA, Σvar and ΣPF means SUM W, SUM VA, SUM var and SUM PF in the same line.

Note 7. deg is calculated by PF on the display.

		Voltage (V)	Current (A)	Effective power (W)	Apparent power (VA)	Power factor (PF)
CHi ($1 \leqq i \leqq 3$)		Vi	Ai	Wi	ViAi	$si \left\lvert \frac{Wi}{ViAi} \right\rvert$
SUM	1φ3W	$\frac{V1+V2}{2}$	$\frac{A1+A2}{2}$	W1+W2	$\sqrt{(\Sigma var)^2+(\Sigma W)^2}$	$su \left\lvert \frac{\Sigma W}{\Sigma VA} \right\rvert$
	3φ3W	$\frac{V1+V2}{2}$	$\frac{A1+A2}{2}$	W1+W2	$\sqrt{(\Sigma var)^2+(\Sigma W)^2}$	$su \left\lvert \frac{\Sigma W}{\Sigma VA} \right\rvert$
	3V3A	$\frac{V1+V2+V3}{3}$	$\frac{A1+A2+A3}{3}$	W1+W2	$\sqrt{(\Sigma var)^2+(\Sigma W)^2}$	$su \left\lvert \frac{\Sigma W}{\Sigma VA} \right\rvert$
	3φ4W	$\frac{V1+V2+V3}{3}$	$\frac{A1+A2+A3}{3}$	W1+W2+W3	$\sqrt{(\Sigma var)^2+(\Sigma W)^2}$	$su \left\lvert \frac{\Sigma W}{\Sigma VA} \right\rvert$

		Wattless power (var)	Phase angle (deg)
CHi ($1 \leqq i \leqq 3$)		$si \sqrt{(ViAi)^2-Wi^2}$	$si\ COS^{-1}(\lvert PFi \rvert)$
SUM	1φ3W	$s1 \sqrt{(V1A1)^2-W1^2} + s2 \sqrt{(V2A2)^2-W2^2}$	$su\ COS^{-1}(\lvert \Sigma PF \rvert)$
	3φ3W	$s1 \sqrt{(V1A1)^2-W1^2} + s2 \sqrt{(V2A2)^2-W2^2}$	$su\ COS^{-1}(\lvert \Sigma PF \rvert)$
	3V3A	$s1 \sqrt{(V1A1)^2-W1^2} + s2 \sqrt{(V2A2)^2-W2^2}$	$su\ COS^{-1}(\lvert \Sigma PF \rvert)$
	3φ4W	$s1 \sqrt{(V1A1)^2-W1^2}+s2 \sqrt{(V2A2)^2-W2^2}+s3 \sqrt{(V3A3)^2-W3^2}$	$su\ COS^{-1}(\lvert \Sigma PF \rvert)$

Table 2-3-2. Ranges

Note 1. W means effective power of each channels.
W SUM (3ϕ3W) means effective power of single-phase three-wire (1ϕ3W) and three-phase three-wire (3ϕ3W and 3V3A).
W SUM (3ϕ4W) means effective power of three-phase four-wire (3ϕ4W).

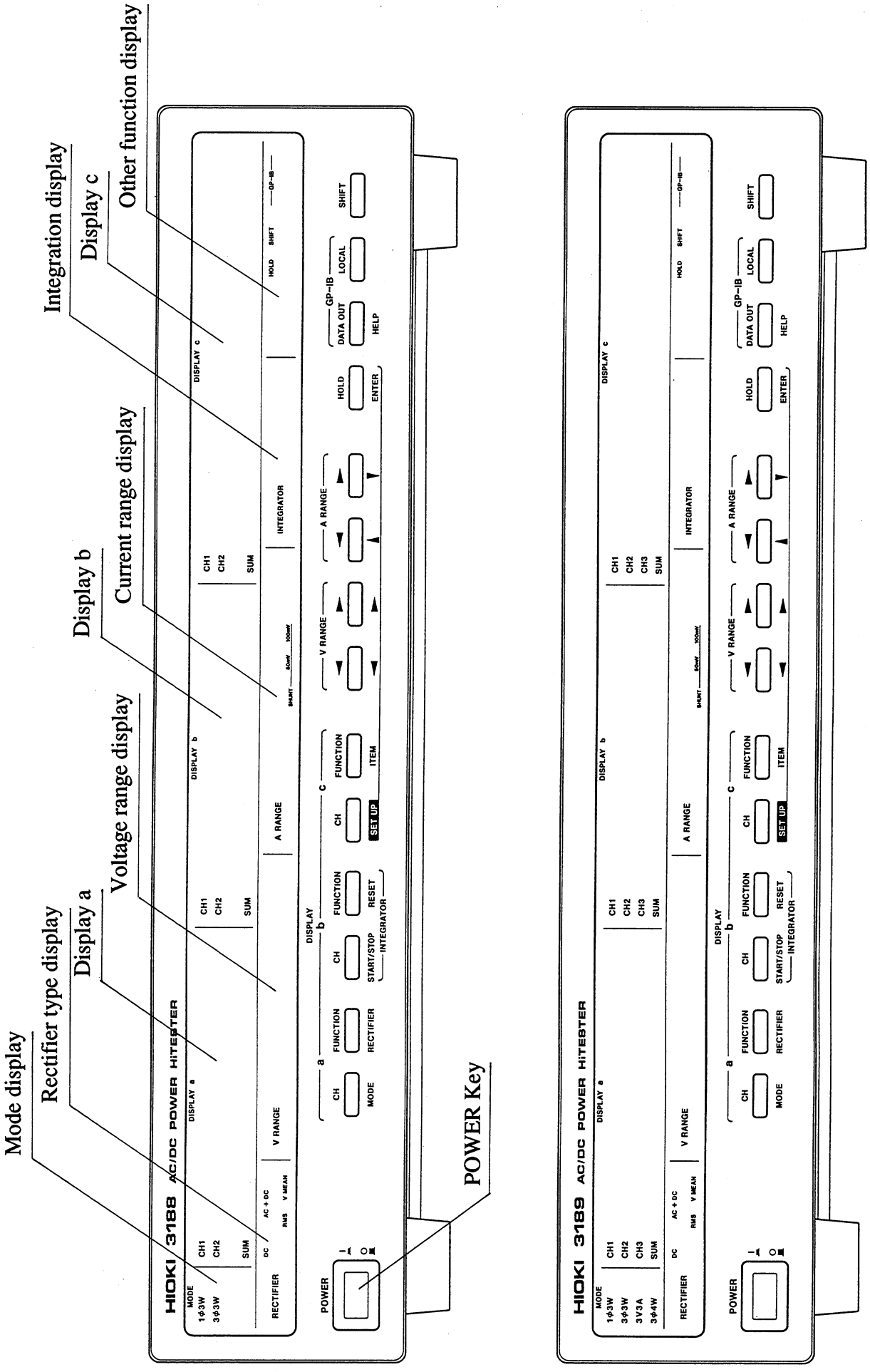
Note 2. For apparent power and wattless power, consider units in the table below as W, VA or var.

Note 3. In the table below, for example, there are such two ranges as 0 to 999.9W and 1.000kW to 1.200kW in 2A and 300V range of W SUM (3ϕ3W) (single-phase three-wire and three-pahse three-wire).
In this case, range shifts automatically.

		500.0mA	1.000A	2.000A	5.000A	10.00A	20.00A
15.00V	Wi (1 ≦ i ≦ 3)	7.500W	15.00W	30.00W	75.00W	150.0W	300.0W
	W SUM (3 ϕ 3W)	15.00W/9.999W	30.00W	60.00W	150.0W/99.99W	300.0W	600.0W
	W SUM (3 ϕ 4W)	22.50W/9.999W	45.00W	90.00W	225.0W/99.99W	450.0W	900.0W
30.00V	Wi (1 ≦ i ≦ 3)	15.00W	30.00W	60.00W	150.0W	300.0W	600.0W
	W SUM (3 ϕ 3W)	30.00W	60.00W	120.0W/99.99W	300.0W	600.0W	1.200kW/999.9W
	W SUM (3 ϕ 4W)	45.00W	90.00W	180.0W/99.99W	450.0W	900.0W	1.800kW/999.9W
60.00V	Wi (1 ≦ i ≦ 3)	30.00W	60.00W	120.0W	300.0W	600.0W	1.200kW
	W SUM (3 ϕ 3W)	60.00W	120.0W/99.99W	240.0W	600.0W	1.200kW/999.9W	2.400kW
	W SUM (3 ϕ 4W)	90.00W	180.0W/99.99W	360.0W	900.0W	1.800kW/999.9W	3.600kW
150.0V	Wi (1 ≦ i ≦ 3)	75.00W	150.0W	300.0W	750.0W	1.500kW	3.000kW
	W SUM (3 ϕ 3W)	150.0W/99.99W	300.0W	600.0W	1.500kW/999.9W	3.000kW	6.000kW
	W SUM (3 ϕ 4W)	225.0W/99.99W	450.0W	900.0W	2.250kW/999.9W	4.500kW	9.000kW
300.0V	Wi (1 ≦ i ≦ 3)	150.0W	300.0W	600.0W	1.500kW	3.000kW	6.000kW
	W SUM (3 ϕ 3W)	300.0W	600.0W	1.200kW/999.9W	3.000kW	6.000kW	12.00kW/9.999kW
	W SUM (3 ϕ 4W)	450.0W	900.0W	1.800kW/999.9W	4.500kW	9.000kW	18.00kW/9.999kW
600.0V	Wi (1 ≦ i ≦ 3)	300.0W	600.0W	1.200kW	3.000kW	6.000kW	12.00kW
	W SUM (3 ϕ 3W)	600.0W	1.200kW/999.9W	2.400kW	6.000kW	12.00kW/9.999kW	24.00kW
	W SUM (3 ϕ 4W)	900.0W	1.800kW/999.9W	3.600kW	9.000kW	18.00kW/9.999kW	36.00kW

Chapter 3

Controls and Indications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Rectifier type display
Display a
Voltage range display
Display b
Current range display
Integration display
Display c
Other function display
POWER Key
HIOKI 3188 AC/DC POWER HITESTER
HIOKI 3189 AC/DC POWER HITESTER
DISPLAY a
DISPLAY b
DISPLAY c
MODE
RECTIFIER
V RANGE
A RANGE
INTEGRATOR
DISPLAY
CH
FUNCTION
MODE
RECTIFIER
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RESET
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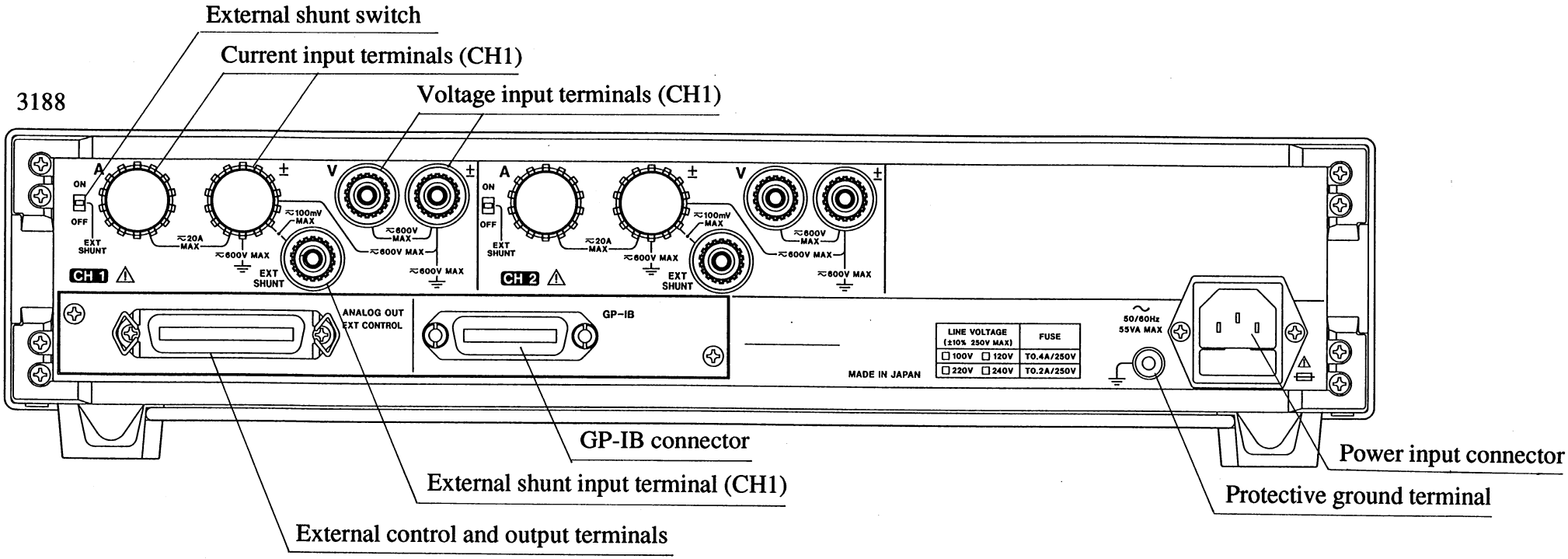
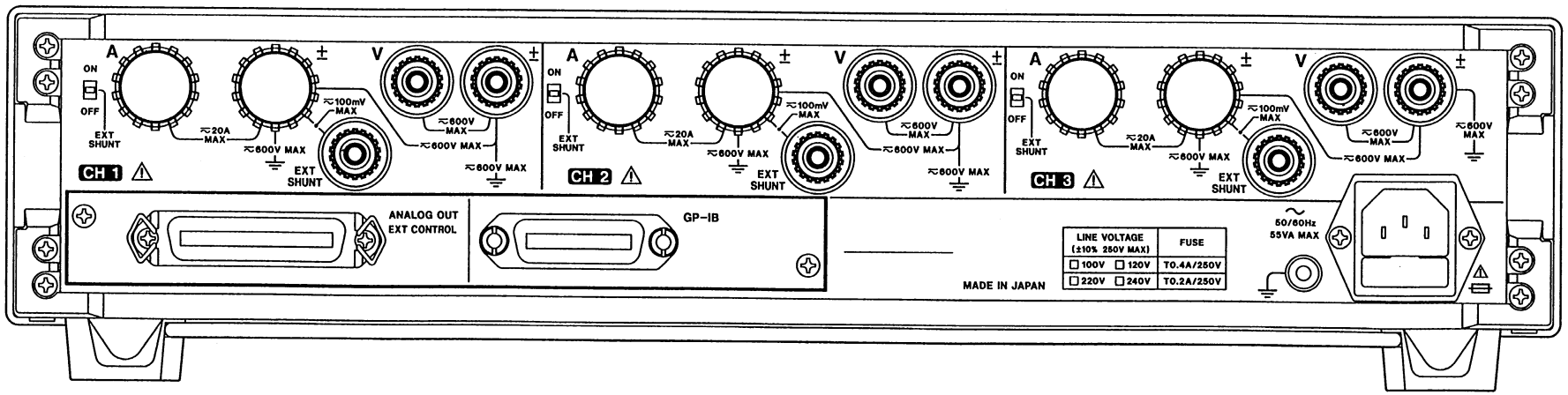
SET UP
ENTER
HOLD
SHIFT
HELP
LOCAL
DATA OUT
GP-IB
POWER

Front panel

3188



3189



Rear panel

Chapter 4

Preparations for Measurement

4-1. Attentions

⚠ DANGER

- In order to prevent electric shock and short circuiting, only connect up the wiring after checking that the power to the line to be measured is definitely cut off.
- To prevent electric shock and short circuit hazards,the wiring which is used for making the connections between the voltage input terminals and the line or external shunt and this equipment to be measured should have sufficient insulation. Similarly, the wiring which is used for making the connections to the current input terminals should have sufficient current carrying capacity and insulation: do not use bare wires or the like.
- When connecting up the wiring, do not confuse the voltage input terminals with the current input terminals. If measurement is attempted with the wiring connected up incorrectly, it is likely that a short circuit will occur and/or this unit will be damaged.
- The power supply for this unit is set to a specific voltage. This unit cannot operate if the voltage of the power supplied is different.If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and life threatening risk to the operator.
- In order to maintain the safety and stable operating performance of this unit, be sure to connect the ground terminal to a proper ground.
- When using external shunt, be careful not to touch the shunt to human body or the cable to avoid circuit short.

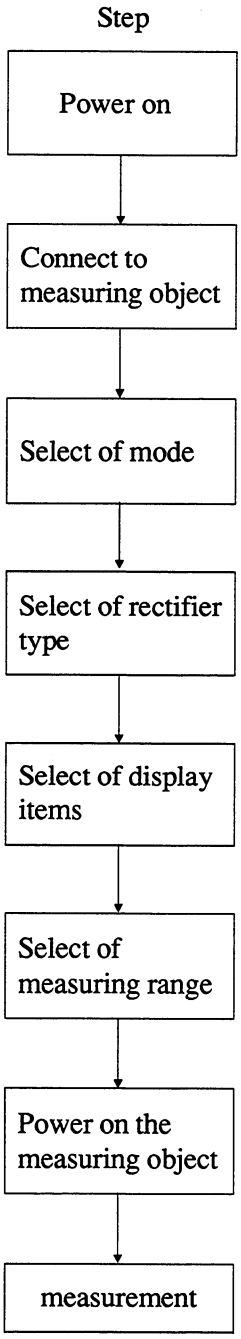
⚠ WARNING

Do not apply voltage or current at levels in excess of these maximum sustainable values.
If voltage or current in excess of these maximum sustainable values is applied, there is danger of damage to this unit and life threatening risk to the operator.

CAUTION

- Because the polarity of the voltage and the current is relevant to electrical power measurement, be sure to connect up the wiring correctly. If a wiring error is made, correct measurement cannot be performed.
- If an external voltage or current transformer is used, there is a possibility that its phase difference may cause great errors in power measurement. For accurate power measurement, use a transformer which has a phase error as small as possible, with regard to the frequency band of the circuit to be used.
- If the voltage or the current of the circuit which is to be measured will exceed its range as set on this unit, use an external voltage or current transformer so as to ensure that the maximum sustainable value is not exceeded.
  When this is done, it is possible to read out the measured values directly by using the PT and CT scaling functions.
- When extension wiring is in use, keep such wiring as far as possible away from this unit in order to minimize the disturbing effects upon measurement of the external magnetic field which it generates.
- When using external shunt, the specification corresponds to this equipment only. When measuring, current and power accuracy is influenced by the accuracy of external shunt for current detection and frequency characteristic.
- Wiring from external shunt to this equipment must be as shorter as possible. Because wiring resistance could cause the error. Use enough twisted wire or shield wire to reduce the influence from external noise.

4-2. Simple Use



Described in sections:

Chapter 4	4-4. "When the Power is Turned On" 4-5. "Self Test"
Chapter 4	4-3. "How to Make the Connections"
Chapter 5	5-1. "Selecting the Mode"
Chapter 5	5-2. "Selecting the Rectifier Type"
Chapter 5	5-3. "Selecting the Display"
Chapter 5	5-4. "Selecting the Range"

4-3. How to Make the Connections

4-3-1. General Precautions

(1) Connect to designated channel (CH1, CH2 or CH3) certainly.

(2) When connect directly or use PT or CT, set the external shunt switch "OFF". When use the external shunt, set that switch "ON". (This switch can set with such as small-sized minus screwdriver.)

(3) Use the wire which has enough current capacitance and withstand voltage.

(4) It is possible to read upstream of PT and CT ratio directly, by setting them. For settings of them, refer to section 6-5 "PT Settings" and 6-6 "CT Settings".

(5) A edge of downstream of PT and CT must be grounded.(Please confirm it. Many founded PT and CT are already grounded.)

(6) Shunt input voltage is 50 mV and 100mV. In this case, current range is 5A and 10A. Calculate as follows and set CT ratio.

Example ..... When using 100A/50mV shunt, 50mV corresponds to 5A range;

$$\text{CT ratio} = \frac{100\text{A}}{5\text{A}} = 20$$

When using 2,000A/100mV shunt, 100mV corresponds to 10A range;

$$\text{CT ratio} = \frac{2{,}000\text{A}}{10\text{A}} = 200$$

4-3-2. Single-phase, Three-wire and Three-phase, Three-wire (1φ3W and 3φ3W)

- For single-phase, three-wire cable, line ② in fig. 4-3-1 to 4-3-3 corresponds to N line.
- For three-phase, three-wire cable, line ①, ② and ③ corresponds to R, S and T, respectively.
- In three-phase, three-wire cable, it is so impossible to measure phase voltage that voltage measurement of each phase is also impossible. Each measured value of W1 and W2 (power for channel 1 and 2) are the power which is obtained with line voltage and line current and as individual data, they do not make much sense.
  This also corresponds to 3-voltage, 3-current measurement described in next paragraph.

(1) When connect directly

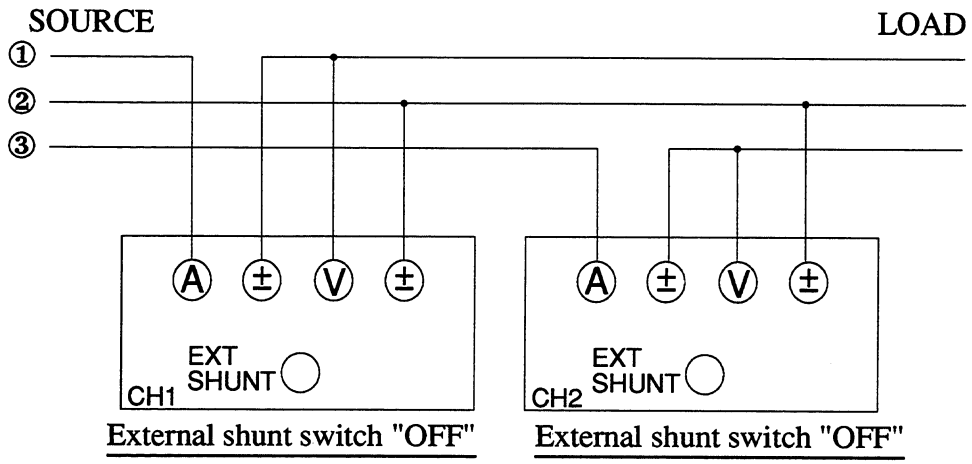


Fig. 4-3-1. Schematics for single-phase, three-wire and three-phase, three-wire

(2) When use PT and CT

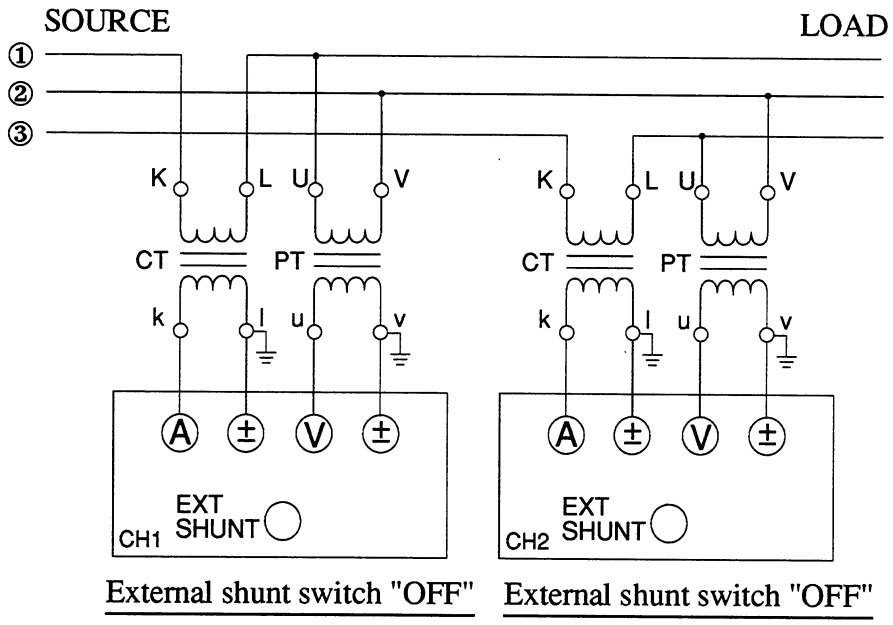


Fig. 4-3-2. When use PT and CT in single-phase, three-wire and three-phase, three-wire

(3) When use external shunt

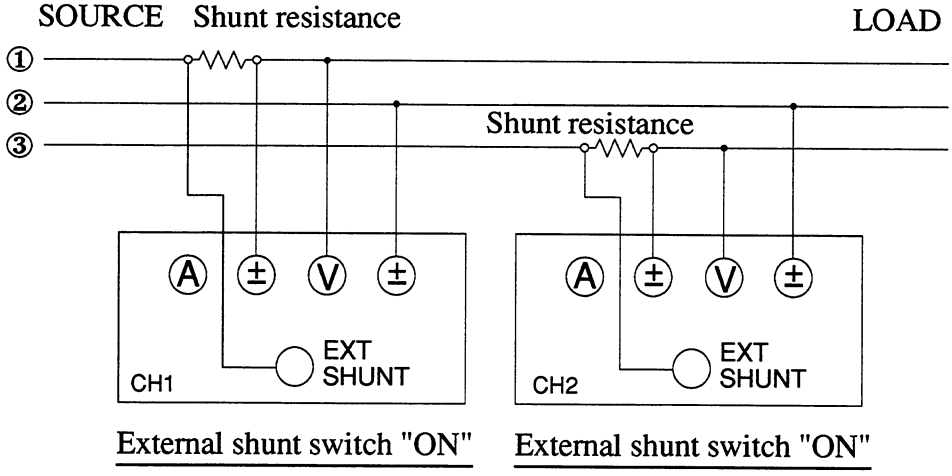


Fig. 4-3-3. When use external shunt in single-phase, three-wire and three-phase, three-wire

4-3-3. 3-voltage, 3-current measurement (3V3A)

- This connecting method is possible only for the 3189.
- This connecting method is able to display average voltage and average current with three elements of voltage and current, compare with regular connection of three-phase three-wire system. For effective power, apparent power, wattless power, power factor and phase angle measurement, same value is obtained with regular three-phase three-wire connection. Values of W, var, PF and deg in CH3 are nonsence.

(1) When connect directly

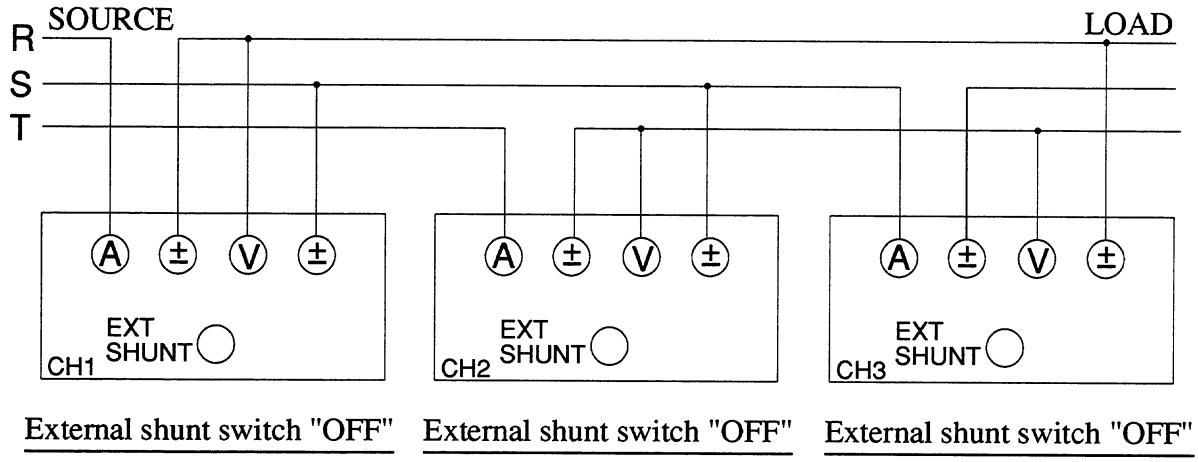


Fig. 4-3-4. Schematics for 3V3A

(2) When use PT and CT

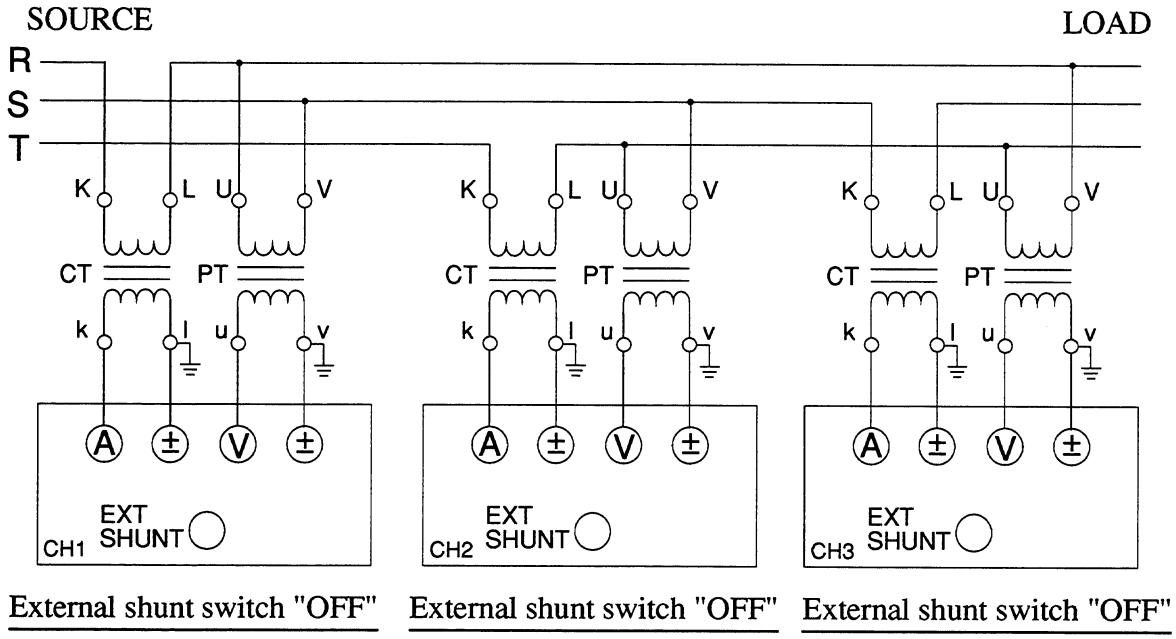


Fig. 4-3-5. When use PT and CT in 3V3A

(3) When use external shunt

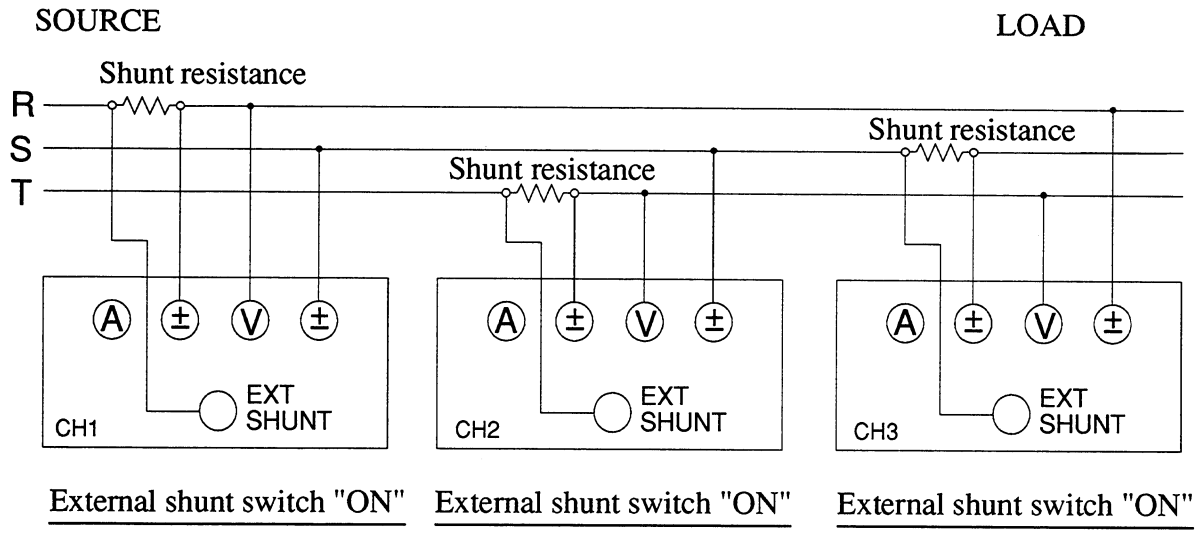


Fig. 4-3-6. When use external shunt in 3V3A

4-3-4. Three-phase, Four-wire

- This connecting method is possible only for the 3189.

(1) When connecting directly

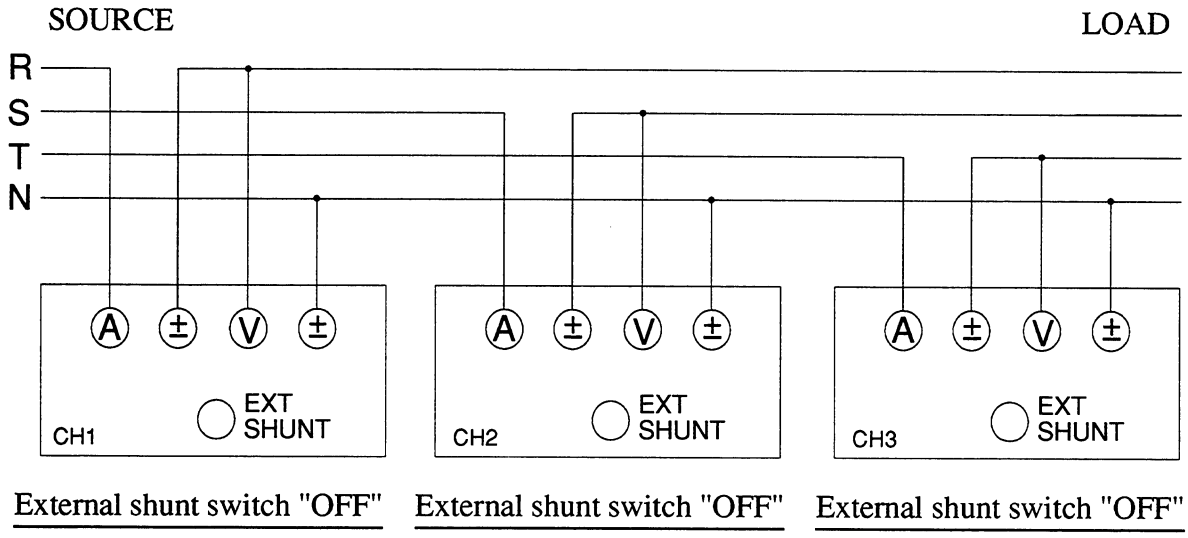


Fig. 4-3-7. Schematics for three-phase, four-wire

(2) When use PT and CT

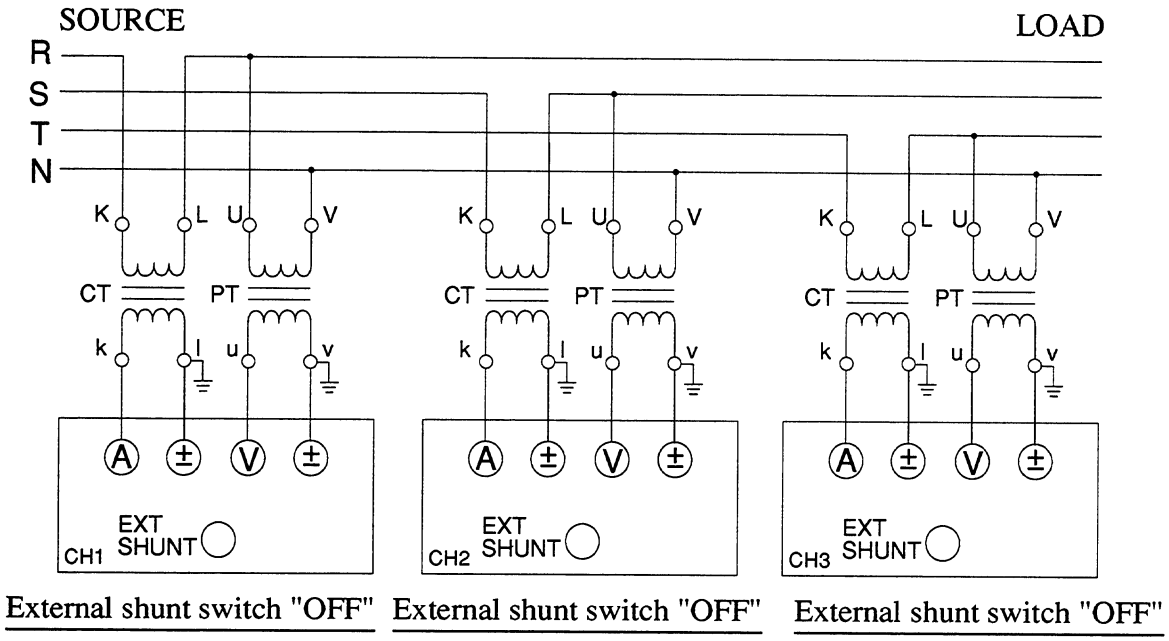


Fig. 4-3-8. When use PT and CT in three-phase, four-wire

(3) When use external shunt

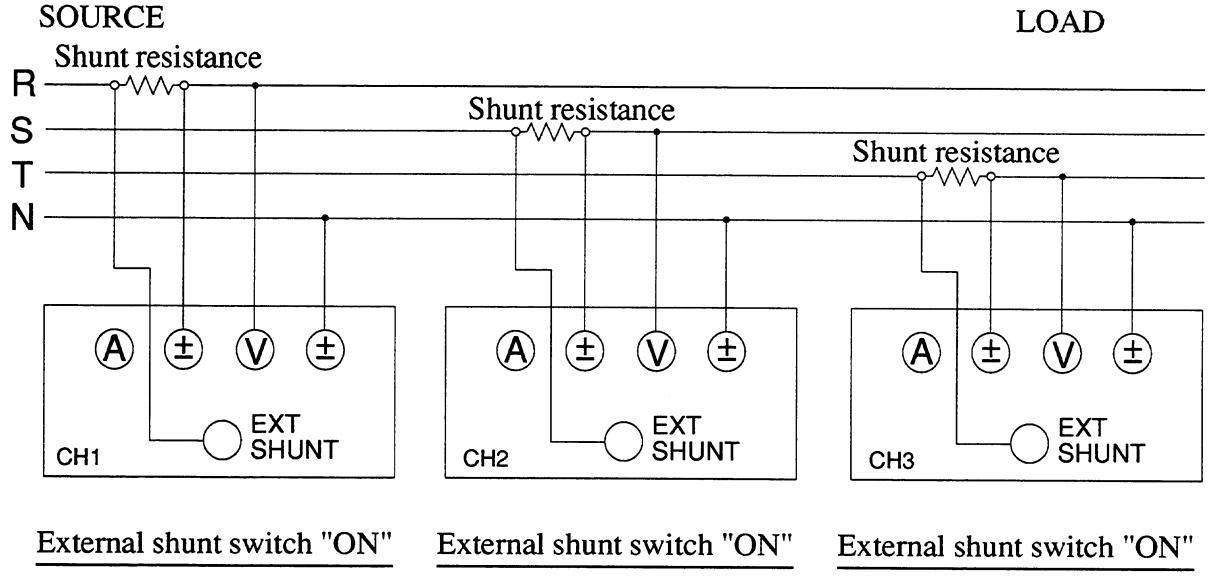


Fig. 4-3-9. When use external shunt in three-phase, four-wire

4-3-5. Measurement in Single-phase two-wire

- There are several channels for power measurement in this unit, and it is possible to perform some power measurement in single-phase two-wire simultaneously.
  However, there is not an exclusive mode for single-phase two-wire, because of following restrictions. (In which mode, it is possible to read measured value, if you select the correspondent channel.)
  (1) Range setting, rectifier type, PT ratio and CT ratio are common with each channel.
  (2) Frequency measurement is possible only for CH1.
  Display value of SUM sometimes poses nonsense value for it is calculated with the calculation expression shown in the table 2-3-1 in section 2-3. "Specification".

(1) When connect directly

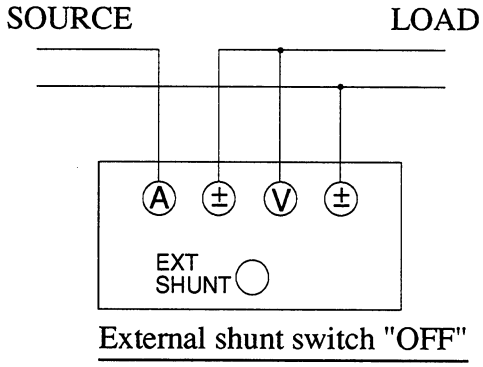


Fig. 4-3-10. Schematics for single-phase two-wire

(2) When use PT and CT

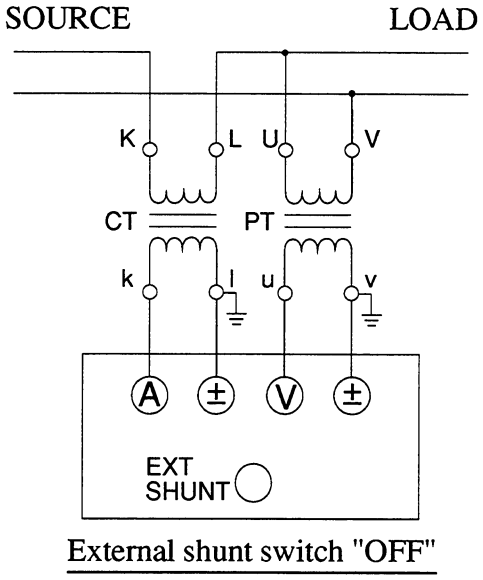
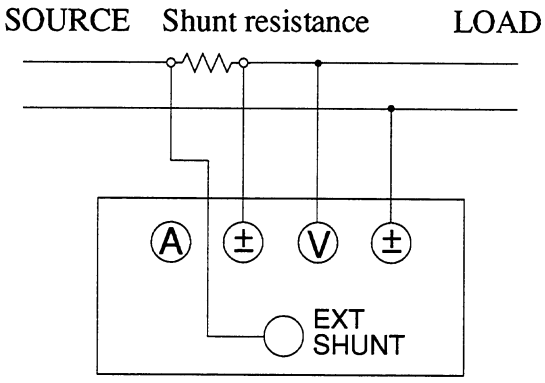


Fig. 4-3-11. When use PT and CT in single-phase two-wire

(3) When use external shunt



External shunt switch "ON"

Fig. 4-3-12. When use external shunt in single-phase two-wire

4-4. When the Power is Turned On

(1) Please confirm whether power supply voltage mark on rear panel and that you would use are same or not.

(2) Confirm power switch on front panel is "OFF".

(3) Connect accessory power code to AC power inlet on rear panel.

(4) Connect power code three pole power outlet with protective earth terminal.
When it is two pole, use accessory conversion plug. Its grounding line (green) must be grounded certainly.

(5) Turn on the power switch on front panel.

(6) All Indicators on front panel illuminate and begin self testing.
(Refer to 4-5. "Self Test" for details.)
This test ends about for 7 seconds.

⚠ DANGER

Do not cut the ground line or take the connection of protective earth terminal (earth terminal) off intentionally.

CAUTION

- When power is turned off, do not apply voltage or current to voltage input terminal, current input terminal and shunt input terminal.
- Before measuring, please perform a warm-up at least for sixty minutes after the power is turned on.

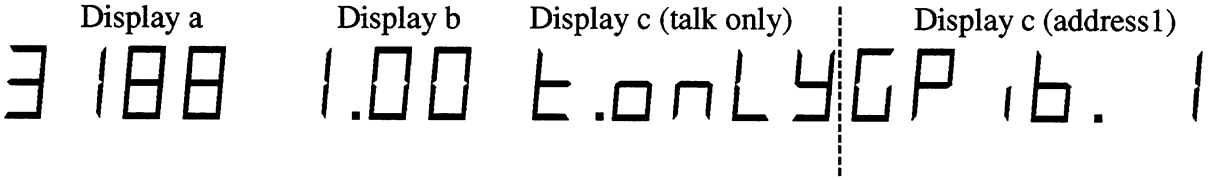
4-5. Self Test

Indications in self test shifts as follows:

① All indicators illuminate

② Display a ... 3188 or 3189
Display b ... Software version number
Display c .... GP-IB address

Display example



③ After self checking, errors are indicated in case that unusual matter is founded.

④ Nothing is displayed for two seconds.

⑤ Enter normal measurement state.

For error indications, refer to 8-3 "Error Indications".

CAUTION

- Settings at the power is turning on become previous condition.
  (Backup function)
  However, this function does not work when internal lithium battery is used up.
  In this case, error is indicated at the power is turning on.

  The battery would run down after six years. Please contact your nearest service representative for battery change.
- Don't press the keys unnecessarily during self testing.

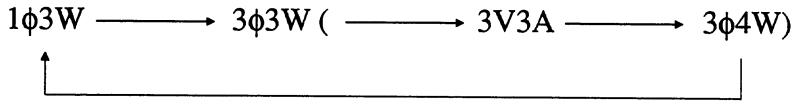
Chapter 5

Basic Operation

5-1. Selecting the Mode

(1) Mode which can be set to 3188 are 1φ3W or 3φ3W and to 3189 are 1φ3W, 3φ3W, 3V3A or 3φ4W.
(Different calculation expression is used according to the types of measuring line.)
It is necessary to select one mode before start measuring as well as section 5-2. "Selecting the Rectifier Type".

(2) To change the mode, press SHIFT key and illuminate shift lamp (shift condition).
Next, press the CH/MODE key, mode is changed and shift lamp puts out.
Select suitable mode repeating these operation.
In this operation, shift condition is canceled with every key operation after that.



Items in ( ) is corresponds to the 3189 only.

(3) The present mode displays on mode display.

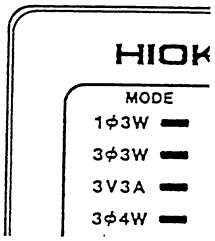


Fig. 5-1-1. Mode display

CAUTION

- Different calculation expression is used according to mode, so mode must be selected certainly.
(Refer to the calculation expressions described in section 2-3. "Specification".)

5-2. Selecting the Rectifier Type

(1) This equipment equips three way type rectifier circuit. It is necessary to select one rectifier type before start measuring as well as section 5-1. "Selecting the Mode".

① DC ..... Measure DC only.

② AC+DC (RMS)..... Measure DC only or real effective value AC and DC mixed.

③ AC+DC (V MEAN) .. Measure DC only or average rectifier effective value converted for voltage, real effective value for current in AC and DC mixed.

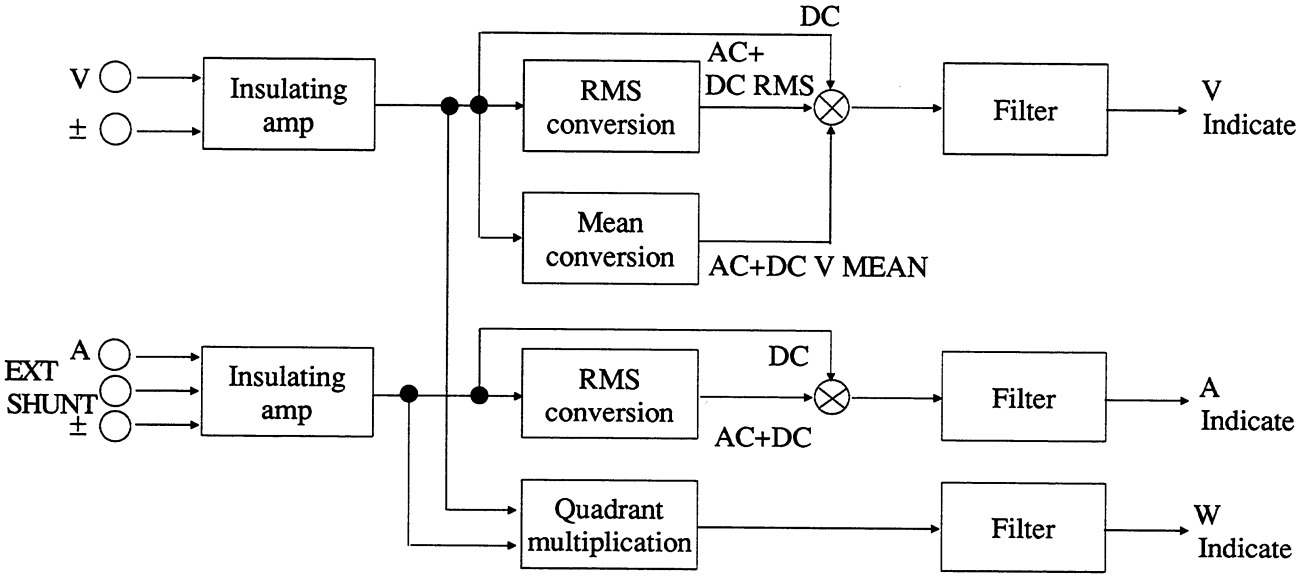


Fig.5-2-1. Rectifier type overview

(2) The present rectifier type displays on rectifier display.

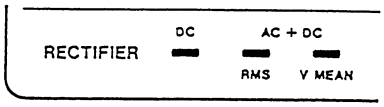


Fig.5-2-2. Rectifier display

(3) To change the type press SHIFT key and illuminate the shift lamp (shift condition). Next, press the FUNCTION RECTIFIER key, the rectifier type is changed and shift lamp puts out. Select suitable rectifier type repeating these operation.
In this operation, shift condition is canceled with every key operation after that.

DC ⇨ AC + DC (RMS) ⇨ AC + DC (V MEAN)

CAUTION

- The rectifier type is common with each channel.
- When selecting DC, it is possible to display the polarity of voltage and current.
- When selecting AC+DC, the displayed value of voltage and current become always plus.
- For sinewave, both "average rectifier effective value converted (MEAN)" and "real effective value (RMS)" indicate correct effective value. However, only "real effective value" indicates correct value for the input which include distorted wave or DC element.

5-3. Selecting the Display

(1) Each time the FUNCTION / RECTIFIER key is pressed, the selected item for display a shifts according to the following cycle.

Voltage (V) ⇨ Current (A) ⇨ Effective power (W) ⇨ Apparent power (VA) ⇨
Wattless power (var) ⇨ Power factor (PF) ⇨ Phase angle (deg) ⇨ (back to Voltage (V))

And, each time the CH / MODE key is pressed, the channel for display shifts according to the following cycle.

CH 1 ⇨ CH 2 ⇨ (CH 3) ⇨ SUM ⇨ (back to CH 1)

Items in ( ) corresponds only for the 3189.

(2) Each time the FUNCTION / RESET key is pressed, the selected item for display b shifts according to the following cycle.

Voltage (V) ⇨ Current (A) ⇨ Effective power (W) ⇨ Apparent power (VA) ⇨
Wattless power (var) ⇨ Power factor (PF) ⇨
Phase angle (deg) ⇨ Integration elapsed time (TIME) ⇨ (back to Voltage (V))

And, each time the CH / START/STOP key is pressed, the channel for display shifts according to the following cycle.

CH 1 ⇨ CH 2 ⇨ (CH 3) ⇨ SUM ⇨ (back to CH 1)

Items in ( ) corresponds only for the 3189.

(3) Each time the FUNCTION / ITEM key is pressed, the selected item for display c shifts according to the following cycle.

Voltage (V) ⇨ Current (A) ⇨ Effective power (W) ⇨ Apparent power (VA) ⇨
Wattless power (var) ⇨ Power factor (PF) ⇨ Phase angle (deg) ⇨
Frequency (Hz) ⇨Plus integrate value (+ Ah/Wh) ⇨
Minus integrate value (-Ah/Wh) ⇨ Total integrate value (ADD Ah/Wh) ⇨ (back to Voltage (V))

And, each time the CH / SET UP key is pressed, the channel for display shifts according to the following cycle.

CH 1 ⇨ CH 2 ⇨ (CH 3) ⇨ SUM ⇨ (back to CH 1)

Items in ( ) corresponds only for the 3189.

(4) During the integrate value is displayed, following mark is displayed on integration display.

+ ..... Display plus integrate value

− ..... Display minus integrate value

ADD ..... Display total integrate value

The lamp of channel illuminates which corresponds to integration items, selected in section 6-4. "Integration", on display c.
CH
SET UP key does not work.

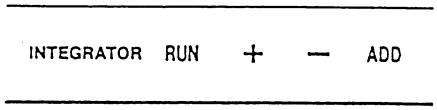
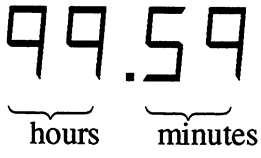


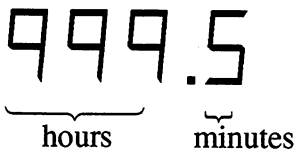
Fig.5-3-1. Integration display

(5) When selecting "TIME" in display b, integration elapsed time is displayed as follows;

From 0 minute to 99 hours and 59 minutes

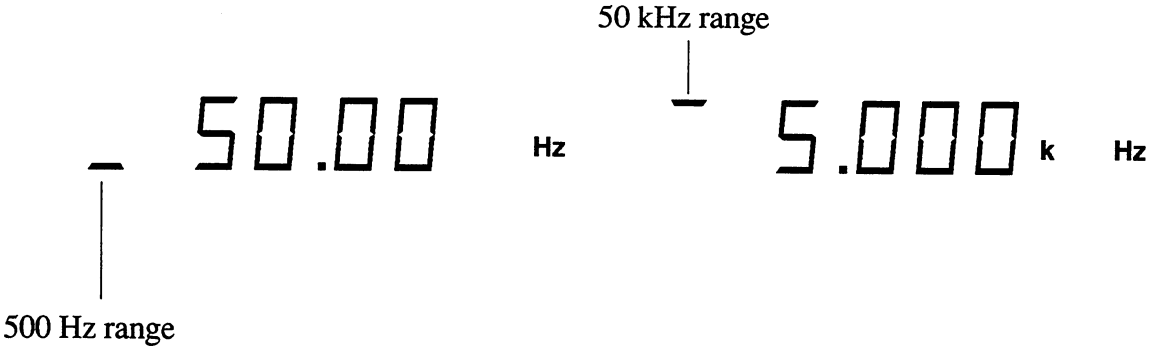


From 100 hours to 999 hours and 59 mintes



1000 hours

(6) In frequency display, the frequency measurement range is displayed as follows;



On shipping, frequency for voltage input is able to measure until 500 Hz.

Refer to Chapter 6 "Applied Operation" when measuring current input or frequency over 500 Hz.

When displays frequency, channel indication of display c is fixed on "CH 1".

CAUTION

Under setting condition, constants or condition is displayed on the display.

5-4. Selecting the Range

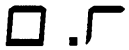
(1) Setting limits

Voltage range..... 15 V, 30 V, 60 V, 150 V, 300 V, 600 V

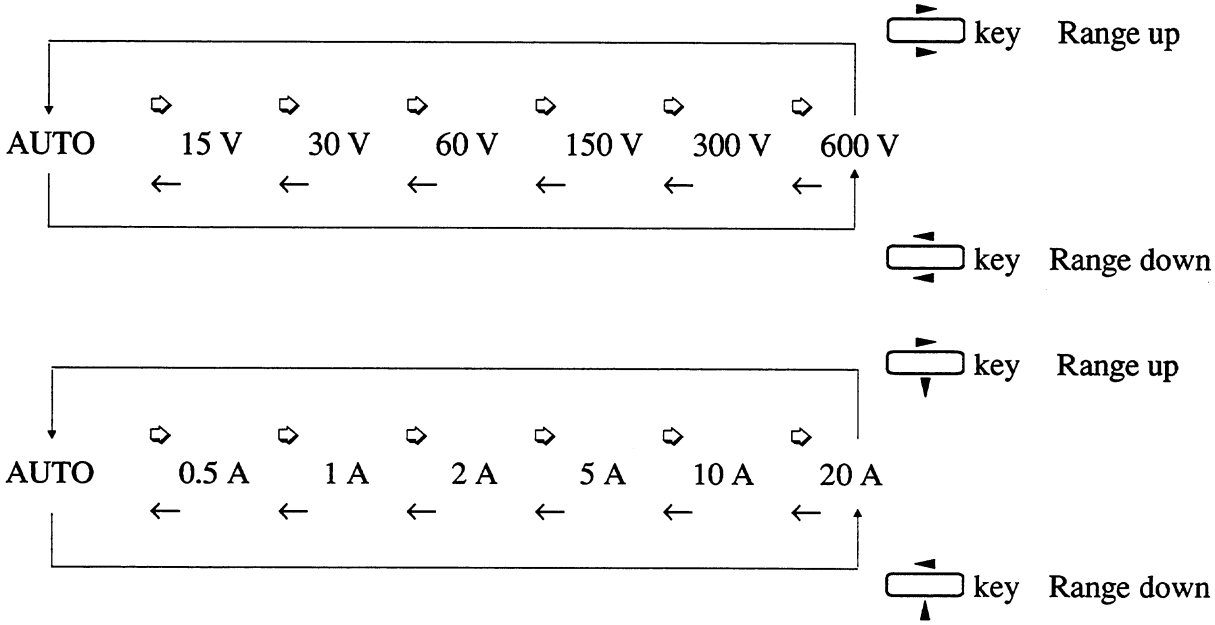
Current range..... 0.5 A, 1 A, 2 A, 5 A, 10 A, 20 A

External shunt range... 50 mV (combined with 5 A), 100 mV (combined with 10 A)

Effective, watt-less and apparent power are combined with voltage and current range.
Refer to table 2-3-2 in 2-2. "Specification".
Effective input limit (accuracy assuring limit) is 10% to 110% for range.
Indicatable limit is 130% for range. In case of over this limit, following mark is displayed (this means out of range).



(2) Settings



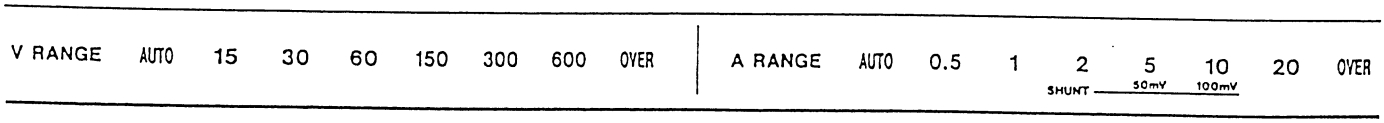


Fig.5-4-1. Range display

(3) Auto-ranging function

Auto means auto-ranging function.
Shift level for auto-ranging function shows as follows;

When measuring value is over 110% for range
When OVER lamp is illuminate ——— Range up
When measuring value is less than 30% for range ——— Range down

To release auto-ranging function press any key for range setting.

CAUTION

- In auto-ranging function sometimes range goes on up and down according to distortion of input wave or size of measuring value.
  In this case, release auto-ranging function and select range manually.
- OVER lamp illuminates when peak value of voltage input and current input waveform are over three times for range.
  In this case, internal circuit works abnormally. Select the range not to illuminate OVER lamp.
- When over input is applied such as out of range displayed by either voltage or current, sometimes other measuring value become abnormal.
  Be sure to select the range not to show out of range or illuminate OVER lamp in both voltage and current.
- Apparent power shows out of range when either voltage or current shows same display. Wattless power, power factor and phase angle shows out of range when either effective power and apparent power shows same display.
  Power factor and phase angle shows out of range when apparent power is 0.

5-5. Holding the Display

Press HOLD/ENTER key, holding lamp is illuminated and preserve all measuring value at that point. (Hold state)

Press HOLD/ENTER key again, this lamp is turned off, and return normal measuring condition.

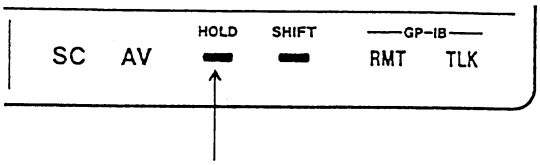


Fig.5-5-1. Holding lamp

Under hold state, operating is controlled as follows;

(1) Shifting of range and rectifier type are not allowed. (Error No.016 is displayed.)

(2) Following settings are unable to change which are explained in Chapter 6. "Applied Operation". (Error No.017 is displayed.)

Items	Abbreviation
① Selecting frequency measurement source and range	FrEq
② Setting integrate time and items	intG
③ Setting PT ratio	Pt
④ Setting CT ratio	Ct
⑤ Selecting number of frequency	Au
⑥ Selecting D/A output items	d-A oUt

5-6. Operating Overview

5-6-1. Operating Overview 1

While the shift lamp is on, refer to 5-6-2. "Operating Overview 2".
In this section, explains the function which is able to execute during the shift lamp is not lightening.
Item in [ ] corresponds to the 3189 only.

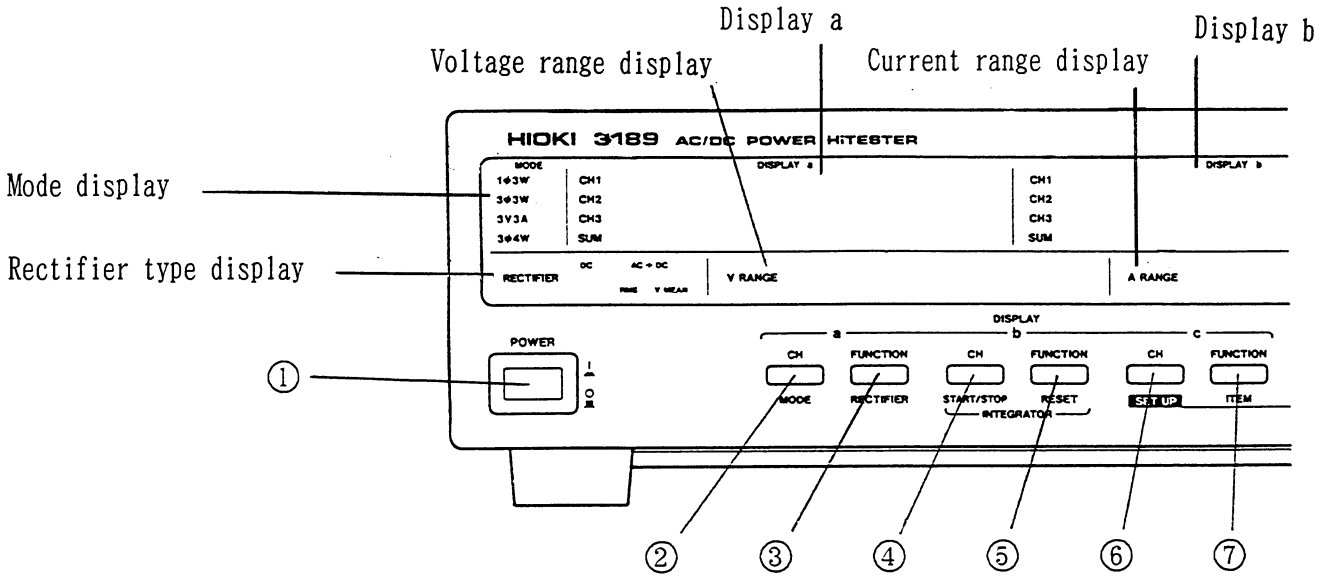


Fig.5-6-1. Operating overview 1

① Power switch
Powers on and off.

② Shift of the display channel on display a. (Refer to section 5-3. "Selecting the Display".)

CH1 → CH2 → [CH3] → SUM

③ Shift of the display items on display a. (Refer to section 5-3. "Selecting the Display".)

V(Voltage) → A(Current) → W(Effective power) → VA(Apparent power)
↓
deg(Phase angle) ← PF(Power factor) ← var(Watt-less power)

④ Shift of the display channel on display b. (Refer to section 5-3. "Selecting the Display".)

CH1 → CH2 → [CH3] → SUM

⑤ Shift of the display items on display b. (Refer to section 5-3. "Selecting the Display".)

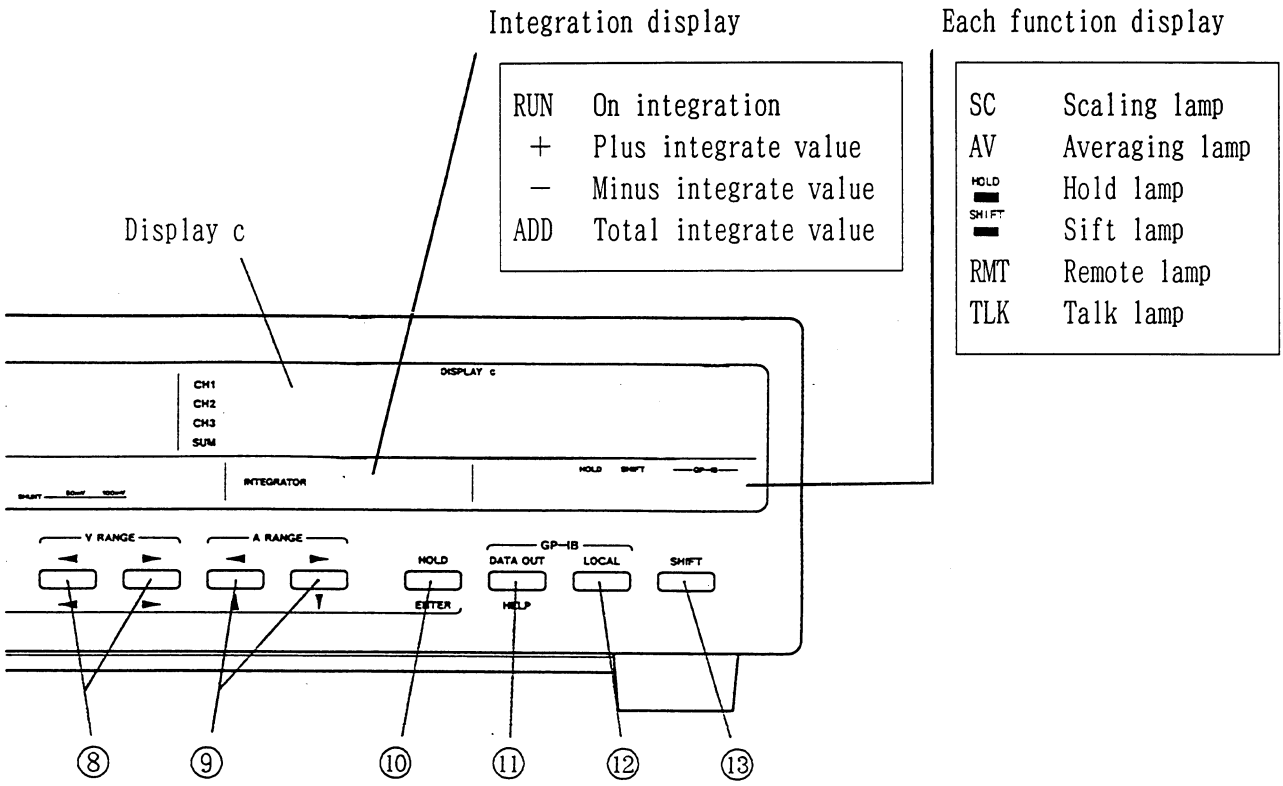
V → A → W → VA → var → PF → deg
TIME(Integration elasped time) ←

⑥ Shift of the display channel on display c. (Refer to section 5-3. "Selecting the Display".)

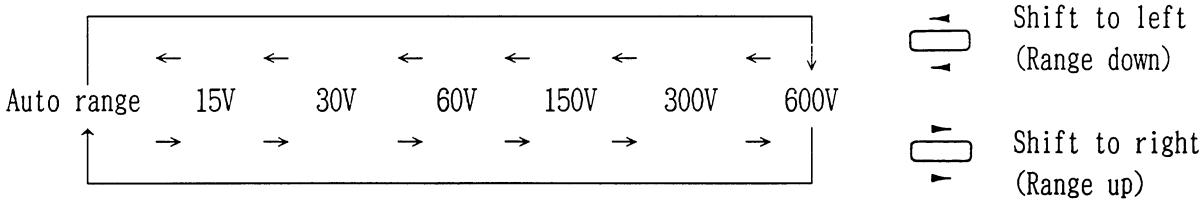
CH1 → CH2 → [CH3] → SUM

⑦ Shift of the display items on display c. (Refer to section 5-3. "Selecting the Display".)

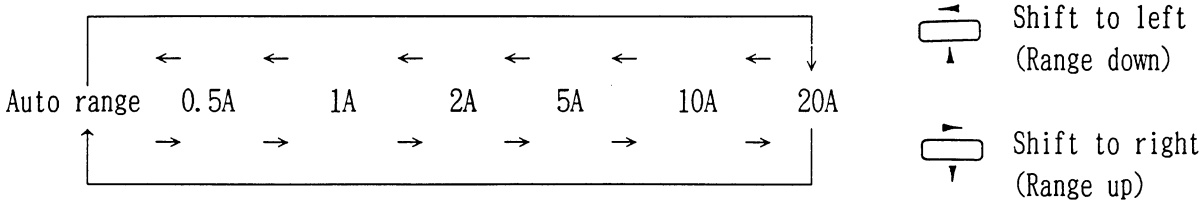
V → A → W → VA → var → PF → deg → Hz (Frequency)
↓
Total integrate value ← Minus integrate value ← Plus integrate value



⑧ Shift voltage range and auto and manual range. (Refer to section 5-4. "Selecting the Range".)



⑨ Shift current range and auto and manual range. (Refer to section 5-4. "Selecting the Range".)



⑩ Holding display. (Refer to section 5-5. "Holding the Display".)

Display	→	Release
stopping	←	stopping

⑪ Printing order to GP-IB printer

⑫ Release GP-IB remote condition

⑬ Shift lamp light

5-6-2. Operating Overview 2

While the shift lamp is out, refer to 5-6-1. "Operating Overview 1".
In this section, explains the function which is able to execute during the shift lamp is lightening.
Shift lamp is able to turn off with once key operation. (Shift is released.)
But, during operating Setup keys, shift lamp goes on lightening as long as pressing CH SET UP key is pressed. (Shift is continued.)
Items in [ ] corresponds to the 3189 only.

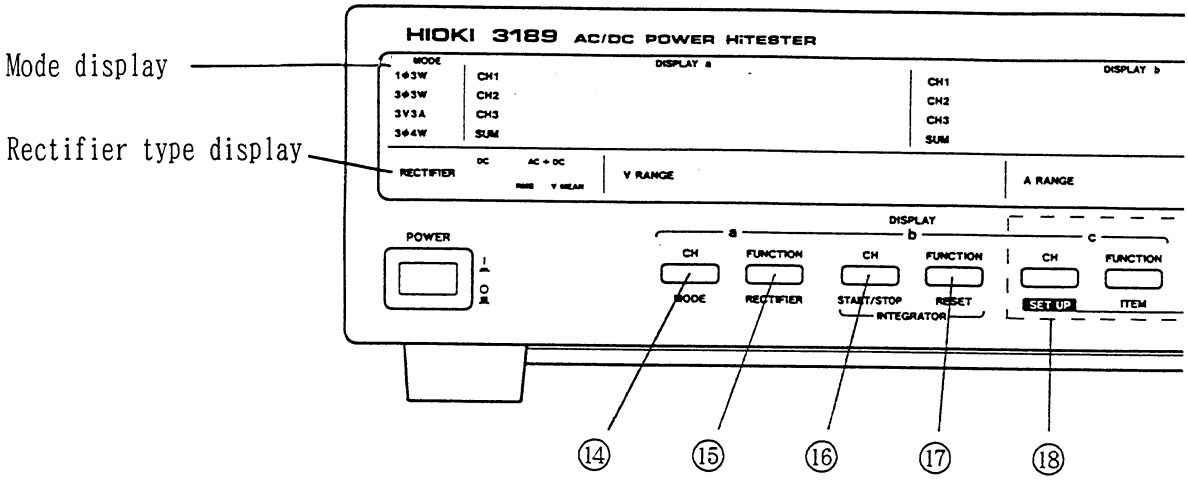


Fig. 5-6-2. Operating overview 2

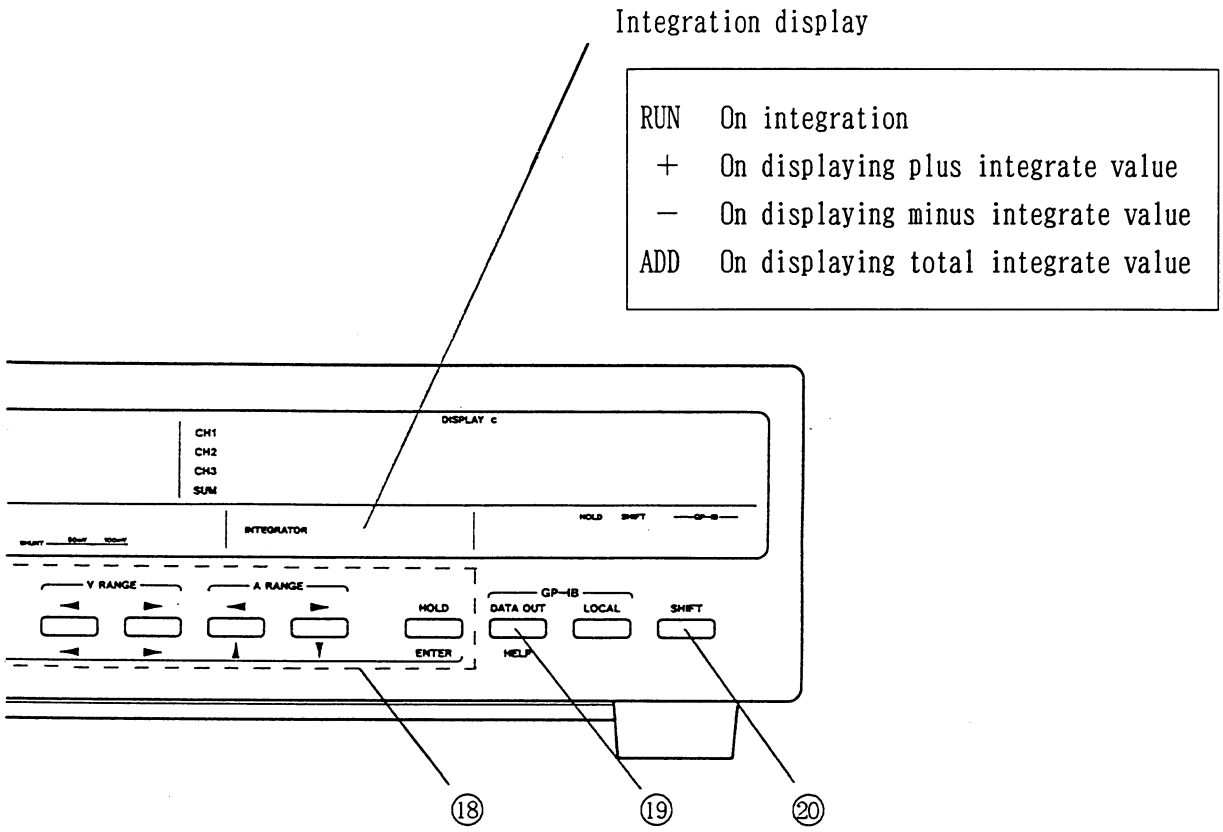
⑭ Shift of mode. (Refer to section 5-1. "Selecting the Mode".)
1φ3W(Single-phase three- wire)→ 3φ3W(Three-phase three-wire)
↑ ↓
[3φ4W(Three-phase four-wire) ← 3V3A(3-voltage, 3-current)]

⑮ Shift of rectifier type. (Refer to section 5-2. "Selecting the Rectifier Type")
DC(Direct current) → AC+DC RMS (Alternating current, real effective value)
↑ ↓
AC+DC V MEAN (Alternating current, for voltage, displays averaging rectifier effective value)

⑯ Starting and stopping integration. (Refer to section 6-4. "Integration")

⑰ Resetting integrate value. (Refer to section 6-4. "Integration")

⑱ Following seven keys are named as Setup keys, for details to chapter 6 "Applied Operation" to the text.
Items able to set are:
(1) Selection of frequency measurement source and range
(2) Selection of integrate time and items
(3) Setting PT ratio
(4) Setting CT ratio
(5) Selection of the number of averaging
(6) Selection of D/A output items
(7) Setting the GP-IB address
(8) Selection of printing items for GP-IB listen only printer
(9) Setting printing interval time for GP-IB listen only printer



Basic operations are:

(1) CH / SET UP Go in and out for setting (or setup) condition

(2) FUNCTION / ITEM Select setting items

(3) ◄ · ► Move among each units

(4) ▲ · ▼ Increase or decrease the values

(5) HOLD / ENTER Decide setting items

⑲ Help output to GP-IB printer

Output the settings such as mode, rectifier type and range.

⑳ Turning off the shift lamp

Chapter 6

Applied Operation

6-1. Items Set by Setup Keys

Following items are set by setup key.

Items	Abbreviation
① Selecting frequency measurement source and range	FrEq
② Setting integrate time and items	intG
③ Setting PT ratio	Pt
④ Setting CT ratio	Ct
⑤ Selecting the number of frequency	Au
⑥ Selecting D/A output items	d-A out
⑦ Setting GP-IB address	GP ib
⑧Selecting printing items for GP-IB listen only printer	dAtA out
⑨Setting printing interval time for GP-IB listen only printer	dAtA out

6-2. Operating Setup Keys

"Setup key" means every key shown in Fig.6-2-1. Those key work as "Setup key" during shift lamp is lightening.

During shift lamp is put out, this function does not work. However, those key work as the function shown with black letters above them.

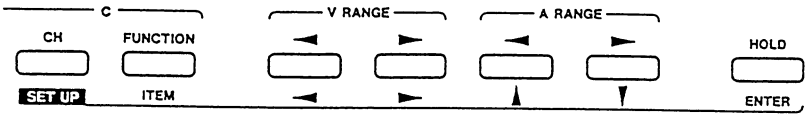


Fig.6-2-1. Setup keys

Function of those keys are shown with blue letters or marks under them.

Overview for operating is as follows;

(1) Press SHIFT key and illuminate shift lamp. Then press CH (SET UP) key it would be setting condition.
To return to normal measuring condition, press CH (SET UP) key again.

(2) Press FUNCTION (ITEM) key under setting condition setting items shift according to the following cycle.

FREQ → INTG → PT → CT → AV
↑
DATA OUT ← GP-IB ← D-A OUT

Setting items and present setting condition and so on are displayed.
Changable setting value and so on flash.

(3) To change setting condition press ◄, ►, ▲, ▼ key. They select mode or digit or increase and decrease values and so on.

(4) Changed setting condition is decided by pressing HOLD (ENTER) key. At this time flashing stops. (light becomes nomal condition)

(5) To continue changing setting items press FUNCTION (ITEM) key again.

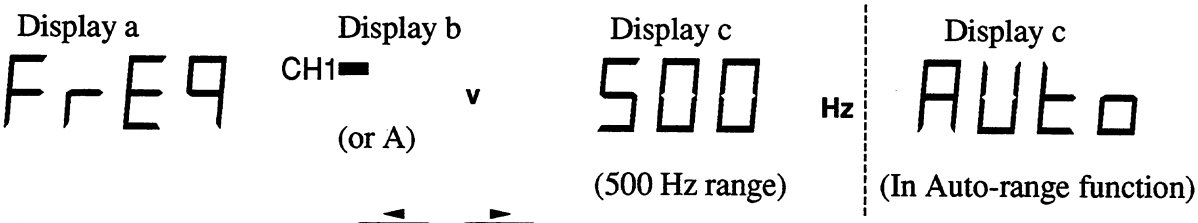
(6) Press CH (SET UP) key, return to normal measuring condition.

CAUTION

During integrating (for RUN lump is lightening) Setup keys don't work.
(For invalid key operation error No.012 is displayed.)
Refer to 6-4. "Integration" for details.

6-3. Frequency Measurement

(1) Setup keys are able to select frequency measurement source (either voltage or current waveform frequency) and frequency measurement range (either auto range or fix range 500 Hz or 50 kHz). Display example under setting condition is shown as follows;



(2) To select source press ◄ , ► key during display b is flashing.

To select range press ◄ , ► key during display c is flashing.

Pressing ◄ , ► key can exchange flashing of display b for display c.

(3) Pressing HOLD / ENTER key stops flashing and decide settings.

Internal settings does not change until this is operated.

(4) When changing settings again press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(5) To return to normal measuring condition press CH / SET UP key.

(6) To move to integration setting press FUNCTION / ITEM key.

CAUTION

- Frequency measurement is performed only for CH1.
- Frequency is able to measure in following limits.
  In 500 Hz range 4 Hz to 500 Hz
  In 50 kHz range 400 Hz to 50 kHz
  When it exceeds measuring limit following mark is dispalayed. (out of range)

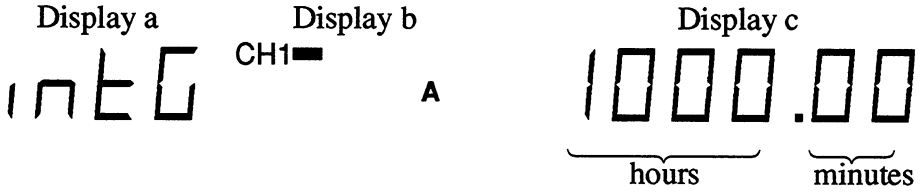
- When the auto range mode is selected for frequency measurement, if there is no input, or if the input is outside the permitted range, the display appears as follows:

- This unit has a low-pass filter to remove harmonics which exceed the upper limit of measurement and ensure that the target frequency can be measured correctly. The cut-off frequency of this filter is switched together with the range.

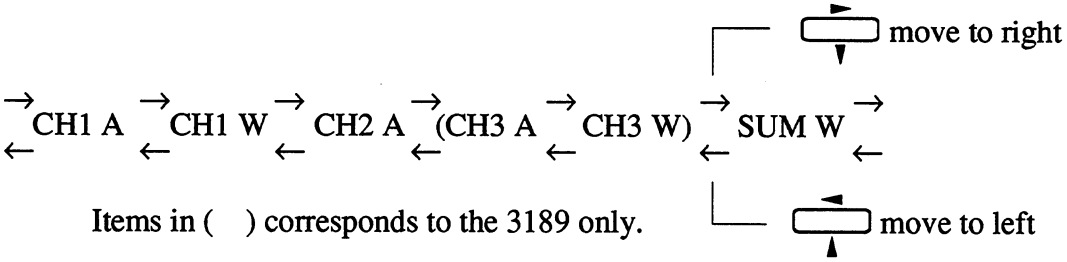
6-4. Integration

6-4-1. Settings

(1) Setup keys are able to select integrate items (either current or power integration) and set integrate time.
Display example under setting condition is shown as follows;



(2) To select integrate items press ◄ , ► key during display b is flashing.



During flashing display c values can change by ▲ , ▼ key.
To move the digit flashing press ◄ , ► key.
It can also select whether to select integrate items or to set integrate time.
The setting limit of integrate time is 1 minute to 1000 hours. If hours more than this is imputted, it is set 1000 hours forcibly on pressing HOLD/ENTER key.

(3) Pressing HOLD/ENTER key stops flashing and decide the settings. As long as this key is pressed, internal settings are unable to change.

(4) When chenging settings again press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(5) To return to normal measuring condition press CH/SETUP key.

(6) To move to PT setting press FUNCTION/ITEM key.

6-4-2. Integrating

(1) Integrating can start by following two way.

① By key operation

② By external control signal...Refer to 7-2. "External Control Terminal"

(2) To start integrating lighten shift lamp by pressing SHIFT key and press CH/START/STOP key under normal measuring condition. simultaneously RUN lamp on the display is lit.

(3) To stop integrating lighten shift lamp by pressing SHIFT key, and press CH/START/STOP key. Simultaneously RUN lamp on the display is lit.

(4) If integration is stopped then started again, the integration count will continue from the previous cumulative value.

(5) Integrating value must be resetted when you want to begin it from 0 after stopping.
To reset values lighten shift lamp by pressing SHIFT key and press FUNCTION RESET key.

(6) Integrating would stop under following condition.

① When achieving integrate time.

② When stopped by key operation. (or by stop command of GP-IB)

③ When integrate time achieve 1000 hours.

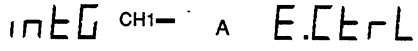
④ When integrate value achieve ±999999 MAh (MWh).

CAUTION

- When starting integration auto range setting is released and fixed on starting point. It is necessary to set range not to be over inputting while integrating. If during integration an input value exceeds 130% of the current range setting, the value added is just 130% of the range. The Ah or Wh unit indication flashes to indicate that an out-of-range value has occurred. This continues flashing until the integration value is reset.
- When lightening RUN lamp for integration, range and rectifier can not change. And setup keys are invalid. (error No.012 is displayed)
- Even if RUN lamp is turned off, when there is integrate data (the data is not resetted) range and rectifier are unable to change. (error No.012 is displayed) As following table, one of setup keys function are in valid. And in case of holding display under this condition, changeable items are limited.

Items	Display	Change	Change on holding
① Selecting frequency measurement source and range	○	○	×
② Setting integrate time and items	○	×	×
③ Setting PT ratio	○	×	×
④ Setting CT ratio	○	×	×
⑤ Selecting the number of averaging	○	○	×
⑥ Selecting D/A output items	○	○	×
⑦ Setting GP-IB address	○	○	○
⑧Selecting printing items for GP-IB listen only printer	○	○	○
⑨Setting printing interval time for GP-IB listen only printer	○	○	○

- When integrated by external control,display ② in table above would be as follows;



- During lightening RUN lamp for integration, resetting is out of order (error No.015 is displayed)
  Resetting must be done after stopping integration.
- On starting and stopping integration key operating (and START command of GP-IB) and external control are unable to mix. (error No.011 is displayed)

- When using external control, integrating has no relation to integrate time which is set according to 6-4-1 "Settings".
  After all, integration stops in following cases.
  ① Stopped by external control signals.
  ② When the integrate time achieves 1000 hours.
  ③ When the integrate value achieves ±999999MAh(MWh).
  But, integrate passage time can display normally same as key operating.
- Set address to talk only and connect GP-IB listen only printer, measuring value which is set in 6-10. "Selecting Printing Items" are able to print according to every certain interval simultaneously as starting integration.
- When doing system resetting, integrating is stopped and the requipment is resetted to initial condition. For system resetting refer to 8-2. "System Resetting".

6-4-3. Display Format of Integrating Value.

Format in integration resetted are showed in table 6-4-1 and 6-4-2.
Digits of integrate value and integrate range format carry up or down simultaneously.
(However, digits do not carry down in integration resetted format.)

Table 6-4-1. constitution of current intergrate range

A range	500.0mA	1.000A	2.000A	5.000A	10.00A	20.00A
Reset value	000.000mAh	0.00000Ah	0.00000Ah	0.00000Ah	00.0000Ah	00.0000Ah

Table 6-4-2. Constitution of power integrate range. (common with W1, W2, W3 and W SUM)

V \ A	500.0mA	1.000A	2.000A	5.000A	10.00A	20.00A
15.00V	0.00000Wh	00.0000Wh	00.0000Wh	00.0000Wh	000.000Wh	000.000Wh
30.00V	00.0000Wh	00.0000Wh	00.0000Wh	000.000Wh	000.000Wh	000.000Wh
60.00V	00.0000Wh	00.0000Wh	000.000Wh	000.000Wh	000.000Wh	0.00000kWh
150.0V	00.0000Wh	000.000Wh	000.000Wh	000.000Wh	0.00000kWh	0.00000kWh
300.0V	000.000Wh	000.000Wh	000.000Wh	0.00000kWh	0.00000kWh	0.00000kWh
600.0V	000.000Wh	000.000Wh	0.00000kWh	0.00000kWh	0.00000kWh	00.0000kWh

What is integration resetting value?

Display format of current range and effective power range applies to integrate value format under resetted condition.

Examples:	Display format	Integrating value format	Resetted value
30WRange	30.00W	30.0000Wh	00.0000Wh
1.5kWRange	1.500kW	1.50000kWh	0.00000kWh

Also in scaling display format applies to integrating value format.

Example:			
30W × 5(CT)	150.0W	150.000Wh	000.000Wh

6-5. PT Settings

(1) When using external PT, upstream value can read directly by operating with setup key.(scaling function)
Display example under setting condition would be as follows;

Display a	Display b	Display c
PE	Blank	1.000

(2) When display c is flashing values can change by ◄ , ► key. (The digits do not carry up or down.)
To move flashing digit press ◄ , ► key.

(3) When left side disit is flashing, dicimal point flashes by pressing ◄ key.
When right side digit is flashing dicimal point flashes by pressing ► key.
When dicimal point is flashing it can move by ▲ , ▼ key.

(4) Pressing HOLD / ENTER key stops flashing and dicide settings. As long as this key is pressed, internal settings unable to change.
Scaling lamp is lit when PT is except 1.(Refer to fig.6-5-1)

(5) When changing settings again, press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(6) To return to normal measuring condition press CH / SET UP key.

(7) To move to CT setting press FUNCTION / ITEM key.

CAUTION

- PT ratio is common with each channel.
- When display PT ratio less than 1 and press HOLD / ENTER key, "1.000" is set forcibly.
- As result of scaling, if value is over the maximum value "9999M", following mark is displayed.(Means scaling error)

When effective and apparent power become scaling error, wattless power, power factor, phase angle and power intergrate value display this error too.

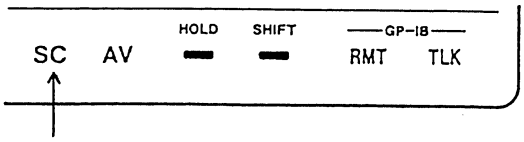


Fig.6-5-1. Scaling lamp

6-6. CT Settings

(1) When using external CT, upstream value can read directly by operating with setup key. Display example under setting condition would be as follows;

Dispaly a	Display b	Display c
	Blank	

(2) When display c is flashing values can change by ◄ , ▼ key. (The digits do not carry up or down.)
To move flashing digit press ◄ , ► key.

(3) When left side digit is flashing, dicimal point flashes by pressing ◄ key.
When right side digit is flashing, dicimal point flashes by pressing ► key.
When dicimal point is flashing it can move by ▲ , ▼ key.

(4) Pressing HOLD / ENTER key stops flashing and dicide settings. As long as this key is pressed, internal settings are unable to change.
Scaling lamp is lit when CT is except 1.(Refer to Fig.6-5-1)

(5) When changing settings again, press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(6) To return to normal measuring condition press CH / SET UP key.

(7) To move to average setting press FUNCTION / ITEM key.

CAUTION

- CT ratio is common with each channel.
- When display CT ratio less than 1 and press HOLD / ENTER key, "0.01" is set forcibly.
- As result of scaling, if values is over the maximum value "9999M", following mark is displayed.(Means scaling error)

- When effective and apparent power become scaling error, wattless power, power factor, phase angle, current and power integrate value display this error too.

6-7. Selecting the Number of Averaging

(1) Average function is good when the mesuring value is hard to read for its instability. This unit performs movable averaging but can select its number.
(For frequency measurement, this function is invalid.)
display example under setting condition would be as follows;

Display a	Display b	Dispaly c
Au	Blank	oFF

(2) During display c is flashing, the number of averaging can change by key operation as follows;

(64) → OFF → 8 → 16 → 32 → 64 → (OFF)
← ← ← ← ← ←

move to right
move to left

(3) Pressing HOLD / ENTER key stops flashing and decide settings. As long as this key is pressed, internal settings are unable to change.
Average lamp is lit when the number of averaging is except off. (Refer to Fig.6-7-1)

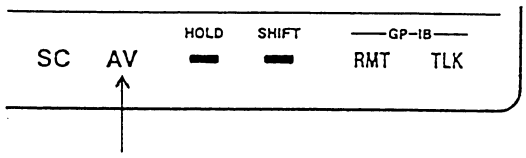


Fig.6-7-1. Average lamp

(4) When changing settings again, press ◄, ►, ▲, ▼ key. Flashing indication appears.

(5) To return to normal measuring condition press CH / SET UP key.

(6) To move to selecting D/A output press FUNCTION / ITEM key.

CAUTION

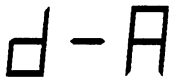
If during averaging an input value exceeds 130% of the current range setting, the value used for averaging is just 130% of the range. While an averaged value which includes an out-of-range value is being displayed, the unit indication flashes to indicate this fact.

6-8. Selecting D/A output

(1) By converting the measurement data to a DC voltage, and outputting it to a recorder, it is possible to monitor long-term changes at a glance.
D/A output means the function which changes measuring data (digital value) to voltage (analog value).
For voltage, current and effective power use analog output.
Both D/A and analog are output from rearpanel connector. Refer to Chapter 7 "External Control Terminal and Output Terminal".

(2) Display example under setting condition would be as follows;

Display a



Display b

Display C

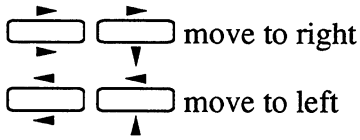
CH1 ▬ VA

(One of the unit symbols)

(3) Measuring data output from D/A is displayed by symblos in display c.
During unit symbols in display c is flashing, they shift according to the following cycle by key operation;

(ADD Ah/Wh) → VA1 → var1 → PF1 → deg1 → VA2 → var2 → PF2 → deg2 → [VA3 → var3 →
→ PF3 → deg3] → V SUM → A SUM → W SUM → VA SUM → var SUM →
→ PF SUM → deg SUM → Hz → +Ah/Wh → -Ah/Wh → ADD Ah/Wh → (VA1)

Items in [ ] corresponds to the 3189 only.



For integrated values, the current setting (current integration or power integration) is determined automatically and the corresponding value output.

(4) Pressing HOLD / ENTER key stops flashing and decide settings. As long as this key is pressed, internal settings are unable to change.

(5) When changing settings again, press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(6) To return to normal measuring condition press CH / SET UP key.

(7) To move to setting GP-IB address press FUNCTION / ITEM key.

(8) For D/A output example refer to fig.6-8-1 to fig.6-8-5.

Fig.6-8-1 D/A output of apparent and wattless power

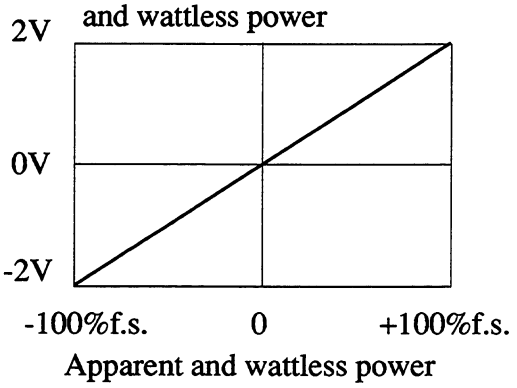


Fig.6-8-2 D/A output of power factor

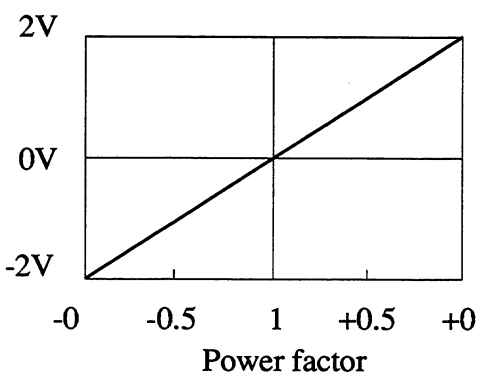


Fig.6-8-3. D/A output of phase angle

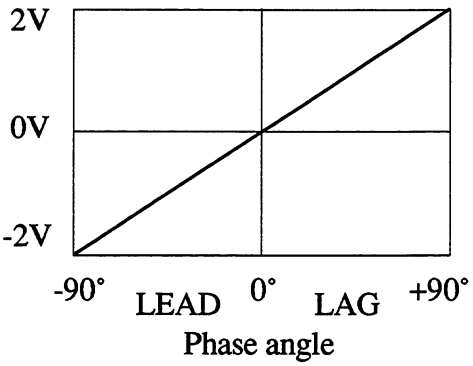
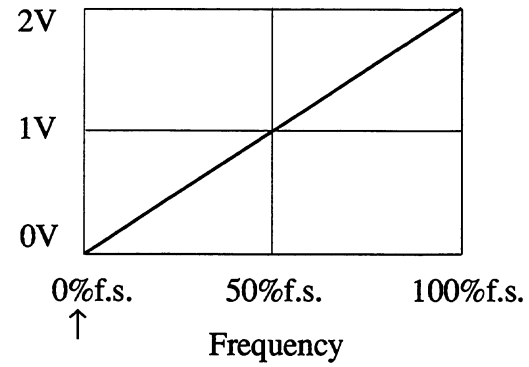


Fig.6-8-4. D/A output of frequency

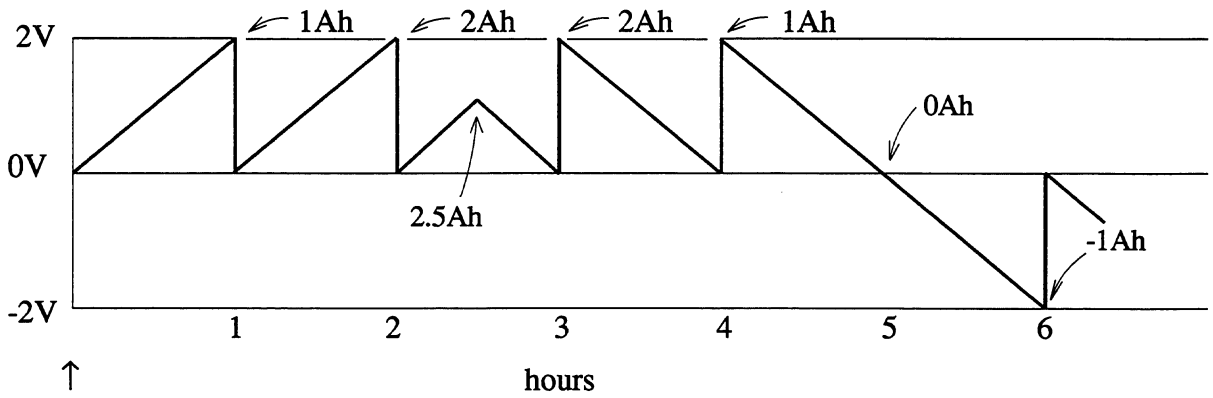


Lower than 0.8% f.s. becomes out of range.(Approx.3.3V)

In 500Hz range, 500Hz is 100%

In 50kHz range, 50kHz is 100%

Fig.6-8-5. D/A output of Integration (Example for current integration)



With the 1 A range selected, and the integration time set to one hour, in the case that +1 A is measured for 2 hours 30 minutes, and thereafter -1 A. (Cumulative integration)

Range × integrate time would be 2Vf.s..(For external control integrate time set in this equipment is put on the basis.)

CAUTION

- About 3.3V is output in plus out of range.
  About -3.3V is output in minus out of range.
- In holding or avaraging, value on display is output.
- D/A exchanging rate is about five times/second.
  There is filter in output circult, and the response time is about a half seconds.

6-9. Setting the GP-IB Address

(1) Address is set by setup key.
Setting limit of address is 0 to 30 and talk only.
Display example under setting condition would be as follows;

Display a	Display b	Display c	Display c
GP ib	Blank	01	t.onLY
		(For address 1)	(for talk only)

(2) During display c flashing each of ◄ , ► , ▲ , ▼ key are able to change address.
When address is "00", pressing ◄ , ▼ key makes mode of talk only. When it is "30" pressing ► , ▲ key also makes mode of talk only.

(3) Pressing HOLD / ENTER key stops flashing and decide the settings. As long as this key is pressed, internal settings are unable to change.

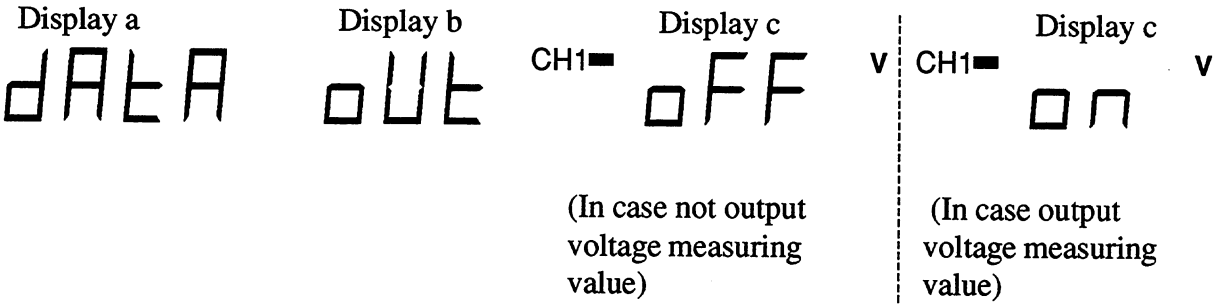
(4) When changing settings again press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(5) To return to normal measuring condition press CH / SET UP key.

(6) To move to selecting the printing items press FUNCTION / ITEM key.

6-10. Selecting the Printing Items

(1) When set GP-IB address to talk only, and connect GP-IB listen only printer measuring value are able to print to printer.
Display example under setting condition would be as follows;



(2) Select printing items with ◄ , ► key. At this time, unit symbols of display b and c are lit and displays items.
"ON" showed on display c means printing that item.
"OFF" showed on display c means not printing that item.
Whether on or off can change by pressing ◄ , ► key.
Repeating this operating and select "ON" or "OFF" for every items.

(3) Pressing HOLD / ENTER key stops flashing and decide settings. As long as this key is pressed, internal settings are unable to change.

(4) When changing settings again, press ◄ , ► , ◄ , ► key. Flashing indication appears.

(5) To return to normal measuring condition press CH / SET UP key.

(6) To move to setting the print interval time press FUNCTION / ITEM key.

6-11. Setting the Print Interval Time

(1) When set GP-IB address to talk only, and connect GP-IB listen only printer measuring value are able to print to printer.
And at the same time of integration starting, in every certain intervals, measuring value which is set in 6-10. "Selecting the Printing Items" can print.
In this section, set that interval.
Display example under setting condition would be as follows;

(2) Flashing unit can move with ◄ , ► key.
Values of flashing unit can change with ▲ , ▼ key.
The smallest unit of setting limit is 10 second and biggest is 100 hours. If input more times, it is set to 100 hours in force at pressing HOLD / ENTER key.

(3) Pressing HOLD / ENTER key stops flashing and decide settings. As long as this key is pressed, internal settings are unable to change.

(4) When changing settings again, press ◄ , ► , ▲ , ▼ key. Flashing indication appears.

(5) To return to normal measuring condition press CH / SET UP key.

(6) To return to first condition of frequency measuring press FUNCTION / ITEM key.

CAUTION

If the printing interval is set to 0, printing is synchronized with the start of integration.

6-12. PT and CT Setting Samples

1. Confirm whether hold lamp is turned off and integrate data is resetted.
   (For integration refer to 6-4. "Integration".)

> When hold lamp is lit, setting is out of order.
> During integrating or in case of not resetted integrate data in spite of stopping integration, setting is also unable.

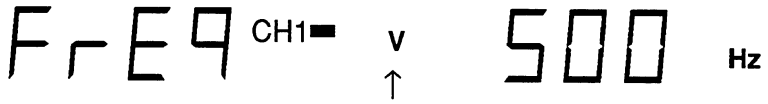
2. In this section, explain when using following PT and CT.

   PT: Upstream - 6,600V Downstream - 110V (PT ratio 6,600 ÷ 110=60)

   CT: Upstream - 2,000A Downstream - 5A (CT ratio 2,000 ÷ 5=400)

   (1) Press SHIFT key and lighten shift lamp.

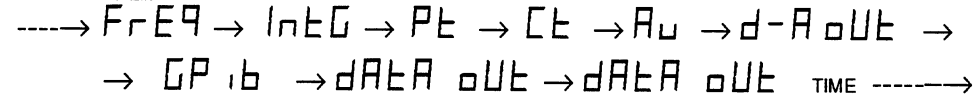
   (2) Press CH (SLT UP) key and make setting condition. Displays in this case become as follows;



Flashing

If this equipment is changed from intial setting, which item of (3) is displayed.

   (3) Press FUNCTION (ITEM) key, setting items shift according to the following cycle.



   (4) First, set PT. Press FUNCTION (ITEM) key and display following marks.

the highest unit flashing

(When PT ratio except 1 is already set that value is displayed.)

Not flashing the highest unit means not resetted the integrate data. In this case, press CH (SLT UP) key and return normal condition and reset data then reoperate from (1).

   (5) Set PT according to following order.

   ① Press ◄ key 5 times. Or press ► key 5 times. ① 6.000 Flashing

   ② Press ◄ key once. Or press ► key 4 times. ② 6.000 Flashing

   ③ Press ► key once. Or press ◄ key 3 times. ③ 60.00 Flashing

④ Finally press HOLD/ENTER key.
By above operation, PT ratio is decided at 60 and scaling lamp is lit.

④ 60.00
light (stop flashing)

If shift next setting items or return normal measuring condition under flashing condition PT remains previous settings.

(6) Next, set CT. After previous operation press FUNCTION/ITEM key and display following marks.

CT 1.000
the highest unit flashing

(When CT ratio except 1 is set that value is displayed)

(7) Set CT according to following order.

① Press ◄ key 3 times.
Or press ▲▼ key 7 times.

① 4.000
Flashing

② Press ◄ key once.
Or press ▲▼ key 4 times.

② 4.000
Flashing

③ Press ◄ key twice.
Or press ▲▼ key twice.

③ 400.0
Flashing

④ Finally press HOLD/ENTER key.
By above operation, CT ratio is decided at 400 and scaling lamp is lit.

④ 400.0
light (stop flasing)

(8) Next, when press CH/SET UP key, shift lamp is turned off and return to normal measuring condition. Scaling lamp is still light.

(9) Because range setting is set at downstream of PT and CT, as a rule make it 150V and 5A range.
Resolvable range such as voltage, current on effective power become as followingly.

Voltage:	9.000kV(150V × 60)
Current:	2.000kA(5A × 400)
Effective power:	18.00MW(150V × 5A × 60 × 400)
Apparent power:	18.00MVA
Wattless power:	18.00Mvar
Current integration:	0.00000kAh(On starting integration)
Power integration:	0.0000MWh(On starting integration)

For SUM, when the mode is 1φ3W, 3φ3W or 3V3A, they would be 36.00 MW (18.00 MW×2) and when it is 3φ4W, they would be 54.00 MW (18.00 MW×3).

Chapter 7

External Control Terminal and Output Terminal

7-1. Pin Arrangement

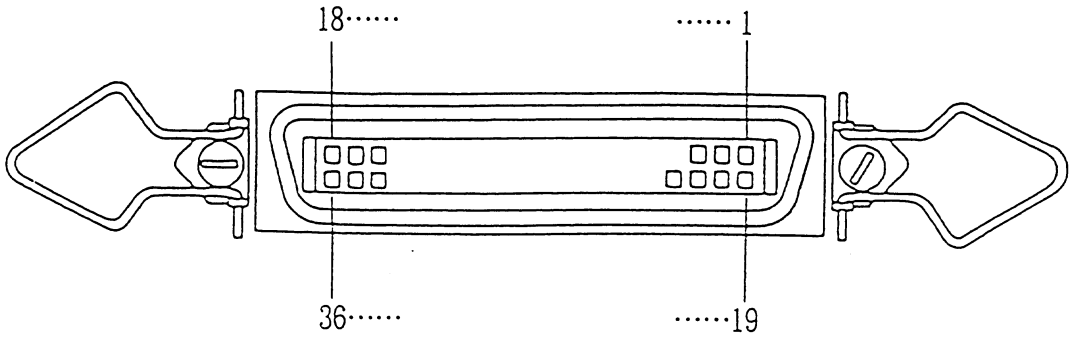


Fig. 7-1-1. Pin arrangement for connector

ANALOG OUT/EXT CONTROL

Suitable connector : ADS-B36LMR (Equivalent to Honda Tsushin Kogyo CO.,LTD)
(This unit contains this connector.)

Pin number	Signal name	Pin number	Signal name
1	V 1	19	INTEGRATOR START/STOP
2	A 1	20	D. GND
3	W 1	21	DATA OUT
4	V 1 monit	22	D. GND
5	A1 monit	23	
6	A. GND	24	
7	V2	25	INTEGRATOR RESET
8	A2	26	D. GND
9	W2	27	
10	V2 monit	28	
11	A2 monit	29	
12	A. GND	30	
13	(V 3)	31	
14	(A 3)	32	D/A OUT
15	(W 3)	33	A. GND
16	(V 3 monit)	34	W1 + W2
17	(A 3 monit)	35	(W1 + W2 + W3)
18	A. GND	36	A. GND

A. GND is common terminal for analog and waveform output.

D. GND is common terminal for external control signal.

Items in ( ) corresponds to the 3189 only.

7-2. Output Terminal

(1) Analog output
Outputs 2V DC f.s. direct voltage for range.
Outputs simultaneously for voltage (V1, V2 and V3), current (A1, A2 and A3) and effective power (W1, W2, W3, W1+W2 and W1+W2+W3).
1, 2 and 3, put beside V, A and W, correspond to measuring channels.
W1+W2 corresponds to W SUM in 1φ3W, 3φ3W and 3V3A.
W1+W2+W3 corresponds to W SUM in 3φ4W.

(2) Monitor output
Waveform output 2Vf.s. for range.
Outputs simultaneously for voltage (V1 monit, V2 monit and V3 monit) and current (A1 monit, A2 monit and A3 monit).
1, 2 and 3, put beside V and A, correspond to measuring channels.

(3) D/A output (D/A OUT)
Refer to 6-8. "Selecting D/A output".

Output resistance of these terminals are about 100Ω,.

7-3. External Control Terminal

The external control terminals accept a 0/5 V logic signal or a relay contact short/open signal to control the unit.

For details of the settings, see section 6-4. "Integration", and sections 6-9. "GP-IB Address Setting" through 6-11. "Printing Interval Setting".

CAUTION

- Excessive voltage applyment causes damages.
- If there is remarkable chattering in contact point signal sometimes controls become abnormally.

(1) Integration start and stop (INTEGRATOR START/STOP)

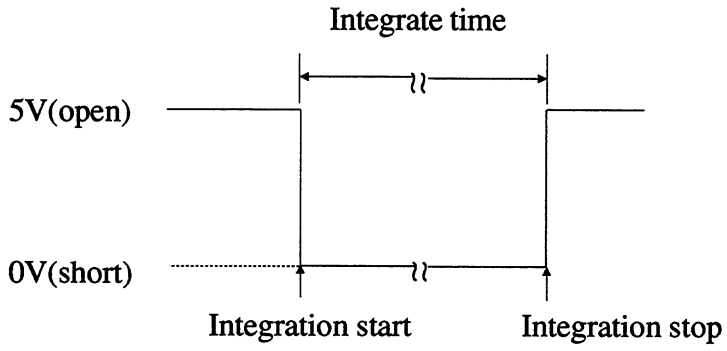


Fig.7-3-1. Integration start/stop

(2) Reset integration (INTEGRATOR RESET)

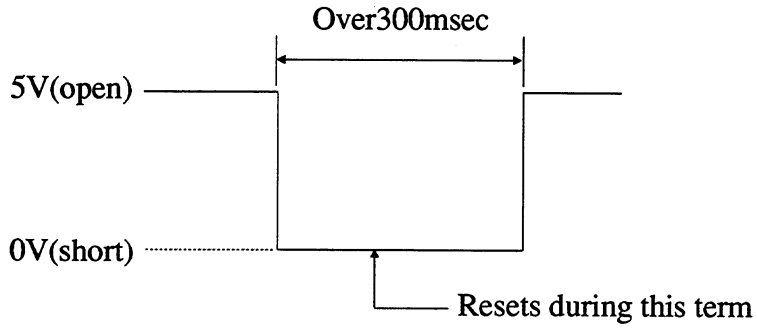


Fig.7-3-2. Reset integration

(3) Data output (print order for GP-IB listen only printer) (DATA OUT)

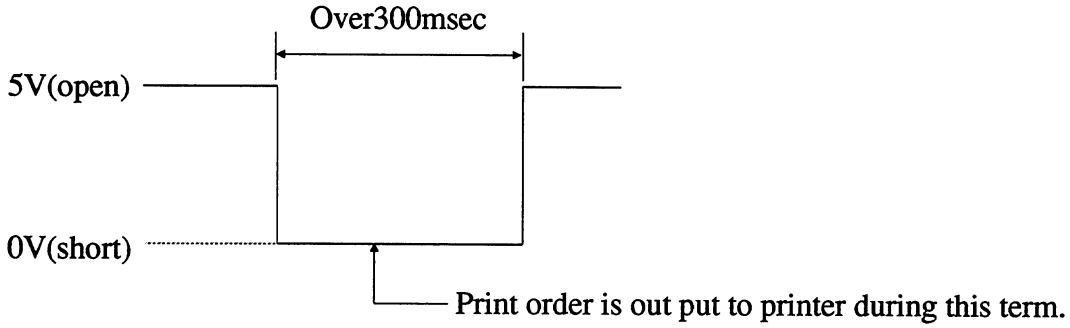


Fig.7-3-3. Data output

(4) The circuit in external control terminal consists followingly.

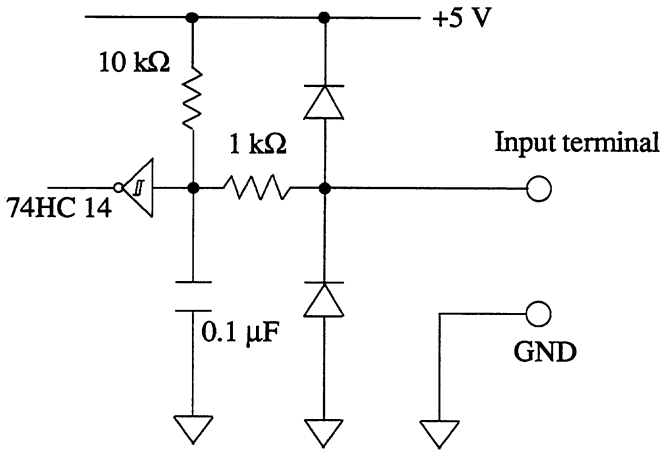


Fig.7-3-4. Internal circuit

7-4. Points for Particular Attention

⚠ WARNING

Because of damages or danger for the equipment, not apply input externally to output terminal.

CAUTION

- Output voltage is 2V DC for each range. When using power range or PT, CT be careful of value conversion.
- When using measuring range as auto ranging, analog output rate changes as range changing. Be careful of making mistake for range conversion when recording on the such line measuring value changes hard.
  In such measurement we advice you to measure in fixed ranging.
- Output response time is about 1.6 sec. Note that if there are fluctuations on the line being measured which happen faster than the response time of the unit, errors in the output voltage may occur.

Chapter 8

Other Functions

8-1. When the power is cut off

(1) When the power is cut off during integrating, integration starts again after that.

(2) When the power is cut off for using listen only printer with GP-IB interface, after returned,

① When the power is cut off during data forwarding, refoward from the top of the data.

② When it is cut off during integrating, print integration elapsed time and power cut comment "POWER FAILURE".

(3) During above-stated transaction display following marks.

Display b

Display c

8-2. System Resetting

After power turning on, press SHIFT and FUNCTION/RESET key continuously during self testing, you can do system resetting. (For self testing, refer to 4-5. "Self Test.")

By above-stated operation, settings are resetted following initial condition. (On shipping each settings are set under initial condition)

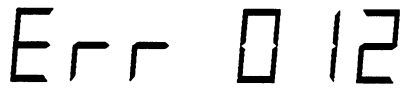
Integration elapsed time or integrate value and so on are also resetted.

Items	Settings
Display a	Voltage CH1
Display b	Current CH1
Display c	Effective power CH1
MODE	3188:3φ3W, 3189:3φ4W
Voltage range	600V
Current range	20A
Rectifier type	AC+DC RMS
Frequency range	500Hz
Frequency measurement source	Voltage
Integrate time	1000:00(1,000hours)
Integrate items	Effective power SUM
PT ratio	1.000
CT ratio	1.000
D/A output items	Apparent power CH1
The number of averaging	OFF(No averaging)
GP-IB address	1
Printing items	All items
Print interval time	00:00:00

8-3. Error indications

When there is something wrong for self testing at the power turning on or operates wrong key in integrating or holding the display, error indications are displayed.

Example of error indication



A list of error indication

Error number	Errors	Pages
001	Backup error	
101	ROM 1 error	
102	RAM 1 error	
103	I/O port 1 error	
104	Dual port RAM 1 error	
105	A/D and D/A converter error	
106	Display and key control circuit 1 error	
107	Display and key control circuit 2 error	
108	Interrupt handler fault	
201	ROM 2 error	
202	RAM 2 error	
203	I/O port 2 error	
204	Dual port RAM 2 error	
205	Frequency counter error	
011	Integration - key operation and external control used together	P.6-6
012	Integration - invalid key press during integration operation	P.6-6
013	Integration - integration started while scaling error has	P.6-8,9
014	Integration - restarted from maximum integration count oroccurred integration elapsed time	P.6-6
015	Integration - integration reset carried out during integration	P.6-6
016	Invalid key press during display hold	P.5-7
017	Invalid key press during setting	P.5-7
018	Transfer in channel attempted under invalid state	P.5-4
021	GP-IB - data out or help operation carried out while not set to "talk only" or when GP-IB interface is not installed	
022	GP-IB - no space left in internal data buffer	P.9-88
023	Not connected GP-IB printer	

CAUTION

- Error 001: When there is a backup error, pressing any key frees the display and returns to the normal measurement state. This unit, however, undergoes a system reset. (See Section 8-2. "System Resetting".)
- Errors 101 to 108 and 201 to 205 indicate internal problems with this unit. If these error indications appear, the unit requires repair.

Chapter 9

GP - IB Interface

9-1. Specifications

IEEE-488.1 1987

IEEE-488.2 1987

NOTE

On this unit, if the output queue becomes full, it is cleared and a query error is generated. This does not correspond to the clearing of the output queue and the outputting of a query error in the deadlock state as stipulated in IEEE 488.2.
(A deadlock state occurs when both the input buffer and the output queue are full, and processing cannot continue normally.)

Interface functions provided

SH1	All source handshake functions
AH1	All accepter handshake functions
T5	Basic talk functions Serial poll function Talk-only mode is provided. The talker cancellation function with MLA (My Listen Address) is provided.
L4	Basic listener functions Listen-only mode is not provided. The listener cancellation function with MTA (My Talk Address) is provided.
SR1	All service request functions
RL1	All remote/local functions
PP0	Parallel polling is not provided.
DC1	All device clear functions
DT1	All device trigger functions
C0	The controller function is not provided.

ASCII codes are used.

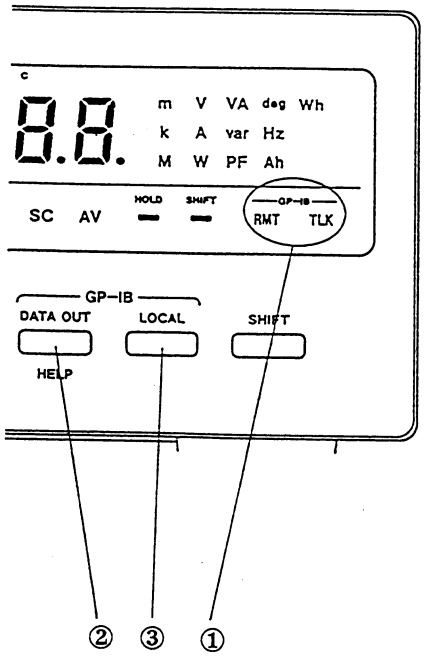
9-2. Points for Particular Attention

(1) Always be sure to secure the GP-IB cable to this unit by tightening up the fixing screws provided.
(2) If the controller dispatches a command while the set values (PT, CT, AV etc.) are being displayed, then the display will start to show measured data values.
(3) Program messages sent just after the power has been turned on are executed after the self test has terminated.
(4) It is vital that the proper data format is used when inputting commands with data values to this unit.
(5) Commands specific to this unit are all sequential commands.

⚠DANGER

In order to prevent any danger of electric shock to the operator, check carefully that the power cable and the connectors to this unit have been removed first, before connecting the GP-IB cable to this connector.

9-3. Controls and Connections



① GP-IB status display

These indicators show the GP-IB control state:

RMT: Remote
TLK: Talker

② Data out/help output key

When using GP-IB in talk only mode, measuring value or setting state can output with this key.

③ LOCAL key

Press this key to release the remote state of the GP-IB interface and to resume the local state. However, the LOCAL key is disabled if the GP-IB controller has put the unit into the local out state.

9-4. Setting GP-IB Address/Talk only

Refer to 6-9. "Setting GP-IB Address".

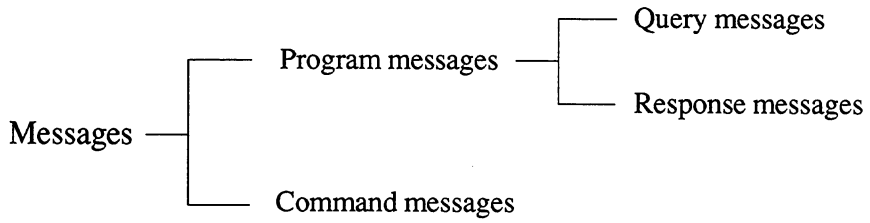
9-5. Introduction to the GP-IB Interface

9-5-1. Features

(1) All of the functions of the main unit, except for powering on, and setting the address can be controlled via the GP-IB interface.
(2) The unit can be reset.
(3) In the hold state, single-shot measurement is possible.
(4) IEEE 488.2-1987 standard (essential) commands can be used.
(5) This unit can output manual, time interval and help output using the talk only mode.

9-5-2. Messages

Data received or sent by the GP-IB interface is called a message.
The following are the message types:



Of these, program messages are those received by the unit from the controller, while response messages are those sent from the unit to the controller.

(1) Program messages

Program messages can be divided into either command messages or query messages.

Command messages are orders for control of the unit, such as for making settings or for reset or the like.

Query messages are orders for responses relating to results of operation, results of measurement, or the state of device settings.

(2) Response messages

After a query message has been received, a response message is produced the moment that its syntax has been checked. It is also possible to change the message unit separator of response messages from the semicolon ";" to the comma "," when headers are off, using the command "TRANsmit:SEParator". Initially this separator is set to the semicolon ";".

Headers on: "V1 ␣+101.2E+0;A1 ␣ +1.200E-3"

Headers off: "+101.2E+0;+1.200E-3"

↓

Headers off: "+101.2E+0,+1.200E-3"

A detailed explanation is given on page 9-69.

"␣" means a space. In fact, the place which corresponds to this mark is a blank.

9-5-3. Command Syntax

The names of commands for this unit are as far as possible mnemonic. Furthermore, all commands have a long form, and an abbreviated short form.

In command references in this manual, the short form is written in upper case letters, and then this is continued in lower case letters so as to constitute the long form. Either of these forms will be accepted during operation, but intermediate forms will not be accepted. Further, during operation both lower case letters and upper case letters will be accepted without distinction.

Example:

For "DISPLAY", either "DISPlay" or "DISP" will be accepted. However, any one of "DISPLA", "DISPL", or "DIS" is wrong and will generate an error.

Response messages generated by this unit are in long form and in upper case letters.

9-5-4. Headers

Whether or not headers are prefixed to response messages is set by the "HEADer" command. It is essential to prefix headers to program messages.

(1) Command program headers

There are three types of command: simple commands, compound commands, and standard commands.

① Simple command header
This header is a sequence of letters and digits.

HEADer

② Compound command header
This header is made up from a plurality of simple command type headers marked off by colons.

VOLTage:RANGe

③ Common command header
This header begins with an asterisk, and continues with a standard command stipulated by IEEE 488.2.

*RST

(2) Query program headers

These are for commands used for interrogating the unit about the results of operations, about measured values, or about the current states of settings for the unit.

As shown by the following examples, they can be recognized as queries by a question mark appearing after the program header. The structure of the header is identical to that of a command program header, with "?" always being affixed to the last command. There are queries possible in each of the three previously described types of command form.

SCALe?

SCALe:PT?

9-5-5. Message Terminators

This unit recognizes either a linefeed character (0AH) or the EOI signal, or both, as message terminators.

To terminate a response message, this unit always provides the appropriate EOI signal, and also sends a terminating character sequence. By the use of the "TRANsmit:TERMinator" command either of the following can be selected as response message terminator sequence:

(1) LF with EOI (linefeed only)

(2) CR + LF with EOI (carriage return plus linefeed)

The initial selection is (1).

A detailed explanation of the "TRANsmit:TERMinator" command is given on page 9-71.

9-5-6. Separators

(1) Message unit separator

A semicolon ";" is used as a message unit separator when it is desired to set out several messages on a single line.

Example: "*RST [;] :SCALe:CT␣4 [;] :AVERaging␣64"

(2) Header separator

In a message which has a header and data, a space (represented by " ␣ " in the examples) is used as the header separator to separate the header from the data.

Example: ":VOLTage:AUTO [␣] ON"

(3) Data separator

If a message has several data items, commas are required as data separators for separating these data items from one another.

Example: ": MEASure? ␣ V1 [,] A1 [,] W1 [,] VA1"

9-5-7. Data Formats

This unit uses character string data and decimal numeric data, and the type used varies according to the command in question.

(1) Character data

Character string data must always begin with an alphabetic character, and the following characters can be either alphabetic characters or numerals. Although in character data either upper case letters or lower case letters are accepted, response messages output by this unit are always in upper case letters.

Example: ":DISPlay ␣ V1 , a1 , W 1 "

(2) Decimal data

The numeric data values are all represented in decimal, in three formats identified as NR1, NR2 and NR3, and each of these can appear as either a signed number or an unsigned number. Unsigned numbers are taken as positive.

Further, if the accuracy of a numerical value exceeds the range with which this unit can deal, it is rounded off. (5 and above is rounded up; 4 and below is rounded down).

NR1 format - integer data.

Examples: +12, -23, 34

NR2 format - fixed point numbers.

Examples: +1.23, -23.45, 3.456

NR3 format - floating point numbers.

Examples: +1.E-2, -2.3E+4

The term "NRf format" includes all these three formats.

When this unit is receiving it accepts NRf format, but when it is sending response messages it utilizes whichever one of the formats NR1 to NR3 is indicated in the particular command. All of the following examples set the voltage range to 150 V:

":VOLTage:RANGe ␣ 150"

":VOLTage:RANGe ␣ 150.2"

":VOLTage:RANGe ␣ 1.495E2"

9-5-8. Abbreviation of Compound Commands

When several compound commands have a common head portion, for example :SCAL:PT and :SCAL:CT, then, when and only when writing them directly following on from one another, this common portion (:SCAL: in this example) can be omitted from each command except for the first one. This common portion is called "the current path", by analogy with the general concept of the current directory in the directory structure of UNIX or MSDOS, and until it is cleared the analysis of following commands is performed by deeming them to be preceded by the current path which has been curtailed in the interests of brevity. This manner of using the current path is shown in the following example:

Normal expression:

":SCALe:CT ␣ 2;:SCALe:PT ␣ 10;:SCALe:CT?"

Abbreviated expression:

" : SCALe: CT ␣ 2;PT ␣ 10;CT?"

└── This becomes the current path, and can be curtailed from the following commands.

The current path is cleared when the power is turned on, when a system reset is performed by key input, when a colon ":" appears at the start of a command, and when a message terminator is detected.
Messages of standard command form can be executed without relation to the current path. Further, they have no effect upon the current path.
It is not necessary to prefix a colon ":" at the start of headers of simple commands and compound commands. However, in order to prevent confusion with abbreviated forms and mistakes in operation, it is recommended practice always to prefix ":" to headers. With this unit, there are seven possible current paths:

":VOLTage:", ":CURRent:", ":SCALe:", ":TRANsmit:", ":FREQuency:", ":INTEGrate:" and ":DATAout:"

9-5-9. Output Queue

Response messages accumulate in the output queue and are read out as data and cleared by the controller.
The output queue is also cleared in the following circumstances:

- When a device clear is issued.
- When the power is turned off and turned on again.
- When the unit is reset by a key press.
- When the query error is generated.

This unit has an output queue of 1500 bytes capacity. If the response messages overflow this limit of 1500 bytes, a query error is generated, and the output queue is cleared. Further, if a new message is received while the output queue still contains data, the output queue is cleared, and a query error is generated.

9-5-10. Input Buffer

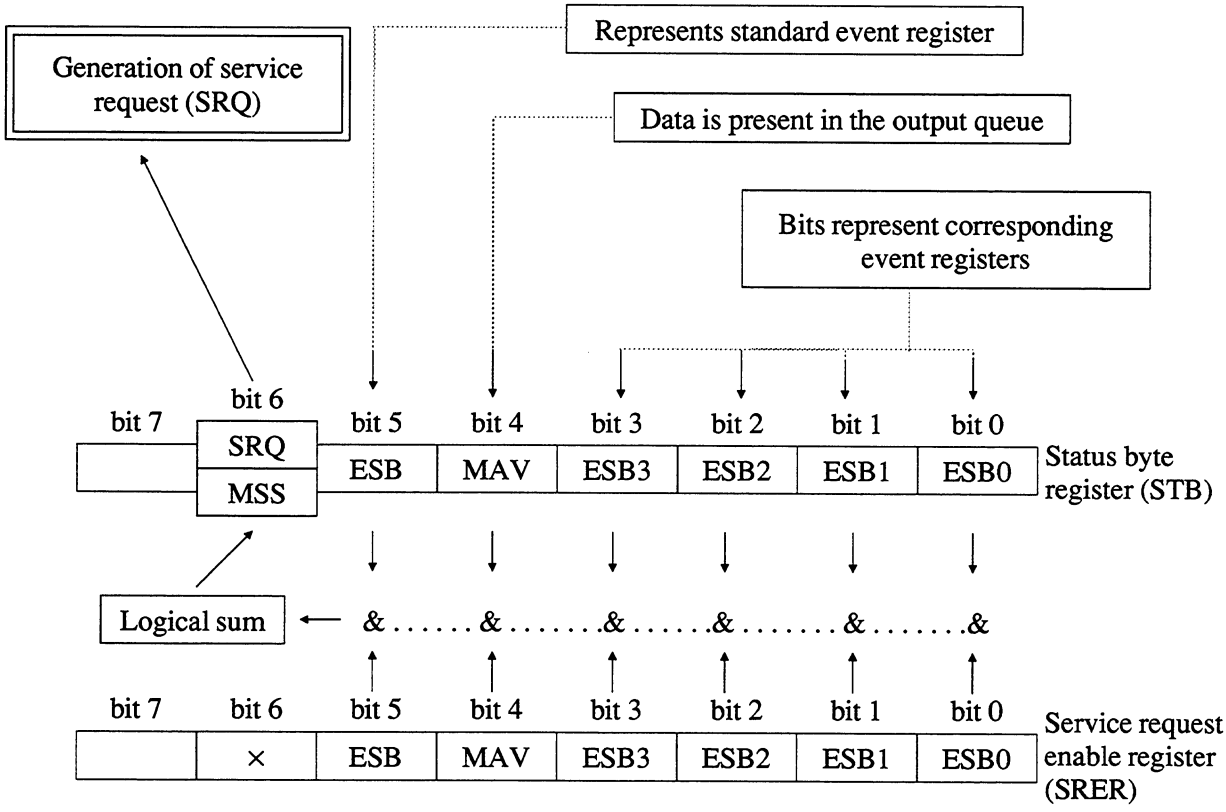
This unit has an input buffer of 300 bytes capacity. Messages which are received are put into this buffer and executed in order. If the data accumulated in this buffer exceeds 300 bytes the buffer becomes full, and until a space again becomes available in the buffer the GP-IB interface bus goes into the waiting state.

9-5-11. Status Model

In its implementation of the serial polling function using service requests, this unit employs the status model specified by IEEE 488.2.

The term "event" refers to any phenomenon which generates a service request.

Generation of service requests



The status byte register holds information relating to the event registers and the output queue. It is further possible to use the service request enable register as a mask to select the items required. If any of the bits selected by the mask becomes 1, bit 6 (the master summary status or MSS bit) is also set to 1, an SRQ message is generated, and this generates a service request.

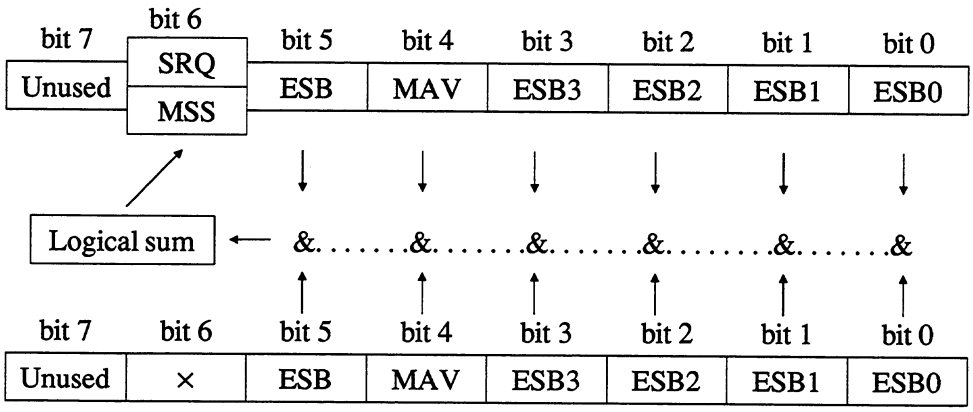
9-5-12. Status Byte Register

(1) Status byte register (STB)

The status byte register is an 8-bit register whose contents are output from this unit to the controller, when serial polling is being performed.

If even only one bit in the status byte register has changed from 0 to 1 (provided that it is a bit which has been set in the service request enable register as a bit which can be used), then the MSS bit is set to 1. Simultaneously with this the SRQ bit is set to 1, and a service request is generated.

The status byte register (STB)



The service request enable register (SRER)

The SRQ bit is synchronized with service requests, and is read out and simultaneously cleared when serial polling is being performed. Although the MSS bit is only read out on an "*STB?" query, on a "*CLS" command for example it is not cleared until the event is cleared.

Status byte register bit assignments

Bit 7	Unused
Bit 6 SRQ	Set to 1 when a service request is dispatched
MSS	Logical sum of the other bits of the status byte register
Bit 5 ESB	Standard event summary (logical sum) bit Bitwise logical sum of the standard event status register
Bit 4 MAV	Message available Indicates that there is at least one message in the output queue
Bit 3 ESB3	Event summary bit 3 (the 3189 only) Bitwise logical sum of event status register 3
Bit 2 ESB2	Event summary bit 2 Bitwise logical sum of event status register 2
Bit 1 ESB1	Event summary bit 1 Bitwise logical sum of event status register 1
Bit 0 ESB0	Event summary bit 0 Bitwise logical sum of event status register 0

(2) Service request enable register (SRER)

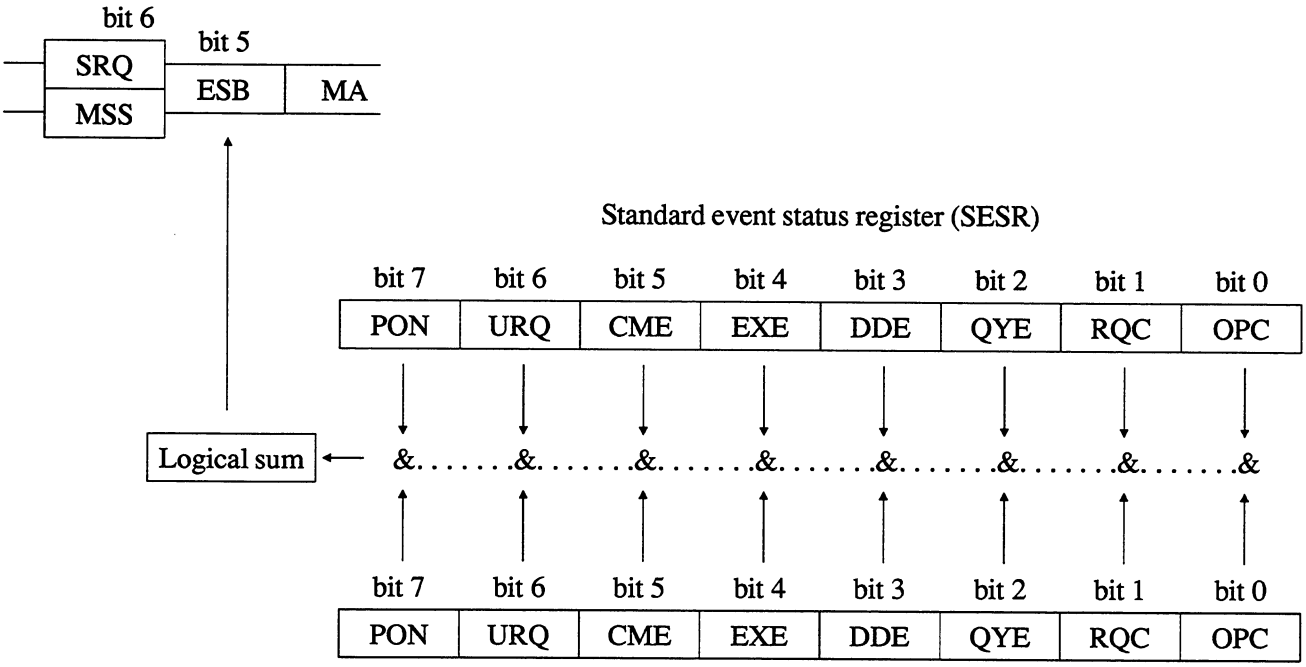
This register masks the status byte register. Setting a bit of this register to 1 enables the corresponding bit of the status byte register to be used.

9-5-13. Event Registers

(1) Standard event status register (SESR)

The standard event status register is an 8-bit register. If any bit in the standard event status register is set to 1 (after masking by the standard event status enable register), bit 5 (ESB) of the status byte register is set to 1.

Status byte register (STB)



The standard event status register is cleared in the following three situations:

① When a "*CLS" command is received.

② When an "*ESR?" query is received.

③ When the unit is powered on.

(2) Standard event status enable register (SESER)

Setting any bit of the standard event status enable register to 1 enables the corresponding bit of the standard event status register to be accessed.

Standard event status register (SESR) bit assignments

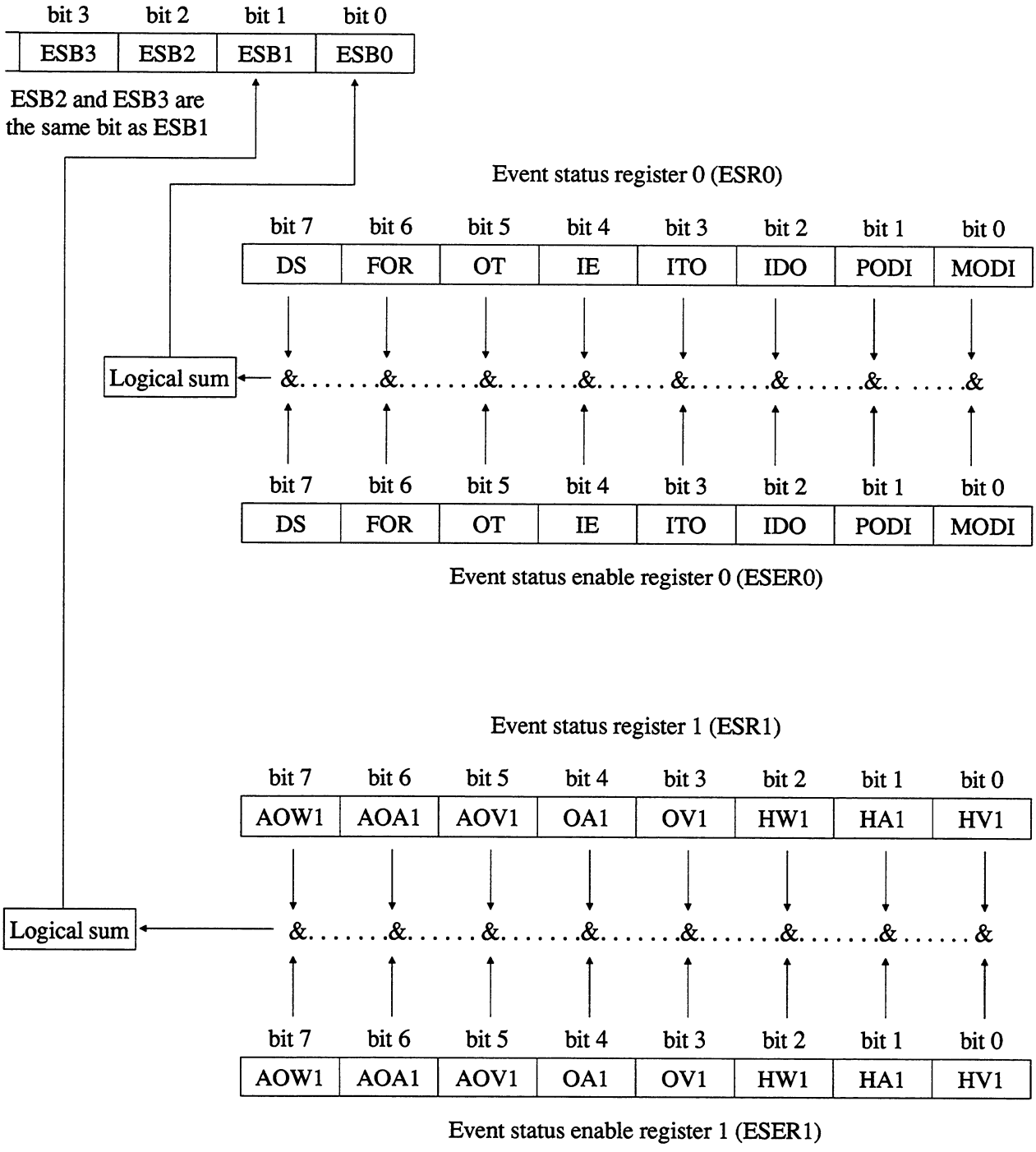
Bit 7 PON	Power on flag. When the power is turned on, or on recovery from a power cut, this bit is set to 1.
Bit 6 URQ	User request. Not used by this unit.
Bit 5 CME	Command error. When a command which has been received contains a syntactic or semantic error, this bit is set to 1. • The command is not supported by this unit. • There is a mistake in a program header. • The number of data parameters is wrong. • The format of the parameters is wrong.
Bit 4 EXE	Execution error When for some reason a command which has been received cannot be executed, this bit is set to 1. • The designated data value is outside the set range. • The designated data value is not acceptable.
Bit 3 DDE	Device dependent error. When a command cannot be executed due to some cause other than a command error, a query error, or an execution error, this bit is set to 1. • Execution is impossible due to an abnormality inside this unit. • Execution is impossible because some other function is being performed (during holding and integrating). • If input out of range, or scaling overflow has occurred, when the "MEASure?" command has read this out-of-range value.
Bit 2 QYE	Query error. This bit is set to 1 when a query error is detected by the output queue control. • When an attempt has been made to read the output queue when it is empty. • When the data overflows the output queue. • When data in the output queue has been lost. • When, on the same line, a query occurs after an "*IDN?" query.
Bit 1 RQC	Request for controller authority. Not used by this unit.
Bit 0 OPC	Operation terminated. This bit is set to 1 when an "*OPC" command is executed. • When the operation of all the messages up to the "*OPC" command has been completed.

(3) Event status registers specific to this unit (ESR0, ESR1, ESR2 and ESR3)

For 3188, three 8-bit event status registers ESR0 to ESR2 and for 3189, four 8-bit registers ESR0 to ESR3 are provided for managing events on this unit. If any bit in one of these event status registers is set to 1 (after masking by the corresponding event status enable register), the following happens:

- For event status register 0, bit 0 of the status byte register (ESB0) is set to 1.
- For event status register 1, bit 1 of the status byte register (ESB1) is set to 1.
- For event status register 2, bit 2 of the status byte register (ESB2) is set to 1.
- For event status register 3, bit 3 of the status byte register (ESB3) is set to 1.

Status byte register (STB)



Event status register 0, 1, 2 and 3 are cleared in the following three situations:

① When a "*CLS" command is received.

② When an "ESR0?" query (for event status register 0), "ESR1?" query (for event status register 1), "ESR2?" query (for event status register 2) or "ESR3?" query (for event status register 3) is received.

③ When the unit is powered on.

Event status register 0 (ESR0)
Event status innable register 0 (ESER0)

Bit 7 DS	Sets at every time the display data (measuring value) is made. (Data Set)
Bit 6 FOR	Sets when frequency becomes o.r. (Frequency Out of Range)
Bit 5 OT	Sets when achieved output time during integrating. Sets when integrating has been started and stopped. When output time has been 000:00:00, this is not set. (Output Time)
Bit 4 IE	Sets when integrating has been stopped. (Integrate End)
Bit 3 ITO	Sets when integrate time achieves 1000 hours. (Integrate Time Over)
Bit 2 IDO	Sets at every time sampling is performed during integrate data has been over (±999999 M) (Integrate Data Over)
Bit 1 PODI	Sets when the plus over data (o.r) is added to integrate value. (Plus Over Data Integrate)
Bit 0 MODI	Sets when the minus over data (-o.r) is added to integrate value. (Minus Over Data Integrate)

Event status register 1 (ESR1)
Event status innable register 1 (ESER1)

Bit 7 AOW1	CH1 AVERAGE OVER-W Average power value in CH1 includes input out of range data.
Bit 6 AOA1	CH1 AVERAGE OVER-A Average current value in CH1 includes input out of range data.
Bit 5 AOV1	CH1 AVERAGE OVER-V Average voltage value in CH1 includes input out of range data.
Bit 4 OA1	CH1 OVER-A Peak value of current input in CH1 out of range
Bit 3 OV1	CH1 OVER-V Peak value of voltage input in CH1 out of range
Bit 2 HW1	CH1 HIGH-W Power input in CH1 out of range
Bit 1 HA1	CH1 HIGH-A Current input in CH1 out of range
Bit 0 HV1	CH1 HIGH-V Voltage input in CH1 out of range

AOV1, AOA1 and AOW1 is set when the display has been renewaled.

Event status register 2 (ESR2)
Event status innable register 2 (ESER2)

Bit 7 AOW2	CH2 AVERAGE OVER-W Average power value in CH2 includes input out of range data.
Bit 6 AOA2	CH2 AVERAGE OVER-A Average current value in CH2 includes input out of range data.
Bit 5 AOV2	CH2 AVERAGE OVER-V Average voltage value in CH2 includes input out of range data.
Bit 4 OA2	CH2 OVER-A Peak value of current input in CH2 out of range
Bit 3 OV2	CH2 OVER-V Peak value of voltage input in CH2 out of range
Bit 2 HW2	CH2 HIGH-W Power input in CH2 out of range
Bit 1 HA2	CH2 HIGH-A Current input in CH2 out of range
Bit 0 HV2	CH2 HIGH-V Voltage input in CH2 out of range

AOV2, AOA2 and AOW2 is set when the display has been renewaled.

Event status register 3 (ESR3) (3189 only)
Event status innable register 3 (ESER3) (3189 only)

Bit 7 AOW3	CH3 AVERAGE OVER-W Average power value in CH3 includes input out of range data.
Bit 6 AOA3	CH3 AVERAGE OVER-A Average current value in CH3 includes input out of range data.
Bit 5 AOV3	CH3 AVERAGE OVER-V Average voltage value in CH3 includes input out of range data.
Bit 4 OA3	CH3 OVER-A Peak value of current input in CH3 out of range
Bit 3 OV3	CH3 OVER-V Peak value of voltage input in CH3 out of range
Bit 2 HW3	CH3 HIGH-W Power input in CH3 out of range
Bit 1 HA3	CH3 HIGH-A Current input in CH3 out of range
Bit 0 HV3	CH3 HIGH-V Voltage input in CH3 out of range

AOV3, AOA3 and AOW3 is set when the display has been renewaled.

Summary of commands for writing and reading each of the registers

Register	Read	Write
Status byte register	*STB?	———
Service request enable register	*SRE?	*SRE
Standard event status register	*ESR?	———
Standard event status enable register	*ESE?	*ESE
Event status register 0	ESR0?	———
Event status enable register 0	ESE0?	ESE0
Event status register 1	ESR1?	———
Event status enable register 1	ESE1?	ESE1
Event status register 2	ESR2?	———
Event status enable register 2	ESE2?	ESE2
Event status register 3	ESR3?	———
Event status enable register 3	ESE3?	ESE3

9-5-14. GP-IB Commands

The following commands are used for performing interface functions:

Command	Function
GTL	Go To Local The remote state is canceled, and the system goes into the local state.
LLO	Local Lock Out All keys, including the LOCAL key, become inoperable.
DCL	Device CLear Clears the input buffer and the output queue.
SDC	Selected Device Clear Clears the input buffer and the output queue.
GET	Group Execute Trigger During the hold condition, performs one-shot sampling processing.

9-6. Command Reference

(1) Command reference

(2) Format of command explanations

Syntax Specifies the syntax for the command.

Data For a command that has parameters, specifies their format.

Function Specifies the function of the command.

Note Specifies points to which attention should be paid when using the command.

Response syntax Only appears for a command (query) to which a response message is returned. Specifies the syntax for the response message, both when headers are on and when headers are off.

Errors Specifies what types of error may occur. However of course all commands are susceptible to spelling mistakes.

Example These are simple examples of the use of the command. The examples all show commands in the short form.

(3) " ␣ " mark, used in format means a space.

*CLS

Clears the status byte register and the event registers.

Syntax *CLS

Function
- This instruction clears the event registers and the bits of the status byte register associated with that register (SESR, ESR0, ESR1, ESR2 and ESR3).

Note
- This has no effect upon the output queue, the various enable registers, or bit 4 (the MAV bit) of the status byte register.

Errors
- This command is executed even in the event of a system error.

*ESE

Sets the standard event status enable register.

Syntax *ESE ␣ <data>

Data <data> 0 to 255 numerical data in NR1 format

Function
- This instruction sets the standard event status enable register (SESER) to a bit pattern which is used to mask the standard event status register (SESR).
- Any decimal fraction in the data value is rounded.

Standard event status enable register (SESER)

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

Note
- When the power is turned on, and when a system reset has taken place upon key input, the data is reinitialized to zero.

Errors
- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If an attempt is made to set with <data> not of NRf type, a command error occurs.
- In the case of a system error, this command is not executed, and a device dependent error is generated.

Example Transmission: "*ESE ␣ 36"

Bits 2 and 5 of SESER are set to 1.

*ESE?

Reads the standard event status enable register (SESER).

Syntax *ESE?

Function
- The contents of SESER as set by the *ESE command are returned as an NR1 integral value (<data>) in the range 0 to 255.

Note
- If any error occurs, no response message to this query is produced.

Response syntax
- If headers are on, "*ESE ␣ <data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	"*ESE?"	"*ESE?"
Response:	"ESE␣36"	"36"

*ESR?

Reads out the contents of the standard event status register (SESR).

Syntax *ESR?

Function
- The contents of the standard event status register SESR are returned as an numerical value (<data>) in NR1 format between 0 and 255.

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

Notes
- No header is affixed to the response message.
- If any error occurs, no response message to this query is produced.
- Even in the event of a system error, this query is executed.

Response syntax
- Whether headers are on or off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.

Example

Transmission: "*ESR?"
Response: "32"

*IDN?

Queries manufacturer's name, model name, and software version.

Syntax

*IDN?

Function

- The response consists of the name of the manufacturer of the unit, the model name, and the software version.

Notes

- The "*IDN?" query is the last query message in the program messages. Accordingly, if another query is detected after this query, a query error is generated, and no response message after the "*IDN?" query is produced.
- No header is affixed to the response message.
- If any error occurs, no response message to this query is produced.

Response syntax

- Whether headers are on or off, "HIOKI, 3188, 0, V1.00"

First field	:	Manufacturer's name
Second field	:	Model name (3188 or 3189)
Third field	:	Not used - always zero
Fourth field	:	Software version

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

Transmission: "*IDN?"
Response: "HIOKI, 3188, 0, V1.00"

*OPC

After all action has been completed during execution, performs an SRQ request.

Syntax *OPC

Function
- When a number of commands are written on one line, the "*OPC" command sets bit 0 (the OPC bit) of the standard event status register (SESR) to 1 at the instant the previous commands have been completed,

Errors
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example Transmission: "*RST;:MEAS?;*OPC;:DISP␣V1, A1,W1"

When the entire action of the commands *RST and MEAS? has been completed, OPC bit is set to 1.

*OPC?

Queries whether or not all action has been completed during execution.

Syntax *OPC?

Function
- The same as the *OPC command, except in that, at the instant that the previous commands have been completed, instead of bit 0 (the OPC bit) of the standard event status register (SESR) being set to 1, the response message "1" is returned.

Notes
- With this query, if any error occurs, no response message is produced.
- No header is affixed to the response message.

Response syntax
- Whether headers are on or off, "1"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

*RST

Performs device initial setting.

Syntax *RST

Function

- Resets this unit. The parameters which are reset, the values to which they are reset, and those items which are not affected by this command, are listed below.
  (1) Parameters which are reset, and their new values:

• Display	V1, A1, W1
• Mode	3φ3W (3188) 3φ4W (3189)
• Rectifier type	AC+DC (Vrms, Arms)
• Voltage range	600 Vrms (if auto ranging is off)
• Current range	20 Arms (if auto ranging is off)
• Frequency source, range	V1 500Hz
• PT ratio, CT ratio	1.000, 1.000
• AV	OFF
• INTEG items	Wsum
• INTEG TIME	1000:00
• Output internal	00:00:00
• Output items	All items
• D/A output	VA1
• HOLD	OFF
• Header	ON
• Data separater	semicolon ";"

  (2) Items which are not reset.
  - Interface functions
  - GP-IB device address
  - The output queue
  - The input buffer
  - The terminator for query messages
  - The various event registers (SESR, ESR0, ESR1, ESR2 and ESR3)
  - The various enable registers (SRER, SESER, ESER0, ESER1, ESER2 and ESER3)

Notes

- When executes this command under integration, it stops by force and its data are reset.

Errors

- In the event of system error, for backup error only, this command is executed. In the event of other system errors, this command is not executed, and a device dependent error is generated.

*SRE

Sets the service request enable register (SRER).

Syntax *SRE␣<data>

Data <data> 0 to 255 numerical data in NR1 format

Function

- Sets the service request enable register SRER to a pattern is used to mask the status byte register (STB).
- After the decimal point, 5 and above is rounded up, while 4 and below is rounded down.

Service request enable register (SRER)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	×	ESB	MAV	ESB3	ESB2	ESB1	ESB0

(ESB3 is only for the 3189)

Notes

- The unused bits (bit 3 and 7 for the 3188 and bit 7 for the 3189) and bit 6 are disregarded.
- When the power is turned on, and when a system reset has taken place upon key input, the data is reinitialized to zero.

Errors

- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If an attempt is made to use a <data> value which is not of NRf format, a command error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example Transmission: "*SRE␣34"
Bits 1 and 5 of SRER are set to 1.

*SRE?

Reads the service request enable register (SRER).

Syntax *SRE?

Function

- Returns the value of the service request enable register (SRER) as a numerical data value in NR1 format taken from the set:
  3188 - 0 to 7, 16 to 23, 32 to 39 and 48 to 55
  3189 - 0 to 63

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, "*SRE␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	"*SRE?"	"*SRE?"
Response:	"*SRE␣34"	"34"

*STB?

Queries the status byte register.

Syntax *STB?

Function

- Returns the set contents of the status byte register (STB) as a numerical data value (<data>) in NR1 format taken from the set: 0 to 127.

  The status byte register (STB):

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	MSS	ESB	MAV	ESB3	ESB2	ESB1	ESB0

(ESB3 is only for the 3189)

Notes

- Bit 6 is the MSS bit.
- Even if service requests are cleared by serial polling, the MSS bit is not cleared.
- No header is affixed to the response message.
- With this query, if any error occurs, no response message is produced.
- Even if a system error occurs, this query is executed.

Response syntax

- Whether headers are on or off, "<data>"

Error

- If the response message is longer than 1500 bytes, a query error is generated.

Example

Transmission: "*STB?"
Response: "32"

Some event has been generated in the standard event status register (SESR).

*TRG

Request for sampling.

Syntax *TRG

Function

- If the system is currently in the hold state, performs sampling once.

Errors

- If the system is not currently in the hold state, executing this command generates a device dependent error.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example

Transmission: ": HOLD␣ON;:MEAS?␣A1;*TRG;:MEAS?␣A1"
Response: "A1␣+2.120E+0;A1␣+2.240E+0"

*TST?

Requests execution of, and queries the result of, the self test.

Syntax

*TST?

Function

- Causes this unit to perform the self test, and returns the result thereof as a numerical data value (<data>) in NR1 format in three unit. The value of the result has the following meaning:

0:	Normal
1:	Backup error
101:	ROM 1 error
102:	RAM 1 error
103:	I/O port 1 error
104:	Dual Port RAM 1 error
105:	A/D and D/A error
106:	Display/key 1 error
107:	Display/key 2 error
108:	Timer error
201:	ROM 2 error
202:	RAM 2 error
203:	I/O port 2 error
204:	Dual Port RAM 2 error
205:	Frequency counter error

Notes

- No header is affixed to the response message.
- With this query, if any error occurs, no response message is produced.
- Even in the event of a system error, this query is still executed.
- A backup error (only) can be cleared with the "*RST" command.

Response syntax

- Whether headers are on or off, "<data>"

Error

- If the response message is longer than 1500 bytes, a query error is generated.

Example

Transmission: "*TST?"
Response: "0"

The result is OK.

*WAI

Waits until sampling is fully completed.

Syntax

*WAI

Function

- If this command is executed during continuous display, the measurement data is updated.

Notes

- If this command is executed during the hold condition, the displayed data will not change.
- If this command is executed during range switching over, the system will remain in the waiting state until the measured data are displayed.

Error

- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

Transmission: ":HOLD␣OFF;:MEAS?␣V1;*WAI;:MEAS?␣V1"

Response: "V1␣+100.1E+0;V1␣+101.2E+0"

AOUT

Sets the items of D/A output.

Syntax AOUT␣<data>

Data

<data> (3188) V0, A0, W0, VA1, VA2, VA0, VAR1, VAR2, VAR0, PF1,PF2, PF0, DEG1, DEG2, DEG0, FREQ, INTEG, PINTEG, MINTEG

(3189) V0, A0, W0, VA1, VA2, VA3, VA0, VAR1, VAR2, VAR3, VAR0, PF1, PF2, PF3, PF0, DEG1, DEG2, DEG3, DEG0, FREQ, INTEG, PINTEG, MINTEG (1 to 3 means channels and 0 means SUM)

Function

- Sets the items of D/A output.

Errors

- If <data> is not one of the above listed character data, an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) When executes this command under holding state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating

Example Transmission: ":AOUT ␣VA1"
The items of D/A output are set to VA1.

AOUT?

Queries which the items of D/A output is to be performed

Syntax AOUT?

Function

- Returns the D/A output items as character data (<data>).

Note

- With this query, if any errors occurs, no response message is produced.

Response syntax

- If headers are on, " : AUTO␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longen than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	": AOUT?"	":AOUT?"
Response:	":AOUT␣VA1"	"VA1"

AVERaging

Sets the number of measurements over which the averaging calculation is to be performed.

Syntax AVERaging␣<data>

Data <data> 1, 8, 16, 32, 64 - numerical data in NR1 format

Function
- Sets the number of measurements over which the averaging calculation is to be performed.
- <data> can be received in NRf format, but after the decimal point 5 and above will be rounded up while 4 and below will be rounded down.

Notes
- Setting the averaging count causes a restart.
- The AV indication lights for a setting other than 1, and goes off for a setting of 1.

Errors
- If <data> is not in NRf format, a command error is generated.
- If <data> is not one of the above listed values, an execution error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating

Examples
Transmission: ":AVER␣15.5"
The averaging count is set to 16.
Transmission: ":AVER␣15.4"
An execution error is generated. (This numerical value is rounded to 15, according to the above described rounding process, and this causes the error).

AVERaging?

Queries the number of measurements over which the averaging calculation is to be performed.

Syntax AVERaging?

Function
- Returns the current setting of the number of measurements over which the averaging calculation is to be performed, as a numerical value in NR1 format.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":AVERAGING␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":AVER?"	":AVER?"
Response:	":AVERAGING␣16"	"16"

CURRent?

Queries the present setting for the current (amperage) range.

Syntax

CURRent?

Function

- Returns the presently set current range as a numerical value (<data1>) in NR2 format, and also returns whether current auto-ranging is presently taking place or not as on or off (as <data2>).

Note

- With this query, if any error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

- If headers are on, ":CURRENT:RANGE␣<data1>;AUTO␣<data2>"
- If headers are off, "<data1>;<data2>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":CURR?"	"CURR?"
Response :	": CURRENT : RANGE ␣0.5;AUTO␣ON"	"0.5;ON"

CURRent:AUTO

Turns current (amperage) auto range setting on and off.

Syntax CURRent:AUTO␣<data>

Data <data> ON or OFF - character data

Function
- Turns current auto ranging on or off.

Errors
- If <data> is set to character data other than "ON" or "OFF", an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Example Transmission: ":CURR:AUTO␣ON"

Current auto range setting is turned on.

CURRent:AUTO?

Queries whether or not current auto ranging is enabled.

Syntax CURRent:AUTO?

Function
- Returns as "ON" or "OFF" (<data>) whether or not current (amperage) auto ranging is presently enabled.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":CURRENT:AUTO␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":CURR:AUTO?"	":CURR:AUTO?"
Response:	":CURRENT:AUTO␣ON"	"ON"

CURRent:RANGe

Sets the current range.

Syntax CURRent:RANGe␣<data>

Data <data> 0.5, 1.0, 2.0, 5.0, 10.0, or 20.0 - numerical data in NR2 format

Function

- Sets the current range. The units are amps (A).
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fourth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Note

- If the value specified is not a valid range setting × 100%, the next largest range is selected.

Errors

- If the maximum range is exceeded, or a negative range is designated, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Examples

Transmission: ":CURR:RANG␣0.5004"

The range is set to 0.5 A.

Transmission: ":CURR:RANG␣0.5005"

The range is set to 1 A.

CURRent:RANGe?

Queries the current range.

Syntax CURRent:RANGe?

Function
- Returns the presently set current range as a numerical value in NR2 format.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":CURRENT:RANGE␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":CURR:RANG?"	":CURR:RANG?"
Response:	":CURRENT:RANGE␣0.5"	"0.5"

DATAout?

Queries the printer output.

Syntax

DATAout?

Function

- Returns the printer output items as four or five NR1 values, and the interval setting as three NR1 values.
- Returns the output items as four data for the 3188 and as five data for the 3189.
- The interval setting is returned as hours, minutes and seconds.

Notes

- With this query, if any error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

- If headers are on,
  3188 ":DATAOUT:ITEM␣<data1>,<data2>,<data3>,<data4>;
  TIME ␣<data5>,<data6>,<data7>"
  3189 ":DATAOUT:ITEM␣<data1>,<data2>,<data3>,<data4>,<data5>;
  TIME ␣<data6>,<data7>,<data8>"
- If heades are off,
  3188 "<data1>,<data2>,<data3>,<data4>;<data5>,<data6>,<data7>"
  3189 "<data1>,<data2>,<data3>,<data4>,<data5>;<data6>,<data7>,
  <data8>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":DATA?"	":DATA?"
Response (3188):	":DATAOUT:ITEM␣255,0,0,0; TIME␣10,10,10"	"255,0,0,0;10,10,10"
Response (3189):	":DATAOUT:ITEM␣255,0,0,0,0; TIME␣10,10,10"	"255,0,0,0,0;10,10,10"

DATAout:ITEM

Sets printer output item (:MEAS? output item).

Syntax

3188 DATAout:ITEM␣<data1>,<data2>,<data3>,<data4>
3189 DATAout:ITEM␣<data1>,<data2>,<data3>,<data4>,<data5>

Data

<data1> to <data5> 1 to 255 -numerical data in NR 1

3188

	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
<data1>	FREQ	deg1	PF1	var1	VA1	W1	A1	V1
<data2>		deg2	PF2	var2	VA2	W2	A2	V2
<data3>		deg0	PF0	var0	VA0	W0	A0	V0
<data4>					TIME	–	+	ADD

3189

	128	64	32	16	8	4	2	1
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
<data1>	FREQ	deg1	PF1	var1	VA1	W1	A1	V1
<data2>		deg2	PF2	var2	VA2	W2	A2	V2
<data3>		deg3	PF3	var3	VA3	W3	A3	V3
<data4>		deg0	PF0	var0	VA0	W0	A0	V0
<data5>					TIME	–	+	ADD

Function

- Sets the printer output items. The bits corresponding to the items to be printed must be set to 1 in the two values.
- If no parameters are specified to the MEASure? command, the items specified here are used to supply the measurement values.
- It is not an error to specify values with no bits set to 1.
- The values in <data1> to <data5> are accepted in NRf format, but decimal fractions are rounded off.

Errors

- If sets to value other than setting limit, an execution error is generated.
- If <data1> to <data5> is other than NRf type, a command error is generated.
  (1) In the event of a system error (the command is not executed).
  (2) During integrating

Example

Transmission (3189): ":DATA:ITEM␣255, 0, 0, 0, 0"

Set V1, A1, W1, VA1, var1, PF1, deg1 and FREQ for printer output items.

DATAout:ITEM?

Queries the printer output item.

Syntax

DATAout:ITEM?

Function

- Returns the settings of printer output items as a numerical value (<data1> to <data5>) in NR1 format 1 through 255.
- There shoud be four items in the 3188 and five items in the 3189.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on,
  3188 ":DATAOUT:ITEM␣<data1>,<data2>,<data3>, <data4>"
  3189 ":DATAOUT:ITEM␣<data1>,<data2>,<data3>, <data4>, <data5>"
- If headers are off,
  3188 "<data1>, <data2>,<data3>, <data4>"
  3188 "<data1>, <data2>,<data3>, <data4>,<data5>

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":DATA:ITEM?"	":DATA:ITEM?"
Response (3188):	":DATAOUT:ITEM␣255, 0, 0, 0 "	"255, 0, 0, 0"
Response (3189):	":DATAOUT:ITEM␣255, 0, 0, 0, 0 "	"255, 0, 0, 0, 0"

DATAout:TIME

Sets the printer output interval.

Syntax DATAout:TIME␣<data1>, <data2>, <data3>

Data

<data1>	0 to 100	-numerical data in NR1
<data2>	0 to 59	-numerical data in NR1
<data3>	0, 10, 20 30, 40, 50	-numerical data in NR1

Function

- Sets the data output interval in hours <data1>, minutes <data2> and seconds <data3>. The setting range is from 10 seconds to 100 hours, in 10-second steps.
- The values in <data> are accepted in NRf format, but decimal fractions are rounded off.

Errors

- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If <data1>, <data2> and <data3> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated.
  (1) In the event of a system error (the command is not executed).
  (2) During integrating.

Examples Transmission: ":DATA:TIME␣10, 10, 10"

Sets the printer output interval to 10 hours, 10 minutes and 10 seconds.

DATAout:TIME?

Queries the printer output interval.

Syntax DATAout:TIME?

Function

- Returns the data output interval as three NR1 values, in hours <data1>, minutes <data2> and seconds <data3>.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on,
  ":DATAOUT:TIME␣<data1>, <data2>, <data3>"
- If headers are off,
  "<data1>, <data2>, <data3>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":DATA:TIME?"	":DATA:TIME?"
Response:	":DATAOUT:TIME␣10, 10, 10	"10, 10, 10"

DISPlay

Sets the items displayed.

Syntax

DISPlay␣<data1>,<data2>,<data3>

Data

3188/89 Items in ( ) would cause an execution error for the 3188.

<data1>	V1, V2, (V3,) V0, A1, A2, (A3,) A0, W1, W2, (W3,) W0, VA1, VA2, (VA3,) VA0, VAR1, VAR2, (VAR3,) VAR0, PF1, PF2, (PF3,) PF0, DEG1, DEG2, (DEG3,) DEG0	-character data
<data2>	V1, V2, (V3,) V0, A1, A2, (A3,) A0, W1, W2, (W3,) W0, VA1, VA2, (VA3,) VA0, VAR1, VAR2, (VAR3,) VAR0, PF1, PF2, (PF3,) PF0, DEG1, DEG2, (DEG3,) DEG0, TIME	-character data
<data3>	V1, V2, (V3,) V0, A1, A2, (A3,) A0, W1, W2, (W3,) W0, VA1, VA2, (VA3,) VA0, VAR1, VAR2, (VAR3,) VAR0, PF1, PF2, (PF3,) PF0, DEG1, DEG2, (DEG3,) DEG0, FREQ, INTEG, PINTEG, MINTEG	-character data

Function

- Sets the items to be shown on display a, display b and display c, and switches over the display.

Note

- There should be three items of character data.
- 1 to 3 means channel numbers and 0 means SUM.
- <data1>,<data2> and <data3> are respectively the items to be shown on display a, display b and display c.

Errors

- If <data1> ,<data2> and <data3> are set to character data other than above-stated data, an execution error is generated.
- If <data1>, <data2> or <data3> is other than character data, a command error is generated.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example

Transmission: ":DISP␣V1,A1,W1"

Display a is set to show voltage in CH1, display b current in CH1 and display c effective power in CH1.

DISPlay?

Queries the items displayed.

Syntax

DISPlay?

Function

- Returns as <data1>,<data2> and <data3> (possible values are V, A, W, and VA) the presently set items which are being shown on display a, display b and display c.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, "DISPLAY␣<data1>,<data2>,<data3>"
- If headers are off, "<data1>,<data2>,<data3>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":DISP?"	":DISP?"
Response:	":DISPLAY␣V1,A1,W1"	"V1, A1, W1"

ESE0

Sets event status enable register 0.

Syntax ESE0␣<data>

Data <data> 0 to 255 - numerical data in NR1 format

Function

- Sets event status enable register 0 (ESER0) to the bitmask for controlling access to events in event status register 0 (ESR0).
- After the decimal point, 5 and above is rounded up, while 4 and below is rounded down.

Event status enable register 0 (ESER0)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
DS	FOR	OT	IE	ITO	IDO	PODI	MODI

Notes

- Directly after the power has been switched on, or after a system reset caused as a result of key operation, the data is initialized to 0.

Errors

- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example Transmission: ":ESE0␣1"

Bit 0 of ESER0 is set to 1.

ESE0?

Reads out event status enable register 0.

Syntax ESE0?

Function
- Returns the value of event status enable register 0 as a numerical value (<data>) in NR1 format, 0 through 255.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":ESE0␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":ESE0?"	":ESE0?"
Response:	":ESE0␣1"	"1"

ESE1

Sets event status enable register 1 (ESER for CH1).

Syntax ESE1␣<data>

Data <data> 0 to 255 - numerical data in NR1 format

Function

- Sets event status enable register 1 (ESER1) to the bitmask for controlling access to events in event status register 1 (ESR1).
- After the decimal point, 5 and above is rounded up, while 4 and below is rounded down.

Event status enable register 1 (ESER1)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW1	AOA1	AOV1	OA1	OV1	HW1	HA1	HV1

Notes

- Directly after the power has been switched on, or after a system reset caused as a result of key operation, the value is initialized to 0.

Errors

- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example Transmission: ":ESE1␣48" Bits 4, and 5 of ESER1 are set to 1.

ESE1?

Reads out event status enable register 1 (ESER for CH1).

Syntax ESE1?

Function

- Returns the value of event status enable register 1 (ESER1) as a numerical value (<data>) in NR1 format. This value is one of the set: 0 through 255.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, ":ESE1␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":ESE1?"	":ESE1?"
Response:	":ESE1␣48"	"48"

ESE2

Sets event status enable register 2 (ESER for CH2).

Syntax ESE2␣<data>

Data <data> 0 to 255 - numerical data in NR1 format

Function

- Sets event status enable register 2 (ESER2) to the bitmask for controlling access to events in event status register 2 (ESR2).
- After the decimal point, 5 and above is rounded up, while 4 and below is rounded down.

Event status enable register 2 (ESER2)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW2	AOA2	AOV2	OA2	OV2	HW2	HA2	HV2

Notes

- Directly after the power has been switched on, or after a system reset caused as a result of key operation, the value is initialized to 0.

Errors

- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example Transmission: ":ESE2␣48" Bits 4, and 5 of ESER2 are set to 1.

ESE2?

Reads out event status enable register 2 (ESER for CH2).

Syntax ESE2?

Function

- Returns the value of event status enable register 2 (ESER2) as a numerical value (<data>) in NR1 format. This value is one of the set: 0 through 255.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, ":ESE2␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":ESE2?"	":ESE2?"
Response:	":ESE2␣48"	"48"

ESE3 (3189 only)

Sets event status enable register3 (ESER for CH3).

Syntax ESE3␣<data>

Data <data> 0 to 255 - numerical data in NR1 format

Function

- Sets event status enable register 3 (ESER3) to the bitmask for controlling access to events in event status register 3 (ESR3).
- After the decimal point, 5 and above is rounded up, while 4 and below is rounded down.

Event status enable register 3 (ESER3)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW3	AOA3	AOV3	OA3	OV3	HW3	HA3	HV3

Notes

- Directly after the power has been switched on, or after a system reset caused as a result of key operation, the value is initialized to 0.

Errors

- If an attempt is made to make a setting outside the range of validity, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the event of a system error, this command is not executed, and a device dependent error is generated.

Example Transmission: ":ESE3␣48" Bits 4, and 5 of ESER3 are set to 1.

ESE3? (3189 only)

Reads out event status enable register 3 (ESER for CH3).

Syntax ESE3?

Function

- Returns the value of event status enable register 3 (ESER3) as a numerical value (<data>) in NR1 format. This value is one of the set: 0 through 255.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, ":ESE3␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":ESE3?"	":ESE3?"
Response:	":ESE3␣48"	"48"

ESR0?

Reads out event status register 0.

Syntax ESR0?

Function

- Returns the value of event status register 0 (ESR0) as a numerical value (<data>) in NR1 format, either 0 or 255, and then clears event status register 0.

  Event status register 0 (ESR0)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
DS	FOR	OT	IE	ITO	IDO	PODI	MODI

Note

- No header is prefixed to the response message.
- With this query, if any error occurs, no response message is produced.

Response syntax

- Whether headers are on or off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

Transmission: ":ESR0?"

Response: "16"

The integrating end (IE) flag is raised.

ESR1?

Reads out event status register 1 (ESR for CH1).

Syntax ESR1?

Function

- Returns the value of event status register 1 (ESR1) as a numerical value (<data>) in NR1 format, and then clears event status register 1. The numerical value is one of the set: 0 through 255.

  Event status register 1 (ESR1)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW1	AOA1	AOV1	OA1	OV1	HW1	HA1	HV1

Note

- No header is prefixed to the response message.
- With this query, if any error occurs, no response message is produced.

Response syntax

- Whether headers are on or off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

Transmission: ":ESR1?"

Response: "24"

The peak voltage out of range flag (OV1) and peak current out of range flag (OA1) are raised.

ESR2?

Reads out event status register 2 (ESR for CH2).

Syntax ESR2?

Function

- Returns the value of event status register 2 (ESR2) as a numerical value (<data>) in NR1 format, and then clears event status register 2. The numerical value is one of the set: 0 through 255.

  Event status register 2 (ESR2)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW2	AOA2	AOV2	OA2	OV2	HW2	HA2	HV2

Note

- No header is prefixed to the response message.
- With this query, if any error occurs, no response message is produced.

Response syntax

- Whether headers are on or off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

Transmission: ":ESR2?"

Response: "24"

The peak voltage out of range flag (OV2) and peak current out of range flag (OA2) are raised.

ESR3? (3189 only)

Reads out event status register 3 (ESR for CH3).

Syntax

ESR3?

Function

- Returns the value of event status register 3 (ESR3) as a numerical value (<data>) in NR1 format, and then clears event status register 3. The numerical value is one of the set: 0 through 255.

  Event status register 3 (ESR3)

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
AOW3	AOA3	AOV3	OA3	OV3	HW3	HA3	HV3

Note

- No header is prefixed to the response message.
- With this query, if any error occurs, no response message is produced.

Response syntax

- Whether headers are on or off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

Transmission: ":ESR3?"

Response: "24"

The peak voltage out of range flag (OV3) and peak current out of range flag (OA3) are raised.

FREQuency?

Queries the frequency range items.

Syntax

FREQuency?

Function

- Returns the presently set frequency measuring items as character data (<data1>), frequency range as a numerical value (<data2>) in NR3 format and frequency auto ranging as "ON" or "OFF" (<data3>).

Notes

- With this query, if any error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

- If headers are on,
  ":FREQUENCY:SOURCE␣<data1>;RANGE␣<data2>;
  AUTO␣<data3>"
- If headers are off,
  "<data1>;<data2>;<data3>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

If headers are on

Transmission: ":FREQ?"

Response: ":FREQUENCY:SOURCE␣V1;RANGE␣+500.0E +0;AUTO␣ON"

If headers are off

Transmission: ":FREQ?"

Response: "V1;+500.0E+0;ON"

FREQuency:AUTO

Sets the frequency auto range.

Syntax FREQuency:AUTO␣<data>

Data <data> ON/OFF - character data

Function
- Sets the frequency auto range either on or off.

Error
- If <data> is set to character data other than "ON" or "OFF", an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) In the event of a system error (the command is not executed).
  (2) During integrating.

Examples Transmission: ":FREQ:AUTO␣ON"

Frequency auto range setting is turned on.

FREQuency:AUTO?

Queries the frequency auto range.

Syntax FREQuency:AUTO?

Function
- Returns as "ON" or "OFF" (<data>) whether or not current (amperage) frequency auto ranging is presently enabled.

Notes
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on,
  ":FREQUENCY:AUTO␣<data>"
- If headers are off,
  "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":FREQ:AUTO?"	":FREQ:AUTO?"
Response:	":FREQUENCY:AUTO␣ON"	"ON"

FREQuency:RANGe

Sets the frequency range.

Syntax FREQuency:RANGe␣<data>

Data <data>+500.0E+0, +50.00E+3 - numerical data in NR3 format

Function

- Sets the frequency range. The units are hertz (Hz).
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fourth digit on the basis of 6 and above being rounded up and 5 and below being rounded down.

Note

- If the value specified is not a valid range setting, "the measurable range for designated value" is selected. However, when exceed full scale of the range, the next largest one is selected.

Errors

- If the maximum range is exceeded, or a negative range is designated, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating.

Examples

Transmission: ":FREQ:RANG␣+500.04E+0"

The range is set to 500 Hz.

Transmission: ":FREQ:RANG␣+500.05E+0"

The range is set to 50 kHz.

FREQuency:RANGe?

Queries the frequency range.

Syntax

FREQuency:RANGe?

Function

- Returns the presently set frequency range as a numerical value in NR3 format.

Note

- With this query, if any error occurs, no response message is produced.

Respons syntax

- If headers are on,
  ":FREQUENCY:RANGE␣<data>"
- If headers are off,
  "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":FREQ:RANG?"	":FREQ:RANG?"
Response:	":FREQUENCY :RANGE␣+500.0E+0"	"+500.0E+0"

FREQuency:SOURce

Sets the frequency measuring items.

Syntax FREQuency:SOURce␣<data>

Data <data> V1, A1 - character data

Function
- Sets the prevent frequency measuring items.

Errors
- If <data> is set to character data other than above-stated data, an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating.

Example Transmission: ":FREQ:SOUR␣V1"

Sets the frequency measuring item to V1.

FREQuency:SOURce?

Queries the frequency measuring items.

Syntax FREQuency:SOURce?

Function
- Returns as V1 and A1 (<data>) whether or not frequency measuring items is presently enabled.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":FREQUENCY:SOURCE␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":FREQ:SOUR?"	":FREQ:SOUR?"
Response:	":FREQUENCY:SOURCE␣V1"	"V1"

HEADer

Turns response headers on or off.

Syntax HEADer␣<data>

Data <data> ON or OFF - character data

Function
- This sets whether or not this unit will prefix headers to its response messages.

Note
- In any case, responses to the queries *IDN?, *OPC?, *ESR?, *STB?, *TST?, ESR0?, ESR1?, ESR2? and ESR3? are not prefixed with any headers.

Errors
- If <data> is set to character data other than "ON" or "OFF", an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example Transmission: ":HEAD␣OFF"
No headers will henceforward be prefixed to response messages.

HEADer?

Queries whether or not headers on response messages are enabled.

Syntax HEADer?

Function
- Returns as "ON" or "OFF" whether or not headers on response messages are enabled.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":HEADER␣ON"
- If headers are off, "OFF"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":HEAD?"	":HEAD?"
Response:	":HEADER␣ON"	"OFF"

HOLD

Sets the display hold on or off.

Syntax HOLD␣<data>

Data <data> ON or OFF - character data

Function
- Holding of the display is enabled or disabled.

Errors
- If <data> is set to character data other than "ON" or "OFF", an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example Transmission: ":HOLD␣ON"

The display is put into held state.

HOLD?

Queries whether or not the display is currently held.

Syntax HOLD?

Function
- Whether or not the display is currently held is returned as "ON" or "OFF" in <data>.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":HOLD␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

	If headers are on	If headers are off
Transmission:	":HOLD?"	":HOLD?"
Response:	":HOLD␣ON"	"ON"

INTEGrate?

Queries the integrate setting items.

Syntax

INTEGrate?

Function

- Returns the current integration item in character format in <data1>, the integration time in NR1 format as two values <data2> and <data3>, hours and minutes respectively, and the integration state START/STOP/RESET as <data4>.

Note

- With this query, if any error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".
- During external control output "1000,0" for TIME.

Response syntax

- If headers are on,
  ":INTEGRATE:SOURCE␣<data1>;TIME␣<data2>,<data3>;
  STATE␣<data4>"
- If headers are off,
  "<data1>;<data2>,<data3>;<data4>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

If headers are on

Transmission: ":INTEG?"

Response: ":INTEGRATE:SOURCE␣W1
;TIME␣100,0;STATE␣START"

If headers are off

Transmission: ":INTEG?"

Response: "W1;100,0;START"

INTEGrate:STATe

Set the integrate meter condition

Syntax INTEGrate:STATe␣<data>

Data <data> START/STOP/RESET - character data

Function

- Sets the integrate meter condition (start or stop on reset).

Errors

- A device dependent error is generated according to condition.

<data>		Key input		External control	
	RESET	RUN	STOP	RUN	STOP
START	○	×	○	×	×
STOP	×	○	×	×	×
RESET	○	×	○	×	○

○: The command is executed.
×: A device dependent error is generated.

- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples Transmission: ":INTEG:STAT␣START"

Starts integrating.

INTEGrate:STATe?

Queries the integrate meter condition.

Syntax INTEGrate:STATe?

Function
- Returns the condition of integrate meter (start, stop or reset) as a character data in <data>.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":INTEGRATE:STATE␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":INTEG:STAT?"	":INTEG:STAT?"
Response:	":INTEGRATE:STATE␣START"	"START"

INTEGrate:SOURce

Sets the integrate items.

Syntax INTEGrate:SOURce␣<data>

Data <data> A1, A2, W1, W2, W0 - character data (3188)
A1, A2, A3, W1, W2, W3, W0 - character data (3189)

Function
- Sets the integrate items.

Errors
- If <data> is set to character data other than above character data execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Example Transmission: ":INTEG:SOUR␣A1"

Sets the integrate item to A1.

INTEGrate:SOURce?

Queries the integrate items.

Syntax INTEGrate:SOURce?

Function Returns as character data (<data>) whether or not integrate items is presently enabled.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":INTEGRATE:SOURCE␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

	If headers are on	If headers are off
Transmission:	":INTEG:SOUR?"	":INTEG:SOUR?"
Response:	":INTEGRATE:SOURCE␣A1"	"A1"

INTEGrate:TIME

Sets the integrate timer.

Syntax INTEGrate:TIME␣<data1>,<data2>

Data <data1> 0 to 1000 - numerical data in NR1

<data2> 0 to 59 - numerical data in NR1

Function

- Sets the integration time in NR1 format as two values <data1> and <data2>, hours and minutes respectively.
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fourth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Errors

- In the value other than setting limit is designated, an execution error is generated.
- If <data1> and <data2> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Example Transmission: ":INTEG:TIME␣100, 30"

Sets the integrate timer to 100 hours and 30 minutes.

INTEGrate:TIME?

Queries the integrate timer.

Syntax

INTEGrate:TIME?

Function

- Returns the hours of integrate timer as a numerical value (<data1>) in NR1 format and minutes as (<data2>) in same format.

Note

- With this query, if any error occurs, no response message is produced.
- During external control, outputs "1000.0".

Respons syntax

- If headers are on, ":INTEGRATE:TIME␣<data1>,<data2>"
- If headers are off, "<data1>,<data2>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

	If headers are on	If headers are off
Transmission:	":INTEG:TIME?"	":INTEG:TIME?"
Response:	":INTEGRATE:TIME␣100,30"	"100, 30"

MEASure?

Queries measured data items.

Syntax MEASure?␣<data>,<data>,<data>,...

Data

<data> - character data

3188 V1, A1, W1, VA1, VAR1, PF1, DEG1, V2, A2, W2, VA2, VAR2, PF2, DEG2, V0, A0, W0, VA0, VAR0, PF0, DEG0, FREQ, INTEG, PINTEG, MINTEG, TIME

3189 V1, A1, W1, VA1, VAR1, PF1, DEG1, V2, A2, W2, VA2, VAR2, PF2, DEG2, V3, A3, W3, VA3, VAR3, PF3, DEG3, V0, A0, W0, VA0, VAR0, PF0, DEG0, FREQ, INTEG, PINTEG, MINTEG, TIME

Function

- Produces the measured value of the data item specified by <data>.
- If no <data> is specified, produces the measured value set by ":DATAout:ITEM" command.
  When this command sets all items off, produce the measured value on display a, b and c.

Note

- 1 to 3 means channel numbers and 0 means SUM.
- If <data> is set to character data other than above-stated data, an execution error is generated.
- With this query, if any error other than out-of-range or a scaling error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".
- If FREQ dispalys "———", outputs previous value.

Response syntax

Header portion	Data portion
Vi, Ai, Wi, VAi, VARi, PFi, DEGi, FREQ (i = 0 to 3)	Numerical data in NR3 format ± □□□□□ E ± □ Mantissa - 4 digits with a decimal point — Exponent - 1 digit
INTEG PINTEG MINTEG	Numerical data in NR3 format ± □□□□□□□ E ± □ Mantissa - 6 digits with a decimal point — Exponent - 1 digit
TIME	Numerical data in NR1 and 3 format □□□□, □□, □□ Hours Minutes Seconds

Data / Error	Vi, Ai, Wi, VAi, VARi, PFi, DEGi, FREQ (i = 0 to 3)	INTEG, PRINTEG, MINTEG
Over range	±999.9E+9	No syntax
Scaling error	±888.8E+9	±88888.8E+9

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this query is executed in over ranging and scaling error.
  (2) In the event of a system error (the command is not executed).

MODE

Sets the mode (measuring line).

Syntax MODE␣<data>

Data

3188	<data>	1 (1φ3W) 2 (3φ3W)	-numerical data in NR1
3189	<data>	1 (1φ3W) 2 (3φ3W) 3 (3V3A) 4 (3φ4W)	-numerical data in NR1

Function

- The measuring line is set.
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fifth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Errors

- If the value other than setting range is designated, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Example Transmission: ":MODE␣2"

Sets the measuring line to 3φ3W.

MODE?

Syntax MODE?

Function

- Returns the presently set measuring line as a numerical value in NR1 format in the range 1 through 4.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, ":MODE␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":MODE?"	":MODE?"
Response:	":MODE␣2"	"2"

RECTifier

Sets the rectifier type.

Syntax RECTifier␣<data>

Data

<data>	1	DC	- numerical data in NR1
	2	AC+DC	Vrms, Arms
	3	AC+DC	Vmean, Arms

Function

- Sets the rectifier type.

Errors

- If the value other than setting range is designated, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Example Transmission: ":RECT␣1"
Sets the rectifier type to DC.

RECTifier?

Queries the rectifier.

Syntax RECTifier?

Function

- Returns the presently set rectifier type as a numerical value in NR1 format in the range 1 through 3.

Note

- With this query, if any error occurs, no response message is produced.

Respons syntax

- If headers are on, ":RECTIFIER␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Example

	If headers are on	If headers are off
Transmission:	":RECT?"	":RECT?"
Response:	":RECTFIER␣1"	"1"

SCALe?

Queries the scaling factors being applied.

Syntax

SCALe?

Function

- The current values of the PT ratio and CT ratio are returned as numerical values (<data1> and <data2>) in NR2 numerical format.

Notes

- With this query, if any error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

- If headers are on, ":SCALE:PT␣<data1>;CT␣<data2>"
- If headers are off, "<data1>;<data2>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":SCAL?"	":SCAL?"
Response:	":SCALE:PT␣2.000;CT␣3.000"	"2.000;3.000"

SCALe:CT

Sets the CT ratio.

Syntax SCALe:CT␣<data>

Data <data> is a numerical value in NR2 format taken from the set 0.01 to 9999.0.

Function
- The current value of CT ratio is set.
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fifth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Errors
- If <data> is set to a numerical value out of range, an execution error is generated.
- If <data> is other than a numerical value in NRf format, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Examples

Transmission:	":SCAL:CT␣2.0004"	The CT ratio is set to 2.000.
Transmission:	":SCAL:CT␣2.0005"	The CT ratio is set to 2.001.

SCALe:CT?

Queries the CT scaling item.

Syntax SCALe:CT?

Function
- The current value of CT ratio is returned as a numerical value (<data>) in NR2 numerical format.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":SCALE:CT␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":SCAL:CT?"	":SCAL:CT?"
Response:	":SCALE:CT␣2.000"	"2.000"

SCALe:PT

Sets the PT ratio.

Syntax SCALe:PT␣<data>

Data <data> is a numerical value in NR2 format taken from the set 1.000 to 9999.0.

Function
- The current value of PT ratio is set.
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fifth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Errors
- If an attempt is made to make <data> setting outside the range of validity, an execution error is generated.
- If <data> is other than a numerical value in NRf format, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Examples

Transmission:	":SCAL:PT␣2.0004"	The PT ratio is set to 2.000.
Transmission:	":SCAL:PT␣2.0005"	The PT ratio is set to 2.001.

SCALe:PT?

Queries the PT scaling item.

Syntax SCALe:PT?

Function
- The current value of PT ratio is returned as a numerical value (<data>) in NR2 numerical format.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":SCALE:PT␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":SCAL:PT?"	":SCAL:PT?"
Response:	":SCALE:PT␣2.000"	"2.000"

TRANsmit:SEParator

Sets the message unit separator for response messages.

Syntax

TRANsmit:SEParator␣<data>

Data

<data> 0 or 1 - numerical data in NR1 format

Function

- The data separator for response messages is set as follows:
  (1) If <data> = 0, the separator is set to semicolon ";".
  (2) If <data> = 1, the separator is set to comma ",".
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off from the decimal point on the basis of 5 and above being rounded up and 4 and below being rounded down.

Notes

- Even if you set the command to the comma, message unit separator will appear as a semicolon when headers are on.
- After <data> has been rounded as explained above, if it becomes a numerical value other than 0, the message unit separator is set to the comma.

Errors

- If <data> is other than NRf format, a command error is generated.
- Even in the event of a system error, this command is executed.

Examples

Transmission: ":TRAN:SEP␣0:HEAD␣OFF;:MEAS?␣V1,A1"
Response: "+101.2E+0;+2.120E-3"

Transmission: ":TRAN:SEP␣1;:HEAD␣OFF;:MEAS␣V1,A1"
Response: "+101.2E+0,+2.120E-3"

Transmission: ":TRAN:SEP␣0;:HEAD␣ON;:MEAS?␣V1,A1"
Response: "V1␣+101.2E+0;A1␣+2.120E-3"

Transmission: ":TRAN:SEP␣1;:HEAD␣ON;:MEAS?␣V1,A1"
Response: "V1␣+101.2E+0;A1␣+2.120E-3"

TRANsmit:SEParator?

Queries the message unit separator for response messages.

Syntax TRANsmit:SEParator?

Function

- The message unit separator for response messages is returned (in <data>) as 0 or 1.
- The returned numerical value corresponds to the setting state of the data separator as follows:
  (1) If <data> = 0, the separator is a semicolon ";".
  (2) If <data> = 1, the separator is a comma ",".

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, ":TRANSMIT:SEPARATOR␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":TRAN:SEP?"	":TRAN:SEP?"
Response:	":TRANSMIT:SEPARATOR␣1"	"1"

TRANsmit:TERMinator

Sets the data terminator for response messages.

Syntax

TRANsmit:TERMinator␣<data>

Data

<data> 0 or 1 -numerical data in NR1 format

Function

- The data terminator for response messages is set as follows:

  (1) If <data> = 0, the terminator is set to LF + EOI.

  (2) If <data> = 1, the terminator is set to CR and LF + EOI.

- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off from the decimal point on the basis of 5 and above being rounded up and 4 and below being rounded down.

Notes

- After <data> has been rounded as explained above, if it becomes a numerical value other than 0, the data terminator is set to CR and LF + EOI.
- Even in the event of a system error, this command is executed.

Error

- If <data> is set other than NRf format, a command error is generated.

Example

Transmission: ":TRAN:TERM␣0"

Sets the data terminator to "LF + EOI".

TRANsmit:TERMinator?

Queries the data terminator for response messages.

Syntax

TRANsmit:TERMinator?

Function

- The data terminator for response messages is returned (in <data>) as 0 or 1.
- The returned numerical value corresponds to the setting state of the data terminator for response messages as follows:

  (1) If <data> = 0, the terminator is LF + EOI signal.

  (2) If <data> = 1, the terminator is CR and LF + EOI signal.

Note

- With this query, if any error occurs, no response message is produced.

Response syntax

- If headers are on, ":TRANSMIT:TERMINATOR␣<data>"
- If headers are off, "<data>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":TRAN:TERM?"	":TRAN:TERM?"
Response:	":TRANSMIT:TERMINATOR␣1"	"1"

VOLTage?

Queries the present setting for voltage range.

Syntax VOLTage?

Function

- Returns the presently set voltage range as a numerical value (<data1>) in NR1 format, and also returns whether voltage auto-ranging is presently taking place or not as "ON" or "OFF" (as <data2>).

Note

- With this query, if any error occurs, no response message is produced.
- By using the "TRANsmit:SEParator" command, the message unit separator can be changed from the semicolon ";" to the comma ",".

Response syntax

- If headers are on, ":VOLTAGE:RANGE␣<data1>;AUTO␣<data2>"
- If headers are off, "<data1>;<data2>"

Errors

- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":VOLT?"	":VOLT?"
Response :	": VOLTAGE:RANGE␣300 ;AUTO␣ON"	"300;ON"

VOLTage:AUTO

Turns voltage auto ranging on and off.

Syntax VOLTage:AUTO␣<data>

Data <data> ON or OFF - character data

Function
- Turns voltage auto ranging on or off.

Errors
- If <data> is set to character data other than "ON" or "OFF", an execution error is generated.
- If <data> is other than character data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Example Transmission: ":VOLT:AUTO␣ON"
Voltage auto range setting is turned on.

VOLTage:AUTO?

Queries whether or not voltage auto ranging is enabled.

Syntax VOLTage:AUTO?

Function
- Returns as "ON" or "OFF" (<data>) whether or not voltage auto ranging is presently enabled.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, ":VOLTAGE:AUTO␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":VOLT:AUTO?"	":VOLT:AUTO?"
Response:	":VOLTAGE:AUTO␣ON"	"ON"

VOLTage:RANGe

Sets the voltage range.

Syntax VOLTage:RANGe␣<data>

Data <data>15, 30, 60, 150, 300, 600 - numerical data in NR1 format

Function

- Sets the voltage range. The units are volts (V).
- <data> can be accepted in NRf format, but its effective value will be obtained by rounding off the fourth digit on the basis of 5 and above being rounded up and 4 and below being rounded down.

Note

- If the value specified is not a valid range setting × 100%, the next largest range is selected.

Errors

- If the maximum range is exceeded, or a negative range is designated, an execution error is generated.
- If <data> is other than NRf format data, a command error is generated.
- In the following circumstances, a device dependent error is generated:
  (1) If this command is executed in the hold state.
  (2) In the event of a system error (the command is not executed).
  (3) During integrating (include a suspension of integration).

Examples

Transmission: ":VOLT:RANG␣300.4"
The range is set to 300 V.

Transmission: ":VOLT:RANG␣300.5"
The range is set to 600 V.

VOLTage:RANGe?

Queries the voltage range.

Syntax VOLTage:RANGe?

Function
- Returns the presently set voltage range as a numerical value in NR1 format.

Note
- With this query, if any error occurs, no response message is produced.

Response syntax
- If headers are on, "VOLTAGE:RANGE␣<data>"
- If headers are off, "<data>"

Errors
- If the response message is longer than 1500 bytes, a query error is generated.
- In the event of a system error, this query is not executed, and a device dependent error is generated.

Examples

	If headers are on	If headers are off
Transmission:	":VOLT:RANG?"	":VOLT:RANG?"
Response:	":VOLTAGE:RANGE␣300"	"300"

9-7. Command Summary

9-7-1. Common Commands

Command	Data format (number of data items)	Explanation	Page
*CLS		Clears STB and ESR	9-18
*ESE	NR1 numerical data (1)	Sets bitmask for ESR	9-18
*ESE?		Queries bitmask for ESR	9-19
*ESR?		Queries ESR	9-19
*IDN?		Queries device ID	9-20
*OPC		Issues service request after execution completion	9-21
*OPC?		Queries execution completion	9-21
*RST		Device initialization	9-22
*SRE	NR1 numerical data (1)	Sets bitmask for STB	9-23
*SRE?		Queries bitmask for STB	9-24
*STB?		Queries STB	9-25
*TRG		Performs sampling once	9-25
*TST?		Queries the result of the self-test	9-26
*WAI		Waits until sampling is fully completed	9-27

9-7-2. Specific Commands

Command	Data format (number of data items)	Explanation	Page
AOUT	[V0/A0/W0/VA1/VA2/ VA3/VA0/VAR1/VAR2 /VAR3/VAR0/PF1/PF2/ PF3/PF0/DEG1/DEG2/ DEG3/DEG0/INTEG/ PINTEG/MINTEG/ FREQ] (1)	Sets D/A output items	9-28
AOUT?		Queries D/A output items	9-28
AVERaging	NR1 numerical data (1)	Sets averaging count	9-29
AVERaging?		Queries averaging count	9-29
CURRent?		Queries current settings	9-30
CURRent			
: AUTO	[ON/OFF]	Sets current auto ranging	9-31
: AUTO?		Queries current auto ranging	9-31
: RANGe	NR2 numerical data (1)	Sets current range	9-32
: RANGe?		Queries current range	9-33
DATAout?		Queries printer output settings	9-34
DATAout			
:ITEM	NR1 numerical data (2)	Sets printer output items	9-35
:ITEM?		Queries printer output items	9-36
:TIME	NR1 numerical data (3)	Sets printer output interval	9-37
:TIME?		Queries printer output interval	9-37
DISPlay	[V1/V2/V3/V0/A1/A2/ A3/A0/W1/W2/W3/W0/ VA1/VA2/VA3/VA0/ VAR1/VAR2/VAR3/ VAR0/PF1/PF2/PF3/ PF0/DEG1/DEG2/ DEG3/DEG0/INTEG/ PINTEG/MINTEG/ FREQ/TIME] (3)	Sets display items	9-38
DISPlay?		Queries display items	9-39
ESE0	NR1 numerical data (1)	Sets bitmask for ESR0	9-40
ESE0?		Queries bitmask for ESR0	9-41
ESE1	NR1 numerical data (1)	Sets bitmask for ESR1	9-42
ESE1?		Queries bitmask for ESR1	9-42
ESE2	NR1 numerical data (1)	Sets bitmask for ESR2	9-43
ESE2?		Queries bitmask for ESR2	9-43
ESE3	NR1 numerical data (1)	Sets bitmask for ESR3 (3189 only)	9-44
ESE3?		Queries bitmask for ESR3 (3189 only)	9-44
ESR0?		Queries ESR0	9-45
ESR1?		Queries ESR1	9-46
ESR2?		Queries ESR2	9-47
ESR3?		Queries ESR3 (3189 only)	9-48
FREQuency?		Queries frequency settings	9-49

Command	Data format (number of data items)	Explanation	Page
FREQuency			
:AUTO	[ON/OFF]	Sets frequency auto ranging	9-50
:AUTO?		Queries frequency auto ranging	9-50
:RANGe	NR2 numerical data (1)	Sets frequency range	9-51
:RANGe?		Queries frequency range	9-52
:SOURce	[V1/A1]	Sets frequency items	9-53
:SOURce?		Queries frequency items	9-53
HEADer	[ON/OFF]	Sets header	9-54
HEADer?		Queries header	9-54
HOLD	[ON/OFF]	Sets the hold state	9-55
HOLD?		Queries the hold state	9-55
INTEGrate?		Queries settings of integrate meter	9-56
INTEGrate			
:STATe	[START/STOP/RESET]	Sets integrate meter condition	9-57
:STATe?		Queries integrate meter condition	9-58
:SOURce	[A1/A2/A3/W1/W2/ W3/W0]	Sets integrate items	9-59
		Queries integrate items	9-59
:SOURce?			
:TIME	NR1 numerical data (2)	Sets integrate time	9-60
:TIME?		Queries integrate time	9-61
MEASure?	[V1/V2/V3/V0/A1/A2/ A3/A0/W1/W2/W3/W0/ VA1/VA2/VA3/VA0/ VAR1/VAR2/VAR3/ VAR0/PF1/PF2/PF3/ PF0/DEG1/DEG2/ DEG3/DEG0/INTEG/ PINTEG/MINTEG/ FREQ/TIME]	Queries designated measuring data	9-62
MODE	NR1 numerical data (1)	Sets the measuring line	9-64
MODE?		Queries the measuring line	9-64
RECTifier	NR1 numerical data (1)	Sets rectifier type	9-65
RECTifier?		Queries rectifier type	9-65
SCALe?		Queries the setting of scaling	9-66
SCALe			
: CT	NR2 numerical data (1)	Sets CT ratio	9-67
: CT?		Queries CT ratio	9-67
: PT	NR2 numerical data (1)	Sets PT ratio	9-68
: PT?		Queries PT ratio	9-68
TRANsmit			
: SEParator	NR1 numerical data (1)	Sets the separator	9-69
: SEParator?		Queries the separator	9-70
: TERMinator	NR1 numerical data (1)	Sets the terminator	9-71
: TERMinator?		Queries the terminator	9-72
VOLTage?		Queries voltage settings	9-73
VOLTage			
: AUTO	[ON/OFF]	Sets voltage auto ranging	9-74
: AUTO?		Queries voltage auto ranging	9-74
: RANGe	NR1 numerical data (1)	Sets voltage range	9-75
: RANGe?		Queries voltage range	9-76

9-7-3. Valid Command According to Condition (Commands Specific to the 3187)

Condition / Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD	
*CLS	O	O	O	O	O	O	O	O	O	O	O
*ESE	O	O	O	O	O	O	O	O	O	O	×
*ESE?	O	O	O	O	O	O	O	O	O	O	×
*ESR?	O	O	O	O	O	O	O	O	O	O	O
*IDN?	O	O	O	O	O	O	O	O	O	O	×
*OPC	O	O	O	O	O	O	O	O	O	O	×
*OPC?	O	O	O	O	O	O	O	O	O	O	×
*RST	O	O	O	O	O	O	O	O	O	O	Δ
*SRE	O	O	O	O	O	O	O	O	O	O	×
*SRE?	O	O	O	O	O	O	O	O	O	O	×
*STB?	O	O	O	O	O	O	O	O	O	O	O
*TRG	×	O	×	O	×	O	×	O	×	O	×
*TST?	O	×	×	×	×	×	×	×	×	×	O
*WAI	O	O	O	O	O	O	O	O	O	O	×

Δ In the event of backup error, this query is executed.
In other errors, a device dependent error is generated.

Explanations for conditions

Integration reset..... Integration is stopped (RUN indication off) - integration time and count reset
Integration RUN..... Integration is in progress (RUN indication on)
Integration STOP.... Integration is stopped (RUN indication off)
Continue..... Display is being updated at the sampling frequency (continuous display)
HOLD..... Display is on hold (HOLD indication)
System error..... "Err" for 1, or 101 to 205 is displayed
Key..... Integration started by key operation or GP-IB command
External control..... Integration started by external control signal (START/STOP)

9-7-4. Valid Command According to Condition (Specific Commands)

Condition / Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD	
AOUT	○	×	×	×	○	×	×	×	○	×	×
AOUT?	○	○	○	○	○	○	○	○	○	○	×
AVERaging	○	×	×	×	○	×	×	×	○	×	×
AVERaging?	○	○	○	○	○	○	○	○	○	○	×
CURRent?	○	○	○	○	○	○	○	○	○	○	×
CURRent											
:AUTO	○	×	×	×	×	×	×	×	×	×	×
:AUTO?	○	○	○	○	○	○	○	○	○	○	×
:RANGe	○	×	×	×	×	×	×	×	×	×	×
:RANGe?	○	○	○	○	○	○	○	○	○	○	×
DATAout?	○	○	○	○	○	○	○	○	○	○	×
DATAout											
:ITEM	○	○	×	×	○	○	×	×	○	○	×
:ITEM?	○	○	○	○	○	○	○	○	○	○	×
:TIME	○	○	×	×	○	○	×	×	○	○	×
:TIME?	○	○	○	○	○	○	○	○	○	○	×
DISPlay	○	○	○	○	○	○	○	○	○	○	×
DISPlay?	○	○	○	○	○	○	○	○	○	○	×
ESE0	○	○	○	○	○	○	○	○	○	○	×
ESE0?	○	○	○	○	○	○	○	○	○	○	×
ESE1	○	○	○	○	○	○	○	○	○	○	×
ESE1?	○	○	○	○	○	○	○	○	○	○	×
ESE2	○	○	○	○	○	○	○	○	○	○	×
ESE2?	○	○	○	○	○	○	○	○	○	○	×
ESE3	○	○	○	○	○	○	○	○	○	○	×
ESE3?	○	○	○	○	○	○	○	○	○	○	×
ESR0	○	○	○	○	○	○	○	○	○	○	×
ESR1?	○	○	○	○	○	○	○	○	○	○	×
ESR2?	○	○	○	○	○	○	○	○	○	○	×
ESR3?	○	○	○	○	○	○	○	○	○	○	×
FREQuency?	○	○	○	○	○	○	○	○	○	○	×
FREQuency											
:AUTO	○	×	×	×	○	×	×	×	○	×	×
:AUTO?	○	○	○	○	○	○	○	○	○	○	×
:RANGe	○	×	×	×	○	×	×	×	○	×	×
:RENGe?	○	○	○	○	○	○	○	○	○	○	×
:SOURce	○	×	×	×	○	×	×	×	○	×	×
:SOURce?	○	○	○	○	○	○	○	○	○	○	×
HEADer	○	○	○	○	○	○	○	○	○	○	×
HEADer?	○	○	○	○	○	○	○	○	○	○	×
HOLD	○	○	○	○	○	○	○	○	○	○	×
HOLD?	○	○	○	○	○	○	○	○	○	○	×

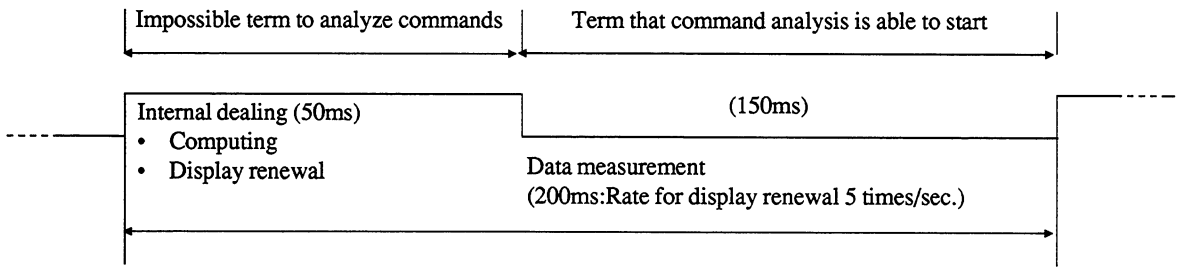
Condition / Command	Integration reset		Key				External control				System error
			Integration RUN		Integration STOP		Integration RUN		Integration STOP		
	Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD	Continue	HOLD	
INTEGrate?	○	○	○	○	○	○	○	○	○	○	×
INTEGrate											
:STATe											
START	○	○	×	×	○	○	×	×	×	×	×
STOP	×	×	○	○	×	×	×	×	×	×	×
RESET	○	○	×	×	○	○	×	×	○	○	×
:STATe?	○	○	○	○	○	○	○	○	○	○	×
:SOURce	○	×	×	×	×	×	×	×	×	×	×
:SOURce?	○	○	○	○	○	○	○	○	○	○	×
:TIME	○	×	×	×	×	×	×	×	×	×	×
:TIME?	○	○	○	○	○	○	○	○	○	○	×
MEASure?	○	○	○	○	○	○	○	○	○	○	×
MODE	○	×	×	×	×	×	×	×	×	×	×
MODE?	○	○	○	○	○	○	○	○	○	○	×
RECTifier	○	×	×	×	×	×	×	×	×	×	×
RECTifier?	○	○	○	○	○	○	○	○	○	○	×
SCALe?	○	○	○	○	○	○	○	○	○	○	×
SCALe											
:CT	○	×	×	×	×	×	×	×	×	×	×
:CT?	○	○	○	○	○	○	○	○	○	○	×
:PT	○	×	×	×	×	×	×	×	×	×	×
:PT?	○	○	○	○	○	○	○	○	○	○	×
TRANsmit											
:SEParator	○	○	○	○	○	○	○	○	○	○	○
:SEParator?	○	○	○	○	○	○	○	○	○	○	×
:TERMinator	○	○	○	○	○	○	○	○	○	○	○
:TERMinator?	○	○	○	○	○	○	○	○	○	○	×
VOLTage?	○	○	○	○	○	○	○	○	○	○	×
VOLTage											
:AUTO	○	×	×	×	×	×	×	×	×	×	×
:AUTO?	○	○	○	○	○	○	○	○	○	○	×
:RANGe	○	×	×	×	×	×	×	×	×	×	×

9-7-5. Execution Time of GP-IB Interface Command

Execution time Displays the analysis and dealing time of long form command. However for commands with parameter data, the time is that for the case determined by the data format specified by the [data] item, and for queries the time is that with headers enabled.

CAUTION

1. For this unit, from catching command to entering analysis, sometimes it lost 50ms maximum because of the influence of internal dealing.
2. In case of achieving the internal dealing time, display is not renewaled until analysis and dealing end.
3. All commands are sequential type.
4. When communicates with controller, it is necessary to add the data transfer time. However, the transfer time differs according to controller type.
5. Commands for setting needs some waiting time until stabilizing measurement after changing them.



Commands	Execution time
*TRG (include GET)	Within 500ms
*WA1, *RST, :MEASure?, :INTEGrate:STATe	Within 250ms
:CURRent:RANGe, :VOLTage:RANGe, :INTEGrate:SOURce, :INTEGrate:TIME, :SCALe:CT, :SCALe:PT	Within 50ms
:MODE, :RECTifier	Within 25ms
*TST?	7s
Commands other than in the table above.	Within 20ms

9-7-6. Initialization

The following table shows which items are initialized and which not, under various conditions.

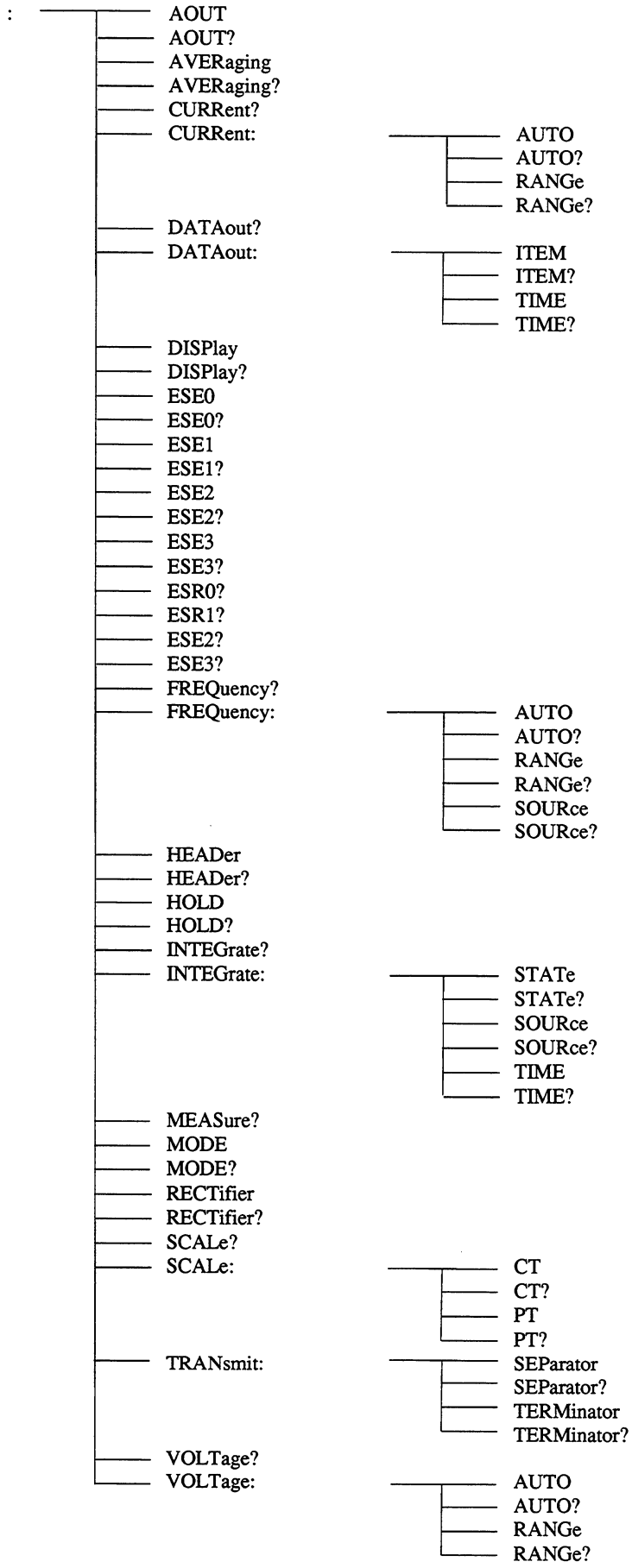
Item \ Initialize method	Power on	Keyboard reset	*RST command	Device clear	*CLS command
GP-IB device address	No	Yes	No	No	No
Device specific functions (ranges etc.)	No	Yes	Yes	No	No
Output queue	Yes	Yes	No	Yes	No
Input buffer	Yes	Yes	No	Yes	No
Status byte register	Yes	Yes	No	No *1	Yes *2
Event registers	Yes *3	Yes	No	No	Yes
Enable registers	Yes	Yes	No	No	No
Current path	Yes	Yes	No	Yes	No
Headers on/off	Yes	Yes	Yes	No	No
Terminator for response messages	Yes	Yes	No	No	No
Separator for response messages	Yes	Yes	Yes	No	No

*1 Only the MAV bit (bit 4) is cleared.

*2 All bits except the MAV bit are cleared.

*3 Except the PON bit (bit 7).

9-7-7. Specific Command Tree



9-8. Talk Only Function

9-8-1. Talk Only Function

For this unit, when setting GP-IB interface to talk only, measuring value and settings can be printed by the listen only printer connected to GP-IB.

For how to set this function, refer to 6-9. "Setting GP-IB address".

9-8-2. Type of Printing

There are three types of printing for this unit.

(1) Manual printing

Pressing DATA OUT / HELP key can print measuring value at that point.

This unit is also able to print by external control.

(2) Interval printing

Synchronized with integration on this unit: printer output appears at the interval set using the procedure described in Section 6-11. "Printing Interval Setting".

(3) Help printing

Internal settings of this unit are printed by DATA OUT / HELP key, after illuminate shift lamp by SHIFT key.

9-8-3. Selecting Printing Items and Setting Printing Interval Time

Refer to 6-10 "Selecting printing items" and "Setting printing interval time".

When no printing items are selected, printer passage time and items which is displayed in display a, b and c are printed.

9-8-4. Printer Output Buffer

Printer output buffer of this unit consists of 1500 bytes.

When buffer exceeds the capacity, "Err. 022" is printed and data which are obtained after that become invalid.

9-8-5. Printing in Power Cut

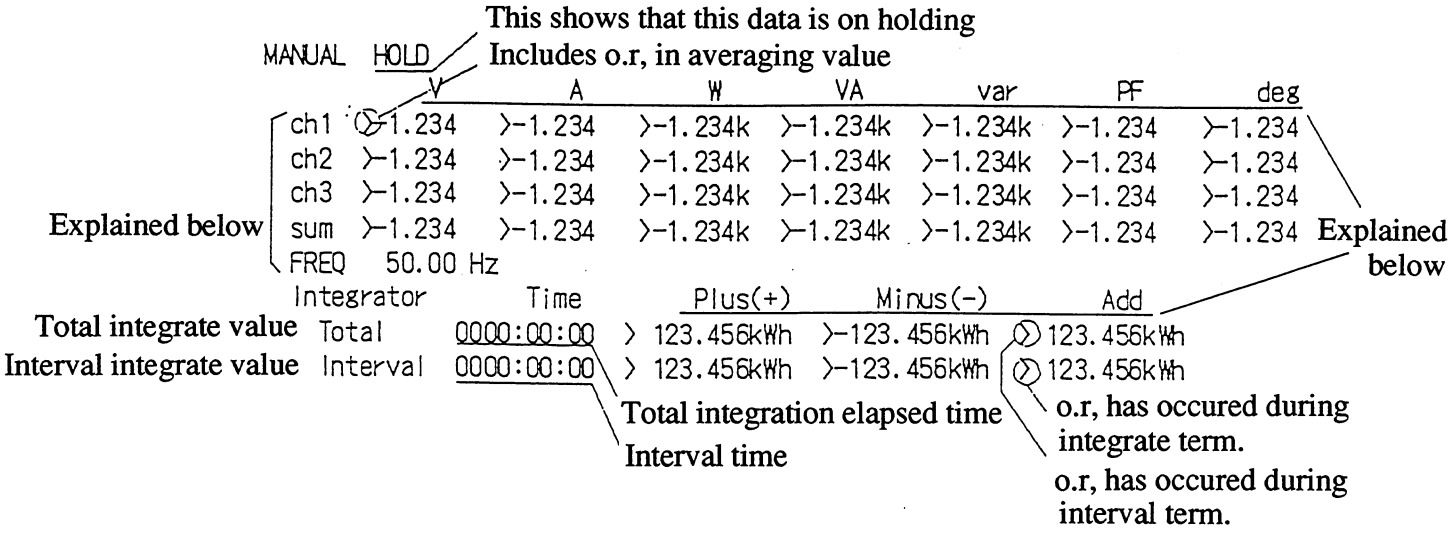
When the power is cut off during interval printing, after returned from that state, integrate passage time and "*** POWER FAILURE ***" are printed and return to normal interval printing.

CAUTION

Use the printer which is able to print at least eighty words for a line.

9-8-6. Explanation of Printing

① Manual printing



V ..... Voltage value

A ..... Current value

W ..... Effective power value

VA ..... Apparent power value

var ..... Wattless power value

PF ..... Power factor

deg ..... Phase angle

FREQ ..... Frequency

Plus (+) ..... Integrate value of plus side

Minus (-) ..... Integrate value of minus side

Add ..... Integrate value add plus to minus.

ch1 ..... Measuring value of CH1

ch2 ..... Measuring value of CH2

ch3 ..... Measuring value of CH3

sum ..... Value, calculated with measuring value of each channels using the calculation expressions.

② Interval printing and power cut printing

INTEGRATOR START This shows start of integration

0000:00:00 Printer elapsed time

	V	A	W	VA	var	PF	deg
ch1	150.0	20.00	1.500k	2.999k	-2.597k	-0.500	-60.00
ch2	150.0	20.00	1.500k	3.000k	-2.598k	-0.500	-60.00
ch3	150.0	20.00	1.499k	2.999k	-2.597k	-0.500	-60.00
sum	150.0	20.00	4.499k	8.997k	-7.791k	-0.500	-60.00

FREQ 50.00 Hz

Integrator	Time	Plus(+)	Minus(-)	Add
Total	0000:00:00	0.00000kWh	-0.00000kWh	0.00000kWh
Interval	0000:00:00	0.00000kWh	-0.00000kWh	0.00000kWh

0000:05:00

	V	A	W	VA	var	PF	deg
ch1	150.0	20.00	1.499k	3.001k	-2.599k	-0.500	-60.00
ch2	150.0	20.00	1.500k	2.999k	-2.597k	-0.500	-60.00
ch3	150.0	20.00	1.500k	3.000k	-2.598k	-0.500	-60.00
sum	150.0	20.00	4.499k	8.999k	-7.794k	-0.500	-60.00

FREQ 50.00 Hz

Integrator	Time	Plus(+)	Minus(-)	Add
Total	0000:05:00	0.12498kWh	-0.00000kWh	0.12498kWh
Interval	0000:05:00	0.12498kWh	-0.00000kWh	0.12498kWh

0000:05:13 *** POWER FAILURE *** Integration elapsed time and power cut comment

0000:10:00

	V	A	W	VA	var	PF	deg
ch1	150.0	20.00	1.500k	2.999k	-2.597k	-0.500	-60.00
ch2	150.0	20.00	1.500k	3.001k	-2.598k	-0.500	-60.00
ch3	150.0	20.00	1.500k	2.999k	-2.597k	-0.500	-60.00
sum	150.0	20.00	4.500k	8.999k	-7.793k	-0.500	-60.00

FREQ 50.00 Hz

Integrator	Time	Plus(+)	Minus(-)	Add
Total	0000:10:00	0.24996kWh	-0.00000kWh	0.24996kWh
Interval	0000:05:00	0.12498kWh	-0.00000kWh	0.12498kWh

0000:15:00

	V	A	W	VA	var	PF	deg
ch1	150.0	20.00	1.500k	3.000k	-2.598k	-0.500	-60.00
ch2	150.0	20.00	1.500k	3.001k	-2.599k	-0.500	-60.00
ch3	150.0	20.00	1.499k	3.000k	-2.598k	-0.500	-60.00
sum	150.0	20.00	4.499k	9.000k	-7.795k	-0.500	-60.00

FREQ 50.00 Hz

Integrator	Time	Plus(+)	Minus(-)	Add
Total	0000:15:00	0.37495kWh	-0.00000kWh	0.37495kWh
Interval	0000:05:00	0.12499kWh	-0.00000kWh	0.12499kWh

0000:20:00

	V	A	W	VA	var	PF	deg
ch1	150.0	20.00	1.500k	3.001k	-2.599k	-0.500	-60.00
ch2	150.0	20.00	1.500k	2.999k	-2.597k	-0.500	-60.00
ch3	150.0	20.00	1.500k	3.001k	-2.599k	-0.500	-60.00
sum	150.0	20.00	4.499k	9.000k	-7.795k	-0.500	-60.00

FREQ 50.00 Hz

Integrator	Time	Plus(+)	Minus(-)	Add
Total	0000:20:00	0.49994kWh	-0.00000kWh	0.49994kWh
Interval	0000:05:00	0.12499kWh	-0.00000kWh	0.12499kWh

INTEGRATOR STOP This shows stop of integration

③ Printing of display data
In case of no printing items are selected, data on display is output.

	Display a	Display b	Display c	
0000:00:00	600.1 V1	20.00 A1	11.99kW1	
0000:00:10	599.9 V2	20.00 A2	12.00kW2	
0000:00:20	599.9 Vsum	20.00 Asum	23.99kWsum	
0000:00:30	600.1 V1	20.00 A1	12.00kVA1	
0000:00:40	599.9 V1	20.00 A1	- 0.00kvar1	
0000:00:50	599.9 V1	19.99 A1	-1.000 PF1	
0000:01:00	600.0 V1	19.99 A1	- 0.00 deg1	
0000:01:10	600.1 V1	20.00 A1	60.00 Hz	
0000:01:20	599.9 V1	20.00 A1	0.5332kWh(+)	
0000:01:30	600.1 V1	19.99 A1	- 0.0000kWh(-)	
0000:01:40	600.2 V1	20.00 A1	0.6665kWh(ADD)	
0000:01:50	600.0 V1	0000:01:50	0.7332kWh(ADD)	
0000:02:00	23.99kWsum	0000:02:00	0.7998kWh(ADD)	
0000:02:10	23.99kWsum	0000:02:10	0.8665kWh(ADD)	
0000:02:20	23.99kWsum	0000:02:20	0.9331kWh(ADD)	
0000:02:30	23.99kWsum	0000:02:30	0.9998kWh(ADD)	
0000:02:32	23.99kWsum	0000:02:32	1.0171kWh(ADD)	HOLD
0000:02:50	24.00kWsum	0000:02:50	1.1331kWh(ADD)	
0000:02:51	24.00kWsum	0000:02:51	1.1411kWh(ADD)	

0000:00:00	23.99kWsum	0000:02:51	1.1411kWh(ADD)
0000:00:10	23.99kWsum	0000:03:01	1.2077kWh(ADD)
0000:00:20	23.99kWsum	0000:03:11	1.2744kWh(ADD)
0000:00:30	24.00kWsum	0000:03:21	1.3410kWh(ADD)
0000:00:40	23.99kWsum	0000:03:31	1.4077kWh(ADD)
0000:00:50	23.99kWsum	0000:03:41	1.4743kWh(ADD)
0000:01:00	23.99kWsum	0000:03:51	1.5410kWh(ADD)
0000:01:10	23.99kWsum	0000:04:01	1.6076kWh(ADD)
0000:01:20	24.00kWsum	0000:04:11	1.6743kWh(ADD)
0000:01:30	23.99kWsum	0000:04:21	1.7409kWh(ADD)
0000:01:40	23.99kWsum	0000:04:31	1.8076kWh(ADD)
0000:01:50	23.99kWsum	0000:04:41	1.8742kWh(ADD)
0000:02:00	23.99kWsum	0000:04:51	1.9409kWh(ADD)
0000:02:10	23.99kWsum	0000:05:01	2.0075kWh(ADD)
0000:02:20	23.99kWsum	0000:05:11	2.0742kWh(ADD)
0000:02:30	24.00kWsum	0000:05:21	2.1408kWh(ADD)
0000:02:40	23.99kWsum	0000:05:31	2.2075kWh(ADD)
0000:02:50	23.99kWsum	0000:05:41	2.2741kWh(ADD)
0000:03:00	23.99kWsum	0000:05:51	2.3408kWh(ADD)
0000:03:04	23.99kWsum	0000:05:55	2.3633kWh(ADD)

unit, display item and channel

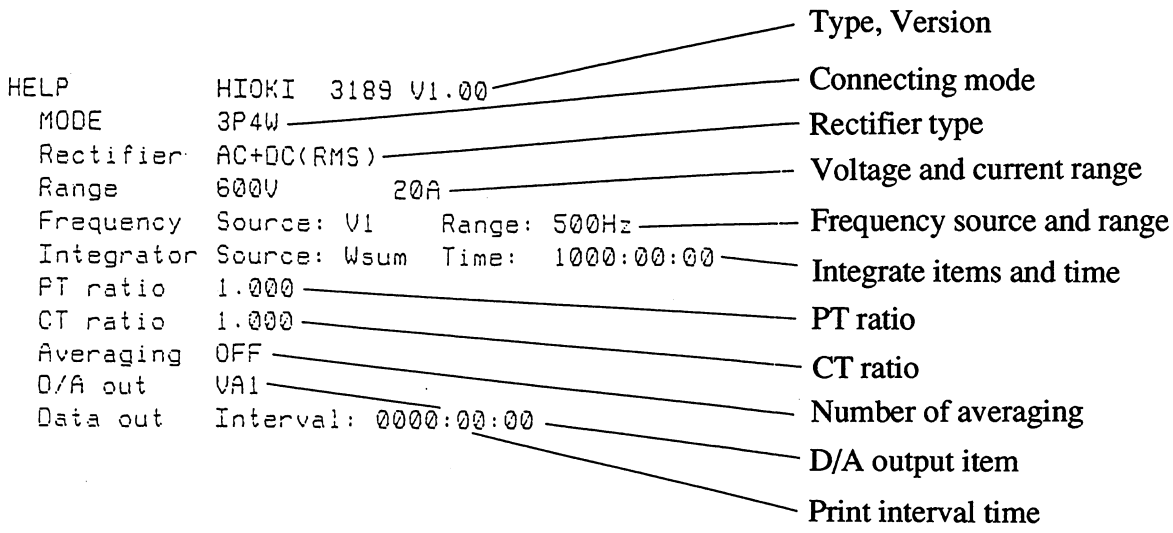
Printer elapsed time

Integration elapsed time

④ Printing when the printer output buffer is over
When the printer output buffer is over, Err 022 is displayed and printed.

```
MANUAL
            V          A          W          VA         var        PF         deg
  ch1     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  ch2     150.0      20.00     1.500k     3.000k    -2.598k    -0.500     -60.00
  ch3     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  sum     150.0      20.00     4.499k     8.997k    -7.792k    -0.500     -60.00
  FREQ    50.00 Hz
  Integrator          Time          Plus(+)          Minus(-)          Add
    Total          0000:20:00    0.49992kWh    -0.00000kWh    0.49992kWh
    Interval       0000:00:00    0.00000kWh    -0.00000kWh    0.00000kWh

MANUAL
            V          A          W          VA         var        PF         deg
  ch1     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  ch2     150.0      20.00     1.500k     3.001k    -2.599k    -0.500     -60.00
  ch3     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  sum     150.0      20.00     4.499k     8.998k    -7.793k    -0.500     -60.00
  FREQ    50.00 Hz
  Integrator          Time          Plus(+)          Minus(-)          Add
    Total          0000:20:00    0.49992kWh    -0.00000kWh    0.49992kWh
    Interval       0000:00:00    0.00000kWh    -0.00000kWh    0.00000kWh

MANUAL
            V          A          W          VA         var        PF         deg
  ch1     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  ch2     150.0      20.00     1.500k     3.000k    -2.598k    -0.500     -60.00
  ch3     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  sum     150.0      20.00     4.500k     8.998k    -7.792k    -0.500     -60.00
  FREQ    50.00 Hz
  Integrator          Time          Plus(+)          Minus(-)          Add
    Total          0000:20:00    0.49992kWh    -0.00000kWh    0.49992kWh
    Interval       0000:00:00    0.00000kWh    -0.00000kWh    0.00000kWh

MANUAL
            V          A          W          VA         var        PF         deg
  ch1     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  ch2     150.0      20.00     1.500k     3.001k    -2.599k    -0.500     -60.00
  ch3     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  sum     150.0      20.00     4.499k     8.999k    -7.793k    -0.500     -60.00
  FREQ    50.00 Hz
  Integrator          Time          Plus(+)          Minus(-)          Add
    Total          0000:20:00    0.49992kWh    -0.00000kWh    0.49992kWh
    Interval       0000:00:00    0.00000kWh    -0.00000kWh    0.00000kWh

MANUAL
            V          A          W          VA         var        PF         deg
  ch1     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  ch2     150.0      20.00     1.500k     3.000k    -2.598k    -0.500     -60.00

Err. 022 <-------------------- Printer output buffer over error

MANUAL
            V          A          W          VA         var        PF         deg
  ch1     150.0      20.00     1.500k     3.000k    -2.598k    -0.500     -60.00
  ch2     150.0      20.00     1.500k     2.999k    -2.597k    -0.500     -60.00
  ch3     150.0      20.00     1.500k     3.000k    -2.598k    -0.500     -60.00
  sum     150.0      20.00     4.499k     8.999k    -7.793k    -0.500     -60.00
  FREQ    50.00 Hz
  Integrator          Time          Plus(+)          Minus(-)          Add
    Total          0000:20:00    0.49992kWh    -0.00000kWh    0.49992kWh
    Interval       0000:00:00    0.00000kWh    -0.00000kWh    0.00000kWh
```

⑤ Help printing




```
HELP          HIOKI  3189 V1.00
  MODE        3P4W
  Rectifier   AC+DC(RMS)
  Range       600V       20A
  Frequency   Source: V1    Range: 500Hz
  Integrator  Source: Wsum  Time:  EXT.Control
  PT ratio    1.000
  CT ratio    1.000
  Averaging   OFF
  D/A out     VA1
  Data out    Interval: 0000:00:00
```

This shows that the integrate meter works with external control.

9-9. Device Compliance Statement

(1) IEEE 488.1 interface functions

- These are detailed in section 2-3, "Specifications".

(2) Operation with a device address other than 0 through 30

- Address is unable to set other than 0 through 30.

(3) Timing of changed device address recognition

- A change of address is recognized by pressing ENTER key while address is on display.

(4) Device settings at power on.

- The status information is cleared, and all other items are preserved. However, the header on/off setting, and response message unit separator and terminator are all reinitialized.

(5) List of message exchange options

(a) Input buffer capacity and operation:

- These are detailed in section 9-5-10 "Input Buffer".

(b) Queries to which multiple response message units are returned:

- CURRent? ... 2
- VOLTage? ... 2
- SCALe? ... 2
- MEASure? ... 1 to 26 (3188)
  1 to 33 (3189)
- DATAout? ... 2
- FREQuency? ... 3
- INTEGrate? ... 3

(c) Queries producing responses as syntax checking is performed:

- On this unit, all queries produce responses when syntax checking is performed.

(d) Whether any queries produce responses when read:

- There are no queries which produce response messages at the instant they are read in by the controller.

(e) Whether any commands are coupled:

- There are no relevant commands.

(6) Summary of functional elements for use when constructing device specific commands:

- Program message, program message terminator, program message unit, program message unit separator, command message unit, query message unit, command program header, query program header, program data, character program data, and decimal program data.
- Compound commands and program headers can be used.

(7) Buffer capacity limitations for block data

- Block data is not used.

(8) Summary of program data elements used in expressions, and deepest nesting level allowable in sub-expressions, including syntax restrictions imposed by the device.

- Sub-expressions are not used. Character data and decimal data are the only program data elements used.

(9) Response syntax for queries

- Response syntax is detailed in "Command Reference".

(10) Transmission congestion relating to device-to-device messages which do not conform to the general principles for basic response messages

- It is possible to output with talk only function. Message format is described in section 9-8-6 "Explanation of printings".

(11) Response capacity for block data

- Block data does not appear in responses.

(12) Summary of standard commands and queries used

- This appears in section 9-7 "Command Summary".

(13) Device state after a calibration query has been completed without any problem

- The "*CAL?" command is not used.

(14) Whether any "*DDT" commands are used:

- The "*DDT" command is not used.

(15) Whether any macro commands are used:

- Macros are not used.

(16) For queries related to identification, explanation of the response to the "*IDN?" query

- This is detailed in "Command Reference".

(17) Capacity of the user data storage area reserved for when the "*PUD" command and the "*PUD?" query are being executed

- The "*PUD" command and the "*PUD?" query are not used. Further, there is no user data storage area.

(18) Resources when the "*RDT" command and the "*RDT?" query are being used

- The "*RDT" command and the "*RDT?" query are not used.

(19) Conditions which are influenced when "*RST", "*LRN?", "*RCL?", and "*SAV" are used

"*LRN?", "*RCL?", and "*SAV" are not used. The "*RST" command returns this unit to its initial state. (Refer to "Standard Commands", and "Initialization").

(20) Scope of the self-testing executed as a result of the "*TST?" query

- This is detailed in "Standard Commands".

(21) Additional organization of the status data used in a device status report

- This is detailed in "Event Registers".

(22) Whether commands are overlap or sequential type

- All the commands are sequential commands.

(23) Criterion relating to the functions required at the instant that the termination message is produced, as a response to each command

- Termination occurs when the command has been parsed. The "MEASure?" query, when and only when there is no effective data, terminates when effective data has been produced. The "*TRG" command terminates the moment that measured data has been obtained.

9-10. Notes on GP-IB Interface

If the GP-IB appears to be malfunctioning, refer to the information below before calling for servicing.

Symptom	Cause / Treatment
The GP-IB has stopped working completely.	• Are the cables properly connected? • Is the device address for this unit set correctly? • Does some other device have the same device address? • Are all the devices powered on?
Transmission on the GP-IB is not taking place properly.	• Is the controller message terminator set correctly? (Refer to "Message Terminators")
After transmission on the GP-IB bus, the keys on this unit freeze up and have no effect.	• Press the LOCAL key on the front panel of this unit to release the remote state. • Has a LLO command (Local Lock-Out) been transmitted? Transmit a GTL command to put this unit into the local state.
When attempting to read data using a BASIC input command statement, the GP-IB bus hangs.	• Be sure to transmit one query before each BASIC input command statement. • Have any of these transmitted queries resulted in an error?
Although a command has been transmitted, nothing has happened.	• Using the "*ESR?" command, inspect the standard event status register, and check what type of error has occurred.
Sending several queries, produces only one response.	• Has an error occurred? • Send the queries one at a time, and read the responses individually. When you want to read them in all at once, try doing so by putting them all on one line separated by the message separator character. • Have you used the "*IDN?" query?
Sometimes service requests are not generated.	• Have the service request enable register and the various event status enable registers been correctly set? • Clear all the event registers at the end of SRQ processing subroutines by using the "*CLS" command. If an event bit is not cleared, no service request will be generated for that event. • If service requests may be generated by performing sampling processing twice or more successively, make sure that the SRQ processing subroutine can be completed within 200 ms.

Symptom	Cause / Treatment
The response message to a query differs from the display on the front panel of this unit.	• Due to the response message being produced at the instant that this unit receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.
Although the talk only has been set, printing has not work.	• Has the printer been set to listen only? • Except this unit and printer, has any other equipments of controller or talk only been connected?
Although the integrating has started, interval printing does not work.	• Has this unit been set to talk only? • Has print interval time (DATA OUT TIME) been set to 000:00:0 ? In this case, set interval time.
Pressing DATA OUT key or HELP key displays "Err 021".	• Has GP-IB interface been equipped? • Has this unit been set to talk only?
Pressing DATA OUT key or HELP key displays "Err 023".	• Has the printer been connected? In this case, confirm the connecting conditions.

Chapter 10

Changing the Power Fuse

The power fuse for this unit is housed within the power inlet with a spare fuse.

⚠ WARNING

In order to prevent danger of electric shock when changing the power fuse, be absolutely sure to disconnect the input connections and the power cord first.

(1) Remove the power cord from the power inlet, and pry out the fuseholder as shown in Fig. 10-1 using a screwdriver or the like.

(2) After checking the fuse to verify that it has blown, change it for the spare fuse.

(3) Push the fuseholder back into the power inlet to complete the changing of the fuse.

* When this unit is shipped from the factory, two fuses in all (the fuse in the fuseholder and the spare fuse) are supplied. When one fuse has blown and the spare fuse has been used to replace it, procure another fuse of the proper rating:
Fuse rating: T0.4A/250 V 20 mm × 5 mm dia. (for 100/120V)
T0.2A/250 V 20 mm × 5 mm dia. (for 220/240 V)

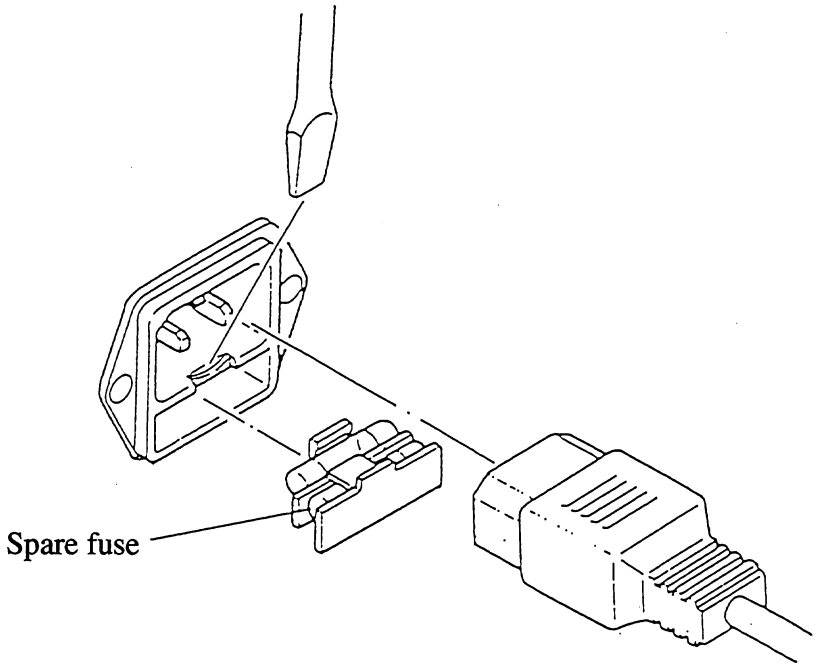


Fig.10-1 changing the fuse

⚠ WARNING

Always use a fuse of the correct rating. If a fuse of incorrect rating is used, there is a risk of damage to this unit or danger to the operator.

Chapter 11

Disposing of the Unit

This unit uses a lithium battery as the power source for the memory for backing up the settings.

If you intend to dispose of the unit, you should first dismantle the unit, and remove the lithium battery.

⚠ WARNING

In order to prevent any danger of electric shock when taking out the lithium battery, you should be quite certain to remove the connection wires and the power cord before dismantling this unit.

(1) Tools needed to dismantle this unit

- Plus screwdriver
- Minus screwdriver
- Nipper

(2) How to dismantle the unit:

① As shown in Fig.11-1, remove the two retaining screw which hold on the upper case of the unit.

② Insert the minus screwdriver in this unit from beside the screw, and prize the substrate off with rear panel.

③ Cut the lead line of a cylindrical lithium battery with a nipper, and cut it off from the substrate.

④ Dispose of the lithium battery according to the manner prescribed by the competent authorities in your locality.

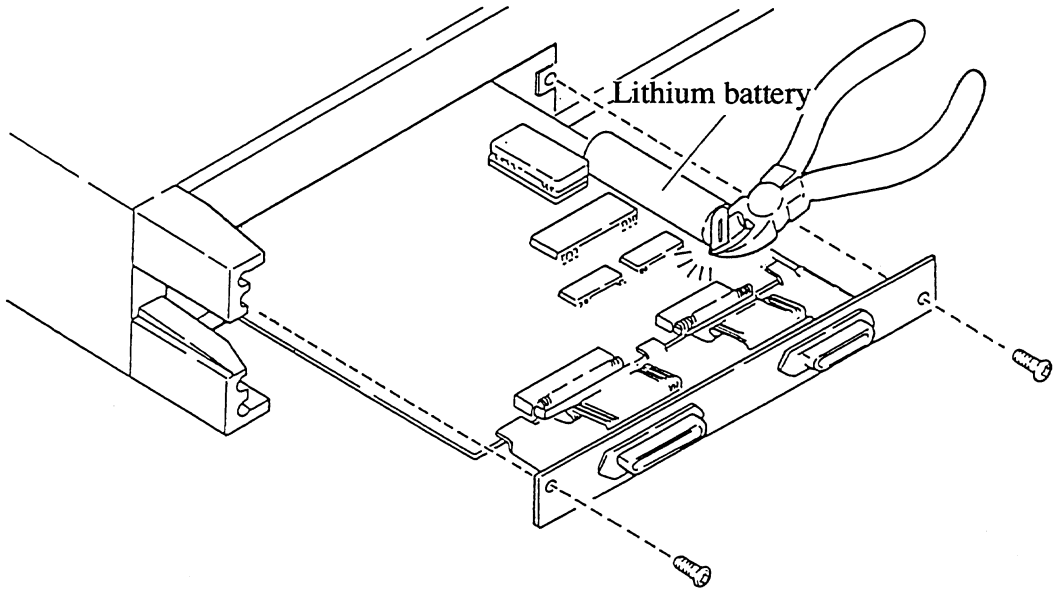


Fig.11-1 Taking out the lithium battery

Index

[A]

[B]

[C]

[D]

[E]

[F]

[G]

[H]

[I]

[L]

[M]

[N]

[O]

[P]

[R]

[S]

[T]

[V]

[W]

HIOKI 3188/3189 AC/DC POWER HITESTER

Instruction Manual

Publication date: April 1994 Edition 1

Edited and published by HIOKI E.E. CORPORATION
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Printed in Japan 3188A981-00

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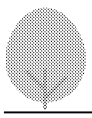
31888A981-00 94-04-0001H



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